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CURRENT STATE OF KNOWLEDGE OF THE MALTESE NON-MARINE FAUNA

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PREAMBLE

In 1993 I published the first review of the non-marine fauna of the Maltese Islands in 80 years (Schembri [P[1]], 1993), the only previous comprehensive review of this type being the work of Giovanni Gulia presented in 1913 (Gulia, 1914). I am glad to report that in the past 10 years my review has become outdated in many places; I say 'glad' because it means that in the interim period, research on the Maltese fauna has continued and new discoveries have been made, while existing information has been revised. My previous review is sufficiently out of date to warrant a revised 'new edition', and this is what I will attempt to do here. In the following work, I have kept the basic structure of my previous review and, where no changes were necessary, also more or less the original text. However, I have completely rewritten those parts where new information has rendered the previous text obsolete. I have opted to do this rather then just review the new information that has become available since 1993 in order that the present work stands alone and the reader does not require to keep referring back to the previous review, not least because the volume in which this was published is not out of print. I have strived to give as complete a picture of our current state of knowledge of the Maltese non-marine fauna as possible, but given the vastness of the literature and the disparity of the sources, I am certain that there are omissions. For these I apologise to the reader but I nonetheless trust that this work will be of some utility.

INTRODUCTION

In 1913, Giovanni Gulia, one of the foremost Maltese naturalists of that period, attended the Ninth International Zoological Congress held in Monaco and read a paper titled "*Uno sguardo alla zoologia delle Isole Maltes*i" (Gulia, 1914). This was a review of zoological research on

[1] A number of workers who have published on the Maltese fauna have the same name. To avoid confusion, initials are used to distinguish between them in the text.

the islands carried out to that date, treating both the marine and the non-marine fauna, and it summarised much of the earlier literature as well as gave additional unpublished information. Since that time, no one has attempted to review the Maltese fauna as a whole, although many studies have been carried out on individual groups. Schembri [P] (1989a; 1991) listed the major faunal taxa occurring in terrestrial and freshwater habitats in the Maltese Islands and gave the number of species known for each, or, in the case of groups which had not been studied, an estimate of the number of species expected to occur on the islands. These estimates were repeated and updated in the sections concerning biodiversity in the two '*State of the Environment*' reports published to date (see Schembri [P] *et al*., 1999; 2002). An annotated list of the endemic[2], rare, threatened and/or scientifically interesting species that occur in the Maltese Islands was given in the '*Red Data Book for the Maltese Islands*' edited by Schembri [P] & Sultana (1989). In 1993, Schembri [P] published a review of the non-marine fauna of the Maltese Islands in which he attempted to give a summary of the state of knowledge to that time as well as a preliminary biogeographical analysis (Schembri [P], 1993). Following this model, Mifsud (2000a) published a review of the insect fauna of the Maltese Islands in which, apart from adding new information that became available since Schembri's work, he also corrected a number of omissions and misinterpretations concerning insects. No other comprehensive reviews have been produced since, although there was an attempt to create a national database on the biodiversity of the Maltese Islands; after a promising start, this project is now dormant (Sant *et al*., 2001). A number of new database initiative are in progress, amongst the most important of which are the biodiversity databases being set up by the Environment Protection Directorate of the Malta Environment and Planning Authority[3], and the Fauna Europaea project[4], however, these are not presently publicly available.

Since Giovanni Gulia's days, hundreds of papers dealing with some aspect or other of the Maltese fauna have been published and it is no longer possible for a short review such as the present one to cover the entire field. For this reason, I have had to be selective in what to include. In this work I shall be concerned only with the terrestrial and freshwater fauna, including only those marine species that are semi-terrestrial or live in brackish water, and exclusively with multicellular forms (Metazoa) and living species. I make no attempt to list and review every publication dealing with a particular faunal group but rather limit myself to key works, particularly those that summarize previous literature and provide some form of synthesis of our knowledge of the group. The present work, therefore, is more of an annotated guide to the literature on the Maltese non-marine fauna than an encyclopaedic account. It should also serve to highlight areas were our knowledge is inadequate and therefore where more work needs to be done. Within each group, I pay particular attention to species of biogeographical interest, such as those with a limited Mediterranean distribution, those linking the Maltese Islands to other regions within the Mediterranean area, and especially to endemic forms and their affinities. However, it should be kept in mind that some supposedly endemic species are only 'endemic' because to date they have not been found elsewhere, either because of lack of research or because they have only been recently described. As will be demonstrated several times in the text that follows, species previously thought to be endemic to the Maltese Islands are now known from elsewhere; this does not

[2] Used here in the context of biogeography to mean a taxon limited to a defined geographical area and not occurring elsewhere outside that area. Taxa native to a defined area are referred to as 'indigenous'.

[3] Information about the activities of the Environment Protection Directorate may be obtained from the Malta Environment and Planning Authority website at: www.mepa.org.mt.

[4] Fauna Europaea is a project funded by the European Union through its 5th Framework Programme for Research and Technological Development. Within the framework of the European Union's Biodiversity Strategy, the aim of Fauna Europaea is to produce a central database with a unique comprehensive list of valid accepted scientific names of the terrestrial and freshwater multicellular animal species that currently live in Europe, and information about their distribution at least at a European country level. Further information is available from the Fauna Europaea website at: www.faunaeur.org

make them any less interesting, however, especially from the biogeographical point of view. Conversely, the application of modern molecular genetic methods of taxonomic analysis has shown that some local populations that are morphologically similar to mainland populations are actually quite well differentiated genetically. This has obvious important implications for their conservation. Finally I also take this opportunity to report some previously unpublished data resulting from recent research by myself and my students and co-workers.

LOWER INVERTEBRATES

The phylum CNIDARIA[5] is represented by one species of freshwater hydrozoan, a species of *Hydra* possibly *H. viridissima*, which, although relatively common and well known, has not been formally studied. Three terrestrial turbellarian PLATYHELMINTHES (flatworms) occur: *Microplana terrestris, Rhynochodemus bilineatus* (Lanfranco [E], 1970) and the introduced *Bipalium kewense* (Lanfranco [E], 1975). At least five species of freshwater turbellarians also occur but these have not been studied. Of the other platyhelminth classes only the medically important flukes and tapeworms have received attention. Savona Ventura (2002) reviews these records and lists a tapeworm belonging to the genus *Taenia* (?*saginata*, ?*solium*).

The aschelminth phyla ROTIFERA, GASTROTRICHA, NEMATODA and NEMATOMORPHA are all represented on the islands but only the last two have received any attention. Plant-parasitic NEMATODA (roundworms) of economic importance have been systematically studied by Lamberti & Dandria (1979), who review previous work and by Lamberti *et al.* (1984) and Larizza & Lamberti (1995); two species, *Longidorus magnus* and *Xiphinema melitense* (both family Longidoridae) were originally described from Malta as new (Lamberti *et al.*, 1982) but are now know also from Sicily and/or the south of Italy. As far as is know, only one species of NEMATOMORPHA (horsehair worms) occurs in the Maltese Islands, *Gordius aquaticus* (W.H. De Smet, personal communication 1995), a common and widespread European species. Records of nematodes of medical importance were reviewed by Savona Ventura (2002) who lists *Ascaris lumbricoides*, *Enterobius vermicularis* and *Trichuris trichiurus*.

To date, no works on the freshwater and terrestrial oligochaetes (freshwater worms and earthworms; phylum ANNELIDA) of the Maltese Islands have been published, although a work in progress has discovered some 10 different species of earthworms (Lumbricidae and related families), including introduced alien species and a number of species of enchytraeids (family Enchytraeidae) from terrestrial (leaf litter, soil) and coastal (seagrass banquettes) habitats (Emila Rota, personal communications, 1996, 2003).

One leech (class Hirudinea), *Haemopis sanguisuga*, a species widely distributed in Europe including Italy and Sicily, occurs locally in the wild as small isolated populations (Schembri [P], 1986; Savona Ventura *et al*., 2000). A second species, *Batracobdella algira*, parasitic on the frog *Discoglossus pictus pictus* and known also from North Africa and Sardinia also occurs but it is not known whether this is a true native or has been introduced; other species have been imported for medical purposes in the past but no longer occur, however, populations of the introduced alien freshwater species *Barbronia* (?) *assiuti* occasionally infest heated aquaria (Savona Ventura *et al*., 2000).

Species of TARDIGRADA (water bears) are known to occur in the Maltese Islands (J. Schembri, personal communication 1989) but this group has not been studied.

[5] For ease of reference, names of phyla are written in upper case letters.

MOLLUSCS

There exists a very rich literature on the terrestrial and freshwater MOLLUSCA of the Maltese Islands with well over 70 publications on individual species or on the group as a whole. Reviews have been provided by Soós (1933), Beckmann (1987) and Mandahl-Barth (1988), while Thake *&* Schembri [P] (1989) listed the endemic and threatened species, Schembri [P] (1995) discussed conservation, and Soós (1933) and Thake (1985) provided biogeographical analyses. Up to 1995, there was a lot of confusion as to which species actually occurred and on the taxonomic status of several Maltese taxa; some 100 species and subspecific taxa were recorded of which a remarkably large number, depending on author, ranging from 20% to 38% of the total number of species, were considered as endemic. In 1995, Folco Giusti and his co-workers published a monograph on the non-marine molluscs of the Maltese Islands in which they gave a complete revision of the Maltese malacofauna using both classical and molecular genetic techniques, aimed at resolving longstanding taxonomic and biogeographical problems (Giusti *et al*., 1995). According to these authors, the terrestrial, freshwater and brackish water malacofauna of the Maltese Islands comprises 70 species of which 68 are gastropods and two are bivalves. Of the gastropods, nine are brackish water species, 10 are freshwater, and the remainder are terrestrial.

Eight species are of more or less recent human introduction: *Pomatias elegans* and *Discus rotundatus* are only found in a single public garden; the freshwater planorbid (rams-horn snail) *Helisoma duryi,* occurs in ponds in public gardens, however, a population became established in the wild during 1986-87 but subsequently disappeared; the freshwater bladder-snail *Physa acuta* has invaded many natural freshwater biotopes, while the others occur in private gardens, agricultural areas and urbanized habitats.

The number of endemic taxa is much less than previously reported: 6 out of 70 living species (9%). None of the brackish water molluscs are now considered endemic. Taxonomically, the most interesting freshwater species are the hydrobiids (snouted water-snails), some of which were described as endemic species (e.g. *Amnicola melitensis, Paludinella kobelti;* see Alzona, 1971 and Boeters & Beckmann, 1989). Only two freshwater hydrobiids occur, *Mercuria* cf. *similis* and *Pseudamnicola moussonii*; the exact identity of the former is somewhat problematic as it belongs to a group of very similar forms occurring all along the coasts of the Mediterranean and in the absence of genetic studies it is not possible to say whether these are sibling species[6] or simple morphs[7].

Of the terrestrial species, the most interesting are the endemics and those species with a limited geographical distribution. These include: a possibly new species of *Vitrea*, the slug *Lehmannia melitensis*, and two other snails – *Cernuella caruanae* and *Schileykiella parlatoris* – all of which are Siculo-Maltese endemics[8]; the very rare subterranean carnivorous slug *Testacella riedeli*, which is a Maghrebian-Maltese endemic[9]; the door snails *Lampedusa imitatrix*, *Lampedusa melitensis* and *Muticaria macrostoma*, the top snails *Trochoidea spratti* and *Trochoidea gharlapsi*, and the helicid *Marmorana melitensis,* all of which are strictly endemic to the Maltese Islands. Of the strict endemics, the clausiliids (*Lampedusa* and *Muticaria*) and the hygromiid *Trochoidea* are particularly interesting from the scientific point

[6] Closely related species that are morphologically very similar but genetically distinct.
[7] Individuals of the same species with a characteristic morphology that makes them distinguishable from other morphs of the same species.
[8] With a distribution limited to Sicily (and possibly some circum-Sicilian islands) and the Maltese Islands.
[9] With a distribution limited to coastal North Africa and the Maltese Islands.

of view, and also, because they demonstrate the taxonomic complexity of the local Mollusca and the confusion that existed before modern molecular genetic methods were applied to the problem.

Soós (1933) split the Maltese *Lampedusa* into two subgenera: *Imitatrix* with three species *(imitatrix, melitensis* and *gattoi)* and *Muticaria* with another three *(syracusana* and its var. *oscitans, scalaris* and *mamotica).* With the exception of *L.syracusana*, he considered all to be endemic to the Maltese Islands. Zilch (1977) regarded all the *Imitatrix* to be subspecies of *L. imitatrix,* and the *Muticaria* to be subspecies of *M. syracusana,* elevating *oscitans* to subspecific rank. Holyoak (1986) followed Zilch except that he did not recognize subgenera. Beckmann & Gittenberger (1987) considered the Maltese populations of *L.syracusana* to be a separate species from Sicilian populations and referred the Maltese populations to *L.macrostoma* with four subspecies: *macrostoma, oscitans, scalaris* and *mamotica.* Applying classical conchological[10] and anatomical analyses as well as modern molecular genetic techniques, Giusti *et al*. (1995) showed that two biological species of *Lampedusa* occur on the Maltese Islands (with a third species, *L. lopadusae*, endemic to the Pelagian islands of Lampedusa and Lampione): *L.imitatrix*, endemic to the islands of Malta and Filfla, and *L.melitensis*, endemic to the island of Malta, that differentiated from *L.imitatrix*. Giusti *et al.* (1995) also confirmed that *Muticaria* is a good genus, but only has two biological species: *M. macrostoma* endemic to the Maltese Islands (except Filfla), and *M. syracusana* endemic to southeastern Sicily. Both species have numerous conchological forms that were assigned specific or infraspecific status in the past, but which molecular genetic analysis has shown to be little more than local demes[11]. The situation with the *Trochoidea* is even more confusing. Recent enumerations (e.g. Soós, 1933; Alzona, 1971; Beckmann, 1987; Mandahl-Barth, 1988) list eight species: *Trochoidea* (*Trochoidea*) *spratti, schembrii, calcarata, ogygiaca, cucullus* and *despotti,* and *Trochoidea (Xeroclausa) gharlapsi* and *meda;* all except the last, considered endemic. However, different authors interpret these species differently and the names used by one worker are not necessarily equivalent to those used by others. Again, applying classical and modern techniques of taxonomic analysis, Giusti *et al*. (1995) showed that many of the taxa attributed to *Trochoidea* (s.str.) can be referred to a single, highly variable species for which the oldest available name is *T. spratti;* the differences in shell morphology on which most of the classical 'species' are based are in reality peculiar to small local populations or else to groups of individuals forming part of larger populations in which shell morphology is very variable. Intermediate forms between most of the classical 'species' can be readily found. However, even if not constituting good biological species, some of the localised demes or ecotypes[12] of both *Muticaria* and *Trochoidea* are sufficiently reproductively isolated to have retained distinct genetic units and are worthy of conservation.

Very little on the Maltese non-marine malacofauna has been published since Giusti *et al*.'s (1995) monograph. Hopfinger & Fischer (1996) report finding a recent specimen of a *Siciliaria* sp. on Gozo – previously only Quaternary fossils of *Siciliaria* cf. *septemplicata* were known (from Malta). However it is not clear if this was an empty shell, in which case it may be a fossil eroded out of its stratum. So far no other specimens have been discovered.

Based on conchological differences, Beckmann (2003a) recently described a new subspecies of '*Trochoidea* (s.str.) *cucullus*' that he named *T.c.soosi*, restricted to the southwestern coast of Malta; Beckmann disagrees with the interpretation of Giusti *et al*. (1995) that all conchological forms of *Trochoidea* (s.str) in the Maltese Islands belong to a single species that is highly variable in shell morphology. Additionally, Beckmann (2003b)

[10] Characters having to do with the shell of molluscs.
[11] Localised populations with some degree of inbreeding.
[12] Individuals within a species genetically adapted to a particular local habitat but which can still breed freelywith other members of the species.

reported *Lehmannia valentiana*, an exotic slug that is now widely distributed in greenhouses, from a hotel at Msida. The present author has received specimens of two species of alien snails (a species of *Otala* and one of *Cernuella*) collected from local garden centres, most likely imported with garden plants (Albert Micallef, personal communication 2003).

CHELICERATES

Of the CHELICERATA, only the orders Scorpiones, Pseudoscorpiones and Araneae have been studied in any detail. Only one species of scorpion occurs. Previously this was considered to be *Euscorpius carpathicus candiota*, a subspecies showing a complex of morphological characters intermediate between those of *E.c.carpathicus* and *E.mesotrichus* (Schembri [P] & Schembri [S], 1990; Kritscher, 1992) and related to similar intermediate populations found in Greece, some Greek islands and in Crete. Because of this biogeographical relationship, Kritscher (1992) considered it to be an introduced alien species. However, a recent analysis of the '*Euscorpius carpathicus*' complex from Italy, Malta and Greece using morphological and molecular genetic techniques (Fet *et al*., 2003) has shown that the Maltese population belongs to a lineage distinct from *Euscorpius carpathicus* proper (which is limited to Romania) and which also occurs in Sicily, Sardinia, central and southern Italy, Greece and possibly parts of coastal North Africa; this has been called *Euscorpius sicanus*.

Mahnert (1975; 1982) studied the pseudoscorpions (false scorpions) of the Maltese Islands and reported 23 species, most of which are widespread in the Mediterranean area; however, two species, *Acanthocreagris italica* and *Chernes siciliensis* were previously known only from southern Italy and/or Sicily, and another, *Minniza algerica*, only from North Africa. Two species, *Chthonius maltensis* and *C. girgentiensis* are so far known only from the Maltese Islands. The last named is a cavernicolous species very close to another such species, *C. balearicus*, from the Balearic Islands and both are probably derived from the same parental stock (*C. gibbus*; Mahnert, 1982). Later, Gardini & Rizzerio (1987) described a third presumably endemic species from the islands, *Roncus melitensis*. This cavernicolous species shows affinities with SE Sicilian species of the *R. siculus* group. There are also recent additional unpublished new records (Volker Mahnert, personal communication, 2002).

The opilionids (harvestmen) of the Maltese Islands have received scant attention. Marcellino (1974) only recorded two species: *Metaphalangium propinquum*, a common and widespread Mediterranean species and *Opilio aspromontanus* which has a Tyrrhenian distribution and for which the Maltese Islands are the most southerly station. Later, Thaler (1996) added another species, *Ptychosoma vitellinum* that is known from Sardinia, southern Italy, Sicily and Algeria. Dandria (1996) records an unidentified species of *Phalangium* and another of *Dicranolasma*. Apart from these, there are unpublished records of at least another six species (Gruber & Schembri [P], in preparation; Jochen Martens, personal communication, 2003). No endemic species occur and while the biogeographical affinities of the Maltese opilionid fauna are still not clear, all species present are represented also in Sicily, southern Italy and North Africa.

It is only recently that the spiders (Araneae) of the Maltese Islands have received attention. The best-known group are the Salticidae (jumping spiders), which were studied by Cantarella (1982). This author recorded 15 species, 12 of which are also known from Sicily, including one, *Aelurillus schembrii*, which is a Siculo-Maltese endemism; of the non-Sicilian species, two are cosmopolitan and a third occurs on the Eolian Islands. Baldacchino *et al.* (1993) reviewed the literature on Maltese spiders and all known records to that date, and added

some 48 new records, not all of which were not identified with certainly, bringing the total know Maltese species to 74 from 21 different families. Another nine species, including one new to science, were added by Bosmans & Dandria (1993) bringing the total to 83 species in 22 families. The new species, *Lepthyphantes melitensis*, is most closely related to *L.carusoi* from Sicily and in turn, both these species show affinities with *L.labilis* from Algeria; to date, *L.melitensis* is still only know from the islands of Malta and Filfla. A little later, Kritscher (1996) published an extensive list of species collected by him from the Maltese Islands. In this he added another 66 new records including an additional four species of salticids to Cantarella's (1982) list, and five species new to science. Two of these new species, *Dipoenata cana* and *Scotina occulta*, are only known from Gozo, in the case of the former, from a single female only; the other three, *Palpimanus punctatus*, *Syedra parvula* and *Poecilochroa loricata* are known from both main islands. Kritscher (1996) does not analyse the affinities of these new species, except for *Dipoenata cana* which he says is close to *D. tristis* and *D. braccata*, which also occur on the Italian mainland. Apart from these apparently endemic species described by Bosmans & Dandria (1993) and Kritscher (1996), the only other endemic Maltese spider known to date is the trapdoor spider *Nemesia arboricola* described by Pocock (1903) and not recorded from anywhere except the Maltese Islands since. The validity of this species was confirmed by Kritscher (1994) who redescribed the type specimen[13] and highlighted the differences between *Nemesia arboricola* and the closely related *N.macrocephala* of Sicily. Dandria (2001) confirmed that all records of the latter (*N.macrocephala*) species from the Maltese Islands actually refer to *N.arboricola*; this same author provides interesting information about the distribution and biology of this species, especially its habit of constructing its 'traps' (nests) in palm trees.

Condé (1988) has described a new species of cavernicolous microwhipscorpion (Palpigradi) from the Maltese Islands. This species, *Eukoenenia christiani*, shows affinities with *E.j.juberthiei* from Lebanon. Many species of Acarina occur but only commercially important ones have been studied (Caruana Gatto, 1926; Saliba, 1963; David Dandria, personal communication 2003). Dandria (1996) records the tick *Ixodes ricinoides and the* red spider mite, *Tetranychus telarius*, while Sultana & Gauci (1977-78) record *Ixodes ricinus* and *Ixodes pari* parasitic on Willow Warbler (*Phylloscopus trochilus*) and Blackcap (*Sylvia atricapilla*), respectively. Savona Ventura (2002) records the tick *Laelaps echidninus* from rats and *Sarcoptes scabiei*, the mite causing scabies in humans and other mammals.

CRUSTACEANS

Baldacchino (1983) has reviewed previous work on freshwater CRUSTACEA from the Maltese Islands to that date and added new records, some of which are now known to be misidentifications.

The Maltese species of the branchiopod orders Anostraca, Notostraca and Spinicaudata have been revised by Lanfranco [S] *et al.* (1991) and again more recently by Lanfranco [S] (2001). All three orders are represented locally by a single species each. The local anostracan (fairy shrimp) is *Branchipus schaefferi*, a species widely distributed throughout the Palaearctic; a second 'species', *B.visnyai* that also occurs is now regarded as synonymous with *B.stagnalis*. The Notostraca (tadpole shrimps) are represented by *Triops cancriformis cancriformis*, which is widely distributed in Europe, while the Spinicaudata (clam shrimps) are represented by *Cyzicus tetracerus*, another widespread Palaearctic species. Lanfranco [S] (2001) also reviewed previous records of the order Cladocera (waterfleas) and added new ones. Seven species and a doubtful eighth occur, all of which have a circum-Mediterranean, Palaearctic or even wider distribution.

[13] The individual specimen on which the original scientific description of a species is based.

Freshwater cyclopoid and calanoid copepods (oar shrimps; class Copepoda) are known to occur. Zammit Lucia (1976) and Lanfranco [S] (1990) record an unidentified species of *Cyclops* and Lanfranco [S] (1996) records *Cyclops vulgaris*. No other studies have been made. Freshwater ostracods (seed shrimps; order Podocopa) also occur, but these have not been studied; Lanfranco [S] (1996) records *Cypris pubera* and *Herpetocypris reptans*, both common Italian species.

One species of freshwater isopod has been recorded, *Proasellus coxalis* (Baldacchino, 1983 as *Asellus coxalia*), and another probably occurs (C. A. Lombardo, personal communication 1975).

The terrestrial Isopoda (woodlice) of the Maltese Islands have been studied by Caruso and his coworkers (see Caruso & Lombardo, 1982; Caruso *et al.*, 1987, and references therein). Forty-two species were recorded of which four are endemic (*Spelaeoniscus vallettai, Armadillidium aelleni, Armadillidium schmalfussi, Bathytropa schembrii*). A further six species, including another endemic (*Armadillidium ghardalamensis*) were added by Caruso & Hili (1991). The new endemic species described by these authors, *Armadillidium ghardalamensis*, is morphologically closely related to *A.lagrecai* known only from the Hyblean region of Sicily[14], while another species recorded by them, *Trichorina paolae*, was previously only known from a single cave near Syracuse in Sicily. A later molecular genetic study on *Armadillidium ghardalamensis* and *A.lagrecai* (Lombardo & Viglianisi, 2002) showed that in spite of their morphological similarity, these two species were genetically well differentiated. Additionally, genetic analysis of Sicilian and Maltese populations previously attributed to '*Porcellio imbutus*' resulted that this species is limited to Sicily while the Maltese and Hyblean populations belong to a distinct (new) species named *Porcellio hyblaeus* (Viglianisi *et al*., 1992).

Based on the data available to them, Caruso & Lombardo (1982) and Caruso *et al.* (1987) compared the oniscoidean fauna (terrestrial woodlice) of the Maltese Islands with that of Sicily, North Africa and the circum-Sicilian islands and concluded that the Maltese fauna and that of all the other circum-Sicilian islands, with the exception of Pantelleria, presented very strong affinities with that of Sicily and not with that of North Africa. Three, possibly four, species found only in Sicily and the Maltese Islands, suggest a connection between these islands and the Hyblean region of Sicily in Quaternary (Pliocene?) times. Two species have a predominantly eastern Mediterranean distribution. The new data presented by Caruso & Hili (1991) strengthen this interpretation.

Caruso & Hili (1991) make the very interesting point that at least as far as the terrestrial isopods are concerned, the Maltese Islands have a true cavernicolous fauna comprising both troglobitic (i.e. obligate carvernicoles) and troglophilic (i.e. frequently but not exclusively carvernicoles) species; the former include *Armadillidium ghardalamensis* and probably also *Armadillidium aelleni* (both endemic) as well as *Trichorina paolae*, and the latter include *Trichoniscus matulici* and *Chaetophiloscia cellaria*.

Even more interesting are the results of a recent genetic study on the four known populations of the endemic cave species *Armadillidium aelleni* (Lombardo *et al*., 2002. These molecular genetic studies, confirmed also by a morphological analysis, showed that the four populations could be separated into two genetically, and to lesser extent also morphologically, distinct groups, a situation interpreted as a case of incipient speciation.

[14] Southeast Sicily

The freshwater and semiterrestrial Amphipoda (sand fleas or beach hoppers) of the Maltese Islands have been studied by Moore & Schembri [P] (1986) who recorded nine species, all common Mediterranean forms. However, re-examination of some of the specimens upon which these identifications were based resulted that what these authors reported as *Echinogammarus ebusitanus* was not actually this species but *Echinogammarus klaptoczi*, while *Talorchestia deshayesii*not reported by Moore & Schembri [P] (1986) also occurs (Sandro Ruffo, personal communication, 2000). Interestingly, a molecular (allozyme) study of this latter species from a number of Mediterranean localities, including Gozo, revealed that the Gozitan population was the most genetically different of all those tested (Sicily, Corsica, the Aegean) (De Matthaeis *et al*., 2000).

One species of freshwater decapod occurs in the Maltese Islands, the crab *Potamon fluviatile*. Capolongo & Cilia (1990) concluded that the Maltese populations belong to a distinct endemic subspecies that they named *Ianfrancoi. Potamon fluviatile Ianfrancoi* is closer to *Potamon fluviatile fluviatile* of Sicily and Italy than to *Potamon fluviatile algeriense* of North Africa (Capologno & Cilia, 1990).

UNIRAMIANS

Few general works on the INSECTA of the Maltese Islands have been published. The most important of these are the work by Saliba (1963) on species of economic importance and in which previous work on the same subject is reviewed, the contributions by Schembri [S], Sammut & Valletta, and Cilia (in Schembri [P] & Sultana, 1989) on rare, threatened and endemic species, the poplar accounts provided by Schembri [S] (1995; 1996) and the review of insects used locally for biological control by Mifsud (1997a)

The apterygote orders Protura, 'Thysanura' (Microcoryphia and Zygentoma), Diplura and Collembola are all represented on the Maltese Islands. Of these, the first group named has not yet received any attention. The Maltese 'Thysanura' have most recently been studied by Mendes (1980; 1981; 1987) who recorded five species of the order Microcoryphia, including the endemic *Charimachilis relicta melitensis* closely related to *C.r.egatensis* endemic to Sicily, and seven of the order Zygentoma. With the exception of *C.r.melitensis*, all are either common Mediterranean species or are cosmopolitan and anthropophilic[15]. Pagés (1978) has recorded two species of Diplura from the Maltese Islands; one, *Monojapyx simplex*, having a western Mediterranean and the other, *Parajapyx isabellae*, a Mediterranean distribution. The Collembola (springtails) were most recently studied by Stach (1967) who enumerated some 30 species including seven new species described by himself; almost all of these are now known from Italy and elsewhere and this work needs revision in the light of advances in taxonomic knowledge and in the faunistics of this group. More recently Thibaud & Christian (1989) studied the interstitial[16] Collembola from dune sand samples from Gozo and recorded eight species, including two, *Odontellina sexoculata* and *Mesaphorura schembrii* that up to the present are only known from the Maltese Islands and may be endemic; both are of European affinity.

Much more work has been done on Maltese Pterygota ('winged insects'). The main works on Odonata (dragonflies and damselflies) are those of Valletta (1949; 1957) who also reviewed previous records. One species of Zygoptera (damselflies) and nine of Anisoptera (dragonflies) have been recorded. Two anisopterans are migratory North African species, while the only zygopteran, *Ischnura genei*, has a distribution restricted to the Maltese Islands, Sicily, Corsica, Sardinia and Capri (Schembri [S], 1989b). Other unrecorded species of

[15] Associating with humans.
[16] Living in the spaces between sand grains.

Odonata also occur (S. Schembri, personal communication 1989). Only one species of Ephemeroptera (mayflies) has been reported from the Maltese Islands: the baetid *Cloeon dipterum* (Schembri [J] & Schembri [S], 1979).

Bacetti (1972) reviewed the species of Blattodea (cockroaches), Mantodea (praying mantises) and Orthoptera (crickets and grasshoppers) known from the Maltese Islands to that time and discussed their biogeography. More recent works on these groups include those of Cilia (1975), Schembri [S] (1980a, 1984a), and Schembri [S] & Ebejer (1983; 1984). To date, seven species of Blattodea, four of Mantodea, 13 of Orthoptera: Gryllidae (crickets), some 25 of Orthoptera: Acrididae (grasshoppers) and related families, and 10 of Orthoptera: Tettigoniidae (long-horned grasshoppers) have been recorded from the Islands. Most of these species have a Mediterranean or wider distribution, about five are cosmopolitan, about three are European forms absent in North Africa, one species, the blattid *Ectobius kraussianus* is known only from Sicily and the Maltese Islands (Schembri [S], 1980a), three species are North African, and one species, the ant-cricket *Myrmecophilus baronii* was considered endemic to the Maltese Islands (Bacetti, 1966; 1972; Schembri [S], 1984a) until it was also recorded from Pantelleria by Bacetti *et al*. (1995), although this may be a very similar species. The North African forms are the migratory locust *Schistocera gregaria*, and the gryllids *Acheta palmetorum*, known only from Africa, Palestine and the Maltese Islands and which may or may not be native to the islands (Bacetti, 1972), and *Brachytripes megacephalus* which is a fossorial[17] species, apart from North Africa known also from Sicily and some circumsicilian islands. The endemic or subendemic[18] *Myrmecophilus baronii* is a myrmecophilous[19] cricket of clear European affinities (Bacetti, 1966).

Two species of termites (Isoptera), *Kalotermes flavicollis* and *Reticulitermes lucifugus*, occur in the Maltese Islands, both common Mediterranean forms (Lanfranco [G], 1974). Maltese species of Dermaptera (earwigs) have been reviewed by Schembri [S] & Schembri [L] (1978). Five species occur of which three are cosmopolitan and two have a North Mediterranean distribution. At least two species of Embioptera (webspinners) occur but this group has not yet been studied (S. Schembri, personal communication 2003).

The orders Psocoptera, Mallophaga, Anoplura (all different types of lice) and Thysanoptera (thrips) all occur in the Maltese Islands but have received scant attention. Economically important members are mentioned by Caruana Gatto (1926), Saliba (1963) and Mifsud & Watson (1999). Lienhard (1990; 1998) records six species of Psocoptera (booklice), none of which are endemic or subendemic. Only sporadic records of Mallophaga (biting lice and bird lice) exist, all listed in Mifsud's (2000a) review. Three species are known, of which one, *Halipeurus pelagicus*, parasitic on the Storm Petrel (*Hydrobates pelagicus*), does not appear to have been recorded from Italy to date. Savona Ventura (2002) records three species of Anoplura (Sucking lice) of medical importance: the Head Louse *Pediculus humanus humanus*, the Body Louse *Pediculus humanus corporis* and the Crablouse *Phthirus pubis*. Both the Mallophaga and the Anoplura of the Maltese Islands are incompletely know and require much further study. The only specific records of Thysanoptera (thrips) to date are the introduced species *Frankliniella occidentalis* and *Heliothrips haemorrhoidalis* (Mifsud & Watson, 1999), and *Thrips tabaci* (Farrugia 1997).

A large number of species of Homoptera occur on the Maltese Islands, which have only recently started being systematically studied. One species of cicada (Cicadidae) occurs, *Cicada orni*, a geographically widespread species. The scale insects (Coccoidea) were

[17] Digs burrows.
[18] In this context, subendemic refers to a species occurring in the Maltese Islands and one or two other islands in the vicinity.
[19] Associating with ants; in this case, this cricket lives in ants' nests.

originally studied by Borg (1932) who recorded some 60 species, but these are in need of modern taxonomic revision. Within this superfamily, Boratynski (1969) has described a new species of Pseudococcidae from the Maltese Islands, which has since fallen into synonymy (Mifsud, 2000a). Economically important whiteflies (Aleyrodoidea), psyllids (Psylloidea) and aphids (Aphidoidea) were treated by Caruana Gatto (1926), Saliba (1963) and Mifsud & Watson (1999). Knowledge of the Aleyrodoidea and the Psylloidea of the Maltese Islands has been vastly improved through the studies of David Mifsud, who has recorded 13 species of Aleyrodoidea (Mifsud, 1995; Mifsud & Palmieri, 1996; Martin *et al*., 2000), including a new species, *Aleurolobus teucrii*, so far known only form Sicily and Malta, and 18 species of Psylloidea (Mifsud, 1997c; 2000a). The local Aphidoidea (aphids) have not been systematically studied. Records are provided by Caruana Gatto (1926), Saliba (1963), Farrugia (1997), Mifsud (1997a) and Mifsud & Watson (1999), while Hille Ris Lambers (1969) has described a new species from the Maltese Islands, *Protrama baronii*, now known also from southern Italy.

Tamanini (1966) reviewed previous records of Heteroptera (true bugs) from the Maltese Islands and reported new ones, listing 67 species in all of which one, the mirid *Psallus varians cornutus* was considered endemic; this species was subsequently discovered in other Mediterranean countries and islands (Schembri [S], 1993a). Later, De Lucca (1969) and Rieger (1986) reported further species from the Maltese Islands, bringing the total to 113. The number of recorded species of Maltese Heteroptera was raised to 209 by Schembri [S] (1993a) who also presented a biogeographical analysis; of the 206 species identified fully, 201 occur also in Italy. Of the remainder, *Kalama lugubris* and *Thaumastopus marginicollis pallescens* are eastern Mediterranean species for which the Maltese Islands represent the westernmost limit of distribution, although for the latter, the nominal subspecies (*Thaumastopus marginicollis marginicollis*) occurs also in Sicily. Other species of biogeographical interest are *Macropterna fovicollis* (Calabria, Sicily and the Maltese Islands), *Odontoscelis signata* (Sicily and the Maltese Islands), *Halonabis sareptanus*, *Anoplocerus luteus* and *Emblethis denticollis* (Sardinia and the Maltese Islands), *Berytinus montivagus rotundatus* (Sicily, Sardinia, Lampedusa and the Maltese Islands) *Caenocoris nerii* (Corsica, Sicily and the Maltese Islands) and *Byrsinus albipennis* (Calabria, Sicily, Lampedusa and the Maltese Islands). Maltese species with a North African affinity include *Reduvius villosus*, also present in Sicily, and *Dicranocephalus agilis moralese*, also reported from Macaronesia, Sicily and Italy.

The only general works on the Coleoptera (beetles) of the Maltese Islands remain the popular account of Caruana Gatto (1894) and the catalogue by Cameron and Caruana Gatto (1907). Commercially important species have been treated by Saliba (1963) and threatened, rare and endemic species by Cilia (1989). Although Cameron & Caruana Gatto list some 600 species, many more are known to occur and it is estimated that the coleopteran fauna of the Maltese islands includes more than 2000 species (Schembri [P], 1989a). Moreover, many of the groups listed in Cameron and Caruana Gatto's catalogue are in need of taxonomic revision in the light of recent advances in coleopteran systematics. In particular, the 50 or so endemic species reported from the Maltese Islands (Cilia, 1989) need re-evaluation. For these reasons, it is not possible to analyse the biogeography of the Maltese Coleoptera as a whole. On the other hand, a few detailed studies have been made on particular groups.

Magrini & Schembri [S] (1997) provide an updated list of the Carabidae (ground beetles) of the Maltese Islands, the first since Cameron & Caruana Gatto's catalogue; 125 species are recorded of which 37 were not included by Cameron & Caruana Gatto (1907) and 27 species recorded in the past were not found and seem to have disappeared from the islands, possibly due to habitat changes. Of interest is *Cymindis suturalis* which occurs also in North

Africa and Palestine, the Siculo-Maltese endemics *Cylindera trisignata siciliensis*, *Philochthus escherichi subatratus*, *Acinopus ambiguous*, and the only strict endemism, *Laemostenus picicornis melitensis*, the nominate form of which (*L.p.picicornis*) occurs in North Africa and Lampedusa. Later, Mifsud & Vigna Taglianti (1999) added a further two species to this list and corrected a misidentification.

Aquatic beetles of the families Haliplidae, Gyrinidae and Dytiscidae, were reviewed by Rocchi & Schembri [S] (1992). In all 16 species (one each of Haliplidae, and Gyrinidae, and 14 of Dytiscidae) have been recorded from the Maltese Islands, although not all were found by Rocchi & Schembri [S] (1992) suggesting that some previously recorded species may now be locally extinct.

Cameron & Caruana Gatto (1907) listed 17 species of Histeridae in their catalogue of Maltese beetles. Vienna (1983) confirmed the presence of 11 of these and added four new records. All except one are species having Mediterranean or wider distributions; apart from the Maltese Islands *Saprinus strigil* is known from Cyprus, Jordan, Syria, Iraq, Lebanon, Abyssinia, Senegal, Zaire and Mozambique.

Bordoni (1972) published a catalogue of the Staphylinidae of the circumsicilian islands in which he included all previous Maltese records of the group and added 16 new ones. A further 28 new records were subsequently added by Schembri [S] & Schembri [J] (1982) bringing the total known species to some 172. Bordoni (1972) also attempted a biogeographical analysis of the Maltese staphylinid fauna based on the species known to him. He found that the bulk of the Maltese species have a Mediterranean or wider distribution. Four species have a very restricted Mediterranean distribution; one of these (*Micropeplus porcatus*) being known only from the Maltese Islands, Sicily, Corsica and Sardinia, and the other three (*Trogophloeus siculus, Scopaeus gracilis siculus, Gabius doderoi*) from the Maltese Islands, Sicily and southern Italy. Three other species are of North African affinity, being known from North Africa, the Maltese Islands, Sicily (in the case of *Stenus brunnipes maximus*) and also from southern Italy (for *Achenium striatum* and *Achenium tenellum*). Four species are endemic to the Maltese Islands: *Trogophloeus championi, Astenus gattoi, Astenus walkeri* and an unnamed species of *Achenium*. The first three have European affinities but the last is apparently more closely related to North African forms (Bordoni, 1972). This analysis may have to be revised, firstly because many of the older records have not been confirmed, secondly because of the many new records added since Bordoni's work was published (e.g. Schembri [S] & Schembri [J], 1982 and other unpublished new records; S. Schembri, personal communication 2003), and thirdly in the light of modern taxonomic interpretation of certain species (Bordoni, 1972; Schembri [S] & Schembri [J], 1982).

Poggi (1980) reviewed all previous records of beetles of the families Pselaphidae and Scydmaenidae from the Maltese Islands and added new records. Six pselaphids were confirmed to occur, all species with a western Mediterranean or wider distribution, to which Poggi (1999) later added a new species, *Amaurops mifsudi*, to date known only from the Maltese Islands; this new species has strong affinities with the Sicilian endemics *Amaurops aubei and A.sulcatula*. Three scydmaenids have been confirmed, an unidentified species of *Stenichnus* and two others, one with a Mediterranean and wider distribution and *Scydmaenus antidotus*, a species occurring in the Maltese Islands, Lampedusa, Sicily and southern Italy (Poggi, 1980).

The Cleridae of the Maltese Islands were reviewed by Mifsud (1997b) who listed six species, one of which is a doubtful record; all have a wide geographical distribution. The Dasytidae have recently been studied by Liberti & Schembri [S] (2002) who recorded nine species

including two new to science and as far as is known endemic: *Danacea edulens* and *Danacea thymi*; a third previously described species, *Dasytiscus melitensis* also seems to be endemic. All three endemic species are related to forms that occur in the central Mediterranean from North Africa to southern Italy. *Danacea nigripalpis* is a Siculo-Maltese endemism.

Platia (1985) has studied the Elateridae (click beetles) of the Maltese Islands. He recorded six species, including the new, possibly endemic, *Ischnodes schembrii*, but was unable to confirm another species previously recorded by Cameron & Caruana Gatto (1907). Platia did not, however, analyse the biogeography of the Maltese species. Only one species of Heteroceridae occurs, *Augyles maritimus*, which has a wide geographical distribution (Mifsud & Mascagni, 1997). Mifsud (2000b) records four species of Languriidae (lizard beetles), all with a more or less wide geographical distribution. Mifsud (2001) also records a single species of the family Eucinetidae, also with a wide geographical distribution.

Mifsud & Bílý (2002) reviewed the Bupestridae (jewel beetles) of the Maltese Islands and listed 17 species including seven new records. Most species recorded have a wide distribution, however, *Anthaxia lucens lucens* and *Anthaxia thalassophila thalassophila* are eastern elements while *Anthaxia aprutiana* is limited to southern Italy and the Maltese Islands.

The Cryptophagidae of the Maltese Islands were studied by Otero *et al.* (2001) who report 12 species including a new species, *Micrambe mediterranica* that apart from the Maltese Islands occurs also in Greece and Jordan and is therefore an eastern element in the Maltese fauna. Švec (2000) described a new species of the family Phalacridae from Malta: *Tinodemus mifsudi*. The Zopheridae were studied by Schuh & Mifsud (2000) who recorded four species including one new to science, *Langelandia niticosta*, so far known only from the Maltese Islands but most similar to *L.hypogea* of Algeria. This apparently endemic species therefore shows a North African affinity.

The Coccinellidae (ladybird beetles) of the Maltese Islands were studied by Schembri [S] (1993b) who reviewed previous records and reported new ones; 34 species occur including two species introduced into the Maltese Islands and now naturalised, one (*Rodalia cardinalis*) for biological control purposes. Of biogeographical interest are *Scymnus levaillanti*, *Scymnus auritus*, *Exochomus nigripennis* and *Coccinella undecimpunctata arabica* that are North African elements, and *Scymnus damryi* and *Nephus schatzmayry* that have a restricted Mediterranean distribution (Corsica and Sardinia for the former and southern Italy and Sicily for the latter).

Bellés & Mifsud (2000) have studied the Ptinidae (spider beetles) of the Maltese Islands and record 10 species, seven of which were already listed in Cameron & Caruana Gatto's (1907) catalogue. *Ptinus affinis* seems to be a Siculo-Maltese endemism and *Microptinus melitensis* is endemic to the Maltese Islands.

Cameron & Caruana Gatto (1907) recorded five species of Oedemeridae from the Maltese Islands and Bologna (1984) added a new record. Although no studies on this group as a whole have been made, Bologna (1979) has confirmed the validity of *Stenostoma melitense*, a species now known to be endemic to the Maltese Islands and closely related to *S.cossyrense* of Pantelleria, previously considered conspecific with the Maltese form (Bologna, 1995). Nardi & Mifsud (2000) added a new record to the Aderidae of the Maltese Islands, bringing the total known species to two; both species have a widespread geographical distribution.

The Anthicidae of the Maltese Islands have been reviewed by Schembri [S] (1991) who recorded 18 species. Of these, three are cosmopolitan or nearly so, 11 have a Mediterranean or more widespread distribution, three have a restricted distribution and one is endemic. The species with a restricted distribution are *Tenuicomus velox velox*, known only from Sicily and the Calabrian and Basilicata regions of Italy, *Anthicus opaculus*, known from the Canary Islands, North Africa and Spain, and *Cyclodinus debilis* which occurs in North Africa, Arabia and Ethiopia but which in Europe is known only from the island of Pantelleria and the Maltese Islands. Bucciarelli (1980) confirmed the status of *Aulocoderus melitensis* described as endemic to the Maltese Islands.

The Meloidae (oil beetles) of the Maltese Islands have been reviewed by Bologna (1985), Schembri [S] (1989a) and most recently by Bologna (1995). Eight species occur, all of which are also found in Sicily. *Cabalia segetum* is a predominantly African species that apart from the Maltese Islands occurs also in Sicily. Bologna (1985) interpreted the occurrence of *Mylabris fabricii* on the islands as suggesting a Quaternary connection between the Maltese Islands and Sicily. No endemic species are apparently present; the *Apalus bimaculatus caruanae* reported by various authors (see Cilia, 1989) is of doubtful taxonomic status.

Focarile (1969) has reviewed previous records of beetles of the family Tenebrionidae (darkling beetles) from the Maltese Islands, added new records, and analysed their biogeography. Excluding some five cosmopolitan and anthropophilic forms, the bulk of the 33 recorded species have a Mediterranean distribution. Canzoneri (1979) described a new endemic species, *Stenosis schembrii*, close to *Stenosis intermedia*, a southern European form, and recorded *Opatrum emarginatum*, a North African species that he considered a recent anthropic introduction. Grimm (1986) added another five species to the Maltese list including one predominantly western Mediterranean species, *Phtora* (=*Cataphronetis*) *crenata* and one with a very restricted distribution: *Stenosis freyi*, known from the Maltese Islands, a single record from southern Sicily and Lipari Island. More recently, Mifsud & Scupola (1998) again reviewed and re-evaluated all previous records of tenebrionids from the Maltese Islands and added new ones; these authors enumerate 56 validated records from the islands, to which Mifsud (1999) later added another two species, bringing the total to 58. Mifsud & Scupola (1998) also provided a biogeographic analysis of the Maltese tenebrionid fauna; of the 56 species listed by these authors, seven are cosmopolitan, 17 have a wide distribution (as do the two additional species recorded by Mifsud, 1999), and 26 species have a Mediterranean distribution. The remaining six species are endemic or probably endemic but in need of taxonomic evaluation; to these Mifsud & Scupola (1998) add another three species which also occur in Sicily but which may result to also be endemic species or subspecies. If the figure of nine endemic taxa is accepted, this constitutes a remarkable 15.5% of the total valid tenebrionid species known from the Maltese Islands. All the endemic or supposedly endemic species show affinities with Sicilian or European forms. Apart from the endemics, other species are of biogeographical interest: at least three species (*Dichillus pertusus*, *Trachyderma lima* and *Cnemeplatia atropos*) have a predominantly eastern Mediterranean distribution; *Opatrum emarginatum* is a North African species that, contrary to the opinion of Canzoneri (1979), Mifsud & Scupola (1998) consider as probably native; while two species (*Clitobius ovatus* and *Cossyphus moniliferus*) have a predominantly Afro-Tropical distribution.

Although no analysis of the Maltese Scarabaeidae (scarab beetles) as a whole has yet been attempted, Sabatinelli & Schembri [S] (1990) have studied those species which visit flowers, identifying nine species. Five of these are widely distributed in the Mediterranean and adjacent regions, three have a wider Palaearctic distribution, and only one species, the Calabro-Sicilian-Maltese endemic *Protaetia cuprea incerta*, has a limited distribution.

Beetles of the family Cerambycidae (long-horn beetles) from the Maltese Islands have been studied by Schembri [S] & Sama (1986) and more recently by Mifsud & Booth (1997) and Mifsud (2002). The latter includes 29 species in his catalogue and rejects some other previously recorded species as unconfirmed. With two exceptions, all the species have a Mediterranean or wider distribution, with some being cosmopolitan or almost so, due to anthropogenic introductions. The two exceptions are *Cerambyx carinatus* which has an eastern Mediterranean distribution and *Parmena* sp., originally ascribed to *Parmena pubescens* by Schembri [S] & Sama (1986) but which may represent a new taxon (Mifsud, 2002). It is interesting to note that five species, including *Cerambyx carinatus*, are most likely introductions that have become naturalised in the Maltese Islands.

Surprisingly, given their diversity and the economic importance of some species, the Chrysomelidae (leaf beetles) of the Maltese Islands have not received specific attention since the catalogue by Cameron & Caruana Gatto (1907). The supposedly endemic species *Timarcha melitensis* was shown by Jolivet (1996) to probably originate from Portugal.

In their catalogue, Cameron & Caruana Gatto (1907) listed 100 species of beetles of the family Curculionidae (weevils) from the Maltese Islands. To this list were added two other species described after 1907 (see Magnano & Osella, 1972). Magnano & Osella (1972) examined these records and, after removing five doubtful species from the Maltese list, have presented a biogeographical analysis. Eighty-seven species have a Mediterranean or wider distribution. The remaining 10 have a restricted distribution: two species (*Brachycerus albidentatus, Larinus vittatus*) have a Tyrrhenian distribution while another (*Ceutorhynchus melitensis*) is known from the Maltese Islands, Sicily and southern Italy but has close affinities with the European *Ceutorhynchus grenieri*. Four species have a predominantly North African distribution, three of these (*Otiorhynchus affaber, Apion robusticorne, Hypera jucunda*) are known from North Africa and the Maltese Islands and Sicily, and the other (*Sitona ocellatus*) from North Africa and the Maltese Islands. Two species have a disjunct distribution: *Otiorhynchus moriger* is known from the Maltese Islands and Corfu, and *Thylacites beloni* from the Maltese Islands, western Sicily and Crete. These have been interpreted by Magnano & Osella (1972) as relict species. Another species of biogeographical interest is *Trachyphloeus melitensis*, described by Borovec & Osella (1993) and know only from Lampedusa and Malta. A relatively large number of species are endemic (6.8% of the validated species). Magnano & Osella (1972) considered two species as endemic: *Chiloneus deluccai*, an insular form of *Chiloneus meridionalis*, a species known from Sicily, Ustica and the Egadian Islands; and *Desbrochersella hoffmanni* described by González (1970) and closely related to *Desbrochersella championi* known only from Sicily. Later, Magnano (1992; 1993) added another two species: *Otiorhynchus schembrii* and *Otiorhynchus ovatulus*. More recently, (Magnano & Mifsud (1998) described *Alaocyba melitensis*, which is most closely related to *A.lampedusae* and in turn, both are related to *A.theryi* found in Tunisia and Algeria This is an important discovery as it concerns one of the few local endemics with African rather than European affinities. More recently still, Magnano & Mifsud (2001) described another two new species, so far known only from the Maltese Islands: *Torneuma strictum* and *Torneuma maltense*, both related to *T.siculum* known from Sicily and Sardinia.

Only one member of the order Strepsiptera (stylopids) is known from the Maltese Islands, *Mengenilla chobauti*, a species widely distributed in the Mediterranean area (Schembri [S], 1984b).

Valletta (1984) recorded species of Neuroptera Myrmeleontidae (antlions) collected or reported from the Maltese Islands by himself and previous workers and listed seven species; he also reported five species of Neuroptera Chrysopidae (lacewings) (Valletta, 1985).

Subsequently, Duelli (1994) recorded 12 species, seven of them new records. Plant & Schembri [S] (1996) reviewed all the neuropteroid insects of the Maltese Islands, confirming 29 species belonging to four families, including their own new records, with another two not definitely identified.

The order Trichoptera (caddisflies) was only recorded from the Maltese Islands relatively recently (Schembri, [S], 1981; Schembri [S] & Johnson, 1987). Two species occur: *Tinodes maclachlani*, which is also known from Britain, Central Europe, Corsica, Italy and Sicily, and *Mesophylax aspersus*, a species with a vast distribution.

There exists a large literature on the Lepidoptera (moths and butterflies) of the Maltese Islands. Notable summaries of this group include the contributions of Valletta (1972, 1973) on Rhopalocera (butterflies) and on Heterocera (moths), respectively; of Schembri [S] (1977) and Sammut (1982) on Rhopalocera; and of Sammut (1983) on Geometridae (geometrid moths). Sammut (1984) has produced a systematic and synonymic catalogue of the Maltese Lepidoptera in which he has updated nomenclature, corrected previous misidentifications, added new records and compiled a bibliography of literature on the Maltese lepidopteran fauna. Endemic and/or threatened species have been treated by Sammut & Valletta (1989), while Sammut (1989) has discussed aspects of the history of lepidopterological studies on the Maltese Islands, and the Maltese lepidopteran fauna, in general. A recent comprehensive compilation is that of Sammut (2000); according to this, 599 species have been recorded from the Maltese Islands.

In spite of the impressive literature on this group, only two authors (De Lucca, 1965; Sammut, 1989) have attempted biogeographical analyses. According to De Lucca, the character of the Maltese lepidopteran fauna is typically southern European, however, some 7% of the local species are found in North Africa but not in Sicily and the rest of Europe. Sammut (1989) analysed the biogeographical relationships of the Maltese Noctuidae (noctuid moths). Of the 128 species that occur, 90.6% have a wide distribution, 7.8% (10 species) have a restricted distribution (known from the Maltese Islands and one or two other countries only) and only 1.6% (2 species) are endemic to the Maltese Islands. The endemic Lepidoptera of the Maltese Islands have most recently been revised by Sammut (1984; 1989) and Sammut & Valletta (1989). All endemics that are well characterized taxonomically appear most closely related to southern European species with the exception of *Antitinea deluccae* which is most closely related to *Tinea palastinella* of the Middle East (De Lucca, 1965). Excluding species whose taxonomic status is debatable, Karsholt & Razowski (1996) consider 15 species as endemic, which is about 2.5% of the species recorded. However, additional new (and presumably endemic) species have been described since (see Mifsud, 2000a), so the percent endemism in the group may be slightly higher. There is need for a detailed taxonomic analysis of the many 'endemic' species, subspecies and 'forms' that have been described from the Maltese Islands, followed by a modern biogeographical analysis.

The Diptera (true flies) of the Maltese Islands had received scant attention until recently, when two Maltese entomologists, Martin Ebejer and Paul Gatt took up study of this group. Newstead (1912) dealt with the medically important sandflies of the genus *Phlebotomus* (recently, interest in these flies of medical and veterinary importance has resumed – see Mifsud, 2000a and Savona Ventura, 2002); Caruana Gatto (1926) listed the gall-forming species known to him; Saliba (1963) reviewed the economically important species; Spencer (1972) gave a list of the Agromyzidae collected by him, and described a new species, *Liriomyza melitensis*; Chvála (1980) described a new species of acrocerid fly, *Ogcodes schembrii*, related to *Ogcodes gibbosus* which is widespread in Europe; Schembri [S] (1985a) studied the Maltese Hippoboscidae; Canzoneri (1985) reviewed records of Ephydridae from the Maltese Islands; and Ebejer (1988a; 1988b) studied the Maltese

Bombyliidae and Syrphidae. Other scattered records of individual species also exist. All known records of Diptera from the Maltese Islands up to *ca* 1990 were listed in a catalogue of the Maltese Diptera by Schembri [S] *et al.* (1991), which includes well over a hundred new records and enumerates 203 species belonging to 27 families. Ebejer (1995b) updated this list for the larger flies by correcting nomenclature and adding a number of new records. Subsequent to this a large number of works have appeared that have treated individual groups of flies in detail and added numerous new records as well as new species. The more important of these are reviewed below.

Maltese Culicidae (mosquitoes) were studied by Gatt (1996) who also reviewed previous records. Nine species are considered valid for the islands; all have a wide geographical distribution. Ebejer (2000) records the family Dixidae from the Maltese Islands for the first time, listing three species, all with a wide distribution. The fungus gnats (families Bolitophilidae, Keroplatidae and Myceophilidae) of the Maltese Islands were studied by Chandler & Gatt (2000), who reported 30 species including two new and (to date) endemic species: *Macrocera buskettina* (Keroplatidae), with eastern Mediterranean affinities, and *Docosia melita* (Mycetophilidae).

Ebejer (1988a; 1995b) recorded 27 species of Bombylidae (beeflies) from the Maltese Islands. The same author recorded 46 species of Syrphidae (hoverflies) (Ebejer, 1988b; 1995b). None of the species are endemic. Plant (1995) described two new species of *Chersodroma* (family Hybotidae) from Malta. Gatt (2000) studied the Sphaeroceridae of the Maltese Islands and recorded 41 species, all but three, new records; *Phthitia sicana* appears to be a Siculo-Maltese endemism while *Thoracochaeta mediterranea* is known only from Pantelleria and Malta. Ebejer (1995a) records one species of Sciomyzidae, widespread in the Mediterranean. He also records seven species of Chyromyidae of which four were new to science and were all collected from the Ghadira bird sanctuary (Ebejer 1993). Ebejer (1998a) later synonymised two of these but the other two (*Aphaniosoma clitellatum* and *A.spatulatum*) are still only known from Malta; in this same work, Ebejer also added new records, including of a new species *Aphaniosoma nigrum*, known only form Tunisia and Malta. Subsequently, Ebejer (1998b) described a second species of this family also known only from Tunisia and Malta: *Gymnochiromyia fallax*.

Ebejer (2001) recorded three families of flies – Camillidae, Campichoetidae and Drosophilidae – for the Maltese Islands for the first time and reported two species of the first, one of the second and 13 of the third; all species have a wide distribution. Munari & Ebejer (2000) recorded the family Tethinidae from the Maltese Islands for the first time and listed seven species, all common Mediterranean forms with the exception of a new species they named *Tethina melitensis*, collected from sandy coastal areas. Ebejer & Gatt (1999) studied the Maltese species of Fannidae and Muscidae and recorded eight species of the former and 36 species of the latter; all species have a wide geographical distribution.

A number of general works on Maltese Hymenoptera (ants, bees and wasps) have been published. The most important of these are the lists of Alfken (1929), Valletta (1971; 1978) and Erlandsson (1974; 1979; 1984). None of these authors has attempted a biogeographical analysis of the hymenopteran fauna, however. Gall-forming species were listed by Caruana Gatto (1926) while Saliba (1963) listed species of economic importance.

Some individual groups of Hymenoptera have been studied in detail. The best known of these are the ants (Formicidae), the subject of comprehensive works by Baroni Urbani (1968a; 1968b) and Schembri [S] & Collingwood (1981; 1995). A total of 50 species have been recorded, the bulk of which have Mediterranean or wider distributions and a few of which are recent anthropic introductions. One species, *Messor caducus*, has a disjunct

distribution, being known only from the Maltese Islands, Rhodes and Turkey. Another two species, *Aphaenogaster inermis* and *Stenamma petiolatum*, have a very restricted Mediterranean distribution, the former being known from the Maltese Islands and southern Italy, and the latter from the Maltese Islands and a few Italian sites. Seven species have North African affinity: *Cardiocondyla nigra, Acantholepis frauenfeldi velox* and *Diplorhoptrum santschii* are known from Tunisia and the Maltese Islands; an as yet unidentified species of *Themnothorax* is probably also a North African species; *Aphaenogaster sicula* is a Siculo-Maltese endemism, probably most closely related to African species; *Pheidole teneriffana* is known from the Canary Islands, North Africa, the Maltese Islands, Asia Minor, Ethiopia and Syria; while *Camponotus barbaricus*, a widely distributed species in North Africa, is in Europe known only from the Maltese Islands, Sicily and southern Spain. Recently, further, as yet unrecorded species of African affinity have been discovered in the Maltese Islands (S. Schembri, personal communication 1989). Two ants are endemic to the Maltese Islands: *Strongylognathus insularis* and *Leptothorax splendiceps*, which is closely related to the Sicilian *L.laestrygon*.

Schembri [S] (1983) reviewed previous records of Mutillidae (velvet ants) from the Maltese Islands, corrected various misidentifications and added new records. Subsequently, Petersen (1988) made various corrections to the Maltese list of these hymenopterans as a result of his re-interpretation of some species. Fifteen species occur in the Maltese Islands, the bulk of which have a South European, Mediterranean or wider distribution. Three species are of particular biogeographical interest: *Mutilla barbara* is a North African species in Europe occurring only in the Maltese Islands; *Stenomutilla hottentotta* is also a North African species, which in Europe occurs only in the Maltese Islands and Sicily; the new species of *Smicromryme* reported by Schembri [S] (1983) shows strong affinities with North African species.

Lists of the Pompilidae (spider-hunting wasps) of the Maltese Islands were presented by Wahis (1997; 1998); 29 species are recorded of which three, *Agenioideus arenicolus*, *Agenioideus seminiger* and *Tachyagetes cinerascens*, are North African species that do not occur on the European mainland.

Strumia (1981) recorded 15 species of Chrysididae (jewel wasps) from the Maltese Islands and listed previous records. The Maltese chrysidid fauna is very similar to that of Sicily and shows strong European affinities; one species, *Hedichrydium dismorphum*, however, was previously known only from Algeria. Schembri [S] (1991a) also reviewed previous records of Sphecidae (digger wasps) from the Maltese Islands and recorded new species; he did not, however, attempt a biogeographical analysis.

Records of Apoidea (bees) from the Maltese Islands and reviews of previous literature on the group have been published by Schembri [S] (1982) and Van Der Zanden (1983). Schembri [S] (1980b, 1985b) has similarly treated the Vespoidea (wasps). These authors do not however analyse the biogeography of either group, although Schembri (1985b) records *Ancistrocerus biphaleratus tripolitanus* previously known only from Cyrenaica. More recently, Sheppard *et al*. (1997) have described the honey bee of the Maltese Islands as an endemic subspecies, *Apis mellifera ruttneri*, which, on the basis of morphological, molecular and behavioural data, is closer to the North African subspecies *A.m.intermissa* than to European subspecies, a situation also found in the Sicilian subspecies *A.m.sicula*.

A special study of parasitoid, parasitic and hyperparasitic Hymenoptera has been made by David Mifsud and his co-workers, who record some 40 species distributed in eight families (Mifsud *et al*., 1995; Mifsud, 1997a; 1997c; see also Mifsud 2000a). It is interesting to note that a number of species were introduced accidentally with their host while others were deliberately introduced as part of biological control programmes.

Schembri [S] (1992) provided a preliminary list of the Ichneumonidae (ichneumons) of the Maltese Islands, a group that was hardly studied previously; 24 species are recorded all with a relatively wide geographical distribution, except for a species that is close to members of *Diadegma*, but which does not quite fit in this genus.

No specific works on the Siphonaptera (fleas) of the Maltese Islands have been published, however, material from Malta appears in a number of general works on fleas, as well as in medical reports (see Mifsud, 2000a; Savona Ventura 2002). Some nine species have been recorded (Mifsud, 2000a) of which the most interesting is a new subspecies (*vogeli*) of the flea *Leptopsylla algira* from a laboratory colony of the Sicilian Shrew (*Crocidura sicula calypso*) founded from specimens originating from the island of Gozo (Beaucournu, 1990). *Leptopsylla algira*, of which nine subspecies are now known, has an overall circum-Mediterranean distribution.

Enghoff & Schembri [P] (1989) have reviewed previous work on the Diplopoda (millipedes) of the Maltese Islands, added new records and discussed the biogeography of the group. Fourteen species occur of which one is cosmopolitan and another, *Glomeris distichella*, is a Siculo-Maltese endemism. There are no species of North African affinity but four species constitute clear eastern (Greek/Balkan) elements in the Maltese fauna. Of these, *Stosatea minima* is known only from the Maltese Islands and Greece, and *Polydesmus mediterraneus* is known from the Maltese Islands, Greece, Bulgaria, Yugoslavia and Turkey. More recently, Jeekel (2000) published a list of six species, all previously recorded, mainly to discuss and update the nomenclature. Reassessment of a polyxenid reported as *Polyxenus lapidicola* by Enghoff & Schembri [P] (1989) has shown that this is referable to Polyxenus macedonicus, known from Macedonia, Southern France and Corsica (Ebejer [K] & Schembri, 2001).

At least one species of the class Symphyla occurs in the Maltese Islands (Schembri [P], 1984) but this group has not been studied. The Chilopoda (centipedes) of the Maltese Islands have been treated by Gulia (1890) and more much later by Matic *et al.* (1967) who listed seven species. A faunistic and zoogeographic study of the centipedes of the Maltese Islands has increased the count to 21 species, mostly with a Mediterranean distribution (Marzio Zapparoli & Alessandro Minelli, personal communication 2003).

VERTEBRATES

The CHORDATA of the Maltese Islands have been well studied. There are no freshwater fish present on the islands, however, one brackish water species, the Killifish *Aphanius fasciatus*, occurs in a very limited number of enclosed brackish water bodies (Deidun *et al*., 2002). This species apparently presents phenotypic differences from mainland populations (Darmanin, 1979) and different ecotypes may exist in different localities within the islands (Zammit & Van Es 1980).

The reptiles and amphibians of the Maltese Islands have been reviewed by Lanza (1972) and most recently by Baldacchino & Schembri [P] (2002). The only member of the Amphibia is the frog *Discoglossus pictus pictus*. As currently recognized, this is a Siculo-Maltese race of a predominantly Northwest African species (see Lanza *et al.*, 1986 for a review and references). The Reptilia are represented by one skink, one chameleon, two geckoes, one lacertid lizard and four snakes. In addition, marine turtles occur in Maltese waters (*Caretta caretta*, very occasionally *Demochelys coriacea* and even more rarely, *Chelonia mydas*) but no longer breed on the islands (see Gramentz, 1989 and references therein); a number of other chelonians are imported as pets.

The chameleon (*Chamaeleo chamaeleon*) is not a native species but was imported into the islands from North Africa round 1880 and has since become naturalized. The skink, *Chalcides ocellatus*, occurs as a subspecies (*tiligugu*) which apart from the Maltese Islands is known from Algeria, Tunisia, Sardinia, Sicily and several minor islands. The snake *Coluber algirus* is a Northwest African species for which the Maltese Islands are the only European station. Another snake, *Elaphe situla* occurs as a subspecies (*leopardina*) whose area of distribution is essentially eastern Mediterranean (Balkan) and in the central Mediterranean occurs only in the Maltese Islands, southern Sicily and southern Italy. A third snake, *Telescopus fallax fallax* is similarly an eastern Mediterranean (Balkan) species whose only central Mediterranean station is the Maltese Islands. It has often been hypothesized that *Coluber algirus* and *Telescopus fallax* were introduced into the islands passively, although Lanza (1973) has argued for active diffusion into the islands from North Africa for the former and via Sicily, from where it then became extinct, for the latter. The Maltese lacertid, *Podarcis filfolensis* is a species endemic to the Maltese Islands and the Pelagian Islands of Linosa and Lampione. Four races have been named from the various islands of the Maltese group and one race from the Pelagian Islands. According to the immunological data of Lanza & Cei (1977) *Podarcis filfolensis* is closely related to *Podarcis wagleriana*, a species endemic to Sicily, however, according to the genetic investigations of Capula *et al.* (1988) *Podarcis filfolensis* is more closely related to *Podarcis sicula*, a predominantly southern European species, and possibly to *Podarcis melisellensis*, a species of the east Adriatic coast, while more recent molecular genetic work (Capula, 1994) has confirmed a closer relation to *Podarcis sicula* but not to *Podarcis wagleriana*.

There is a very extensive literature on the birds (Aves) of the Maltese Islands. Bannerman & Vella Gaffiero (1976), Sultana & Gauci (1982) and Sultana (2001) have provided reviews. All these authors have evaluated previous records and added new ones to the Maltese list and include extensive bibliographies. Of the 379 species recorded, some 18 are resident, five are summer visitors, 52 are winter visitors, 112 are more or less regular migrants and the remainder are irregular migrants or vagrants. Of the locally breeding species, two are of biogeographical interest: *Puffinus yelkouan* is an eastern Mediterranean species for which the Maltese Islands are the westernmost limit of distribution; the local sparrow, previously referred to as *Passer hispaniolensis maltae* is now known to belong to a hybrid population between *Passer hispaniolensis hispaniolensis* and *Passer domesticus italie* which is found south of Rome, in Sicily and in the Maltese Islands (Sultana & Gauci, 1982).

Excluding domestic species, some 19 species of terrestrial Mammalia (mammals) have been recorded from the Maltese Islands. Lanfranco [G] (1969) has summarized the information available at the time and gives a bibliography; Lanfranco [G] & Schembri [P] (1989) listed the rare and/or threatened species, while a recent review is provided by Baldacchino & Schembri [P] (2002). Apart from bats, most species of mammals currently occurring in the Maltese Islands were introduced into the islands following colonization by humans. According to Storch (1970) *Apodemus sylvaticus* and *Rattus rattus* were introduced during the Bronze Age while *Rattus norvegicus, Mus musculus* and *Atelerix algirus* were introduced more recently. Humans also introduced cattle, goats, sheep, pigs and the domestic cat very early following colonization of the islands (Boessneck & Küver, 1970) and later horses and donkeys. These species are therefore of little biogeographical interest. More important from this point of view are the Soricidae (shrews) and the Chiroptera (bats).

A species of shrew, equated with the extinct Pleistocene *Crocidura esuae* of Sicily by Kotsakis (1986), predated human occupation of the islands. Two living species currently occur, *Suncus etruscus*, and a species of *Crocidura* that morphological, karyological and molecular genetic data have shown to be *Crocidura sicula*, a Sicilian species (Vogel *et al*.,

1989; 1990a; 1990b; Maddalena & Vogel, 1990). The present day Sicilian and Maltese populations of this species evolved from the Pleistocene *Crocidura esuae* and the only real difference between the two is reduction in size (Hutterer, 1990). *Crocidura sicula* is a Siculo-Maltese endemism and one of the few survivors of the Pleistocene fauna of the region (Vogel *et al.* 1990a, 1990b). The Maltese population has been named as the subspecies *calypso* (Hutterer, 1991). Hutterer (1991) is of the opinion that *Crocidura sicula* is more closely related to North African forms.

Although some 10 species of bats have been recorded from the Maltese Islands (Lanfranco [G], 1969; Borg *et al*., 1997), only five are at all common, the remainder being either occasional migrants or vagrants. Of the resident species, the local race of *Myotis blythi* is of particular interest, as it appears to be intermediate between the two sibling species *Myotis blythi* and *Myotis myotis,* and has been referred to as *Myotis blythi oxygnathus* (Toschi & Lanza, 1959; Lanfranco [G], 1969). This race was later named *punicus* by Felten *et al.* (1977) who interpret it as occurring in Corsica, Sardinia, the Maltese Islands and parts of Tunisia. On the other hand Strelkov (1972) considers the local race as *omari*, present also in Sardinia, Crete, and the Near and Middle East. Arlettaz *et al*. (1997) have investigated the zoogeography of *Myotis blythi* and *Myotis myotis*, paying particular attention to the marginal populations of Mediterranean islands and analysing morphology, genetics and ecology. These authors show that North Africa, Corsica and Sardinia are inhabited by a monospecific population of *Myotis myotis*, and, in contrast to all other recently studies, these authors have attributed the Maltese population to this entity, mostly on ecological grounds. The question of what exactly is the *Myotis* of the Maltese Islands is therefore still controversial and open.

DISCUSSION AND SYNTHESIS

Reviewing the information presented above, a number of general points about the non-marine terrestrial fauna of the Maltese Islands can be made. The first is that, perhaps surprisingly given the size and limited range of habitats present on the islands, the long human occupancy and the very large human population, nonetheless the Maltese Islands have a diverse terrestrial and aquatic fauna that includes representatives of most animal groups known to occur in the central Mediterranean region. Very few major groups are completely absent from the islands, and in the main, these are those associated with abundant freshwater which is arguably the least common habitat type on the islands. Examples of such 'missing' groups include freshwater sponges (Porifera), stoneflies (Insecta: Plecoptera), alderflies (Insecta: Megaloptera), freshwater fish (Chordata: Osteichthyes) and salamanders (Amphibia: Caudata). For the same reason, it is hardly surprising that some of the rarest groups of those that do occur are also associated with freshwater. Examples include leeches (Annelida: Hirudinea) where only one amphibious species occurs in a single locality (Schembri [P], 1989), caddisflies (Insecta: Trichoptera) where only two species, collected perhaps once or twice each are known (Schembri [S], 1981; Schembri [S] & Johnson, 1987), and the freshwater crab (Crustacea: Decapoda), with very few isolated populations (Schembri [P], 1989b; Capolongo & Cilia, 1990). On the other hand, there are also a few groups that are not aquatic but which are nonetheless missing from the Maltese Islands, even though they occur in nearby islands, including the Pelagian Islands, which geologically and ecologically are part of the Maltese group. Examples include stick insects (Insecta: Phasmatodea) and sun scorpions (Arachnida Solifugae). There does not seem to be any simple explanation for this.

Compared to that of Sicily, the largest island in the Central Mediterranean, the species richness of the Maltese Islands is overall lower, and in many cases, much lower. This is to be expected given the much smaller size and the more limited range of habitats in the Maltese

Islands. In particular, the lack of mountains in the Maltese Islands results in the absence of rain shadow effects, which, together with the desiccated topography give the multiplicity of habitats and microclimates associated with elevated ground, such as is found in Sicily. However, when compared to circum-Sicilian islands of similar size, the Maltese fauna is as, or more, diverse. Such comparisons must be treated with caution however, as not all circum-Sicilian islands have been as well investigated faunistically as the Maltese Islands; absence or reduced representation of a particular taxon on one island as compared to other islands in the region may equally reflect lack of study of the taxon as much as a real difference between the islands. This of course works both ways. Thus, at present, the Maltese Islands appear to have a very limited fauna for some groups compared to the other islands of the Sicilian Channel (for example: mites and ticks – Arachnida: Acari) simply because these groups have not yet been studied much locally, which brings us to the next point.

In spite of the impressive amount of work that has been carried out on the Maltese fauna to date, there are whole groups that have not been studied at all and many others that, although having received some attention, are still not well know. Even a cursory perusal of the information presented above will show that we know next to nothing about freshwater flatworms (Platyhelminthes: Turbellaria), rotifers (Rotifera), waterbears (Tardigrada), mites and ticks (Arachnida: Acari), and the lower myriapods (Pauropoda, Symphyla), to name but a few. Even those groups that have been well studied, such as the larger beetles (Insecta: Coleoptera) and the butterflies and moths (Insecta: Lepidoptera) still provide ample scope for further work. It is particularly important to assess the real taxonomic identity of the species reported as present on the islands, especially where particular island 'races' are involved, especially if the original designations were made a long time ago, before modern ideas of what constitutes biological species, and modern taxonomic methods, became widespread. Two very 'popular' groups, the terrestrial snails (Mollusca: Gastropoda) and the butterflies and moths (Insecta: Lepidoptera) are particularly good examples in this regard. Both have received a great deal of attention from taxonomists, amateur naturalists and collectors and many tens of species, subspecies, 'varieties' and 'forms' have been described and named, sometimes on the flimsiest of characters. In some cases, such distinctions are justified and have actually led to the recognition of distinct genetic units at specific and subspecific levels. A good example is the recent recognition of what was previously regarded as a local variety of the continental Spurge Hawkmoth *Hyles euphorbiae* as a distinct endemic species, now called *Hyles sammuti* (Danner *et al*., 1998). In other cases, some of these 'taxa' have not stood up to modern scrutiny and have been shown to be variants of different types but not distinct genetic entities; as examples of this may be cited the numerous 'forms' and 'varieties' of what is now considered to be a single very variable species *Trochoidea spratti* (Giusti *et al*., 1995).

The application of molecular genetic techniques of taxonomic analysis has had a great impact on previously intractable problems of local taxonomy and has revealed some surprises. Some of these have been discussed above, including: the case of the endemic door snails (Clausiliidae) of the genera *Lampedusa* and *Muticaria* and of the endemic top snail (Hygromiidae) *Trochoidea spratti*, the scorpion *Euscorpius sicanus*, the endemic cave-dwelling woodlouse *Armadillidium ghardalamensis*, the endemic Maltese subspecies of the honey bee *Apis mellifera ruttneri*, and the identity of the Maltese populations of the white-toothed shrew, now regarded as an endemic subspecies *Crocidura sicula calypso*. Unexpected results include the apparent existence of two distinct 'types', interpreted as incipient species, in the endemic cave-dwelling woodlouse *Armadillidium aelleni* and the genetically distinct population of the sandhopper (Crustacea: Amphipoda) *Talorchestia deshayesii* on Gozo.

Such molecular genetic studies are still in their infancy locally and as they are more widely applied, further interesting results are expected. For example, we still do not know just how genetically distinct are local populations of the Killifish *Aphanius fasciatus* or of the Mediterranean Freshwater crab *Potamon fluviatile lanfrancoi*; what is the relationship between the various 'subspecies' of the Maltese Wall Lizard *Podarcis filfolensis* that have been formally or informally described; what is the specific identity of the local Mouse-eared Bat *Myotis* (?) *blythi*; if the subterranean ant-associating cricket *Myrmecophilus baronii* of the Maltese Islands and of Pantelleria are the same or distinct species; if recognition of the local Swallowtail Butterfly as a distinct subspecies *Papilio machaon melitensis* is justified? – and many more. Some of these problems are currently being investigated by my collaborators and myself or by others, but many await attention.

One application of faunistic data of the type reviewed in the present work is to analyse the biogeography of a region – in the specific case of the Maltese Islands, to ask such questions as: What are the affinities of the Maltese fauna? Where did the species currently present come from originally? How and when did they get here? How did the various endemic forms arise and did the same mechanisms operate in each case? How is the faunistic composition of the Maltese Islands changing?

The scientific value of any hypotheses on island biogeography advanced on the basis of comparisons of species presence/absence data between different regions depends in great part on sound taxonomic knowledge. In working out the biogeographical relationships of a locality, the occurrence and affinities of species with restricted or disjunct distributions, and of endemic species, are particularly important. It is imperative to study the relationship of such species occurring on the Maltese Islands to postulated conspecifics or ancestors occurring elsewhere. In spite of the advances made, there is still a lot of confusion as to which species actually occur and to the taxonomic status of several Maltese endemic taxa. There are two main reasons for this: firstly, many works, especially older ones, are based entirely on classical morphological criteria, sometimes rather superficial or plastic ones. Secondly, very little is known about the fauna of some of the surrounding islands and particularly of North Africa and many new taxa have been instituted with very little justification. In some cases, this problem is compounded by loss of type material. There is also a problem with taxa that have been instituted on the basis of a few specimens, occasionally even just a single individual. For these, the range of variation is not known; when a larger series is eventually studied, the type specimen may turn out to be just one, perhaps extreme, form of a very variable species with no clear boundaries between the different variants. Such is the case with the endemic Spratt's Top-snail *Trochoidea spratti*, already discussed. An additional problem arises with species that come from specialised habitats that are difficult to sample and little studied. Thus a number of minute subterranean beetles from soil and litter samples have been described as new to science in recent years and to date are only known from the Maltese Islands; it would not be surprising if when equivalent habitats are sampled in adjacent islands and lands, these species are found to be more widespread than thought at present.

Obviously, biogeographical correlations based on erroneous assumptions of affinity, endemicity and disjunct distributions lead to incorrect results. Further below I discuss one hypothesis of Maltese biogeography that was based on taxonomic information now know to be incorrect. Given the still rather patchy knowledge of the faunistics of the Maltese Islands, no grand synthesis of the islands' biogeography is yet possible, but only a preliminary qualitative assessment.

The main affinities of the Maltese Islands are very obviously with Sicily, and indeed the Maltese fauna has been described as a mere appendage of that of Sicily (e.g. Soós, 1933).

Most Maltese species occur also in Sicily. Some have a distribution limited to Sicily and southern Italy, and other circum-Sicilian islands, apart from the Maltese Islands; others are Siculo-Maltese endemics (for example: the salticid *Aelurillus schembrii,* the blattid *Ectobius kraussianus,* the diplopod *Glomeris distichella* and the frog *Discoglossus pictus pictus*). In the majority of cases where the affinities of strictly Maltese endemic taxa have been worked out, these are clearly derived from Sicilian (or European) ancestors (for example: the gastropods *Cernuella caruanae, Marmorana melitensis, Lampedusa* spp. and *Trochoidea* spp., the pseudoscorpion *Roncus melitensis,* the trapdoor spider *Nemesia arboricola*, the crab *Potamon fluviatile lanfrancoi,* the collembolans *Odontellina sexoculata* and *Mesaphorura schembrii,* the cricket *Myrmecophilus baronii,* the staphylinids *Trogophloeus championi, Astenus gattoi* and *Astenus walkeri,* the tenebrionid *Stenosis schembrii,* the curculionids *Chiloneus deluccai* and *Desbrochersella championi,* the acrocerid *Ogcodes schembrii* and the lizard *Podarcis filfolensis).* The majority of the non-endemic Siculo-Maltese species have a wider Mediterranean, European or even broader (Palaearctic, or Palaearctic and Ethiopian) distribution.

As might be expected from the Maltese Islands' position at the centre of the Mediterranean, at the border of the West and East Basins, species whose centres of distribution are these two basins also occur. However, species of Eastern Mediterranean affinity predominate, and indeed, as first observed by Francini Corti & Lanza (1972), the Maltese Islands have the largest number of such species of any of the circumsicilian islands. Such species include the heteropteran bugs *Kalama lugubris* and *Thaumastopus marginicollis pallescens*, the bupestrids *Anthaxia lucens lucens* and *Anthaxia thalassophila thalassophila*, the tenebrionids *Dichillus pertusus, Trachyderma lima* and *Cnemeplatia atropos*, the diplopods *Stosatea minima* and *Polydesmus mediterraneus,* the snakes *Elaphe situla leopardina* and *Telescopus fallax fallax,* and the bird *Puffinus yelkouan.* Particularly interesting in this respect as those Maltese endemics with eastern Mediterranean affinities, as for example, the palpigrad *Eukoenenia christiani,* the moth *Antitinea deluccae* and the keroplatid fly *Macrocera buskettina*. Only two Maltese endemics, the pseudoscorpion *Chthonius girgentiensis* and the tenebrionid *Alphasida grossa melitana,* have to date been shown to have western Mediterranean affinities.

A number of species have a disjunct Mediterranean distribution, occurring in the Maltese Islands and one or more widely separated Mediterranean localities (for example: the bugs *Halonabis sareptanus*, *Anoplocerus luteus* and *Emblethis denticollis*; the curcurlionid *Otiorhynchus moriger*; the syrphid *Eumerus terminalis*; and the ant *Messor caducus).*

A significant number of species are of North African affinity, either occurring in North Africa, the Maltese and other circumsicilian islands and in Sicily (and perhaps also southern Italy), or having a more restricted distribution, the extreme of which is represented by those North African taxa whose only European station is the Maltese Islands (for example: the pseudoscorpion *Minniza algerica,* the cricket *Acheta palmetorum,* the carabid *Cymindis suturalis*, the curculionid *Sitona ocellatus*, the chyromyid flies *Aphaniosoma nigrum* and *Gymnochiromyia fallax*, the ants *Cardiocondyla nigra, Acantholepis frauenfeldi velox* and *Diplorhoptrum santschii,* the mutillid *Mutilla barbara,* the chrysidid *Hedichrydium dismorphum* and the snake *Coluber algirus).*

Although less numerous than the endemics with European affinities, a significant number of Maltese endemics with North African affinities exist. These include the carabid *Laemostenus picicornis melitensis*, the zopherid *Langelandia niticosta*, the curculionid *Alaocyba melitensis*, and the as yet unnamed species of *Achenium* (Staphylinidae) and *Smicromryme* (Mutillidae).

A number of species are cosmopolitan or have obviously been introduced by humans, or both, and these are of no biogeographical significance. However, introduced aliens are of conservation concern for their potential effect on indigenous species, either directly or through changes they bring about in local habitats and ecosystems. It is beyond the scope of this work to discuss such aspects, and the reader is referred to the reports of a conference on the effects of the introduction of alien species on local flora and fauna (Baldacchino & Pizzuto, 1996) particularly the paper by Schembri [P] & Lanfranco [E] (1996). One aspect needs highlighting nonetheless, that of 'genetic erosion'. Introduced alien species may breed with closely related species to give hybrids that gradually accumulate differences from their native parental stock, resulting in loss of unique genetic characteristics. In this regard, Sheppard *et al*. (1997) have already expressed concern that the genetic identity of the endemic Maltese Honeybee *Apis mellifera ruttneri* is being threatened through breeding with introduced alien subspecies of honeybees. Where local populations present different ecotypes in different localities (such as is the case with the cave woodlouse *Armadillidium aelleni* and, possibly, the Killifish *Aphanius fasciatus*), introducing individuals from one population to another is a threat to the genetic identity of the different populations, for the reasons already discussed.

The affinities of the Maltese fauna (and flora) are clearly with those of Sicily (Francini Corti & Lanza, 1973; Hunt & Schembri, 1999). While many workers have pointed this out, the first comprehensive hypothesis on the origin of the Maltese biota was put forward by Thake (1985) to explain the occurrence and distribution of the clausiliid land snails endemic to the Maltese Islands, the Pelagian Islands, and the Hyblean region of Sicily (see above under 'Mollusca'). Thake (1985) interpreted the extant species of *Lampedusa* as the descendants of an ancient clausiliid stock that colonised the areas now occupied by the Pelagian and Maltese island groups, from Sicily in Messinian[20] times, when the whole Pelagian Block[21] was emerged during the Messinian Salinity Event[22]. From these colonisers, the present species of *Lampedusa* differentiated in isolation following submergence of the land connections between the two island groups and Sicily. Thake postulated that the ancestral clausiliid stock remaining in Sicily gave rise to the genus *Muticaria*, and that these *Muticaria* from Sicily invaded the Maltese Islands during periods of low sea-level when the two areas became joined by land-bridges during the Pleistocene[23] glaciations (ice ages). On the basis of conchological and distributional data, Thake hypothesised that two separate invasions by *Muticaria* may have occurred. Each invading population then developed in isolation following severance of the land connection with Sicily, giving rise to the extant *Muticaria* of the Maltese Islands.

Thake's (1985) biogeographical model has been recently re-examined by Giusti *et al.* (1995). These authors reviewed the taxonomy and phylogeny of the clausiliid taxa considered by Thake, using classical conchological and anatomical analyses as well as modern molecular genetic techniques. They concluded that three biological species of *Lampedusa* occur. *L. lopadusae*, endemic to the islands of Lampedusa and Lampione, and *L.imitatrix*, endemic to the islands of Malta and Filfla, are derived from a common mainland ancestor that colonised

[20] The Messinian is that geological age from 7million years to 5.2 million years before present.
[21] The Pelagian Block is the foreland margin of the African continental plate and consists of thick carbonate deposits extending from the southeastern part of Sicily to the coast of Tunisia. Much of this platform is now submerged and the only exposed parts are the Hyblean region of Sicily, the Maltese and Pelagian archipelagos, and the Tunisian coast (Pedley *et al*., 1978; Pedley 1990; Grasso & Pedley 1985).
[22] The Messinian Salinity Event also known as the Messinian Salinity Crisis, occurred between 6.5 million years and 5.1 million years before present when the connection of the Mediterranean with all adjoining seas was cut off and the Mediterranean was reduced to a series of shallow 'lakes' due to loss of water by evaporation (Hsü *et al*., 1973; see Hsü, 1983 for a semi-popular account).
[23] The Pleistocene is that geological epoch from 1,800,000 years ago to 10,000 years ago.

the areas in question in pre-Quaternary[24] times. The third species, *L.melitensis*, endemic to the island of Malta, has differentiated more recently from *L.imitatrix*. Giusti *et al.* (1995) confirmed that *Muticaria* is a good genus, but do not agree with Thake's (1985) interpretation of the species placed in it. According to Giusti *et al.* (1995) only two biological species occur: *M. macrostoma* endemic to the Maltese Islands (except Filfla), and *M. syracusana* endemic to southeastern Sicily. Both species have numerous conchological forms that were assigned specific or infraspecific status in the past, but which molecular genetic analysis has shown to be little more than local demes. On the basis of this analysis, Thake's model for speciation in *Muticaria* is incorrect and *M. syracusana* and *M. macrostoma* are likely to have arisen by allopatric speciation[25] from a common *macrostoma*-like ancestor that lived in Sicily and reached the Maltese Islands in a single colonisation event (Giusti *et al.*, 1995). It is not clear when this event took place. On the basis of the weak morphological and genetic differentiation between *M. syracusana* and *M. macrostoma*, it is likely that it did not occur before the start of the Quaternary (Giusti *et al.*, 1995).

In summary, as suggested by Thake (albeit based on incorrect data), the emerged parts of the Pelagian Block, including what are now the Maltese and Pelagian island groups and Hyblean Sicily, were originally colonised by species from the surrounding emerged lands, mainly the European mainland, during sea-level lows associated with the Messinian Salinity Event. At the end of the Miocene, after much of the Pelagian Block became inundated, some of these colonisers differentiated in isolation on the still emerged landmasses, one of which was the Maltese complex. During the Quaternary, the Maltese Islands experienced further colonisation episodes, mainly from Sicily, followed by development in isolation of the populations that managed to gain a foothold. What is uncertain is whether these Quaternary colonisations occurred across land-bridges which formed during the marine regressions associated with the Pleistocene glaciations (as suggested by Thake and by others – see for example, Francini Corti & Lanza, 1973), or due to jump dispersal across the channel separating the Maltese group from Sicily. The latter mechanism may have been facilitated by a narrowing of the marine barrier by the Pleistocene marine regressions.

This scenario explains why some endemic species, such as *Lampedusa imitatrix* and the Maltese Wall Lizard *Podarcis filfolensis*, are genetically well-differentiated good species. These represent forms derived from the pre-Quaternary Mediterranean biota that occupied the exposed landmass during the Messinian Salinity Event and then became isolated on the different islands that formed following the final inundation of the Mediterranean at the beginning of the Pliocene[26]. Such endemics may be termed 'plaeoendemics' ('ancient endemics'). This scenario also explains the large number of endemic forms that are less strongly to very weakly differentiated from their Sicilian counterparts, sometimes so weakly that it is debatable if they are sufficient different to warrant their distinction as geographical races (subspecies). These represent those species that reached the islands at different times during the Quaternary mostly by dispersing over from Sicily or nearby lands, and then differentiated in relative isolation; normally, the longer the isolation, the greater the differentiation from their Sicilian or mainland ancestors. Such species may be termed 'neoendemic' ('new endemics'). A more detailed account of this model of the origin of the Maltese biota will be found in Hunt & Schembri [P] (1999) who extend the discussion to include the extinct biotas of the islands and give estimates of when the major connections with Sicily are postulated to have occurred.

However, there are still some features of the biogeography of the Maltese Islands that this model does not adequately explain; for example, the strong eastern Mediterranean affinity. Additionally, while active dispersal across land bridges connecting the Maltese Islands and the various surrounding lands, or across relatively narrow sea channels, is easy to accept for

[24] The Quaternary is that geological period from 1,800,000 years ago to the present.
[25] Speciation that takes place when populations are isolated by a geographical barrier that prevents cross-breeding.
[26] The Pliocene is that geological epoch from 5.2 to 1.8 million years before present.

mobile, eurytopic[27] forms such as many vertebrates and flying insects, it is more difficult to understand how stenotopic[28] forms with limited mobility, such as many terrestrial molluscs, cryptofaunal[29], hypogeal[30] and cavernicolous invertebrates, could have reached the Islands via these connections, especially given the relatively short times that these links are thought to have existed for. The question of a physical connection with North Africa is still open. While such a connection is possible during the Messinian marine regression, it is not probably at any other time since, as the maximum marine regression during the Quaternary is estimated to have been some 120-130m only (see Hunt & Schembri [P], 1999). Species with North African affinity either reached the islands during the Messinian and have remained isolated on the Maltese Islands since, or else reached the islands at other times by passive dispersal, or both. The present paucity of forms with North African affinity that are found on the islands fits both scenarios: the low number of such forms may be a result of the ancient African stock being replaced by more recent and better adapted colonisers, or else may reflect the difficulty of passive dispersal across the relatively wide seaway that separates the islands from North Africa (or both).

Our current understanding of the zoogeography of the Maltese Islands may be broadly summarized as follows. The predominant Sicilian character of the present day Maltese fauna results from the combined effect of a heavier influx of European forms via Sicily, the closest mainland during the Messinian marine regression, than from elsewhere, together with an influx of exclusively Sicilian/European forms during the Pleistocene connections (or near connections) with Sicily, and perhaps almost complete displacement of any remnant faunas from the older land connections with other regions (e.g. Africa). The few palaeoendemics (i.e. those whose ancestors originally reached the islands in Messinian times) of African affinity may be interpreted as relicts from a possible African-Maltese connection during the Messinian. Similarly, palaeoendemics of European affinity may be interpreted as relicts of the Siculo-Maltese Messinian connection. Neoendemics (i.e. those whose ancestors reached the islands after the Pliocene) are (as far as is known) exclusively of Sicilian/European affinity and are interpreted as recently differentiated forms of species reaching the Maltese Islands during the Pleistocene glaciations. Passive dispersal from both Sicily and North Africa may have occurred throughout, complicating the picture. No detailed studies have been carried out on the endemics with eastern Mediterranean affinities and it is not known whether these are palaeo- or neo-endemic. In one case at least, that of the carvernicolous and probably troglobic microwhipscorpion *Eukoenenia christiani,* palaeoendemic status seems likely, given its specialized habitat and very reduced dispersive capabilities. Any land connections that the Maltese Islands might have had with the eastern Mediterranean lands both during the Late Miocene and Pliocene, and during the Pleistocene, are still obscure. Species with disjunct distributions may represent relicts of populations having a much wider distribution in the past, or else are the result of stochastic passive dispersal events. The role played by humans in the deliberate or accidental transport of species is another mostly unknown and confounding factor. Clearly, much more research needs to be done before the origins and relationships of the Maltese fauna are more completely understood.

CONCLUDING REMARK

The need for an accurate knowledge of the species that occur in a given region as the basis for the implementation of management initiatives, including conservation and exploitation, is practically self-evident, has often been emphasized and is now entrenched in a number of

[27] Those having wide habitat preferences; found in many habitat types.
[28] Those with a narrow range of habitats preferences; specialised for particular habitats.
[29] Animals that live in deep crevices or under stones.
[30] Living in subterranean habitats.

international legal instruments and regulations, not least amongst which are the 1992 Convention on Biological Diversity and the wildlife-related Directives of the European Union. Identifying species, mapping their distribution, analysing their evolutionary relationships and cataloguing and analysing the results might seem a boring and not very useful pursuit to some, however, without such sound scientific information, effective initiatives to manage, conserve and exploit sustainably the living natural resources of the nation are futile and may actually be counterproductive. In this regard it is my hope that the information presented here will become outdated in a shorter time than that in my previous effort.

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REFERENCES

Alfken, J. D. (1929) Ueber eine Hymenopteren-Ausbeute von Malta. *Mitteilungen der entomologischen Verein* 15-17: 9-11.

Alzona, C. (1971) Malacofauna Italica. Catalogo e bibliografia dei molluschi viventi, terrestri e d'acqua dolce. *Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*. 111: 1-433.

Arlettaz, R.; Ruedi, M.; Ibañez, C.; Palmierim, J. & Hausser, J. (1997) A new perspective on the zoogeography of the sibling mouse-eared bat species *Myotis myotis* and *Myotis blythii*: morphological, genetical and ecological evidence. *Journal of Zoology* 242: 45-62.

Baccetti, B. (1966) Notulae Orthopterologicae XXII. Il genere *Myrmecophilus* Berth. in Italia. *Redia* 50: 1-33.

Baccetti, B. (1973) Notulae Orthopterologicae XXX. Gli Ortotteroidei dell'arcipelago Maltese. Lavori della Società Italiana di Biogeografia (Nuova Serie) 3: 605-608.

Baccetti, B.; Massa, B. & Canestrelli, P. (1995) Dermaptera, Isoptera, Blattodea, Mantodea, Phasmatodea, Orthoptera. [In: Massa, B. [ed.] Arthropoda di Lampedusa, Linosa e Pantelleria (Canale di Sicilia, Mar Mediterraneo)]. *Naturalista Siciliano* 19 (Supplemento): 163-194.

Baldacchino, A. E. (1983) A preliminary list of freshwater crustaceans from the Maltese Islands. *The Central Mediterranean Naturalist* 1(2): 49-50.

Bannerman, D. A. & Vella Gaffiero, J. A. (1976) *Birds of the Maltese Archipelago*. Valletta, Malta: Museums Department; xxi + 550 pp. + 1 map.

Baldacchino, A. E.; Dandria, D.; Lanfranco E. & Schembri, P. J. (1993) Records of spiders (Arachnida: Araneae) from the Maltese Islands (Central Mediterranean). *The Central Mediterranean Naturalist* 2**(**2): 37-59.

Baldacchino, A.E. & Pizzuto, A. [eds] (1996) *Introduction of alien species of flora and fauna*. [Proceedings of a seminar held at Qawra, Malta, 5 March 1996] pp.29-54. Floriana, Malta: Environment Protection Department; 77pp.

Baroni Urbani, C. (1968a) Studi sulla mirmecofauna d'Italia IV. La fauna mirmecologica delle Isole Maltesi ed il suo significato ecologico e biogeografico. *Annali del Museo Civico di Storia Naturale di Genova* 77: 408-559.

Baldacchino, A.E. & Schembri, P.J. (2002) *Amfibji, rettili, u mammiferi fil-gzejjer Maltin*. [Sensila 'Kullana Kulturali' Nu 39] Il-Pjeta, Malta: Pubblikazzjonijiet Indipendenza; xii + 256pp.

Baroni Urbani, C. (1968b) Studi sulla mirmecofauna d'Italia VI. Il popolamento mirmecologico delle Isole Maltesi. *Archivio Botanico e Biogeografico Italiano* 44: 224-241.

Beaucournu, J. C. (1990). *Leptopsylla algira vogeli* n. ssp. (Siphonaptera, Ceratophyllidae, Leptopsyllinae), parasite de crocidure (Mammalia, Insectivora, Crocidurinae) sur l'île de Gozo (Archipel de Malta). *Bonner zoologische Beiträge* 41: 213-222.

Beckmann, K. H. (1987) Land und Süβwassermollusken der Maltesischen Inseln. *Heldia* 1 (Sonderheft): 1-38.

Beckmann, K.H. (2003a) Beiträge zur Nomenklatur der europäischen Binnenmollusken, XIX. Notizen zu Helicoidea mediterraner Inseln (Pantelleria, Maltesische Inseln). *Heldia* 5(1/2): 33-36.

Beckmann, K.H. (2003b) Neunachweis von *Lehmannia valentiana* für die Maltesischen Inseln. *Heldia* 5(1/2): 37.

Beckmann, K. H. & Gittenberger, E. (1987) The Clausiliidae (Gastropoda) of the Maltese Islands, some additional data. *Journal of Conchology* 32: 335-338.

Bellés, X. & Mifsud, D. (2000) Ptinid beetles (Coleoptera, Ptinidae) from the Maltese Islands. *The Central Mediterranean Naturalist* 3(2): 43-48.

Boessneck, J. & Küver, M. (1970). Alluviale Tierknochenfunde aus der Ghar Dalam-Höhle, Malta. *Senckenbergiana biologica* 51: 147-158.

Boeters, H. D. & Beckmann, K. H. (1991) Wiederbeschreibung von *Paludina* (*Pseudamnicola*) *kobelti* Westerlund 1892 (Prosobranchia: Hydrobiidae). *Archiv für Molluskenkunde* 120: 179-182.

Bologna, M. A. (1979) Studio sul genere *Stenostoma* Latreille (Coleoptera, Oedemeridae). *Animalia* 6: 205-218.

Bologna, M. A. (1984) Segnalazioni faunistiche Italiane: N° 33 *Stenostoma melitense* Cameron (Coleoptera Oedemeridae); N° 34 *Oedemera* (*Oedemerina*) *caudata* Seidlitz (Coleoptera Oedemeridae). *Bollettino della Società Entomologica Italiana* 116: 57.

Bologna, M. A. (1985) Reperti: *Mylabris (Eumylabris) fabricii* Soumacov, 1924 (Coleoptera, Meloidae). *Bollettino dell'Associazione Romana di Entomologia* 39: 83.

Bologna, M.A. (1995) Coleoptera Meloidae ed Oedemeridae di Lampedusa, Pantelleria e delle isole Maltesi. [In: Massa, B. [ed.] Arthropoda di Lampedusa, Linosa e Pantelleria (Canale di Sicilia, Mar Mediterraneo)]. *Naturalista Siciliano* 19 (Supplemento): 505-525.

Bordoni, A. (1973) I coleotteri stafilinidi delle isole circumsiciliane. XXI contributo alla conoscenza degli Staphylinidae. *Lavori della Società Italiana di Biogeografia* (Nuova Serie), 3: 651-754.

Borg, J.J.; Violani, C & Zava, B. (1997) The bat fauna of the Maltese Islands. *Myotis* 35: 49-65.

Borg, P. (1932) *The scale insects of the Maltese Islands*. Malta: Government Printing Office; 67 pp.

Boratynski, K. (1969) A new species of *Lacombia* Goux, 1940 (Pseudococcidae, Homoptera) from ants' nests in the Maltese Islands. *Bollettino delle Sedute dell'Accademia Gioenia di Scienze Naturali in Catania*, (IV) 9: 401-409.

Bosmans, R. & Dandria, D. (1993) Some new records of spiders (Arachnida: Araneae) from the Maltese Islands (Central Mediterranean). *Animalia* 20: 23-26.

Bucciarelli, I. (1980) *Anthicidae*. [Fauna d'Italia 17] Bologna, Italy: Calderini; viii + 240 pp.

Cameron, M. & Caruana Gatto, A. (1907) The Coleoptera of the Maltese Islands. *Transactions of the Entomological Society of London* 59: 383-403.

Cantarella, T. (1982) Salticidae (Araneae) delle isole Maltesi. *Animalia* 9: 239-252.

Canzoneri, S. (1979) Primi appunti sui tenebrionidi dell'arcipelago Maltese (XXXII contributo allo studio dei tenebrionidi). *Società Veneziana di Scienze Naturali Lavori* 4: 20-22.

Canzoneri, S. (1985) Sintesi delle attuali conoscenze degli Ephydridae e Canacidae delle piccole isole Italiane. *Bollettino del Museo Civico di Storia Naturale di Verona* 12: 97-108.

Capolongo, D. & Cilia, J. L. (1990) *Potamon fluviatile lanfrancoi*, a new subspecies of the Mediterranean freshwater crab from the Maltese Islands (Crustacea, Decapoda, Potamidae). *Annales des Naturhistorischen Museums in Wien* (B) 91: 215-224.

Capula, M. (1994) Evolutionary relationships of *Podarcis* lizards from Sicily and the Maltese Islands. *Journal of Zoological Systematics and Evolutionary Research* 32: 180-192.

Capula, M., Nascetti, G. & Bullini, L. (1988) Genetic differentiation among species of the genus *Podarcis* (Reptila: Lacertidae). *Abstracts of the LII Congesso Nazionale dell'Unione Zoologica Italiana, Camerino 12-16 Settembre 1988*: 59.

Caruana Gatto, A. (1894). *Common beetles of the Maltese Islands*. Malta: G. Muscat; 14 pp.

Caruana Gatto, A. (1926) Primo contributo alla conoscenza dei zoocecidii delle Isole Maltesi. *Archivium Melitense* (Malta) 7(3): 103-126.

Caruso, D., Baglieri, C., Di Maio, M. C. & Lombardo, B. M. (1987) Isopodi terrestri di Sicilia ed isole circumsiciliane (Crustacea, Isopoda, Oniscoidea). *Animalia* 14 (Supplemento): 211 pp.

Caruso, D. & Hili, C. (1991) Nuovi dati sugli isopodi terrestri delle isole dell'arcipelago maltese. *Animalia* 18: 115-124.

Caruso, D. & Lombardo, B. M. (1982) Isopodi terrestri delle isole maltesi. *Animalia* 9: 5-52.

Chandler, P. & Gatt, P. (2000) Fungus gnats (Diptera: Bolitophilidae, Keroplatidae and Myceophilidae) from the Maltese Islands. *Studia Dipterologica* 7: 69-81.

Chvála, M. (1980) Two new European *Ogcodes* species (Diptera, Acroceridae). *Acta Entomologia Bohemoslovaca* 77: 131-137.

Cilia, J. L. (1975) The crickets of the Maltese Islands (Orthoptera - Grylloidea) with observations on *Gryllus bimaculatus* De Greer. *The Maltese Naturalist* (Malta) 2(1): 13-24.

Cilia, J. L. (1989) Coleoptera. In: Schembri, P.J. & Sultana, J. [eds] *Red data book for the Maltese Islands*. pp.105-128 Valletta, Malta: Department of Information; viii + 142pp. + plates I-VIII.

Condé, B. (1988) Nouveaux Palpigrades de Trieste, de Slovénie, de Malte, du Paraguay, de Thaïlande et de Bornéo. *Revue Suisse de Zoologie* 95: 723-750.

Dandria, D. (1996) Arachnids. pp. 257-262. In: Sultana, J. & Falzon, V. [ed.] *Wildlife of the Maltese Islands* [translation, with additions, of *Flora u fawna ta' Malta* (1995)]. Floriana, Malta: Environment Protection Department; 336pp.

Dandria, D. (2001) Observations on the endemic Maltese trap-door spider *Nemesia arboricola* Pocock, 1903 (Araneae: Nemesiidae). *The Central Mediterranean Naturalist* 3(3): 103-107.

Danner, F.; Eitschberger, U. & Surholt, B. (1998) Die Schwarmer der westlichen Palaerktis. *Herpoliana* 4(1/2): 1-369 [part 1], 1-772 [part 2].

Darmanin, L. (1979) The only killifish in Maltese waters. *The Sunday Times*, 11 March 1979, p.12.

Deidun, A.; Arcidiacono, I.; Tigano, C. & Schembri, P.J. (2002) Present distribution of the threatened killifish *Aphanius fasciatus* (Actinopterygii, Cyprinodontidae) in the Maltese Islands. *The Central Mediterranean Naturalist* 3(4): 177-180.

De Lucca, C. (1965) The place of the Lepidoptera in the zoogeography of the Maltese Islands. *Rapports et Proces-Verbaux des Reunions de la Commission International pour l'Exploration Scientifiques de la Mer Méditerranée* 18: 511-515.

De Lucca, C. (1969) Emitteri eterotteri Maltesi. *Bollettino della Società Entomologica Italiana* 99-101: 115-116.

De Matthaeis, E.; Ketmaier, V.; Cobolli, M.; Davolos, D. & Schembri P.J. (2000) Patterns of genetic diversity in Mediterranean supralittoral amphipods (Crustacea, Amphipoda). *Polskie Archiwum Hydrobiologii*. 47(3/4): 473-487.

Duelli, P. (1994) Neuroptera from the Mediterranean islands of Malta (Neuroptera). *Entomofauna* 15: 125-128.

Ebejer, K.A. & Schembri, P.J. (2001) Polyxenid millipede (Diplopoda, Polyxenida) associated with empty snail shells. *The Central Mediterranean Naturalist* 3(3): 97-100.

Ebejer M.J. (1988a) Beeflies (Dipt. Bombylidae) from Malta. *Entomologist's Monthly Magazine* 124: 233-241.

Ebejer M.J. (1988b) Some records of hoverflies (Diptera Syrphidae) from. *Entomologist's Gazette* 39: 160-164.

Ebejer M.J. (1993) The Chyromyidae fo Malta, with description of new species of *Aphaniosoma* (Dipt., Schizophora). *Entomologist's Monthly Magazine* 129: 125-133.

Ebejer M.J. (1995a) The snail-killing fly *Pherbellia cinerella* (Fallen) in Malta. *The Central Mediterranean Naturalist* 2(3): 79-80.

Ebejer M.J. (1995b) Notes and new records of the larger Brachycera (Diptera) of Malta. *The Central Mediterranean Naturalist* 2(3): 86-96.

Ebejer M.J. (1998a) A review of the Palaearctic species of *Aphaniosoma* Becker (Diptera, Chyromyidae), with descriptions of new species and a key for the identification of adults. *Mitteilungen aus dem Museum für Naturkunde in Berlin - Deutsche Entomologische Zeitschrift* 45: 191-230.

Ebejer M.J. (1998b) A new species of *Gymnochiromyia* Hendel (Diptera: Chyromyidae) from the Mediterranean, with notes, lectotype designations and a key to the species from the West Palaearctic. *Studia Dipterologica* 5: 19-29.

Ebejer, M.J. (2000) First records of Dixidae (Diptera, Nematocera) from Malta. *The Central Mediterranean Naturalist* 3(2): 57-58.

Ebejer, M.J. (2001) A contribution to the knowledge of the Ephydroidea (Diptera: Camillidae, Campichoetidae and Drosophilidae) of Malta. *The Central Mediterranean Naturalist* 3(3): 85-88.

Ebejer, M.J. & Gatt, P. (1999) The species of Fanniidae and Muscidae of the Maltese Islands. *Studia Dipterologica* 6: 79-92.

Enghoff, H. & Schembri, P. J. (1989) The millipedes of the Maltese Islands (Central Mediterranean) (Diplopoda). *Bollettino della Società Entomologica Italiana* 120: 164-173.

Erlandsson, S. (1974) Hymenoptera Aculeata from the European parts of the Mediterranean countres. *Eos - Revista Espanola de Entomologia* 48: 11-93.

Erlandsson, S. (1979) Hymenoptera Aculeata from the European parts of the Mediterranean countries, II. *Acta Entomologica Jugoslavica* 15: 111-130.

Erlandsson, S. (1984) Hymenoptera Aculeata from the European parts of the Mediterranean countries, III. *Bollettino del Museo Civico di Storia Naturale di Venezia* 35: 53-66.

Farrugia, C. (1997) Insect pests on cauliflower (*Brassica oleracea* var. *Botrytis*) in Gozo (Maltese Islands, Central Mediterranean). *The Central Mediterranean Naturalist* 2(4): 152-165.

Felten, H., Spitzenberger, F. & Storch, G. (1977) Zur Kleinsaugerfauna West-Anatoliens. Teil III. *Senckenbergiana biologica* 58: 1-44.

Fet, V.; Soleglad, M.E.; Gantenbein, B.; Vignoli, V.; Salomone, N.; Fet, E.V. & Schembri, P.J. (2003) New molecular and morphological data on the '*Euscorpius carpathicus*' species complex (Scorpiones: Euscorpiidae) from Italy, Malta, and Greece justify the elevation of *E. c. sicanus* (C.L. Koch, 1837) to the species level. *Revue Suisse de Zoologie* 110: 355-379.

Focarile, A. (1969) Sintesi preliminare delle attuali conoscenze sui coleotteri tenebrionidi delle piccole isole circum-siciliane (Coleoptera Tenebrionidae). *Memorie della Società Entomologica Italiana* 48: 402-416.

Francini Corti, E. & Lanza, B. (1972) XVIII Congresso della Società Italiana di Biogeografia: note conclusive sulla storia del popolamento animale e vegetale delle isole circumsiciliane. *Lavori della Società Italiana di Biogeografia* (Nuova Serie) 3: 911-918.

Gardini, G. & Rizzerio, R. (1987) I *Roncus* eucavernicoli del gruppo *siculus*. *Bollettino della Società Entomologica Italiana* 119: 67-80.

Gatt, P. (1996) Mosquitoes from the Maltese Islands: new records and observations (Diptera Culicidae). *Bollettino della Società Entomologica Italiana* 128: 77-84.

Gatt P. (2000) The lesser dung flies (Diptera, Sphaeroceridae) of the Maltese Islands. *Studia Dipterologica* 7: 511-524.

Giusti, F.; Manganelli, G. and Schembri, P.J. (1995) *The non-marine molluscs of the Maltese Islands.* [Museo Regionale di Scienze Naturali, Torino, Monografie 15]; Torino, Italy: Museo Regionale di Scienze Naturali; 607pp.

González, M. (1970) El género *Desbrochersella* Reitter (Coleoptera, Curculionidae). *Publicaciones del Instituto de Biologia Aplicada de Barcelona* 48: 49-72.

Gramentz, D. (1989). Marine turtles in the central Mediterranean Sea. *Centro* (Malta) 1(4): 41-56.

Grasso, M. & Pedley, H.M. (1985) The Pelagian Islands: a new geological interpretation from sedimentological and tectonic studies and its bearing on the evolution of the Central Mediterranean Sea (Pelagian Block). *Geologica Romana* 24: 13-44.

Grimm, R. (1986) Tenebrionidae vom Maltesischen Archipel (Insecta: Coleoptera). *Stuttgarter Beiträge zur Naturkunde* Series A (*Biologie*) 392: 1-17.

Gulia, Giovanni (1890). Indice dei miriapodi maltesi. *Il Naturalista Maltese* (Malta) 1(5): 41-42.

Gulia, Giovanni (1914) Uno sguardo alla zoologia delle "Isole Maltesi". *IX° Congrès international de Zoologie (Monaco 1913)* Section 4 pp. 545-555; Rennes (France).

Hille Ris Lambers, D. (1969) A new species of *Tactilotrama* Börner, 1950? (Aphididae, Homoptera). *Bollettino delle Sedute dell'Accademia Gioenia di Scienze Naturali in Catania* (IV) 9: 657-661.

Holyoak, D. T. (1986) Biological species limits and systematics of the Clausiliidae of the Maltese Islands (Gastropoda). *Journal of Conchology* 32: 211-220.

Hopfinger, O. & Fischer, W. (1996) Eine rezente *Siciliaria* sp. (Gastropoda: Clausiliidae) von Malta. *Club Conchylia Informationen* 28(1/2): 53-54.

Hsü, K.J. (1983) *The Mediterranean was a desert. A voyage of the Glomar Challenger.* Princeton, New Jersey: Princeton University Press; 216pp.

Hsü, K.J.; Ryan, W.B.F. & Cita, M.B. (1973) Late Miocene desiccation of the Mediterranean. *Nature* 242: 240-244.

Hunt, C.O. & Schembri, P.J. (1999) Quaternary environments and biogeography of the Maltese Islands. In: Mifsud, A. & Savona Ventura, C. [eds] *Facets of Maltese prehistory*. pp. 41-75; Malta: The Prehistoric Society of Malta; vii + 243pp.

Hutterer, R. (1990) Temporal and geographical variation of shrews of the Sicilian-Maltese archipelago since the Pleistocene. *Vie Milieu* 40: 213-217.

Hutterer, R. (1991) Variation and evolution of the Sicilian shrews: taxonomic conclusions and description of a possibly related species from the Pleistocene of Morocco (Mammalia: Soricidae). *Bonner zoologische Beiträge* 42: 241-251.

Jeekel, C.A.W. (2000) On some millipedes from the island of Malta. *Myriapod Memoranda* 2: 49-54.

Jolivet, P. (1996) A la poursuite du *Timarcha* perdu *Timarcha melitensis* Weise (Col. Chrysomelidae). *L'Entomologiste* 52(6): 203-211.

Karsholt, O. & Razowski, J. [eds] (1996) *The Lepidoptera of Europe: a distributional checklist*. Denmark: Apollo Books; 380pp.

Kotsakis, T. (1986) *Crocidura esui* n.sp. (Soricidae, Insectivora) du Pléistocène de Spinagallo (Sicilie orientale, Italie). *Geologica Romana* 23: 51-64.

Kritscher, E. (1992) Erstnachweis von Skorpionen auf den Maltesischen Inseln. *Euscorpius carpathicus candiota* (Birula, 1903) (Arachn.: Scorp.: Chactidae) auf Malta und Gozo. *Annalen des Naturhistorischen Museums in Wien* (B) 93: 185-188.

Kritscher, E. (1994) *Nemesia arboricola* Pocock, 1903, eine durch ein Jahrhundert hindurch verschollene Spinnenart der Maltesischen Inseln (Araneae: Nemesiidae). *Annalen des Naturhistorischen Museums in Wien* (B) 96: 49-57.

Kritscher, E. (1996) Ein Beitrag zur Kenntnis der Spinnen-Fauna der Maltesischen Inseln. *Annalen des Naturhistorischen Museums in Wien* (B) 98: 117-156.

Lamberti, F., Bleve-Zacheo, T. & Arias, M. (1982) The Longidoridae of the Maltese Islands with the description of *Longidorus magnus* sp.n. and *Xiphinema melitense* sp.n. *Nematologia Mediterranea* 10: 183-200.

Lamberti, F., Capusso, A. & Dandria, D. (1984) *Atlas of plant parasitic nematodes of the Maltese Islands*. [European Plant Parasitic Nematode Survey No. 4] Dundee, Scotland: Scottish Crop Research Institute; ii + 25pp.

Lamberti, F., & Dandria, D. (1979) Plant parasitic nematodes in the Maltese Islands and the problems they cause. *Phytopathologia Mediterranea* 18: 71-76.

Lanfranco, E. (1970) Terrestrial flatworms in Malta. *The Maltese Naturalist* (Malta) 1(1): 9-12.

Lanfranco, E. (1975) *Bipalium kewense* Mosley (Platyhelminthes) in Malta. *The Maltese Naturalist* (Malta) 2(2): 50.

Lanfranco, G.G. (1969) *Maltese mammals (Central Mediterranean).* Malta; 28 pp. + Plates 1-8.

Lanfranco, G.[G.] (1974) The termites of Malta (Superorder Blattoidea; Order Isoptera). *The Maltese Naturalist* (Malta) 1(6): 10-12.

Lanfranco, S. (1990) *The ecology of freshwater rockpools in Malta*. Unpublished B.Ed.(Hons) dissertation, Faculty of Education, University of Malta; ix + 195pp.

Lanfranco, S. (1996) Crustaceans. pp. 245-256. In: Sultana, J. & Falzon, V. [eds] *Wildlife of the Maltese Islands* [translation, with additions, of *Flora u fawna ta' Malta* (1995)]. Floriana, Malta: Environment Protection Department; 336pp.

Lanfranco, S. (2001) A review of the branchiopod fauna of the Maltese Islands (Crustacea: Branchiopoda). *The Central Mediterranean Naturalist* 3(3): 109-114.

Lanfranco, S.; De Walsche, C.; Schembri, P. J. & Mertens, J. (1991) Branchiopods (non-cladocerans) of the Maltese Islands (Central Mediterranean). *Hydrobiologia* 212: 241-243.

Lanza, B. (1973). Gli anfibi e i rettili delle isole circumsiciliane. *Lavori della Società Italiana di Biogeografia* (Nuova Serie) 3: 755-804.

Lanza, B. & Cei, J.M . (1977). Immunological data on the taxonomy of some Italian lizards (Reptilia Lacertidae). *Monitore Zoologico Italiano* (Nuova Serie) 11: 231-236.

Lanza, B., Nascetti, G., Capula, M. & Bullini, L. (1986) Les Discoglosses de la région Méditerranéenne Occidentale (Amphibia; Anura; Discoglossidae). *Bulletin de la Sociétè Herpetologique de France* 40: 16-27.

Larizza, A. & Lamberti, F. (1995) Some Tylenchida (Nematoda) from Malta and Gozo. *Nematologia Mediterranea* 23: 153-165.

Liberti, G & Schembri, S (2002) Dasytidae of the Maltese archipelago (Coleoptera Cleroidea). *Bollettino della Società Entomologica Italiana* 134: 175-186.

Lienhard, C. (1990) Revision of the western Palaearctic species of *Liposcelis* Motschulsky (Psocopera: Liposcelididae). *Zoologisches Jahrbuch Systematik* 117(2): 117-174.

Lienhard, C. (1998) Psocopteres euro-méditerranéens. *Faune de France* 83: xx + 517pp.

Lombardo, B.M. & Viglianisi, F. (2002) Differenziamento genetico tra due specie troglobie di Sicilia e di Malta: *Armadillidium lagrecai* Vandel 1969 e *Armadillidium ghardalamensis* Caruso e Hili 1991 (Crustacea Isopoda Oniscoidea). *Bollettino delle Sedute dell'Accademia Gioenia di Scienze Naturali in Catania* 35: 603-610.

Lombardo, B.M.; Viglianisi, F. & Caruso, D. (2002) Genetic and morphological differentiation in some populations of *Armadillidium aelleni* (Crustacea, Isopoda, Oniscoidea), a carvernicolous species of the Maltese archipelago. *Italian Journal of Zoology* 69: 381-384.

Maddalena, T. & Vogel, P. (1990) Relations génétiques entre crocidures Méditerranéennes: le cas des musaraignes de Gozo (Malte). *Vie Milieu* 40: 119-123.

Magnano, L. (1992) Note sugli *Otiorhynchus* del sottogenere *Arammichnus*. 2. Le specie dei gruppi di *O. proximophthalmus*, *cribricollis*, *stiatosetosus* e *sulcirostris* (Coleoptera, Curculionidae). *Fragmenta Entomologica* 24: 99-130.

Magnano, L. (1993) Note sugli *Otiorhynchus* del sottogenere *Arammichnus*. 3. Le specie dei gruppi *lubricus*, *hellenicus* e *torretassoi* (Coleoptera, Curculionidae). *Fragmenta Entomologica* 24: 291-242.

Magnano, L. & Mifsud, D. (1998) A new species of Alaocyba Perris, 1869 (Insecta: Coleoptera: Curculionidae: Raymondionyminae) from the Maltese Islands. *Annales des Naturhistorischen Museums in Wien* (B) 100: 175-178.

Magnano, L. & Mifsud, D. (2001) Descrizione di quattro nuove specie di *Torneuma* Wollaston, 1860 delle isole Pelagie e Maltesi (Coleoptera, Curculionidae). *Annali del Museo Civico di Storia Naturale 'G. Doria'* 93: 451-460.

Magnano, L. & Osella, G. (1973) La curculionidofauna delle isole circumsiciliane: alcune osservazioni zoogeografiche. *Lavori della Società Italiana di Biogeografia* (Nuova Serie) 3: 621-649.

Magrini, P. & Schembri, S. (1997) A topographic catalogue of the Carabidae of the Maltese Islands (Coleoptera). *Bollettino della Società Entomologica Italiana* 129: 213-234.

Mahnert, V. (1975) Pseudoscorpione von den Maltesischen Inseln. *Fragmenta Entomologica* 11: 185-197.

Mahnert, V. (1982) Neue höhlenbewohnende Pseudoscorpione aus Spanien, Malta und Griechenland (Arachnida, Pseudoscorpiones). *Bulletin de la Societé Entomologique Suisse* 55: 297-304.

Mandahl-Barth, G. (1988) *The shell-bearing land snails of Malta (A comprehensive fieldguide). Including the first English description of a new species of snail to science by Karl. Heinz Beckmann*. Mdina, Malta: Friends of the National Museum of Natural History; 64 + 4 pp.

Marcellino, I. (1974) Nuovi dati sugli opilioni (Arachnida) di Sicilai e di altre isole del Mediterraneo. *Animalia* 1: 185-200.

Martin, J.H.; Mifsud, D. & Rapisarda, C. (2000) The whiteflies (Hemiptera: Aleyrodidae) of Europe and the Mediterranean basin. *Bulletin of Entomological Research* 90: 407-448.

Matic, Z., Darabantu, C. & Clichici, M. (1967) Contributo alla conoscenza dei chilopodi di Spagna e di Malta. *Bollettino delle Sedute dell'Accademia Gioenia di Scienze Naturali in Catania* (IV) 9: 175-199.

Mendes, L. F. (1980) New data on the thysanurons from Malta. *Bollettino della Società Entomologica Italiana* 112: 94-98.

Mendes, L. F. (1981) Nova nota sobre os tisanuros (Apterygota, Microcoryphia e Zygentoma) da Europa e da bacia Mediterrânica. *Boletim da Sociedad Portuguesa de Entomologia* 1(18): 8 pp.

Mendes, L. F. (1987) Some new data on the thysanurons (Microcoryphia and Zygentoma) from Malta and the adjacent islands of Gozo, Fifla and Comino. *Boletim da Sociedad Portuguesa de Entomologia* 3(79): 7 pp.

Mifsud, D. (1995) Whiteflies of the Maltese Islands. *The Central Mediterranean Naturalist* 2(3): 61-78.

Mifsud, D. (1997a) Biological control in the Maltese Islands. *Bulletin OEPP/EPPO Bulettin* 27: 77-84.

Mifsud, D. (1997b) The chequered beetles (Coleoptera: Cleridae) of the Maltese Islands (Central Mediterranean). *The Central Mediterranean Naturalist* 2(4): 166-169.

Mifsud, D. (1997c) The jumping plant-lice (Hemiptera: Psylloidea) of the Maltese Islands. In: Dandria, D [ed.] *Biology abstracts BSc 1996-1997, MSc 1996-1997*. pp.35-36; Msida, Malta: Department of Biology, University of Malta.

Mifsud, D. (1999) Tenebrionids associated with sandy shores in the Maltese Islands (Coleoptera, Tenebrionidae). *The Central Mediterranean Naturalist* 3(1): 23-26.

Mifsud, D. (2000a) Present knowledge of the entomofauna of the Maltese Islands. *Entomologica Basiliensia* 22: 75-86.

Mifsud, D. (2000b) The Languriidae (Coleoptera) of the Maltese Islands. *The Central Mediterranean Naturalist* 3(2): 101-102.

Mifsud, D. (2001) First record of Eucinetidae (Coleoptera) from the Maltese Islands. *The Central Mediterranean Naturalist* 3(3): 49-52.

Mifsud, D. (2002) Longhorn beetles (Coleoptera, Cerambycidae) of the Maltese Islands (Central Mediterranean). *The Central Mediterranean Naturalist* 3(4): 161-169.

Mifsud, D. & Bílý, S. (2002) Jewel beetles (Coleoptera, Bupestridae) from the Maltese Islands (Central Mediterranean). *The Central Mediterranean Naturalist* 3(4): 181-188.

Mifsud, D. & Booth, R. (1997) Further contributions to the knowledge of the longhorn beetles (Coleoptera, Cerambycidae) of the Maltese Islands. *The Central Mediterranean Naturalist* 2(4): 170-174.

Mifsud, D. & Mascagni, A. (1997) Heteroceridae (Coleoptera) of the Maltese Islands (Central Mediterranean). *The Central Mediterranean Naturalist* 2(4): 175.

Mifsud, D. & Palmieri, V. (1996) A new species of *Aleurolobos* Quaintance et Baker (Homoptera, Aleyrodidae) from southern Europe. *Bollettino del Laboratorio di Entomologia Agraria – Portici 'Filippo Silvestri'* 52: 89-95.

Mifsud, D. & Scupola, A. (1998) The Tenebrionidae (Coleoptera) of the Maltese Islands (Central Mediterranean). *Annali del Museo Civico di Storia Naturale 'G. Doria'* 92: 191-229.

Mifsud, D.; Viggiani, G.; Dandria, D & Lanfranco, E. (1995) Whitefly parasitoids from the Maltese Islands. *The Central Mediterranean Naturalist* 2(3): 101-107.

Mifsud, D. & Vigna Taglianti, A. (1999) Notes on three carabids collected from the Maltese Islands (Coleoptera, Carabidae). *The Central Mediterranean Naturalist* 3(1): 27-28.

Mifsud, D. & Watson, G.W. (2000) Introduced sap-feeding insect pests of crops in the Maltese Islands. *The Central Mediterranean Naturalist* 3(1): 29-34.

Moore, P. G. & Schembri, P. J. (1986) Notes concerning the semi-terrestrial and freshwater amphipods (Crustacea: Peracarida) of the Maltese Islands. *Animalia* 13: 65-75.

Munari, L & Ebejer, M.J. (2000) Three new species of *Tethina* Haliday, 1838 from Malta and Tunisia, with a revised key to the *alboguttata*-group (Diptera, Tethinidae). *Bollettino del Museo Civico di Storia Naturale di Venezia* 51: 131-145.

Nardi, G & Mifsud, D. (2000) The aderids of the Maltese Islands (Central Mediterranean) (Coleoptera, Aderidae). *Bollettino dell'Associazione Romana di Entomologia* 55: 19-25.

Newstead, R. (1912) The papataci flies (*Phlebotomus*) of the Maltese Islands. *Journal of the Royal Army Medical Corps* 18: 613-625, 19: 28-41, 162-174, Pls. 1-3.

Otero, J.C.; Johnson, C. & Mifsud, D. (2001) Cryptophagids from the Maltese Islands with description of a new species of *Micrambe* Thomson (Coleoptera: Cryptophagidae). *Koleopterologische Rundschau* 71: 163-170.

Pagés, J. (1978) Dicellurata Genavensia V. Espèces d'Europe et du bassin Méditerraneén N° 1.*Revue Suisse de Zoologie* 85: 31-46.

Pedley, H. M. (1990) Syndepositional tectonics affecting Cenozoic and Mesozoic deposition in the Malta and SE Sicily areas (Central Mediterranean) and their bearing on Mesozoic reservoir development in the N Malta offshore region. *Marine and Petroleum Geology* 7: 171-180.

Pedley, H.M.; House, M.R. & Waugh, B. (1978) The geology of the Pelagian Block: the Maltese Islands. In: Nairn, A.E.M.; Kanes, W.H. & Stehli, F.G. [eds] *The ocean basins and margins*. Vol. 4B *The western Mediterranean.* pp. 417-433; London: Plenum Press.

Petersen, B. (1988) The Palaearctic Mutillidae of I. C. Fabricius and some related material (Insecta, Hymenoptera, Aculeata). *Steenstrupia* 14: 129-224.

Plant, A.R. (1995) *Chersodromia* (Diptera, Empidoidea, Hybotidae) from the Maltese Islands with descriptions of two new species. *Studia Dipterologica* 2: 51-56.

Plant, C.W. & Schembri, S. (1996) A review of the Neuropteroidea of the Mediterranean islands of Malta, Gozo and Comino (the Maltese Islands) (Neuroptera: Coniopterygidae, Hemerobiidae, Chrysopidae, Myrmeleontidae). *Entomofauna* 17: 25-36.

Platia, G. (1985) Descrizione di due nuove specie di elateridi Paleartici (Coleoptera) (V contributo alla conoscenza dei Coleoptera Elateridae). *Bollettino della Società Entomologica Italiana* 117: 93-96.

Pocock, R. I. (1903) Description of four new Arachnida of the orders Pedipalpi, Solifugae and Araneae. *Annals and Magazine of Natural History* (Series 7) 11: 220-226.

Poggi, R. (1980) Appunti su alcuni Pselaphidae e Scydmaenidae di Malta (Coleoptera). *Bollettino della Società Entomologica Italiana* 112: 167-170.

Poggi, R. (1999) Descrizione di *Amaurops mifsudi*, nuova specie dell'isola di Malta. *Doraiana* 7(309): 1-6.

Rieger, C. (1986) Wanzen aus Malta (Insecta, Heteroptera). *Carolinea* 44: 87-90.

Rocchi, S & Schembri, S. (1992) I coleotteri idroadefagi delle isole maltesi. *Bollettino della Società Entomologica Italiana* 124: 121-126.

Sabatinelli, G. & Schembri, S. (1990) Gli scarabeidi floricoli delle Isole Maltesi (Coleoptera Scarabaeoidea). *Bollettino della Società Entomologica Italiana* 122: 31-36.

Saliba, L. J. (1963) *Insect pests of crop plants in the Maltese Islands*. Valletta, Malta: Department of Information; 35 pp.

Sammut, P.M. (1982) Eine Revision über die Tagfalterfauna (Lepidoptera, Rhopalocera) der maltesischen Inselgruppe. *Entomologische Nachrichten und Berichte* 81: 71-78.

Sammut, P.[M.] (1983) Die Geomitriden der Maltesischen Inseln (Lepidoptera: Geomitridae). *Neue entomologische Nachrichten* 6: 61-64.

Sammut, P.M. (1984) A systematic and synonymic list of the Lepidoptera of the Maltese Islands. *Neue entomologische Nachrichten* 13: 124 pp.

Sammut, P.M. (1989). Il-Lepidoptera Maltija. In: Curtis, T. [ed.] *L-Identità kulturali ta' Malta*. pp.117-139; Valletta: Department of Information; 296pp.

Sammut, P.[M.] (2000) *Il-Lepidoptera*. [Sensila 'Kullana Kulturali' Nu 12]. Pieta, Malta: Pubblikazzjonijiet Indipendenza; x + 246pp.

Sammut, P.M. & Valletta, A. (1989) Lepidoptera. In: Schembri, P. J. & Sultana, J. [eds] *Red data book for the Islands*. pp. 97-104; Valletta, Malta: Department of Information; viii + 142pp. + plates I-VIII.

Sant, M.J.; Fiorentino, J.; Mallia, A. & Schembri, P.J. (2001) National Database on Biodiversity – a tool contributing to a better understanding of the flora and fauna of the Maltese Islands. *The Central Mediterranean Naturalist* 3(3): 119-124.

Savona Ventura, C. (2002) Parasites and pests of medical significance in the Maltese environment – a historical review of culprit species. *The Central Mediterranean Naturalist* 3(4): 149-152.

Savona Ventura, C.; Sawyer, R.T. & Schembri, P.J. (2000) Medicinal and other leeches (Annelida, Hirudinea) in the Maltese Islands. *The Central Mediterranean Naturalist* 3(2): 65-68.

Schembri, J. L. & Schembri, S. P. (1979) Freshwater insects in Malta. *Potamon* (Malta) 1: 3-6, Pl. 1.

Schembri, P. J. (1984) First record of the class Symphyla from the Maltese Islands. *Potamon* (Malta) 13: 90.

Schembri, P. J. (1986) A note on non-marine leeches (Annelida: Hirudinea) from the Maltese Islands. *The Central Mediterranean Naturalist* 1(4): 81-83.

Schembri, P.J. (1989a) Conservation of the Maltese fauna. In: Baldacchino, A.E. [ed.] *State of the Environment Report 1985: a comparative aid to the state of the environment today*. Malta [Compilation of papers originally presented at forum 'The future of the Maltese environment'; Floriana, Malta, 5 June 1985; each paper paginated separately.]

Schembri, P.J. (1989b) Invertebrates other than insects and molluscs. In: Schembri, P.J. & Sultana, J. [eds] *Red data book for the Maltese Islands*. pp.71-78; Valletta, Malta: Department of Information; viii + 142pp. + plates I-VIII.

Schembri, P. J. (1991). *Report of survey: natural resources* [Malta Structure Plan Technical Report 5.4] Malta: Colin Buchanan and Partners/Generale Progetti Spa/Planning Services Division, Government of Malta; viii + 138 pp.

Schembri, P.J. (1993) The fauna of the Maltese Islands: a review and analysis. In: Ellul-Micallef, R. & Fiorini, S. [eds] *Collegium Melitense Quartercentenary Celebrations (1592-1992); Collected papers contributed by members of the academic staff of the University of Malta*. pp. 541-573; Msida, Malta: University of Malta; xxv + 621pp.

Schembri, P.J. (1995) Diversity and conservation of the non-marine molluscs of the Maltese Islands. In: Van Bruggen, A.C.; Wells, S.M. & Kemperman, Th.C.M. [eds] *Biodiversity and conservation of the Mollusca.* pp.217-222; Oegstgeest, Leiden: Backhuys Publishers.

Schembri, P.J., Baldacchino, A.E., Camilleri, A., Mallia, A., Rizzo, Y., Schembri, T., Stevens, D.T. & Tanti, C.M. (1999) State of the environment report for Malta 1998: Living resources, fisheries and agriculture. pp.109-283 In: *State of the environment report for Malta 1998*. Floriana, Malta: Environment Protection Department, Ministry for the Environment; 448pp.

Schembri, P.J., Baldacchino, A.E., Mallia, A., Schembri, T., Sant, M.J., Stevens, D.T. & Vella, S.J. (2002) State of the environment report for Malta 2002: Living resources, fisheries and agriculture. pp.162-346. In: *State of the environment report for Malta 2002*. Santa Venera, Malta: Ministry for Home Affairs and the Environment; iv + 581pp.

Schembri, P.J. & Lanfranco, E. (1996) Introduced species in the Maltese Islands. In: Baldacchino, A.E. & Pizzuto, A. [eds] *Introduction of alien species of flora and fauna*. [Proceedings of a seminar held at Qawra, Malta, 5 March 1996] pp.29-54. Floriana, Malta: Environment Protection Department; 77pp.

Schembri, P. J. & Schembri, S. (1990) A note concerning the scorpions (Arachnida: Scorpiones) of the Maltese Islands (Central Mediterranean). The Central Mediterranean Naturalist 2(1): 15-21.

Schembri, P.J. & Sultana, J. [eds] (1989) *Red data book for the Maltese Islands*. Valletta, Malta: Department of Information; viii + 142pp. + plates I-VIII.

Schembri, S. (1977) A review of the Lepidoptera (Papilionoidea) of the Maltese Islands. *Lepidoptera Group of 1968 (Vejle, Denmark)*, supplement 1, 10 pp.

Schembri, S. (1980a) An addition to the list of Maltese Blattidae. *Bulletin of the Amateur Entomologists' Society* 39: 38-39.

Schembri, S. (1980b) Vespoidea from the Maltese Islands (Hymenoptera Aculeata). *Bollettino della Società Entomologica Italiana* 112: 90-93.

Schembri, S. (1981) First record of the order Trichoptera from the Maltese Islands. *Bulletin of the Amateur Entomologists' Society* 40: 25-26.

Schembri, S. (1982) Recent records of Hymenoptera Apoidea from the Maltese Islands. *Bulletin of the Amateur Entomologists' Society* 41: 36-41.

Schembri, S. (1983) The Mutillidae of the Maltese Islands: remarks and additions. *Bollettino della Società Entomologica Italiana* 115: 25-30.

Schembri, S. (1984a) Notes on the Orthoptera of the Maltese Islands: the genus *Myrmecophilus* (Orthoptera, Gryllidae). *The Central Mediterranean Naturalist* 1(3): 57-59.

Schembri, S. (1984b) The order Strepsiptera in Malta. *Bulletin of the Amateur Entomologists' Society* 43: 200-201.

Schembri, S. (1985a) Diptera Hippoboscidae of the Maltese Islands. *Potamon* (Malta) 14: 107-109.

Schembri, S. (1985b) The Vespoidea of the Maltese Islands: remarks and additions (Hymenoptera Aculeata). *Bollettino della Società Entomologica Italiana* 117: 115-116.

Schembri, S. (1989a) Maltese Coleoptera: the family Meloidae. *Potamon* (Malta) 17: 168-171.

Schembri, S. (1989b) Insects excluding Coleoptera and Lepidoptera. In: Schembri, P. J. & Sultana, J. [eds] *Red data book for the Islands*. pp. 90-96; Valletta, Malta: Department of Information; viii + 142pp. + plates I-VIII.

Schembri, S. (1991a) Sphecid waps of the Maltese Islands (Hymenoptera Sphecidae). *Bollettino della Società Entomologica Italiana* 122: 175-184.

Schembri, S. (1991b) The Anthicidae of the Maltese Islands (Coleoptera). *Bollettino della Società Entomologica Italiana* 123: 32-38.

Schembri, S. (1992) A preliminary list of the Ichneumonidae of the Maltese Islands (Hymenoptera). *Bollettino della Società Entomologica Italiana* 124: 49-54.

Schembri, S. (1993a) An annotated catalogue of the heteropteran bugs of the Maltese Islands. *Memorie della Società Entomologica Italiana* 71: 467-503.

Schembri, S. (1993b) The coccinellid fauna of the Maltese Islands (Central Mediterranean): an annotated list (Coleoptera Coccinellidae). *Bollettino della Società Entomologica Italiana* 125: 45-52.

Schembri, S. (1995) Insetti. pp. 193-273. In: Sultana, J. [ed.] *Flora u fawna ta' Malta.* Floriana, Malta: Dipartiment ghall-Harsien ta' l-Ambjent; 434pp.

Schembri, S. (1996) Insects. pp. 121-244. In: Sultana, J. & Falzon, V. [eds] *Wildlife of the Maltese Islands* [translation, with additions, of *Flora u fawna ta' Malta* (1995)]. Floriana, Malta: Environment Protection Department; 336pp.

Schembri, S. & Collingwood, C. A. (1981) A revision of the myrmecofauna of the Maltese Islands (Hymenoptera, Formicidae). *Annali del Museo Civico di Storia Naturale di Genova* 83: 417-442.

Schembri, S. & Collingwood, C.A. (1995) The myrmecofauna of the Maltese Islands. Remarks and additions. *Bollettino della Società Entomologica Italiana* 127: 153-158.

Schembri, S. & Ebejer M. J. (1983) A review of the Tettigoniidae of the Maltese Islands. *Bollettino della Società Entomologica Italiana* 115: 135-138.

Schembri, S. & Ebejer, M. J. (1984) Recent additions to the Orthoptera of the Maltese Islands. *Bollettino della Società Entomologica Italiana* 115: 81-82.

Schembri, S.; Gatt, P. & Schembri, J. L. (1991) Recent records of flies from the Maltese Islands (Diptera). *Memorie della Società Entomologica Italiana* 70: 255-277.

Schembri, S. & Johnson, D. (1987) The order Trichoptera in the Maltese Islands. *Bulletin of the Amateur Entomologists' Society* 46: 50-51.

Schembri, S. & Sama, G. (1986) The Cerambycidae of the Maltese Islands (Coleoptera). *Bollettino della Società Entomologica Italiana* 118: 93-100.

Schembri, S. & Schembri, J. L. (1978) A preliminary report on the Dermaptera of the Maltese Islands. *Annali del Museo Civico di Storia Naturale di Genova* 82: 329-332.

Schembri, S. & Schembri, J. L. (1982) Recent records of Coleoptera Staphylinidae from the Maltese Islands. *Società Veneziana di Scienze Naturali Lavori* 7: 45-53.

Schuh, R. & Mifsud, D. (2000) The cylindrical bark beetles of Malta (Insecta: Coleoptera: Zopheridae, Colydiinae). *Annales des Naturhistorischen Museums in Wien* (B) 102: 259-267.

Sheppard, W.S.; Arias, M.C.; Grech, A. & Meixner, M.D. (1997) *Apis mellifera ruttneri*, a new honey bee subspecies from Malta. *Apidologie* 28: 287-293.

Soós, L. (1933) A systematic and zoogeographical contribution to the mollusc-fauna of the Maltese Islands and Lampedusa. *Archiv für Naturgeschichte Zeitschrift für wissenschaftliche Zoologie Abteilung B Neue Folge* 2: 305-353.

Spencer, K. A. (1972) Some Agromyzidae (Diptera) from the Maltese Islands. *Entomologist's Monthly Magazine* 108: 190-192.

Stach, J. (1967) Collembola fauna of Malta. *Acta Zoologica Cracoviana* 12(15): 393-418.

Storch, G. (1970) Holozäne Kleinsäugerfunde aus der Ghar Dalam-Höhle, Malta (Mammalia: Insectivora, Chiroptera, Rodentia). *Senckenbergiana biologica* 51: 135-145.

Strelkov, P.P. (1972) *Myotis blythi* (Tomes, 1857): distribution, geographical variability and differences from *Myotis myotis* (Borkhausen, 1797). *Acta Theriologica* 17: 355-380. [In Russian with English summary].

Strumia, F. (1981) Imenotteri crisididi delle Isole Maltesi (Hymenoptera Chrysididae). *Bollettino della Società Entomologica Italiana* 113: 167-168.

Sultana, J. (2001) *L-Ghasafar ta' Malta*. [Sensila 'Kullana Kulturali' Nu 26]. Pieta, Malta: Pubblikazzjonijiet Indipendenza; xiv + 184pp.

Sultana, J & Gauci, C. (1977-1978) Ectoparasites (other than Hippoboscidae) collected from birds. *Il-Merill* (Malta) 19: 21.

Sultana, J. & Gauci, C. (1982) *A new guide to the birds of Malta*. Valletta, Malta: The Ornithological Society; 207 pp.

Švec, Z. (2000) *Tnodemus mifsudi* sp.n. (Coleoptera, Phalacridae) from Malta. *The Central Mediterranean Naturalist* 3(2): 61-64.

Tamanini, L. (1966) Eterotteri delle Isole Maltesi (Hemiptera, Heteroptera). *Bollettino delle Sedute dell'Accademia Gioenia di Scienze Naturali in Catania* (IV) 8: 679-697.

Thake, M.A. (1985) The biogeography of the Maltese Islands illustrated by the Clausiliidae. *Journal of Biogeography* 12: 269-287.

Thake, M.A. & Schembri, P.J. (1989) Mollusca. In: Schembri, P.J. & Sultana, J. [eds] *Red data book for the Maltese Islands.* pp.79-89; Valletta, Malta: Department of Information; viii + 142pp. + plates I-VIII.

Thaler, K. (1996) Neue Funde europäischer Krallenweberknechte (Arachnida, Opiliones: Phalangodidae, Travuniidae). *Berichte naturwissenschaftlich-medizinischer Verein Innsbruck* 83: 135-148.

Thibaud, J. M. & Christian, E. (1989) Collemboles interstitiels aériens des sables littoraux Méditerranéens. *Annales de la Societé Entomologique de France* 25: 71-81.

Toschi A. & Lanza B. (1959) *Mammalia: generalità, Insectivora, Chiroptera*. [Fauna d'Italia, 4] Bologna: Calderini; 485pp.

Valletta, A. (1949) A preliminary list of the Odonata of the Maltese Islands. *Entomologist* 82: 85-87.

Valletta, A. (1957) Second contribution to the Odonata of the Maltese Islands. *Entomologist* 90: 306-307.

Valletta, A. (1971) A preliminary list of the Hymenoptera Aculeata (excluding ants) of the Maltese Islands. *Entomologist's Monthly Magazine* 107: 45-46.

Valletta, A. (1972) *The butterflies of the Maltese Islands*. Malta: G.Muscat; 64 pp.

Valletta, A. (1973) *The moths of the Maltese Islands*. Malta: Progress Press; 120 pp.

Valletta, A. (1978) Second contribution to the Hymenoptera Aculeata (excluding ants) of the Maltese Islands. *Entomologist's Monthly Magazine* 114: 215.

Valletta, A. (1984) Ant-lions. *Potamon* (Malta) 12: 46.

Valletta, A. (1985) Lacewings. *Potamon* (Malta) 14: 97-98.

Van Der Zanden, G. (1983) Taxonomische und faunistische Bemerkungen zu einigen paläarktischen Bauchsammler-Arten (Insecta, Hymenoptera, Apoidea, Megachilidae). *Faunistiche Abhandlungen* 10: 125-139.

Vienna, P. (1983) Note su alcuni Histeridae (Coleoptera) dell'Arcipelago Maltese. *Società Veneziana di Scienze Naturali Lavori* 8: 49-54.

Viglianisi, F.; Lombardo, B.M. & Caruso, D. (1992) Differenziamento genetico e morfologico in alcune specie siciliane di isopodi terrestri del genere *Porcellio* e descrizione di tre nuove specie (Crustacea, Isopoda, Oniscoidea). *Animalia* 19: 235-273.

Vogel, P., Hutterer, R. & Sara', M. (1989) The correct name, species diagnosis, and distribution of the Sicilian shrew. *Bonner zoologische Beiträge* 40: 243-248.

Vogel, P.; Schembri, P.J.; Borg, M. & Sultana, J. (1990a) The shrew (*Crocidura* sp.) of Gozo, a probable survivor of the Pleistocene fauna of Mediterranean islands. *Zeitschrift fur Säugetierkunde* 55: 357-359.

Vogel, P.; Maddalena, T. & Schembri, P.J. (1990b) Cytotaxonomy of shrews of the genus *Crocidura* from Mediterranean islands. *Vie Milieu* 40: 124-129.

Wahis, R. (1997) Pompilides de l'Archipel Maltais (Hymenoptera: Aculeata, Pompilidae). *Entomofauna* 18: 101-112.

Wahis, R. (1997) Sur les pompilides de l'Archipel Maltais – supplement (Hymenoptera: Aculeata, Pompilidae). *Entomofauna* 19: 333-336.

Zammit, C. & Van Es, H. (1980) *Aphanius fasciatus* Valenciennes 1821. *Killi News: Journal of the British Killifish Association* 179: 141-144.

Zammit Lucia, M. (1971) *A study of the macrofauna of Chadwick Lakes, Malta.* Unpublished M.Sc. dissertation, Department of Biology, Royal University of Malta; ii + 84pp.

Zilch, A. (1977) Die Typen und Typoide des Natur-Museums Senckenberg, 58: Mollusca: Clausiliidae (5): Alopiinae (3): Alopiini (2). *Archiv für Molluskenkunde* 108: 109-161.

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Patrick J. Schembri was born at Birkirkara, Malta in 1954. He studied at the Lyceum Grammar School, the Royal University of Malta's Junior College, and at the University of Malta from where he graduated B.Sc. in chemistry and biology in 1975 and M.Sc. in biology in 1977. He was then awarded a Commonwealth Scholarship at the University of Glasgow, Scotland from where he obtained a Ph.D. degree in zoology in 1980. He later carried out research work at the University of Otago, New Zealand (Postdoctoral Fellowship 1981-82), at the University of Delaware, USA (Fulbright Scholarship 1985-86), and at the University of Durham, England (Visiting Fellowship 1992). In 1999 he was elected a Fellow of the Institute of Biology (Britain) and registered as a Chartered Biologist. In 2000 he was appointed Honorary Research Associate of the University Marine Biological Station, Millport (University of London). He is a Full Professor in the Department of Biology of the University of Malta and was Head of the department between 1992 and 1996. His research interests are marine benthic ecology,

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