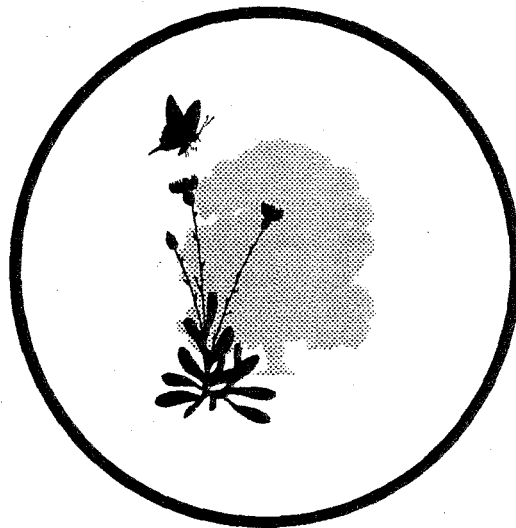

**THE
CENTRAL MEDITERRANEAN
NATURALIST**



Nature Trust (Malta)

VOLUME 3 PART 3

MALTA, DECEMBER 2001

THE CENTRAL MEDITERRANEAN NATURALIST

DECEMBER 2001

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Nature Trust (Malta)

In 1998, three N.G.O.'s which shared the common aim of promoting awareness, conservation and study of Malta's natural heritage decided to join forces so as to form a single, more effective association. The organisations were the Society for the Study and Conservation of Nature, which was founded in 1962, and the more recently formed groups Arbor and Verde.

The merger resulted in the formation of Nature Trust (Malta) which was officially launched by His Excellency the President of the Republic on Friday, 8th January 1999. In June 2001, another organisation, the Marine Life Care Group also joined Nature Trust (Malta). The aims of Nature Trust (Malta) are to enhance public awareness and appreciation of the rich biodiversity of the Maltese Islands through educational campaigns, conservation schemes and research projects. Ongoing activities include tree-planting and frog-conservation projects, the protection of indigenous trees, the fostering of eco-tourism and a nation-wide campaign against illegal dumping. The Trust is also promoting a number of educational campaigns in schools.

"The Central Mediterranean Naturalist" is the official scientific journal of Nature Trust (Malta). All papers submitted for publication therein are peer-reviewed prior to acceptance.

EDITOR: DAVID DANDRIA

TYPESETTING AND LAYOUT: DAVID DANDRIA

PRINTED AT SALESIANS PRESS, SLIEMA, MALTA.

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Price: Lm3.00

A CONTRIBUTION TO THE KNOWLEDGE OF THE EPHYDROIDEA (DIPTERA: CAMILLIDAE, CAMPICHOETIDAE AND DROSOPHILIDAE) OF MALTA.

Martin J. Ebejer¹

ABSTRACT

The families of Ephydroidea, which to date are known to occur in Malta, are the Camillidae, Campichoetidae, Drosophilidae and Ephydriidae. The first three are reviewed and an annotated list of species is given. None of the species have been previously recorded from Malta. The Ephydriidae are the subject of a separate study to be published elsewhere.

INTRODUCTION

The families which are currently included in the Ephydroidea are the Camillidae, Campichoetidae, Curtonotidae, Diastatidae, Drosophilidae and Ephydriidae (Mathis & Zatwarnicki, 1998; Papp, 1998a, 1998b). The Ephydriidae of Malta are the subject of a separate study (Gatt & Ebejer, in prep.). Neither Diastatidae nor Curtonotidae have been found in Malta to date. Therefore, this article deals with the remaining three families, the Camillidae, Campichoetidae and Drosophilidae.

There are no published studies of these families relating to species occurring in the Maltese Islands. Earlier workers (Cilia, 1973; Rondani, 1856-1880; Saliba, 1963 and Schembri *et al.*, 1991) who dealt with Maltese Diptera did not record any species of Ephydroidea save a few in the family Ephydriidae. In Table I, data is given on the fauna of Malta relative to regional and global faunas of the families of Ephydroidea. This information is based on Chandler (1998a, 1998b), Cogan (1984), Bächli (1998); Bächli *et al.* (1995), Bächli & Rocha Pité (1984), Mathis & Zatwarnicki (1998),

Papp (1984a, 1984b, 1984c, 1998a, 1998b).

The biology and ecology of the Camillidae are poorly known. Adults are frequently observed on flowers but the larval stages of most species are unknown. Barraclough (1998), while studying the Afrotropical species, reared them from faecal pellets in arid environments. Ferrar (1987), summarising the little that was previously known, states that they have been reared from soil at the entrance of small mammal burrows. Recently, Kirk-Spriggs & Barraclough (1998) described the larva of one cavernicolous species. There are no records of early stages of Maltese species.

The Campichoetidae (Chandler, 1998a) are uncommon flies associated with dark, humid woodland. The early stages and developmental history are unknown. The habits of adults are equally unknown save that they fly very close to the ground.

By comparison, the Drosophilidae are a well-studied group although this does not apply to Malta. Other than one occasion, which is recorded below, there have been no attempts to trap Drosophilidae using bait known to be highly

Table I The Ephydroidea of Malta compared to the world fauna and that of the Palaearctic, the Mediterranean and Sicily. (Numbers refer to the number of species in each family known from the particular region or country.)

Family	Worldwide	Palaearctic	Mediterranean	Sicily	Malta
Camillidae	37	11	4	0	2
Campichoetidae	10	7	5	0	1
Curtonotidae	60	2	2	0	0
Diastatidae	39	11	3	0	0
Drosophilidae	3500	364	45	17	13
Ephydriidae	1750	505	200	66	50

¹ 14. Triq Sigismondo Dimech, Balzan BZN 08, Malta.

attractive to these flies, for example, fruit and yeast mixture or beer, wine and vinegar. Baited trapping in wooded areas and orchards may reveal more species. Ferrar (1987) summarises their diverse biology. Most are saprophagous, feeding on microorganisms (usually yeasts) growing in fermenting fruits and decaying vegetation, whereas a few are leaf miners. Some genera (not found in Malta) contain a number of species that are entomophagous, attacking mainly Hemiptera (Aleyrodidae and Pseudococcidae). There are many instances of specialization within the Drosophilidae, especially in the tropics.

MATERIAL AND METHODS

Unless otherwise indicated, all species here recorded were collected by the author and are preserved in his private collection. Most of the material is preserved dry-mounted. Where it is preserved in alcohol, this is stated after the respective data. Identification was based on Chandler (1987), Bächli & Burla (1985) and Papp (1985).

ANNOTATED LIST OF SPECIES

CAMILLIDAE

Camilla acutipennis (Loew, 1865)

Material examined: 1♂, Chadwick Lakes, 30.i.1977; 1♀, Ghajn Rihana, 10.ii.1977; 2♂♂, Wied Incita, 4.iii.1991; 2♂♂, Marfa Ridge, 22.iii.1992; 1♂, Chadwick Lakes, 8.xi.1992; 3♂♂ and 3♀♀, Wied l-Isqof, Rabat, 15.xi.1992; 1♂, il-Qolla, Bidnija 7.iii.1999; 1♂, Marfa Ridge, 30.i.2000.

This is a fairly common species, which is often taken when sweeping low vegetation in the shade of trees. It can be observed also on flowers of *Ceratonia*, *Foeniculum*, *Ferula*, *Dacus* and *Euphorbia*.

Distribution: Mediterranean, from Spain across North Africa and southern European countries to Israel.

Camilla nigrifrons Collin, 1933

Material examined: 1♂, Għgant, 3.iii.1991; 1♂ and 1♀, Gozo, Għarb, Wied il-Mielah, 30.xi.1991; 4♂♂, Gozo, Mgarr ix-Xini, 23.iv.1992; 7♂♂ and 3♀♀, Mgħbah, 9.xi.1997; 1♂, Wied l-Isqof, Rabat, 3.v.1998; 1♀, Tal Handaq, Qormi, 7.i.1999.

This species is common and widespread on Malta and Gozo, especially near lush vegetation. It can occur in large numbers under *Ceratonia* during the flowering season. It is sometimes found on the same flowers as its congener.

Distribution: Britain, Hungary, Malta and Spain.

CAMPICHOETIDAE

Campichoeta grandiloba McAlpine JF, 1962

Material examined: 1♂, Buskett, 29.xii.1998.

This is a rare species in Malta. It has only been found at Buskett. Species of this family are never taken in large numbers.

Distribution: Spain, including Balearic islands, Malta and Tunisia.

DROSOPHILIDAE

Drosophila busckii Coquillett, 1901

Material examined: 2♀♀, Balzan, 3.ii.1977; 1♂ and 1♀, Marfa Ridge, 10.vii.1987; 2♂♂, Balzan, 4.iii.1992; 1♂ and 1♀, Fiddien, 15.iv.1992; 1♂ and 2♀♀, Gozo, Għasri, 26.ii.1995, C. Farrugia; 1♂, Mgħbah, 9.xi.1997; 1♂ and 2♀♀, Wied Babu, 6.iii.1998.

Though frequent in wooded areas, gardens and indoors, it is not usually found in large numbers. It is nevertheless a widespread species. Mr Charles Farrugia (pers. comm.) reared it from the frass of *Psylliodes* sp. (Coleoptera, Chrysomelidae) on the petioles and in the stems of cauliflower, *Brassica oleracea* var. *botrytis*. Dr Paul Gatt (pers. comm.) reared it from an unidentified species of fungus collected at Mīzieb on 8.xii.1993. Larvae pupated on 22.xii.1993 and adults emerged on 31.xii.1993; from decomposing mushrooms on 1.xii.1993, Rabat and from rotting potatoes on 27.v.1992, Rabat.

Distribution: sub-cosmopolitan.

Drosophila buzzatii Patterson & Wheeler, 1942

Material examined: 1♂, Balzan, 6.iii.1976; 1♂ and 1♀, Fiddien, 17.vi.1992; 2♂♂ and 2♀♀, Wied l-Isqof, Rabat, 3.v.1998.

Generally found near *Opuntia* where it breeds in its fallen fruit and rotting stems.

Distribution: sub-cosmopolitan.

Drosophila hydei Sturtevant, 1921

Material examined: 3♀♀, Balzan, 9-13.vi.2001, baited trap in citrus garden (preserved in alcohol).

In Malta, this species is probably more common and widespread than the above record suggests. It can easily be mistaken for *repleta* or *buzzatii*.

Distribution: cosmopolitan.

Drosophila immigrans Sturtevant, 1921

Material examined: 1♂, Balzan 3.iii.1976; 1♀, Balzan, 8.ii.1977; 1♂, Buskett, 14.iv.1977; 4♂♂ and 2♀♀, Balzan, 9.iii.1992; 1♂ and 1♀, Fiddien, 17.vi.1992; 3♂♂ and 1♀, Buskett, 27.iii.1994; 1♂, Wied Babu, 6.iii.1998; 37 ex., ♂♂ & ♀♀, Balzan, 9-13.vi.2001, baited trap in citrus garden (preserved in alcohol).

This species is relatively large. It is very common in citrus orchards and gardens where it can be abundant on fallen damaged fruits. It frequently enters houses.

Distribution: sub-cosmopolitan.

Drosophila melanogaster Meigen, 1830

Material examined: 3♂♂, Balzan, 9-13.vi.2001, baited trap in citrus garden (preserved in alcohol).

Older records represented by dry material are not listed, as it

is very difficult to separate this species from *simulans* without dissection. Much less frequent than *simulans*, the two species share the same habits and biotopes. Detailed phenological and ecological studies may uncover differences in the habits of these species in Malta.

Distribution: cosmopolitan.

Drosophila repleta Wollaston, 1858

Material examined: 1♂, Balzan, 14.xii.1976; 1♂, Sliema, 2.1.1977; 1♂ and 5♀♀, Balzan, 1.ix.1991; 1♀, Wied Babu, 6.iii.1998; 1♂ & 2♀♀, Balzan, 9-13.vi.2001, baited trap in citrus garden (preserved in alcohol).

This is a common species, which sometimes occurs indoors where it is attracted to fruit or beer.

Distribution: cosmopolitan.

Drosophila simulans Sturtevant, 1919

Material examined: 32 ♂♂ (and 27♀♀, *melanogaster/simulans*) Balzan, 9-13.vi.2001, baited trap in citrus garden (preserved in alcohol). (See note under *melanogaster*.)

Abundant wherever fruit is overripe or damaged. It is often found in very large numbers in gardens.

Distribution: cosmopolitan.

Drosophila subobscura Collin, 1936

Material examined: 1♂ and 2♀♀, Buskett, 1.v.1992; 1♂, Buskett, 9.vii.1993; 3♂♂ and 1♀, Wied il-Mistra, 19.iii.1994; 1♂, Buskett, 3.v.2001; 1♂ and 1♀, Balzan, 9-13.vi.2001, baited trap in citrus garden.

Common in wooded areas and gardens; it is the author's observation that, at least in Malta, it seems to be attracted to fruit in smaller numbers than other species.

Distribution: most of Europe, the Mediterranean including North Africa, the Middle East and South America.

Hirtodrosophila cameraria (Haliday, 1833)

Material examined: 1♀, Buskett, 14.iv.1977.

This is apparently a rare species in Malta, the above being the only known record.

Distribution: most of Europe, the Mediterranean, and parts of the Middle East.

Lordiphosa andalusiaca (Strobl, 1906)

Material examined: 1♀, Wied il-Kbir, Qormi, 20.ii.1977; 1♂ and 1♀, Salina, 16.iv.1977; 1♂, Gozo, Ramla dunes, 23.iv.1992; 4♂♂ and 5♀♀, Fiddien, 17.vi.1992; 1♀, Bahrija, 12.vi.1994, J.W. Ismay; 1♀, Buskett, 3.v.2001.

In Malta, it appears to be a rather uncommon and localised

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species usually found in undergrowth near *Arundo*.

Distribution: widespread in Europe, the Mediterranean, North Africa and the Middle East.

Scaptomyza adusta (Loew, 1862)

Material examined: 3♂♂ and 4♀♀, Gozo, Wied il-Mielah, Gharb, 30.xi.1991; 1♂ and 1♀, Wied Qannotta, 16.xii.1995; 1♂, Fiddien, 28.i.2001; 1♂, Buskett, 3.v.2001.

Introduced from North America into the Mediterranean, where it is now naturalised in many places. In Malta it appears to be increasing as it is encountered more often and in new habitats.

Distribution: North America, Mediterranean.

Scaptomyza pallida (Zetterstedt, 1847)

Material examined: 1♂ and 1♀, Wied is-Sewda, 12.ii.1977; 1♀, Wied il Kbir, Qormi, 20.ii.1977; 2♀♀, Madliena, 31.xii.1979; 2♂♂ and 2♀♀, Marfa Ridge, 3.i.1987; 3♂♂ and 1♀, Wied Qannotta, 4.i.1987; 3♂♂ and 1♀, Marfa Ridge, 5.i.1987; 2♂♂ and 2♀♀, Wied Incita, 5.i.1987; 4♂♂, Fawwara, 2.iii.1991; 2♂♂, Gozo, Wied il-Mielah, Gharb, 30.xi.1991.

A very common and widespread species; it is one of the most frequently encountered flies in winter. It is often seen on *Bellis*, *Euphorbia*, *Reichardia* and many Umbelliferae.

Distribution: cosmopolitan.

Zaprionus tuberculatus Malloch 1932

Material examined: 3♂♂, Girgenti, 20.xi.1991; 4♂♂ and 4♀♀, Fiddien, 21.ix.1994; 2♀♀, Buskett, 27.xi.1994; 1♂ and 3♀♀, Mgiebah, 9.xi.1997; 1♀, Wied Babu, 6.iii.1998.

A very common species in Malta especially in citrus orchards, it can be found all year round. Dr Paul Gatt (pers. comm.) took this species at light in October 1994 and reared it from the fruits of *Opuntia* taken at Fiddien on 21.ix.1994.

Distribution: Afrotropical region, extending into the Mediterranean and Arabia.

ACKNOWLEDGEMENTS

I thank Dr John Deeming, Cardiff, for identifying the Camillidae. Thanks are also due to Mr Charles Farrugia and Dr John Ismay (Oxford) for donating specimens, and to Dr Paul Gatt for supplying the information on his rearing of material, for reading the manuscript and for making useful comments. I am also grateful to Dr G. Bächli, (Zurich) for his comments and for the identification of *Scaptomyza adusta* (Loew) and *Zaprionus tuberculatus* Malloch.

(Accepted 26th September 2001)

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TAXONOMIC STATUS OF THE MALTESE WALL LIZARD (*PODARCIS FILFOLENSIS*, BEDRIAGA 1876)

C. Savona-Ventura¹

ABSTRACT

The Maltese-Pelagian area is characterised by an endemic species of Wall Lizard - *Podarcis filfolensis*. This has differentiated into various subspecies on the various islands and rocks of the region including ssp. *filfolensis* on Filfolia, *laurentiimuelleri* of Lampione and Linosa, *generalensis* of Fungus Rock, *kieselbachi* of St. Paul's Islands, *maltensis* of Malta and Gozo and possibly Comino, and an unnamed form from Cominotto. The taxonomical status of the species and its possible origins from *Podarcis sicula* are reviewed in the light of the geological movements which occurred in the Central Mediterranean during the Pleistocene. The colour differences between the various subspecies are reviewed and four degrees of melanism are proposed.

INTRODUCTION

The systematics of the Lacertidae, particularly of some genera such as *Podarcis* Wagler, 1830 seem to be undergoing rapid evolutionary differentiation. The late 19th century arrangement of European lizards was incredibly confused. It was only Mehely (1909) who demonstrated beyond the shadow of doubt that most of the previously described *Lacerta muralis* "varieties" were sometimes phylogenetically rather distant species. One Lacertidae species which suffered from the confusion in taxonomy was the Wall Lizard which inhabited the Maltese-Pelagian area in the Central Mediterranean. This lizard has eventually been defined as a full species - *Podarcis filfolensis* Bedriaga, 1876 with several subspecies and colour forms inhabiting the various islands and islets of the area.

The Maltese-Pelagian area comprises several small islands and rocks (Fig. 1). The Maltese Islands are a group of small low islands aligned in a NW-SE direction and located in the central Mediterranean at latitude 35°48'28" - 36°05'00" North and longitude 14°11'04" - 14°34'37" East. The islands are situated on a shallow shelf, the Malta-Ragusa Rise, part of a submarine ridge which extends from the Ragusa peninsula of Sicily southwards to the African coasts. Geophysically, the Maltese Islands and the Hyblean Plateau of south-eastern Sicily are generally regarded as forming part of the African continental plate. The Maltese archipelago consists of three inhabited islands: Malta (area 245.7 km²), Gozo (67.1 km²) and Comino (2.8 km²), and a number of small uninhabited islets: Cominotto (9.9 ha), Filfolia (2.0 ha), St Paul's Islands (10.1 ha) and General's or Fungus Rock (0.7 ha), and a few other minor rocks. The Pelagian Islands lie about 150 km to the south-west of the Maltese archipelago and include Lampedusa, Linosa, Lampione

and Conigli Island. The biota of the Maltese-Pelagian islands are considered to be of the euro-mediterranean type, with close affinities to that of Sicily (Corti & Lanza, 1973). The region also supports a number of endemic species. The herpetofauna of the Maltese-Pelagian islands is rather restricted and includes a number of introduced naturalised species. The species pertaining to the family Lacertidae include the endemic *Podarcis filfolensis* Bedriaga with its various subspecies described from the islands of the Maltese archipelago and the Pelagian Islands of Lampione and Linosa, and *Psammodromus algirus algirus* on Conigli Island (Table 1).

TAXONOMY

The Maltese-Pelagian species *Podarcis filfolensis* has been described as having close affinities to the Sicilian *P. wagleriana* Gistel, 1868 and a superficial resemblance to the Tirrenian *P. tiliguerta* Gmelin, 1784 (Boulenger, 191; Klemmer, 1957). The similarity to *P. tiliguerta* is probably more due to convergence rather than a genetic relationship; and paleogeographic and immunological evidence suggests that *Podarcis filfolensis* and *P. wagleriana* almost surely arose from common Sicilian stock - *P. sicula* Rafinesque, 1810 (Lanza *et al.*, 1977; Lanza & Cei, 1977). Immunological reactions have confirmed that *Podarcis sicula* and *P. muralis* are two full different species, while *P. tiliguerta* may be a subspecies of *P. muralis*. The lizards of the Sicilian-Maltese-Pelagian area - *Podarcis filfolensis* and *P. wagleriana* - have been shown to be two separate but allopatric and morphologically closely related species with a close relationship to *P. sicula* but not to *P. tiliguerta* (Lanza *et al.*, 1977; Lanza & Cei, 1977). Studies on the electrophoretic variation of 26 presumptive gene loci of the

¹ Institute of Health Care, University of Malta, Gwardamangia, Malta

TABLE 1: Herpetofauna of the Maltese-Pelagian Islands

(1: Malta; 2: Gozo; 3: Comino; 4: Filfola; 5: St. Paul's Islands; 6: Cominotto; 7: General's Rock; 8: Linosa; 9: Lampedusa; 10: Conigli Island; 11: Lampione; 12: Pantelleria)

HERPETOFAUNAL SPECIES	MALTESE ISLANDS							PELAGIAN ISLANDS				
	1	2	3	4	5	6	7	8	9	10	11	12
AMPHIBIA												
<i>Bufo viridis viridis</i>									+			
<i>Discoglossus pictus pictus</i>	+	+										
REPTILIA - TESTUDINAE												
<i>Testudo hermanni</i>								+	+			+
REPTILIA - GEKKONIDAE												
<i>Tarentola mauritanica mauritanica</i>	+	+	+	+		+		+	+	+		+
<i>Hemidactylus turcicus turcicus</i>	+	+	+	+	+	+		+	+			+
REPTILIA - LACERTIDAE												
<i>Podarcis filfolensis</i>	+	+	+	+	+	+	+	+			+	
<i>Podarcis sicula sicula</i>												+
<i>Psammodromus algirus algirus</i>										+		
REPTILIA - SCINCIDAE												
<i>Chalcides ocellatus</i>	+	+	+			?		+	+	+	+	+
REPTILIA - CHAMAELEONTIDAE												
<i>Chamaeleo chamaeleon</i>	+	+										
REPTILIA - COLUBRIDAE												
<i>Macroprotodon cucullatus</i>									+			
<i>Malpolon monspessulanua insignitus</i>									+			
<i>Coluber viridiflavus carbonarius</i>	+	+	+									
<i>Elphae situla leopardina</i>	+	+	+									
<i>Coluber florulentus algirus</i>	+											
<i>Telescopus falax falax</i>	+											
<i>Coluber hippocrepis</i>												+

three siculo-maltese-pelagian *Podarcis* species have confirmed genetic variability between the three species. *P. wagleriana* appeared to be genetically related to *P. sicula raffonei* Mertens, 1952 and genetically highly differentiated from *P. filfolensis*. There appeared to be a close relationship between *P. sicula* and *P. filfolensis*, suggesting that these two species probably diverged from a common ancestor. The results of this analysis are consistent with the predictions of the time-divergence theory of variation, supporting the conclusion that directional selection is the main force eroding generic variation on small islands (Capula, 1994).

Podarcis tilguerta with its eleven described subspecies has a circum-tirrenian distribution on the islands of Corsica, Sardinia and the surrounding smaller islands. *P. sicula* with thirty subspecies has a wide central-north Mediterranean distribution including continental Italy, circum-tirrenian and circum-Sicilian regions. *Podarcis wagleriana* has a circum-Sicilian distribution with three subspecies inhabiting Sicily, Vulcono Island, Favignana Island, Levanzo, and Marettimo. *P. filfolensis* is limited to the islands of the Maltese-Pelagian area (Bruno, 1982). The true taxonomical status of the various subspecies of *P. tilguerta*, *P. sicula*, *P. wagleriana*, and *P. filfolensis* remains undetermined since the differentiating characters are generally based on differences in coloration.

The Pleistocene fossil record in Malta and Sicily has yielded lacertilian remains attributed to *Lacerta siculomelitensis* (Bohme & Zammit-Maempel, 1982). This Sicilian-Maltese lizard of large dimension may be the Pleistocene precursor of *Podarcis filfolensis* and *P. wagleriana*, though lizard remains of a smaller dimension have also been excavated from the region. The latter smaller species have been suggested to belong to a sympatric species possibly of the *Podarcis sicula* group (Savona-Ventura, 1985). The origin of *Podarcis sicula* stock in the Sicilian-Maltese-Pelagian region can be attributed to the Late Pleistocene link of the area with the continental mainland. The Maltese Islands area was intermittently connected to the Hyblean Plateau of south-eastern Sicily during the Pleistocene separating permanently towards the end of the Ice Age about 10,000 years ago. The isolation of the Maltese landmass resulted in the differentiation of *Podarcis sicula* (or *Lacerta siculomelitensis*) stock into *P. filfolensis*, while on Sicily it differentiated into *P. wagleriana*. The later fragmentation of the Maltese archipelago further isolated the various island populations with the development of several subspecies. The presence of *Podarcis filfolensis* on Lampione and Linosa has been attributed to later introduction through passive rafting or anthropogenic introduction (Zavattari, 1960). Geological and historic evidence has been presented for the possibility of a larger central Mediterranean landmass which included the Maltese-Pelagian area in the post-Pleistocene period (Mifsud

et al., 2000). Transportation through the accidental agency of man is unlikely. Neolithic man is known to have arrived on the Maltese Islands about 7000 years ago from mainland Sicily. He is known to have maintained trade links using primitive sea craft with Sicily, Lipari and Pantelleria (Trump, 1966). These trade links should have allowed for the reciprocal transfer of the various species of Wall Lizard. All three islands retain several forms of *Podarcis sicula*, while *P. wagleriana* is found in Sicily. There is no evidence of the presence of *P. filfolensis* in these localities, and similarly *P. sicula* and *P. wagleriana* are unknown in the Maltese region (Mertens & Wermuth, 1960; Lanza, 1973; Bruno, 1982).

The isolation of the various islands in the Maltese-Pelagian area has resulted in allopatry where, in a state of special isolation, the lizards on each island evolved differently resulting in apparently endemic forms, differing from each other in the degree of melanism (Fig. 2). Colour variations in lizards have been defined by Lanza (1972). These definition criteria, modified in the case of dorsal pattern to include completely melanic forms, can be applied to the *P. filfolensis* subtypes, particularly in the male lizard. The criteria chosen included dorsal pattern (graded 1 to 8), degree of development of dark markings under the head (graded 0-6), degree of development of the dark markings on the outer ventral plates (graded 0 to 3), and degree of development of dark markings on the inner ventral plates (graded 0 to 3). There do not appear to be any apparent differences in the external and internal morphology of the various island forms.

Several subspecies and colour forms of the Maltese-Pelagian lizards have been described. Genetic studies have confirmed that the Pelagian Island subspecies is very similar to those from the Maltese Archipelago (Capula, 1994).

SYSTEMATICS

Podarcis filfolensis filfolensis (Bedriaga, 1876)

Distribution: Filfolia Island, about 5 km to the south of Malta.

Previous records: Several naturalists noted the presence of a variety of lizard on Filfolia identifying this as *Podarcis muralis* (Adams, 1870). It was identified as a separate form and named *Lacerta filfolensis* by Bedriaga (1876). Its subspecies status was established by Mertens (1924).

Descriptions: Bedriaga (1876); Despott (1915); Boulenger (1921); Fejervary (1924); Savona-Ventura (1974)

Colouration: Dorsal pattern: heavily reticulated to completely melanic (grade 7-8); Degree of development of the dark markings under the head: heavily marked with black (grade 5-6); Degree of development of the dark markings on the outer ventral plates: moderately to very heavily marked with black (grade 3); Degree of development of the dark markings on the inner ventral plates: moderately to very heavily marked with black (grade 3).

Podarcis filfolensis laurentiimuelleri (Fejervary, 1924)

Distribution: Pelagian Islands of Lampione and Linosa about 150 km SW of Malta.

Previous records: The presence of a variety of lizard on the Pelagian Islands which was taxonomically related to those found on the Maltese Islands had been established by Boulenger (1921). Fejervary (1924) studied and named the subspecies as *Lacerta muralis* s.sp. *laurentii-mulleri*.

Descriptions: Boulenger (1921); Fejervary (1924); Lanza & Bruzzone (1960).

Colouration: Dorsal pattern: reticulated network sometimes very heavily marked (grade 6-7); Degree of development of the dark markings under the head: generally show large spots or marblings (grade 4-5); Degree of development of the dark markings on the outer ventral plates: generally heavily marked (grade 3); Degree of development of the dark markings on the inner ventral plates: generally heavily marked (grade 3).

TABLE 2: Dorsal Pattern (modified after Lanza, 1972).

TOTALLY MELANIC	RETICULATED			INTER- MEDIATE	STRIATED			
	8	7	6		5	4	3	2
								Malta
								Gozo
							Comino	
						St. Paul's Is.		
							Cominotto	
							Fungus Rock	
							Lampione	
							Linosa	
								Filfolia

TABLE 3: Dark markings under head (modified after Lanza, 1972).

VERY CLOSE MARKING	RETICULATED			SEVERAL SPOTS			ABSENT MARKINGS
	6	5	4	3	2	1	
							Malta Gozo
						Comino	
				St. Paul's Is. Cominotto			
		Fungus R.					
		Lampione					
		Linosa					
Filfolia							

Podarcis filfolensis generalensis (Gulia in Despott, 1915)

Distribution: General's Rock (also known as Fungus Rock) about 0.1 km to the west of Gozo.

Previous records: The subspecies was described and illustrated by Despott (1915) who based his description on that of G. Gulia. The original description of Gulia who named the form *Lacerta generalensis* has not been traced.

Descriptions: Despott (1915); Fejervary (1924); Savona-Ventura (1974)

Colouration: Dorsal pattern: strongly reticulated (grade 6); Degree of development of the dark markings under the head: confluent and conspicuous (grade 4); Degree of development of the dark markings on the outer ventral plates: marked longitudinal series (grade 3); Degree of development of the dark markings on the inner ventral plates: moderately marked (grade 2).

Podarcis filfolensis ? ssp.

Descriptions: Savona-Ventura (1983)

Distribution: The islet of Cominotto and possibly associated rocks about 0.5 km off Comino

Previous records: The presence of the lizard on Cominotto was noted in Borg & Busuttil (1925), but the colour differences from the *maltensis* was only noted by Savona-Ventura (1983).

Colouration: Dorsal pattern: partial reticulation (grade 5-6); Degree of development of the dark markings under the head: moderately marked with black (grade 2-4); Degree of development of the dark markings on the outer ventral plates: generally marked with black (grade 2); Degree of development of the dark markings on the inner ventral plates: longitudinal series of dark markings (grade 2).

Podarcis filfolensis kieselbachi (Fejervary, 1924)

Distribution: St. Paul's (also known as Selmunett) Islands, two small islets about 0.1 km NE of Malta.

Previous records: This was identified as a separate form by Despott (1915). This was studied in detail and named *Lacerta muralis* var. *kieselbachi* by Fejervary (1924).

Descriptions: Despott (1915); Fejervary (1924); Savona-Ventura (1974); Savona-Ventura (1983a)

Colouration: Dorsal pattern: generally striped pattern but some early reticulation can occur (grade 3-5); Degree of development of the dark markings under the head: marbled with black (grade 2-4); Degree of development of the dark markings on the outer ventral plates: small spots forming a longitudinal series (grade 1-2); Degree of development of the dark markings on the inner ventral plates: poorly marked with black (grade 1).

Podarcis filfolensis ? maltensis

Distribution: The island of Comino, situated between Malta and Gozo.

Previous records: The presence of the lizard on Comino had long been acknowledged (Despott, 1915), but the differences in colouration were only noted by Savona-Ventura (1983).

Descriptions: Savona-Ventura (1983)

Colouration: Dorsal pattern: reticulated pattern in some limited to the flanks (grade 2-3); Degree of development of the dark markings under the head: very lightly marked (grade 1); Degree of development of the dark markings on the outer ventral plates: very occasional small dark spots (grade 0-1); Degree of development of the dark markings on the inner ventral plates: generally white (grade 0).

Podarcis filfolensis maltensis (Mertens, 1921)

Distribution: The islands of Malta and Gozo.

Previous records: Several naturalists had noted the presence of the Wall Lizard in Malta referring this to *Lacerta agilis*

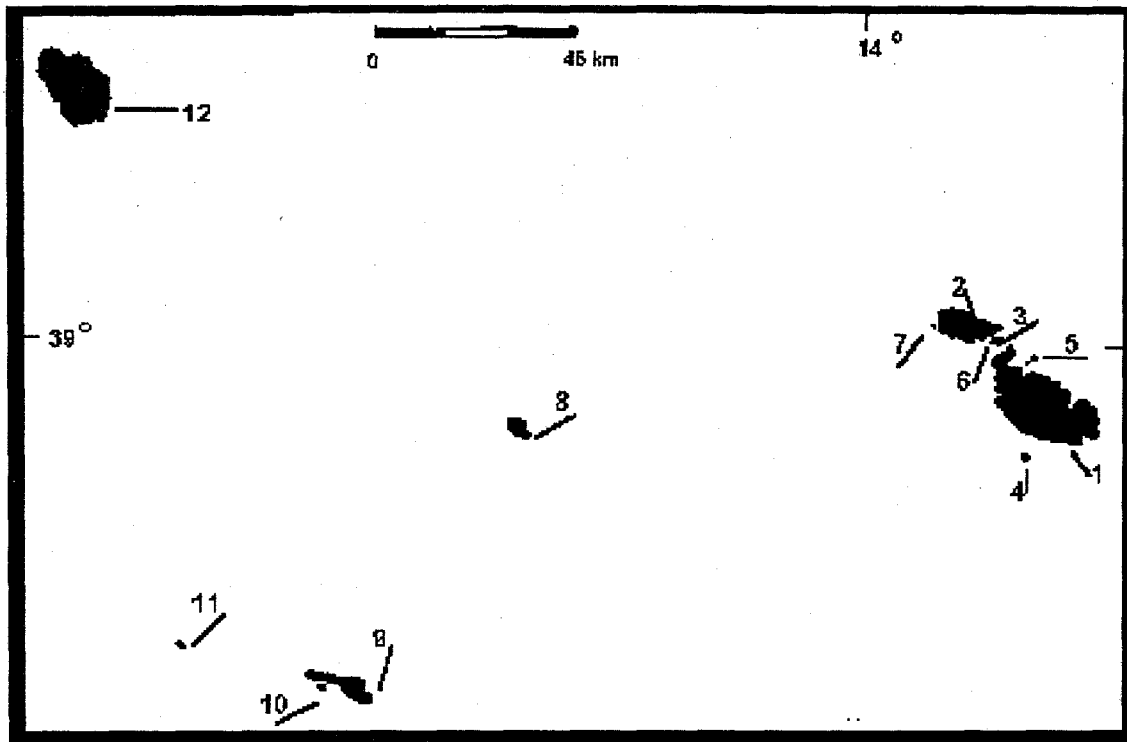


FIG. 1: Maltese-Pelagian Islands (1: Malta; 2: Gozo; 3: Comino; 4: Filfolia; 5: St. Paul's Islands; 6: Cominotto; 7: General's Rock; 8: Linosa; 9: Lampedusa; 10: Conigli Island; 11: Lampione; 12: Pantelleria)

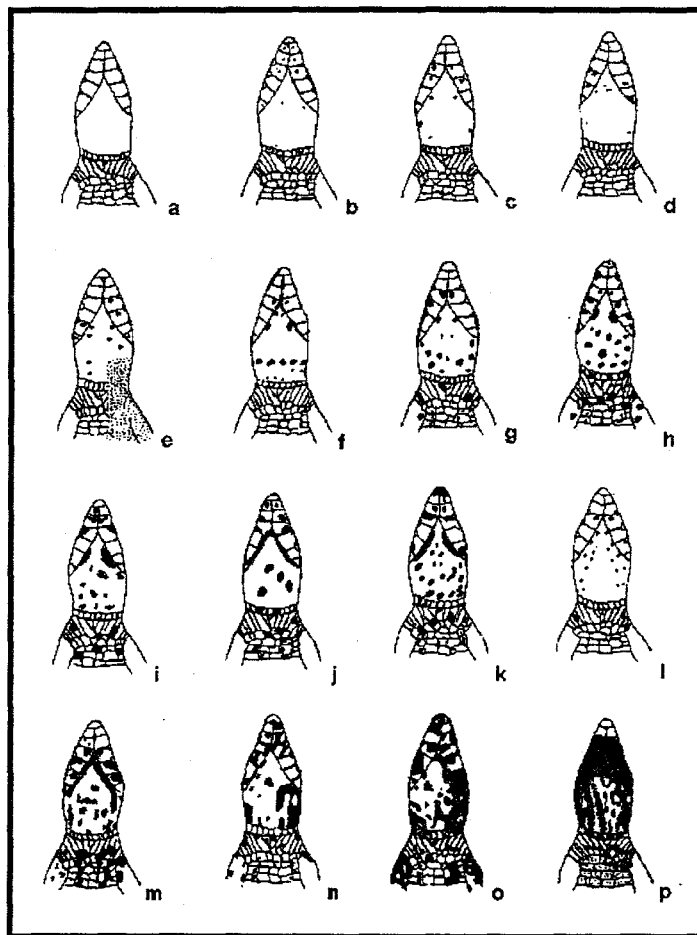


FIG. 2: Ventral views of *Podarcis filfolensis*. [a-b: *maltensis* (Malta & Gozo); c-e: ? *maltensis* (Comino); f-h: *kieselbachii*; i-l: *ssp.* ? (Cominotto); m: *generalensis*; n-o: *laurentiimuelleri*; p: *filfolensis*]

(Waring, 1843), and *Podarcis muralis* (Adams, 1870). Mertens (1921) established the taxonomical status of this subspecies and confirmed its relationship to the Filfola Lizard previously noted by Boulenger (1920). Fejervary (1924) apparently unaware of Mertens description named the subspecies *Lacerta muralis* var. *despotti*.

Descriptions: Boulenger (1921); Mertens (1921); Fejervary (1924); Savona-Ventura (1974)

Colouration [based on parameters established by Lanza (1972)]: Dorsal pattern: generally striated with very marked dorsal bands (grade 1-2); Degree of development of the dark markings under the head: only rare specimens have a few small black spots (grade 0-1); Degree of development of the dark markings on the outer ventral plates: usually unmarked with black (grade 0); Degree of development of the dark markings on the inner ventral plates: usually unmarked with black (grade 0)

CONCLUSIONS

Degree of melanism is not a taxonomical character to be relied upon, especially in the lizards, where it has been shown to play a part in body temperature control. Coloration in lacertidae is also very variable. It would appear however that, in the Maltese-Pelagian lizards, each form inhabiting a particular island has its own range in melanism extension

which seems to be dependant on the habitat. Based on the arbitrary criteria defined by Lanza (1972) for colour pattern in the lacertidae modified to include completely melanic forms, the degree of melanism in *Podarcis filfolensis* can be graded to at least four levels - striated, intermediate, reticulated, and melanic - with marked overlap in the populations inhabiting the various islands (Table 2-3). The lizards from the Islands of Malta, Gozo and Comino apparently fall into the striated variety (ssp. *maltensis*), those for Filfola can be considered melanic (ssp. *filfolensis*), while the lizards from Lampione and Linosa fall into the reticulated variety (ssp. *laurentiimeulleri*). The lizards from St. Paul's Islands, Cominotto and Fungus Rock seem to form an intermediate group. Increased melanism appears to be particularly developed in the garrigue environment on the smaller islets. This melanic development could be attributed to food and territory competition being particularly higher in these environments. Those lizards which attain their optimum temperature earlier during the day have a higher chance of survival in these adverse ecological conditions (La Greca & Sacchi, 1957). A detailed comparative statistical study to assess the colour pattern variation of the different forms is required before the true taxonomical status of the various island forms can really be determined.

(Accepted 27th October 2001)

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POLYXENID MILLIPEDE (DIPLOPODA, POLYXENIDA) ASSOCIATED WITH EMPTY SNAIL SHELLS

Karl A. Ebejer¹ and Patrick J. Schembri¹

ABSTRACT

A polyxenid millipede found singly and in groups of up to nine individuals or their exuviae in dead empty snail shells from Qrejten Point, northeastern coast of Malta, was identified as *Polyxenus macedonicus* Verhoeff, 1952. Other organisms were also collected from the same shells, but there was no evidence to suggest a parasitic or predatory relationship of any of these with the millipedes. We conclude that the polyxenids were exploiting the shells as shelters with a relatively benign microclimate in an otherwise arid environment.

INTRODUCTION

Polyxenid millipedes are minute (<4mm) diplopods characterised by a soft body wall lacking impregnation with calcium and covered with tufts of hair-like setae. Two polyxenid species are known from the Maltese Islands: *Polyxenus lapidicola* Silvestri was collected twice from leaf-litter under large shrubs, and *Lophoproctus jeanneli* Brölemann, collected once from the same habitat (Enghoff & Schembri, 1989). Enghoff & Schembri (1989) did not exclude the possibility that polyxenids are more widespread in the Maltese Islands than their records suggest, since their small size precludes easy observation.

The present paper reports findings of aggregations of polyxenid millipedes in empty (in the sense of lacking the original gastropod soft tissues) snail shells at one site on the east coast of Malta during a study on the resource value of empty terrestrial snail shells in the Maltese Islands (Ebejer, 2001).

METHODS

The study area, Qrejten Point, is a peninsula on the east coast of Malta with a high exposure to wind and sea spray. The flat Coralline Limestone terrain supports a maritime garigue dominated by Golden Samphire (*Inula crithmoides*), Boar Thistle (*Galactites tomentosa*), Clustered Carline-thistle (*Carlina involucrate*), Mediterranean Thyme (*Thymbra capitata*), Maltese Sea-chamomile (*Anthemis urvilleana*), Rock Crosswort (*Crucianella rupestris*), Edible Birdfoot Trefoil (*Lotus edulis*), and various Graminae. The entire area is strewn with rubble.

Sampling was carried out between September and October 2000. Three shore-normal transects were established approximately 20m apart. Sampling stations were located at 10-20m intervals along these transects up to a distance of about 90m from the sea. At each station empty snail shells

were collected by searching the surface of the terrain, ignoring any partially buried shells that did not have an exposed aperture or visible breakage. Each collected shell was immediately placed individually in a sealed plastic container until processed. In the laboratory, shells were identified, measured and carefully broken and searched and any animal contents (or parts thereof) were preserved and identified to the fullest extent possible.

RESULTS

Among the contents of the snail shells were polyxenid millipedes and/or their exuviae (Table 1). None of the polyxenids appeared to be alive. The number of polyxenids found in occupied shells varied from one to nine individuals per shell. In some shells, large masses of exuviae were found in silken nests, which the animals had presumably spun themselves. Of the 61 shells that contained a polyxenid (or exuviae), 59% also had other occupants, or remnants thereof (Table 2). In many cases, shells contained a variety of occupants sharing the shell with the millipedes.

DISCUSSION

Enghoff & Schembri (1989) identified two polyxenids from the Maltese Islands: *Polyxenus lapidicola* Silvestri and *Lophoproctus jeanneli* Brölemann. However, the taxonomic status of *P. lapidicola* is uncertain and the leading authority on polyxenids, M. Nguyen Duy-Jacquemin, who was sent specimens of the polyxenids collected for examination, prefers to refer to the Maltese specimens from Qrejten Point as *Polyxenus macedonicus* Verhoeff, 1952 (H. Enghoff, personal communication).

In addition to Malta, *Polyxenus macedonicus* is known from Macedonia (F.Y.R.O.M.) as well as southern France and Corsica (Henrik Enghoff, personal communication, 2001).

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Table 1 – Frequency of polyxenid occupancy of different snail shells from Qrejten Point.

Snail species ¹	No. shells collected	No. shells Occupied ²	% occupied
<i>Trochoidea spratti</i>	103	24	23.30
<i>Sphincterochila candidissima</i>	73	3	4.11
<i>Eobania vermiculata</i>	52	4	7.69
<i>Pomatias sulcatus</i>	52	14	26.92
<i>Cochlicella acuta</i>	21	3	14.29
<i>Muticaria macrostoma</i>	20	1	5.00
<i>Rumina decollata</i>	15	0	0.00
<i>Chondrula pupa</i>	13	5	38.46
<i>Cantareus aspersus</i>	10	1	10.00
<i>Xerotricha</i> sp.	8	3	37.50
<i>Caracollina lenticula</i>	5	1	20.00
<i>Theba pisana</i>	3	2	66.67
<i>Cantareus aperta</i>	2	0	0.00
<i>Cerņuella caruanae</i>	1	0	0.00
<i>Ferussacia folliculus</i>	1	0	0.00
TOTALS	379	61	16.09

¹ Nomenclature follows Giusti *et al.* (1995) ² Shells listed as occupied contained at least one polyxenid or polyxenid exuvium.

Aggregations of polyxenids in snail shells, but not in other microhabitats, at Qrejten Point indicate that empty snail shells are an important resource for this species. It has been suggested that *Polyxenus macedonicus* may have selected the snail shells if they had any algal growth (H. Enghoff, personal communication). The shells at Qrejten were normally free of such growth except in the case of *Sphincterochila candidissima* and *Pomatias sulcatus*, older specimens of which were sometimes very eroded and showed signs of algal or lichen growth. However, this was not confirmed at the time of collection and no records were made of whether such shells also contained polyxenids. Shells that contained polyxenids but which did not bear any algae may have already been stripped of such growth if there had been any.

There is no literature describing any relationship of polyxenid millipedes with snails or snail shells, although some millipede species have been reported to feed on dead animal remains, including snails (Srivastava & Srivastava, 1967). Their presence in snail shells at Qrejten may not be related to any interaction with the living or recently dead gastropod, but to the microclimatic conditions afforded by the empty shells. In Britain, *Polyxenus lagurus* is found under the bark of dead trees, in leaf litter and under stones (Blower, 1985). All of these places are typically dark, damp and sheltered. However, *Polyxenus lagurus* is extremely successful at colonising dry habitats. In coastal regions they have been found at the roots of halophilic plants and beneath lichens and mosses growing on boulders (Blower, 1985). It therefore appears that *Polyxenus lagurus* can survive in a range of environments, whether moist or dry, if suitable microhabitats are available.

Crawford (1979) describes a number of behavioural and physiological mechanisms employed by millipedes to reduce water loss. These include walking to a wet area and minimisation of cuticular, respiratory and other forms of water loss. The hot, dry summers experienced by *Polyxenus macedonicus* in Malta may be survived through utilisation of such mechanisms. The polyxenids may seek the relative shelter and humidity of discarded snail shells in otherwise exposed areas. The presence of more than one individual in these shells suggests that the shells are preferred 'roosts' in which polyxenids aggregate after feeding.

Empty snail shells were very abundant at Qrejten Point. The tendency for the millipedes to be found in aggregations rather than singly in a greater number of shells may result from the animals following the same environmental cues in seeking shelter but may also be the result of some form of social behaviour. It is also possible that the aggregations may be associated with reproductive or moulting behaviour.

The preference of *Polyxenus macedonicus* for certain shells may be a chance observation resulting from a small sample size. Given the number of shells of all snail species that were found to be empty of any occupants, it is unlikely that the polyxenids were competitively excluded from the shelter offered by any shell.

The occurrence of other organisms in the same shells occupied by polyxenids maybe completely fortuitous but the possibility of predatory or parasitic associations cannot be excluded. There is very little literature on this aspect of polyxenid biology, but predatory and parasitic associations of

Table 2 – Occupants sharing empty snail shells with polyxenids at Qrejten Point.

Occupant	No. of occurrences
Spiders (Araneae)	13
Mites and ticks (Acari)	10
Ants (Formicidae)	9
Beetles (Coleoptera)	6
Unidentified arthropods	5
Pseudoscorpions (Pseudoscorpiones)	4
Snails (Gastropoda)	4
Springtails (Collembola)	2
Bugs (Hemiptera)	2
Woodlice (Isopoda)	1

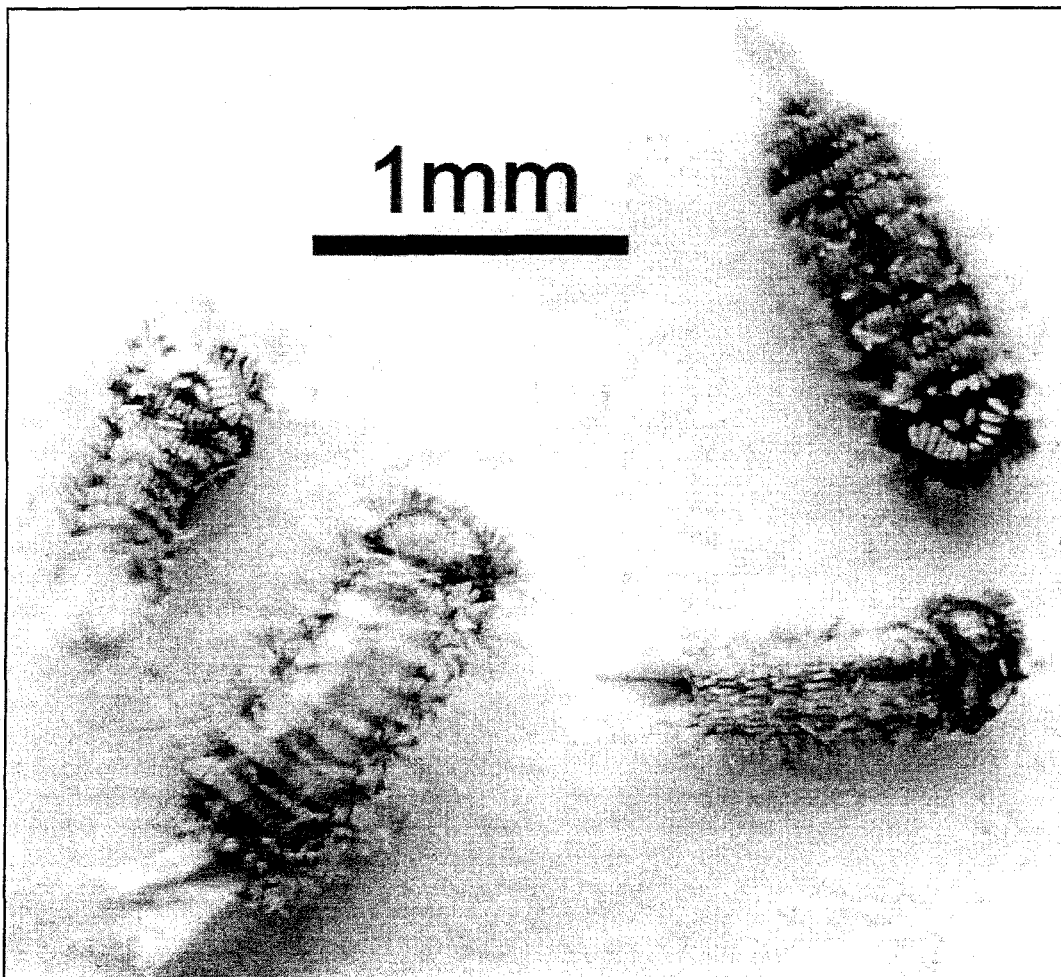


Fig. 1 *Polyxenus macedonicus* Verhoeff, 1952

polyxenids with ants and gall midges respectively have been recorded. Ants of the Neotropical genus *Thaumatomyrmex* are specialised predators on polyxenids that strip the millipedes of their setae before eating most of the prey tissues (Brandão *et al.*, 1991). This or related genera do not occur in the Maltese Islands (Stephen Schembri, *personal communication*) and while remains of ants were found in shells occupied by polyxenids at Qrejten Point, there is no evidence to suggest ant predation or any association between ants and the millipedes.

A parasitoid gall midge (Diptera, Cecidomyiidae), *Chiliodiplosis vasta* Möhn is known to specialise on individuals of *Polyxenus lagurus* in Scandinavia (Möhn, 1955; Enghoff, 1976). In the present study, Cecidomyiidae, including one larva, were found in shells at Qrejten Point, but never in the same shells as *Polyxenus macedonicus*. The Cecidomyiidae also have some members whose larvae are predators (Skuhravá, 1997). Other potential predators that occur in association with polyxenids in snail shells at Qrejten

point include spiders, pseudoscorpions and beetles. As no literature on the interaction of polyxenids with such species seems to exist, further study is required before any assessment of the significance of these co-occurrences can be made.

ACKNOWLEDGEMENTS

We are grateful to Edwin Lanfranco (University of Malta) for identification of plants, Stephen Schembri (University of Malta) for information on ants, Professor Henrik Enghoff (Zoologisk Museum, Copenhagen, Denmark) for information on polyxenids and for arranging for the identification of the polyxenid, and to Professor Monique Nguyen Duy-Jacquemin (Museum National d'Histoire Naturelle, Paris, France) for her identification of the *Polyxenus* species from Qrejten Point. PJS thanks the University of Malta Research Committee for the award of a research grant.

(Accepted 20th September 2001)

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FIRST RECORD OF EUCINETIDAE (COLEOPTERA) FROM THE MALTESE ISLANDS

David Mifsud¹

ABSTRACT

The beetle family Eucinetidae, locally represented by *Nycteus meridionalis* (Laporte), is recorded for the first time from the Maltese Islands. Brief notes on the systematics, biology and distribution of Eucinetidae are included.

INTRODUCTION

A good deal of systematic work on the Coleoptera of the Maltese Islands has been carried out. Despite this, however, our present knowledge is still not sufficient to provide a clear picture of most species inhabiting this archipelago. Caruana Gatto (1894) published a list of common beetles and later co-authored (Cameron & Caruana Gatto, 1907) a list of Coleoptera occurring in the Maltese Islands. The latter still remains the only work dealing with all Coleoptera families. Since then, several families have been reviewed by a number of authors, mostly based on recent collections (cf Mifsud, 2000).

THE EUCINETIDAE

The family Eucinetidae, was never previously recorded from the Maltese Islands. It is included in the superfamily Scirtoidea (=Eucinetoidae), which comprises three other families: Clambidae, Decliniidae and Scirtidae (Lawrence & Newton, 1995). The entire group is characterized by adults having a relatively small pronotum, highly reduced prosternum, and a compaction mechanism involving the opisthognathous head resting against the procoxae or in some cases the meso- or metathorax. Distinguishing features of adult Eucinetidae include a streamlined elliptical body and the ability to jump using their modified hind legs. Sucking mouthparts appear to have evolved on several occasions in this family.

The Eucinetidae are represented worldwide by about thirty described species, currently accommodated in eight genera: *Bisaya* (Central Asia), *Eucilodes* (Eurasia), *Eucinetus* (widespread), *Euscaphurus* (western North America), *Jentozkus* (New World), *Nycteus* (widespread), *Subulistomella* (Japan) and *Tohlezkus* (Turkey and Finland). The Palearctic species of *Eucinetus* Germar were revised by Vit (1985) who recognised two species groups on the basis of adult morphology: the *haemorrhoidalis* group represented by the single species *haemorrhoidalis* (Germar) and the

meridionalis group represented by *bicolor* Reitter, *hopffgarteni* Reitter, *meridionalis* (Laporte) and *rugosus* Portevin. Until recently, *Nycteus* Latreille was in synonymy with *Eucinetus*. This synonymy was removed and the taxa in the *meridionalis* species group (Vit, 1985) were transferred from *Eucinetus* to *Nycteus* (Vit, 1999). Six other taxa (with distribution outside the Palearctic) were also transferred from *Eucinetus* to *Nycteus*, and two new species were described, *N. falsus* Vit, distributed from Arizona to Mexico, and *N. wollastoni* Vit from the Canary Islands.

Little is known about the biology of these beetles, but most records result from collections made in leaf litter. In some cases it has been asserted that these insects feed on spores of slime moulds [Myxomycetes (= Mycetozoa)] or on the fruiting bodies of basidiomycete fungi (Boletaceae, Coniophoraceae) (Wheeler & Hoebeke, 1984).

Nycteus meridionalis (Laporte de Castelnau, 1836)
(Fig. 1)

Material examined. MALTA, Tal-Munxar (St. Thomas Bay), 1 ex., under stone on rubble wall, 18.iii.1996, leg. D. Mifsud; Zejtun, 1 ex., 30.xi.1997, leg. D. Mifsud (material is deposited in the author's private collection).

Distribution. Madeira, Spain, France, Corsica and Italy (Vit, 1985).

Notes. *N. meridionalis* is a new record for the Maltese Islands. In other European parts, *N. meridionalis* was recorded from under bark of *Pinus*, in leaf litter of *Eucalyptus* and in dried debris of *Opuntia* (Vit, 1985).

ACKNOWLEDGEMENTS

I would like to thank Mr. Roland Mühlethaler (NLU-Institut, Universität Basel, Switzerland) for kindly taking the photo of *Nycteus meridionalis* (Laporte).

(Accepted 19th October 2001)

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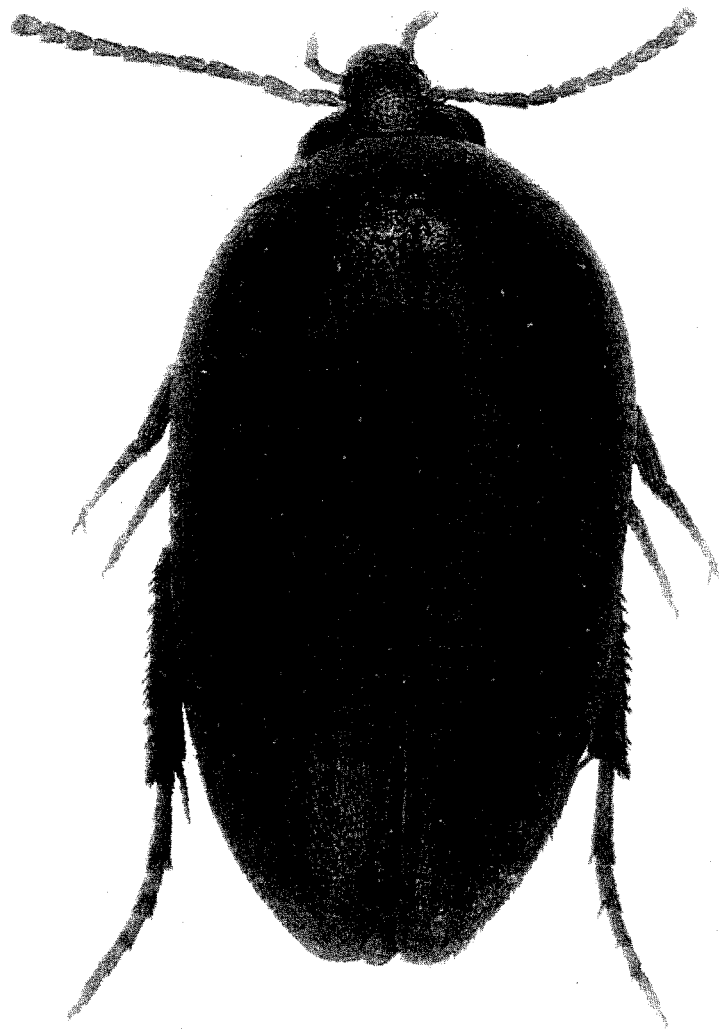


Fig. 1 *Nycteus meridionalis* (Laporte de Castelnau, 1836) (x 32)

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OBSERVATIONS ON THE ENDEMIC MALTESE TRAP-DOOR SPIDER *NEMESIA ARBORICOLA* POCOCK, 1903 (ARANEAE: NEMESIIDAE)**David Dandria¹****ABSTRACT**

The discovery of several traps constructed by *Nemesia arboricola* in palm tree trunks in different localities in Malta is recorded. This confirms the arboreal habits attributed to the species by Pocock when the female was originally described in 1903. Other observations on the biology, ecology and distribution of the species are included.

INTRODUCTION

In 1903 Pocock described a new species of trapdoor spider known only from one or more female specimens collected in the Maltese Islands. He named the species *Nemesia arboricola* on account of the fact that the species had "...the habit of constructing its dwelling on the trunks of trees." (Pocock, 1903). In the "Red Data Book for the Maltese Islands", published in 1989, *N. arboricola* is included on the strength of Pocock's 1903 record with the observation "and not recorded again since". It is indicated as having uncertain taxonomic status and as being questionably endemic, while its status in the Maltese Islands is given as "unknown". (Schembri, 1989)

No further mention of the species appeared in the literature until 1993 when the species was recorded as "endemic, probably extinct" (Baldacchino *et al.*, 1993). In the same work, 3 males and 2 females of the related species *Nemesia macrocephala* Auserrer, collected in the period 1974 - 76, were recorded, none of them from traps constructed in tree-trunks. The original determination of two of these specimens was carried out by A.E. Decae of Holland, and the other specimens were also assigned to this species by one of the authors (D. Dandria), based on Decae's original identification.

In the period 1990-92, Dr. Erich Kraitscher made a number of collecting trips to the Maltese Islands in the course of which he collected several female specimens of a trap-door spider. He later published a paper in which he showed that the specimens he had collected were compatible with Pocock's concise description of *N. arboricola* (Kraitscher, 1994). He confirmed this by comparing his specimens with the holotype of *N. arboricola* at the Natural History Museum, London. This, unfortunately, was not in a good state of preservation as it had originally been pinned in a dry state. He was, however, able to identify his specimens as *N. arboricola* and he fully redescribed the female of this species. He pinpointed three characters which clearly distinguished his specimens as well as the holotype of *N. arboricola* from *N.*

macrocephala (a common Sicilian species) and the other related species *N. caementaria*. None of Kraitscher's specimens had been found on tree-trunks.

Kraitscher also expressed the opinion that the 1993 records by Baldacchino *et al.* were probably based on a misidentification and opined that the specimens they recorded could actually be *N. arboricola*. In 1996 Kraitscher published an important work on Maltese spiders (Kraitscher, 1996) in which he again cited his records of *N. arboricola*.

All documented records of the species in the Maltese Islands, including those in the present work, are listed in Table 1. The aim of the present work is to confirm that the records by Baldacchino *et al.* should in fact have been referred to *N. arboricola*, and to put on record some interesting aspects of the ecology of *N. arboricola* which have been observed by the author subsequent to Kraitscher's publications.

MATERIALS AND METHODS

The female specimens of *N. arboricola* cited in the work by Baldacchino *et al.* (1993) were carefully re-examined in the light of Kraitscher's 1994 description of *N. arboricola*. Other specimens collected subsequently were also carefully examined and are here recorded. Observations were made on the nests of several trapdoor spiders found in different habitats and localities in the Maltese Islands.

RESULTS

The specimens listed below were found to conform to Kraitscher's 1994 description of *Nemesia arboricola* Pocock 1903 and are therefore confirmed as belonging to this species.

(a) Specimens recorded as *N. macrocephala* by Baldacchino *et al.* (1993). (b) Subsequent records: Howard Gardens, Rabat (Malta) 10.vi.96 1 ♀, nest in trunk of *Phoenix canariensis* D.D. leg.; Siggiewi (Hax-Xluq) 5.iv.98, 1 ♀ juv., nest under stone, D.D. leg.; Balzan: 18.v.98 1 ♀, nest in trunk of *P. canariensis* D.D. leg.

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Table I: Documented records of *Nemesia arboricola* in the Maltese Islands.

Locality	Reference	Habitat
"Malta"	Pocock (1903)	"on the trunks of trees"
B'kara	Baldacchino <i>et al.</i> (1993) ¹	The habitat for each record is not specified, but it is stated that the burrow is usually constructed "on the rocky sides of valleys and in soil banks".
Buskett	Baldacchino <i>et al.</i> (1993) ¹	
Mellieha	Baldacchino <i>et al.</i> (1993) ¹	
St. Paul's Island	Baldacchino <i>et al.</i> (1993) ¹	
Mosta: Wied il-Ghasel	Kritscher (1994)	
Mosta: Wied l-Isperanza? ²	Kritscher (1994)	The habitat for each record is not specified, but it is stated that all traps were "in rocks as well as in cracks in the ground".
Bugibba: Wied Qannotta? ³	Kritscher (1994)	
Mistra Valley, Mellieha Ridge	Kritscher (1994)	
Gozo: St. Lucia	Kritscher (1994)	
Gozo: Ramla Valley	Kritscher (1994)	
Rabat (Malta): Howard Gardens	Dandria (2001)	
Marsa: Marsa Sports Club	Dandria (2001)	Palm tree trunk (<i>P. canariensis</i>)
Gzira: Gnien l-Ewropa	Dandria (2001)	Palm tree trunk (<i>P. dactylifera</i>)
Balzan (Nr. Corinthia Hotel)	Dandria (2001)	Palm tree trunk (<i>P. canariensis</i>)
B'kara: Railway Station Garden	Dandria (2001)	Palm tree trunk (<i>P. dactylifera</i>)
Floriana: Maglio Garden	Dandria (2001)	Palm tree trunk (<i>P. dactylifera</i>)
Sliema: Gnien l-Indipendenza	Dandria (2001)	Palm tree trunk (<i>P. dactylifera</i>)
Zebbug (Malta): Nr. San Blas.	Dandria (2001)	On rocky outcrop by the roadside.
Attard	Dandria (2001)	Fissures in stone wall.
Siggiewi: Hax-Xluq.	Dandria (2001)	Under stone; immature spider.

¹ As *Nemesia macrocephala* Ausserer.

² The locality is cited in the German original as "Mosta, Tal Isoposa, Tal SSW der Stadt"

³ The locality is cited in the German original as "Buggibba, Wied Quamolla"

Observations: *Nemesia* nests were found (and kept under intermittent observation between 1994 and 2001) in the following habitats and localities:

Howard Gardens, Rabat (Malta). Several nests of varying dimensions were observed in the trunks of a number of *Phoenix. canariensis* palms in these public gardens. Most nests contained living spiders, but some were empty. This was the author's first observation of *Nemesia* nests in palm-tree trunks. One female was taken in 1996 (see record above). Following this discovery, palm-tree trunks were searched in various localities with the following results:

Marsa Sports Club Grounds, Marsa. One of the *P. canariensis* palm trunks bore a number of *Nemesia* nests.

Balzan (Nr. Corinthia Hotel). Several nests of various dimensions in two large *P. canariensis* palms by the roadside. All contained live spiders, in one case a female with cocoon. One female was taken in 1998 (see record above).

Europa Gardens, Gzira. A few nests in a large *P. dactylifera* trunk.

Old Railway Station Gardens, Birkirkara. Several nests in various *P. dactylifera* palm trunks.

Maglio Gardens, Floriana. Two nests in an old *P. dactylifera* palm.

Independence Gardens, Sliema. One nest in the only *P. dactylifera* in these public gardens. Several *P. canariensis* are also found here, but searches for nests in their trunks proved negative.

All nests observed were at a height of 1–2 metres from the ground, although the possible presence of other nests at higher points cannot be excluded.

Other observations included: **Zebbug (Malta): Near San Blas Caritas Rehabilitation Centre.** Several nests in soil pockets on a rocky outcrop by the roadside. **Attard:** Several nests of various sizes in the cracks of an old masonry wall.

Notes: Apart from Pocock's 1903 statement on the occurrence of nests in trees, the only observed habitats of the species hitherto recorded are rocky situations and cracks in soil (Baldacchino *et al.*, 1993; Kritscher, 1994, 1996). Nests constructed in tree trunks, as originally related by Pocock were discovered by the present author and are here recorded for the first time since 1903. These arboreal nests were only observed in the trunks of palm trees in several locations as indicated above and in Table 1. They are not easy to detect, owing to the near-perfect camouflage of the only visible part of the nest - the lid, whose external surface is identical in colour and texture to the rest of the palm trunk (Plate 1 a). This probably accounts for the fact that no such nests in palm trunks were detected for a long time. The only signs of the trap's presence in the trunk were the fine concentric lines marking the outer perimeter of the lid. In some instances the rather friable fibrous trunk material was eroded away round the outer part of the trap, exposing a short cylindrical portion just behind the lid (Plate 1 b). The diameters of the nests

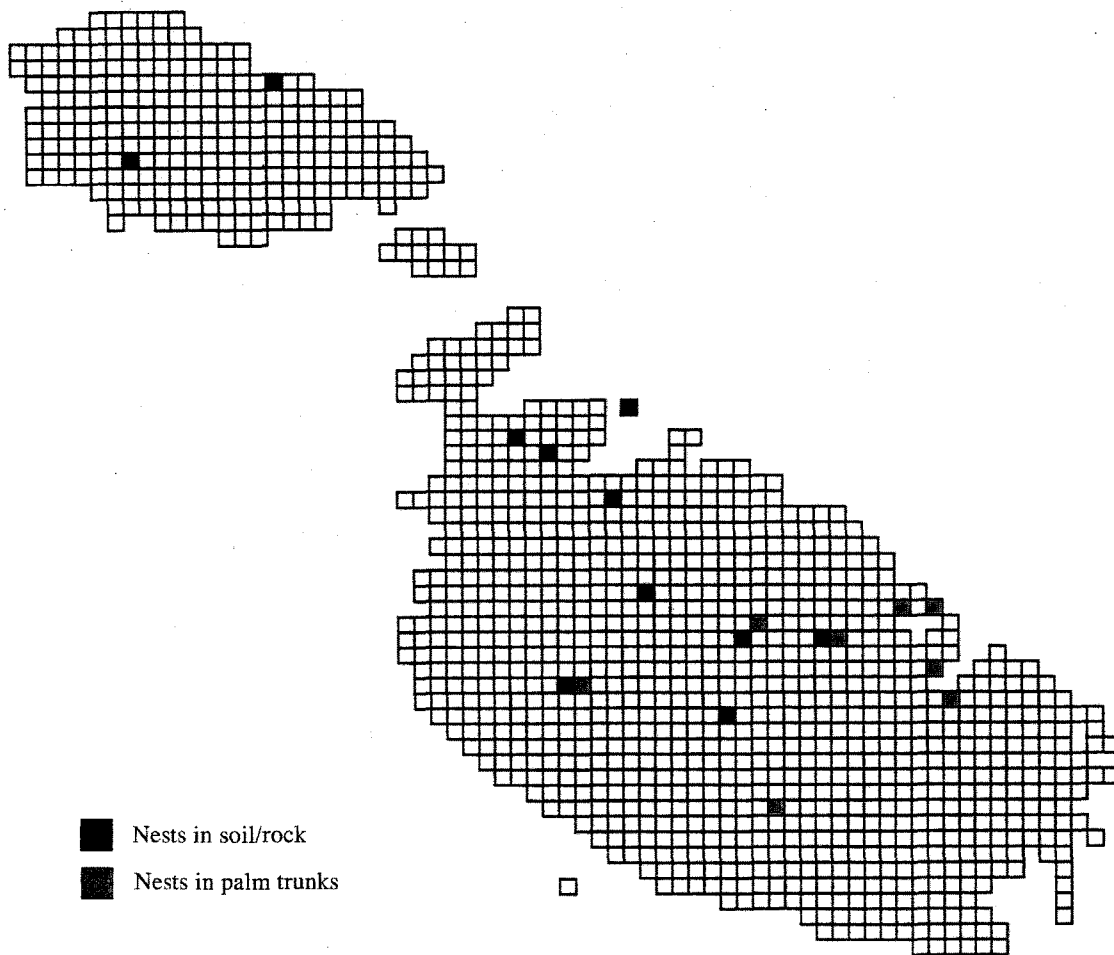


Fig. 1 Distribution of *Nemesia arboricola* Pocock in the Maltese Islands.

observed varied from 3mm to a maximum of 18mm, depending on the state of maturity of the spiders inside.

DISCUSSION

The detection of nests of *Nemesia arboricola* constructed in tree trunks belatedly vindicates Pocock's assertion that the specimen he had described and named did in fact live in such a habitat, and further reinforces Kritscher's conclusion that all trapdoor spiders in Malta belong to the species *N. arboricola*.

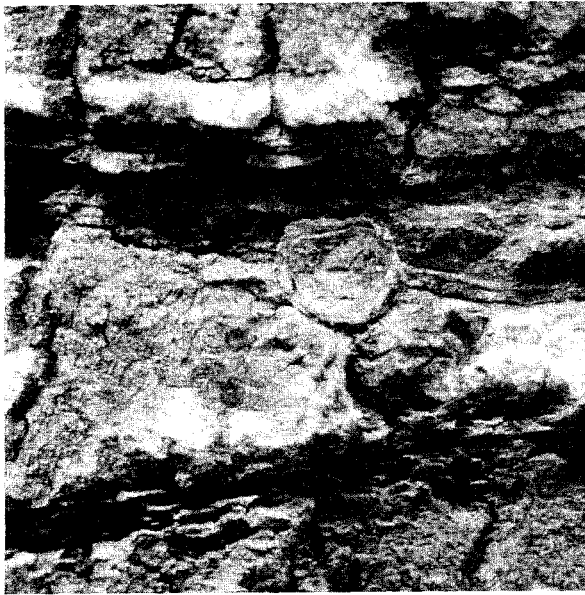
The assumption by Baldacchino *et al.*, therefore, that *N. arboricola* was to be "presumed extinct" no longer holds, while their record of *N. macrocephala* is invalidated.

In 1994 Kritscher ascribed the fact that the species was little known to "the unobtrusive way of life and the camouflage of the trapdoor". The same reasons also account for the non-detection of the nests in tree-trunks for so many years. In fact, the camouflage of the trapdoor against the background of the palm trunks is even more effective, as can be seen by comparing Plate I a and c.

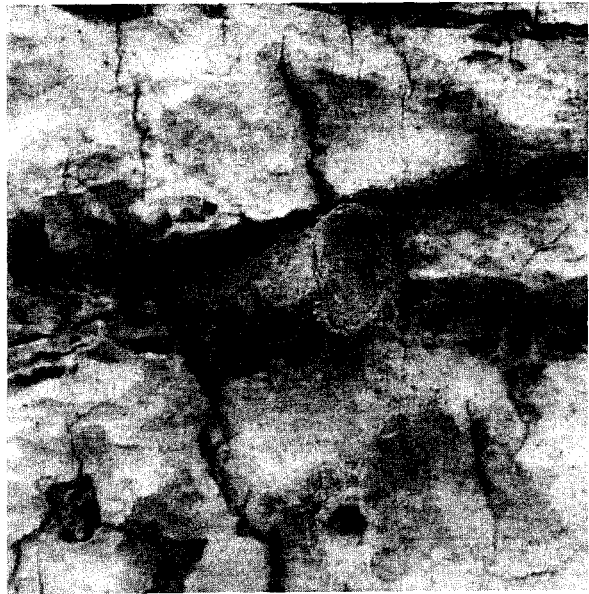
Owing to the several records and observations now at hand, *Nemesia arboricola* can be considered to be of rather frequent occurrence, and its distribution in the Maltese Islands is also quite widespread, as can be seen from Fig. 1.

It is interesting to speculate whether the specimen which was passed on to Pocock in 1903 had been found in a palm trunk or in the trunk of some other tree. Diligent searches by the present author in the trunks of other trees, especially in areas adjacent to palm-trees where nests had been detected, were fruitless. Such searches were also carried out on other species of palm trees including *Chamaerops humilis*, the only palm species which is considered to be indigenous and which is now virtually extinct in the wild (E. Lanfranco, pers. comm.), although numerous specimens have been planted in public and private gardens.

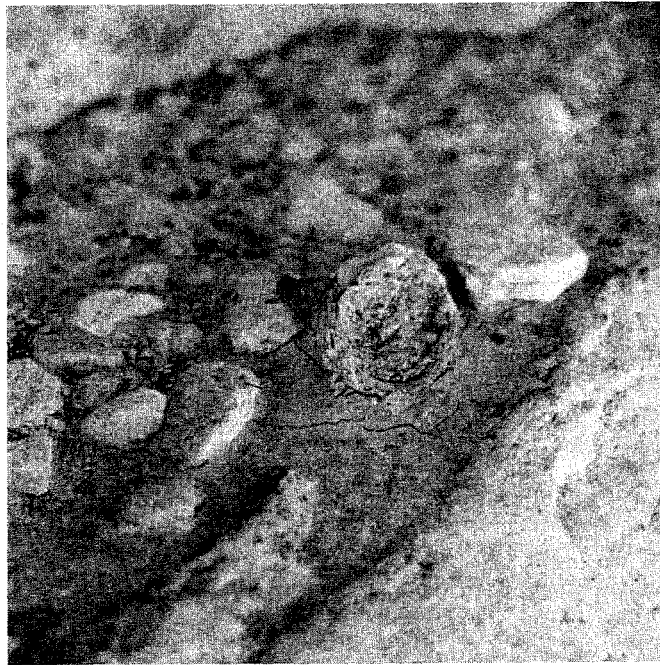
The question also arises concerning the circumstances of the adoption of the arboreal habit, keeping in mind that of the two palm species involved, *P. dactylifera* is probably an archaeophyte while *P. canariensis* is of much more recent introduction, possibly no more than 400 years ago. (E. Lanfranco, pers. comm.). One possibility is that the species is



(a)



(b)



(c)

PLATE I Nests of *Nemesia arboricola* Pocock.

- (a) Nest in trunk of *Phoenix canariensis*. (b) Nest in trunk of *P. canariensis* with part of tube exposed.
(c) Nest in rocky outcrop.

not endemic to Malta but also exists in North Africa, where *P. dactylifera* is native, but has been overlooked for the reasons already mentioned. Alternatively, *N. arboricola* is endemic to Malta, and only adopted arboreal habitats following the introduction of palm-trees to the Islands. I would tend to favour the second hypothesis, due to the apparent absence of *Nemesia* nests in the indigenous *Chamaerops humilis* palms and because the possibility that the species has been overlooked in N. Africa is rather remote, given the size of the spider and considering that the araneid fauna of the region has been studied intensively.

The male of *N. arboricola* has not yet been described in the literature, although three male specimens have been recorded

and the pedipalp of one of them was figured (Baldacchino *et al.*, 1991). A formal description of the male based on these specimens will be the subject of a future publication. As has been pointed out (Kritscher, 1996) the discovery of males of both *N. arboricola* and *N. macrocephala* is essential for a really valid elucidation of their taxonomic relationship.

ACKNOWLEDGEMENTS

I would like to thank Prof. Patrick J. Schembri (University of Malta) for reading the manuscript and making valuable suggestions. I am also grateful to Mr. Edwin Lanfranco (University of Malta) for information about palm trees in the Maltese Islands.

(Accepted 15th October 2001)

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A REVIEW OF THE BRANCHIOPOD FAUNA OF THE MALTESE ISLANDS (CRUSTACEA: BRANCHIOPODA)

Sandro Lanfranco¹

ABSTRACT

Twelve branchiopod species from seven families and four orders have been positively identified from the Maltese Islands. Four orders are recorded (Anostraca, Notostraca, Spinicaudata, Cladocera), three of these (Anostraca, Notostraca, Spinicaudata) represented by only one family. Four families of Cladocera have been recorded (Daphniidae, Moinidae, Macrothricidae, Chydoridae). Only three families are represented by more than a single species (Branchipodidae: 2 species, Daphniidae: 4 species, Chydoridae: 2 species). Three cladoceran species are reported for the first time from the Maltese Islands [*Alona diaphana* King var. *iheringi* Richard; *Moina brachiata* (Jurine) (?) and *Macrothrix hirsuticornis* Norman et Brady].

INTRODUCTION

Published records of Branchiopoda from the Maltese Islands are not numerous. Various genera and species have been recorded by Medlycott (1870), Gulia (1873), Baldacchino (1983), Schembri (1989) and Lanfranco (1996b) as part of more general works on the fauna of the Maltese Islands while a synopsis of the non-cladoceran branchiopods was given by Lanfranco *et al.* (1991). A number of unpublished dissertations also contain records pertaining to branchiopods (Zammit-Lucia, 1971; Lanfranco, 1990; Lanfranco, 1995a; Hewitt, 1996; Grech, 1996). The present work aims to review all published records of Branchiopoda from the Maltese Islands and present new records from previously unpublished material.

CLASSIFICATION

The taxonomy of the Branchiopoda is in a state of flux as a consequence of the morphological heterogeneity of the members of this group. Morphological features that are considered unifying factors for this assemblage are essentially symplesiomorphic and therefore unsuitable as a basis for recognition of phylogenies (Fryer, 1987). Some of the most influential (but not necessarily most logical nor most accurate) classification schemes prior to 1987, such as that of Tasch (1969), subdivided the Branchiopoda into three subclasses (Calmanostraca, Diplostraca and Sarsostraca) and seven orders (Notostraca, Kazachartra, Acerostraca, Conchostraca, Cladocera, Anostraca and Lipostraca). The Lipostraca and Kazachartra are only known from fossils (Devonian and Jurassic, respectively) whilst the Acerostraca are now known not to be crustaceans at all. A new classification of the Branchiopoda proposed by Fryer (1987), separated the Conchostraca into two taxa of ordinal status (Spinicaudata and Laevicaudata) whilst the Cladocera were subdivided into

four orders (Anomopoda, Ctenopoda, Onychopoda, Haplopoda). Nevertheless, recent molecular evidence suggests that the Cladocera form a true monophyletic group (Crease and Taylor, 1998; Hanner and Fugate, 1997). Although the term Conchostraca now has no taxonomic significance, it is still useful for descriptive purposes. A review of all genera and species recorded from the Maltese Islands follows:

ANNOTATED LIST OF SPECIES

Class **Branchiopoda** Latreille, 1817

Order **Anostraca** Sars, 1867
Family **Branchipodidae**

Branchipus schäfferi Fischer

Synonyms: *Branchipus pisciformis* Schaeffer; *Branchipus stagnalis* Latreille; *Branchipus stagnalis* Latreille forma *typica* Kertész

Records from the Maltese Islands: Schembri (1989); Lanfranco (1990); Lanfranco *et al.* (1991); Lanfranco (1995a); Lanfranco & Schembri (1995); Lanfranco (1996a); Hewitt (1996); Grech (1996)

Habitat and local distribution: This anostracan is euryhaline (Lanfranco *et al.*, 1991) and has been recorded from inland pools as well as mesohaline coast-fringing habitats throughout the Maltese Islands.

Global distribution: This species is present throughout the Palearctic region (Cottarelli and Mura, 1983). It is particularly frequent in Western and Southern Europe but is rarer in the northern parts of its range (Nourisson and Thiery, 1988).

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Branchipus visnyai Kertesz

Synonyms: *Branchipus stagnalis* Latreille forma *visnyai* Kertesz

Records from the Maltese Islands: Schembri (1989); Lanfranco (1990); Lanfranco *et al.* (1991); Lanfranco & Schembri (1995); Lanfranco (1996a); Hewitt (1996).

Taxonomic status: The taxonomic rank of this species is under contention. It is morphologically similar to *B. schaefferi* except for the shape of the frontal shield and the degree of flexure of the second antennae in males. These appendages are recurved in *B. visnyai* and unflexed in *B. schaefferi*. It has been maintained that *Branchipus visnyai* should be afforded full species rank (Cottarelli, 1969). This claim is disputed by Petrov and Marinček (1991) who conclude that the separation of *B. visnyai* as a distinct species is unfounded. Other work (Petkovski, 1997; Beladjal and Mertens, 1999) indicates that confusion between the two forms may arise following preservation of specimens in alcohol, since this procedure may lead to deformation of key characteristics of taxonomic importance. This has not been the case for specimens collected from the Maltese Islands since antennal flexure in males was noted in living material. More recent work based on protein electrophoresis of specimens from two natural populations of *B. schaefferi* and *B. visnyai* in central Italy indicates that the genetic divergence between the two forms is very low (Zarattini *et al.*, 2001).

The current state of knowledge suggests that the separation of these two forms as distinct species is presently unfounded and previous records of *Branchipus visnyai* should therefore be referred to *Branchipus schaefferi* until further evidence to the contrary is forthcoming.

Habitat and local distribution: This species is a colonist of temporary freshwater habitats and has been recorded from three localities in the Maltese Islands:

Wied ir-Raheb, Gozo (temporary rockpools): A population colonising freshwater rockpools was recorded by P.J. Schembri in 1984. Representative individuals were collected and identified (P.J. Schembri pers. comm.).

Ghadira s-Safra, Malta (transitional coastal wetland): A single individual, syntopic with *B. schaefferi*, was recorded and subsequently collected by the author on 19 December 1989.

Il-Qaliet, Malta (transitional coastal wetland): A population colonising a maritime freshwater pool and syntopic with *B. schaefferi* was recorded by R. Hewitt and the author in October 1995. Representative individuals were collected and identified. A small number of individuals with taxonomically-significant characteristics intermediate between those of *B. schaefferi* and *B. visnyai* were also collected. These specimens were examined by V. Cottarelli at Università di Roma "La Sapienza" and classified as "malformed" *B. schaefferi*.

Global distribution: Apart from the Maltese Islands, this species has been recorded from Eastern Europe (Czech Republic, Slovakia, Hungary, Romania), Sardinia, Latium (Italy) and Algeria (Cottarelli and Mura, 1983).

Branchipus stagnalis Latreille

Synonym: *Branchipus schaefferi* Fischer

Records from the Maltese Islands: Medlycott (1870) [as *Branchipus stagnalis* (Cuv.)]; Baldacchino (1983) (as *Branchipus stagnalis* L.)

All records of *B. stagnalis* are presumed to refer to *B. schaefferi* Fischer.

Order **Notostraca** Sars

Family **Triopsidae** Keilhack

Triops cancriformis cancriformis (Bosc)

Synonyms: *Monoculus apus* L.; *Apus cancriformis* Bosc; *Triops palustris* Schrank; *Triops cancriformis* Keilhack; *Triops cancriformis cancriformis* Longhurst

Records from the Maltese Islands: Schembri (1989); Lanfranco (1990); Lanfranco & Schembri (1995); Lanfranco (1996a); Lanfranco & Lanfranco (1996) [all as *Triops cancriformis* (Bosc)]; Lanfranco (1990); Lanfranco *et al.* (1991).

Habitat and local distribution: This species is a colonist of temporary freshwater habitats and has only been recorded from the main island, Malta. The most recent records are from the following localities:

Ghadira s-Safra, Malta (transitional coastal wetland): Two juveniles were noted and collected by the author on 18 December 1989.

Mosta, Malta (temporary freshwater rockpools): A single live adult was noted and collected by the author on 3 December 1990.

Tal-Wej, Malta (temporary freshwater rockpools): A single live adult and a single dead adult were noted and collected by the author on 23 December 1994.

Mosta, Malta (temporary freshwater rockpools): Two adults were collected from a drying pool by the author on 10 November 1996.

Southern Malta (temporary freshwater rockpools): Numerous adults were recorded by the author on 18 June 2001.

Individuals belonging to this species have also been noted from il-Qaliet wetland (G Lanfranco pers. comm.; E.Lanfranco pers. comm.) and Wied il-Ghasel (P.J. Schembri pers. comm.). A small number of sporadic sightings from other localities in Malta have been claimed but these have not yet been verified.

Global distribution: The species has been divided into three geographical races by Longhurst (1955): *cancriformis cancriformis* Bosc, *cancriformis simplex* Chigi and *cancriformis mauretanicus* Chigi. The subspecies *cancriformis cancriformis* is found throughout Europe with the exception of Southern Spain where it is replaced by *cancriformis mauretanicus* (Cottarelli and Mura, 1983).

***Limnodia melitensis* Gulia**

Records from the Maltese Islands: Gulia (1873)

Taxonomic status: The taxonomic status and validity of this record are unknown and this is the only reference to the species and the genus in the literature. No type specimens are known and no type localities are listed in Gulia (1873).

Order Spinicaudata Linder
Family Cyzicidae Stebbing

***Cyzicus tetracerus* (Krynicky)**

Synonyms: *Limnadia tetracera* Krynicky; *Estheria tetracera* Baird; *Estheria cycladoides* Chyzer; *Caenestheriella variabilis* Daday; *Cyzicus tetracerus* Audoin

Records from the Maltese Islands: Schembri (1989); Lanfranco (1990); Lanfranco *et al.* (1991); Lanfranco (1995a); Lanfranco (1996a)

Habitat and local distribution: Occurs throughout the Maltese Islands where it is restricted to temporary freshwater rockpools and is generally present at low population densities.

Global distribution: The species occurs throughout the Palearctic region. It is widespread in Eastern Europe (Nourisson and Thiery, 1988) but infrequent in France. The species has not been recorded from Southwestern France. Sicily is the only Italian territory from where *Cyzicus tetracerus* has been recorded (Cottarelli and Mura, 1983).

***Eocyclus* (?) *orientalis* Daday**

Records from the Maltese Islands: Baldacchino (1983)

This record referred to *Cyzicus tetracerus*. The original specimens were misidentified (P.J. Schembri, pers.comm.).

Order Cladocera Latreille
Family Daphniidae Straus

***Ceriodaphnia quadrangula* (O.F. Müller)**

Synonyms: *Daphnia quadrangula* O.F. Müller; *Monoculus clathratus* Jurine; *Ceriodaphnia punctata* P.E. Müller; *C. quadrangula* var. *hamata* Sars

Records from the Maltese Islands: Lanfranco (1990); Lanfranco (1995a); Lanfranco (1995b); Lanfranco (1996a); Hewitt (1996); Grech (1996) (all as *Ceriodaphnia* sp.); Lanfranco (1996b).

Habitat and local distribution: Occurs throughout the Maltese Islands where it is restricted to temporary freshwater rockpools.

Global distribution: This is a holarctic and neotropical species. It has been recorded throughout Europe, as well as from the Canary Islands, North Africa, Central Asia, Japan,

North and South America and in Arctic and Antarctic regions (Margaritora, 1985).

***Simocephalus vetulus* (O.F. Müller)**

Synonyms: *Daphnia vetula* O.F. Müller; *Daphnia sima* O.F. Müller; *Monoculus sima* Jurine; *Monoculus nasutus* Jurine; *Daphnia vetula* Baird; *Simocephalus vetulus* Schödler

Records from the Maltese Islands : Baldacchino (1983)

Habitat and local distribution: This species has only been recorded once from the Maltese Islands. It was noted from a large pool at Rabat where it was present in high abundance.

Global distribution: The species is cosmopolitan and very common (Margaritora 1985).

***Daphnia pulex* Leydig emend. Scourfield**

Synonyms: *Monoculus pulex* L.; *Daphnia pennata* Schödler; *Daphnia pulex* Leydig; *Daphnia ovata* Sars; *Daphnia hastata* Sars; *Daphnia groenlandica* Wesenberg-Lund; *Daphnia helvetica* Stingelin; *Daphnia glacialis* Parenzan.

Records from the Maltese Islands: Gulia (1873) (as *Daphnia pulex* Müller); Lanfranco (1995b). The specimens listed as *D. pulex* by Lanfranco (1995b) refer to *Daphnia* (*Daphnia*) *pulicaria* (F. Margaritora, pers. comm.). Gulia (1873) notes that *D. pulex* was accompanied by other unidentified cladocerans. No description of the habitat from where the material was collected was given.

Global distribution: The species is holarctic and neotropical and is widely distributed in all temperate latitudes. Nevertheless, the precise pattern of distribution is confounded by considerable intraspecific variation since a large number of species generally classified as *D. pulex* should actually refer to *D. obtusa* or *D. curvirostris* (Margaritora 1985).

***Daphnia* (*Daphnia*) *pulicaria* Forbes emend. Hrbáček**

Synonyms: *Daphnia pulex* var. *pulicaria* Forbes; *D. pulex* var. *pulicariodes* Burckhardt; *D. wierzykii* Litynski; *D. pulicaria* Hrbáček

Records from the Maltese Islands Lanfranco (1990) (as *Daphnia* sp.1); Lanfranco (1990) (as *Daphnia* sp.2); Lanfranco (1996b) (as *Daphnia pulicaria*).

Habitat and local distribution: Recorded from aseasonal freshwaters such as artificial ponds and reservoirs. Also recorded from pools in the bed of Wied Ghollieqa (Malta) on 14 February 1990. On this occasion, the species was undergoing a bloom phase and population density was extremely high.

Global distribution: The species is holarctic, although its pattern of distribution is confounded by its imprecisely-defined taxonomic status (Margaritora 1985).

***Daphnia* sp.**

Records from the Maltese Islands: Zammit-Lucia (1971).

Habitat and local distribution: Recorded from Wied il-Qlejgha (Chadwick Lakes), Malta. The material has not been examined.

Family **Moinidae** Goulden

***Moina brachiata* (Jurine) (?)**

Synonyms ; *Monoculus brachiatus* Jurine; *Daphnia brachiata* Liévin; *Moina rectirostris* Baird; *M. brachiata* Baird; *M. lilljeborgi* Schödler.

Records from the Maltese Islands : Lanfranco (1996a) (as Moinidae).

Habitat and local distribution: A single record exists. Material was collected from a freshwater pool in the bed of Wied il-Kbir (Gozo) by E. Lanfranco and passed on to the author. The outer surface of the carapace of all specimens observed was colonised by *Colacium* sp. (Euglenophyta).

Global distribution: The species has been recorded from Europe, central Asia and Africa. It is apparently absent from the Americas (Margaritora 1985).

Taxonomic status: The identity of the specimens collected from the Maltese Islands and assigned to this species is uncertain. The material in the collection showed features shifting towards *Moina micrura* Kurz, although it could also be *Moina micrura dubia* (circum-Mediterranean and North African distribution). Collection of more samples (primarily males) is required to resolve the doubtful identity of these specimens (F. Margaritora, pers. comm.).

Family **Macrothricidae** Norman et Brady

***Macrothrix hirsuticornis* Norman et Brady**

Synonyms: *Macrothrix arctica* Sars; *Macrothrix hirsuticornis* var. *arctica* Lilljeborg; *Macrothrix hirsuticornis* var. *groenlandica* Lilljeborg.

Records from the Maltese Islands: Lanfranco (1996a) (as Macrothricidae)

Habitat and local distribution: A single record exists. Material was collected from a temporary freshwater rockpool at Ta' Cenc (Gozo) by Ms J Grima and passed on to the author.

Global distribution

This species is cosmopolitan and is particularly widespread in Europe (Margaritora 1985).

Family **Chydoridae** Stebbing

***Pleuroxus letourneuxi* Richard**

Synonyms: *Chydorus letourneuxi* Richard; *Pleuroxus obtusirostris* Smirnov; *P. letourneuxi* Smirnov.

Records from the Maltese Islands: Lanfranco (1995b) (as *Alona* sp.); Lanfranco (1996a) (as Chydoridae); Lanfranco (1996b) [as *Pleuroxus letourneuxi* (sic)]; Grech (1996); [as *Pleuroxus letourneuxi* (sic)].

Habitat and local distribution: Recorded from temporary freshwater rockpools throughout the Maltese Islands.

Global distribution: The species is circum-Mediterranean and has been recorded from Tunisia, Algeria, Spain, Turkey and Sardinia (Margaritora 1985).

***Alona diaphana* King var. *iheringi* Richard**

Synonyms: *Alona davidi* Richard; *Alonella diaphana* Sars var. *iheringi* Richard *A. punctata* Daday

Records from the Maltese Islands: Lanfranco (1990) (as *Alonella* sp.); Lanfranco (1995a) (as *Alona* sp.); Lanfranco (1996a) (as Chydoridae); Hewitt (1996) (as *Alona* sp.).

Habitat and local distribution: Recorded from temporary freshwater rockpools throughout the Maltese Islands.

Global distribution: This species is present in all tropical and sub-tropical regions and is particularly widespread in Africa (Margaritora 1985).

DISCUSSION

General The branchiopods recorded from the Maltese Islands represent a depauperate subset of the branchiopod fauna of the circum-Mediterranean region. This comparative scarcity of species is mainly attributable to the following factors:

1. Insularity of the Maltese Islands; colonisers are required to cross an ecological barrier prior to successful establishment.
2. Restricted size of the Maltese Islands, presenting a smaller target destination for potential colonisation.
3. Paucity of colonisation sites as a consequence of the scarcity of suitable wetland habitats.
4. Loss of suitable habitat due to anthropogenic interference.

Records of Cladocera The large branchiopods (Anostraca, Spinicaudata, Notostraca) are visually conspicuous and their occurrence and distribution has been fairly well-documented. The cladocera present a different problem. Most are small and inconspicuous, and would probably be overlooked or ignored during casual or non-specific surveys of freshwater habitats. The cladoceran species recorded from 1990 onwards (six of the eight local records) were noted as part of a broader programme of work on freshwater rockpools of the Maltese Islands. No systematic survey of cladocerans has yet been carried out although such a search is in preparation.

Conservation status Many branchiopods are limited in their occurrence and distribution throughout the Maltese Islands and are therefore of considerable conservation value in a local context. The conservation status of branchiopods

Table 1. Conservation status of Maltese Branchiopods.

Order	Species	Conservation status
Anostraca	<i>Branchipus schäfferi</i> Fischer	Restricted distribution in the Maltese Islands
Anostraca	<i>Branchipus visnyai</i> Kertész	Very rare with a restricted distribution in the Maltese Islands
Spinicaudata	<i>Cyzicus tetracerus</i> listed as (?) <i>Eocyclus</i> cf. <i>orientalis</i> Daday	Restricted distribution in the Maltese Islands
Notostraca	<i>Triops cancriformis</i> (Bosc)	Rare with a restricted distribution in the Maltese Islands

according to Schembri (1989) is given in Table 1. No cladocerans were listed in Schembri (1989), presumably due to the paucity of data pertaining to this group at the time.

ACKNOWLEDGEMENTS

The author would like to express his thanks to Professor Patrick J. Schembri, Edwin Lanfranco, Jacqueline Grima and Robert Hewitt for collection of specimens. Grateful thanks are also due to Professor Fiorenza Margaritora for provision of important literature and for identification of cladoceran

specimens, Prof. Vezio Cottarelli for assessing doubtful *Branchipus visnyai* / *Branchipus schäfferi* material, Edwin Lanfranco for identification of epizoic algae on cladoceran carapaces and Prof. P.J. Schembri and Prof. G. Mura for key literature and for several important discussions regarding the branchiopoda and their ecology. The author is also grateful to Noel Toledo, Paul Catania, Joe Gatt and officials of Nature Trust (Malta) for indicating sites colonised by *Triops cancriformis*.

(Accepted 15th November 2001)

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SOME TRUE FLIES (INSECTA: DIPTERA) REARED FROM A NEST OF THE SPANISH SPARROW (*PASSER HISPANIOLENSIS*) IN MALTAPaul Gatt¹**ABSTRACT**

There exist no previous records of true flies (Insecta, Diptera) reared from birds' nests in Malta. The following six species have recently been reared by the author from an old nest of the Spanish sparrow (*Passer hispaniolensis*): *Elachiptera bimaculata* (Loew), *Scaptomyza pallida* (Zetterstedt), *Scenopinus glabrifrons* Meigen, *Coproica vagans* (Haliday), *Coproica* sp. nov. and *Pullimosina heteroneura* (Haliday).

INTRODUCTION

Many species of true flies from more than fifty families have been reared from birds' nests (Hutson, 1978). A surprisingly rich dipterous fauna may be associated with these nests. Basden, in one of the most extensive studies of nest Diptera ever undertaken, obtained a total of 17,716 flies, representing 158 species in 34 families, from three quarters of 228 birds' nests he investigated (Rotheray, 1989).

Some species parasitize the occupants of the nest. Others feed on decaying debris (nesting material, decaying feathers, guano), or prey on other insect larvae inside the nest. Often, a succession of dipterous fauna will visit the nest, which may continue to be used after the nestlings have left.

There exist no previous records of diptera reared from birds' nests in Malta. It may therefore be of interest to give an account of six species, in four families, which have recently been reared by the author, from an old sparrow's nest.

MATERIALS AND METHODS

An old nest of the Spanish sparrow (*Passer hispaniolensis*) was discovered in a private garden in Rabat, Malta, on the 17th of October 2000. The empty nest had been pushed out of its original site in a ventilator, 6m up the west side of a house, by workmen who were decorating the house, two days previously. When discovered, the nest was lying upside down on bare soil and was moist, but not wet, from previous showers.

The nest, which measured 30cms in diameter, was lined with dry grasses (Poaceae) and bits and pieces of straw. It was immediately consigned to a large, transparent plastic bag to retain its moisture, and was inspected and ventilated for 5 minutes every day. All diptera that emerged between the 17th of October 2000 and the 15th of September 2001 were collected and identified. Voucher specimens were mounted on pins or preserved in alcohol, and are kept in the author's collection.

LIST OF SPECIES**Chloropidae**

Elachiptera bimaculata (Loew, 1845)

Material examined: 12 ♂♂ and 16 ♀♀, emerged from the nest between 15-25.xi.2000.

Drosophilidae

Scaptomyza (Parascaptomyza) pallida (Zetterstedt, 1847)

Material examined: 2 ♂♂, emerged on 26.x.2000.

Scenopinidae

Scenopinus glabrifrons Meigen, 1824

Material examined: 1 ♂, emerged on 19.x.2000.

Sphaeroceridae

Coproica vagans (Haliday, 1833)

Material examined: 1 ♂, emerged on 19.x.2000.

Coproica sp. nov.

Material examined: 20 ♂♂ and 14 ♀♀ emerged between 10.xi. and 7.xii.2000.

Pullimosina heteroneura (Haliday, 1836)

Material examined: 14 ♂ and 16 ♀♀, emerged between 3-10.xi.2000.

DISCUSSION

The species listed above, with the exception of *Coproica* sp. nov. are all common, very widespread or cosmopolitan species. *S. glabrifrons* has been reared from birds' nests before (Hicks, 1959; Narchuk, 1969), as has been *P. heteroneura* (Florén, 1989). I could find no breeding records of *E. bimaculata*, *S. pallida* or *C. vagans* from birds' nests. Indeed, no known species of *Coproica* Rondani seem to have previously been associated with birds' nests.

¹ 51/1 College Street, Rabat, RBT 06, Malta.

The larvae of many species of chloropids are phytophagous, especially on Poaceae (Smith, 1989). *E. bimaculata*, which has not previously been recorded from Malta, has been reared from decaying vegetable matter, from the bases of turnips, barley and sorghum, and from the shoots of Poaceae (Ferrar, 1987). It is also associated with reeds. It would appear that the larvae or puparia of this species were developing in grasses, which were carried by the sparrows to their nest.

The larvae of all European species of *Scaptomyza*, except those of *S. pallida*, mine the stems and leaves of plants, especially crucifers and legumes (Bächli & Burla, 1985). Those of *S. pallida* feed on decaying plant matter, and have only once been discovered in a leaf mine. On this occasion, they may have been secondary invaders, living on the partially decaying mine remains (Bächli, pers. comm.). *S. pallida* is known to occur in Malta (Ebejer, 2001). This appears to be the first rearing record, for this species, from birds' nests. It seems probable that the larvae were living in decaying plant matter inside the nest (Bächli, pers. comm.). Less likely, larvae or pupae might have been carried in plant material used by the sparrows to build their nest.

The larvae of Scenopinidae are all predatory on other insects (Kelsey, 1969). Several species have been reared from birds' nests. *S. glabrifrons* has previously been reared from the nests of starlings (Hicks, 1959) and sparrows (Narchuk, 1969). This species is already known from Malta (Ebejer, 1995).

Flies in the genus *Coproica* Rondani are primarily coprophagous species. A good series of an undescribed species, allied to *C. hirtula* (Rondani) emerged from the nest. This species will be described elsewhere (Gatt, in prep.) *C. vagans* has been collected from dung, carrion, seaweed,

refuse and compost heaps. It has not previously been recorded from birds' nests. *P. heteroneura* is a polysaprophagous, synanthropic species which develops mainly in decaying vegetable matter. It has previously been recorded from small animal burrows, and once from the nest of the hedge sparrow, *Prunella modularis* (Florén, 1989). Both *C. vagans* and *P. heteroneura* have previously been recorded from Malta (Gatt, 2000).

All flies emerged between 19.x and 7.xii.2000. Although the data collected is too scant to support definite conclusions, it may be that some species emerged sequentially from the nest. Thus, for instance, all specimens of *P. heteroneura* emerged between 3 and 10.xi.2000, and all specimens of *E. bimaculata* later, between 15 and 25.xi.2000. It was observed that individuals of *P. heteroneura* only emerged during the short period when the nest had acquired a distinct ammoniacal odour. It is speculated that this may have acted as a cue, triggering off mass emergence of this species from the nest. Adult sphaerocerids are well known to respond to olfactory cues (Roháček, 1982) and many species are readily attracted to the odour of traps baited with decaying organic matter.

ACKNOWLEDGEMENTS

I am indebted to Dr Martin Ebejer (Balzan, Malta) for reading the manuscript, Dr. John Deeming (Cardiff, UK), Dr. Bernhard Merz (Geneva, Switzerland) and Mr. Lorenzo Munari (Venice, Italy) for providing literature, and to Mr. Peter Chandler (Burnham, UK) and Dr. Gerhard Bächli (Zürich, Switzerland) for generously sharing information.

(Accepted 7th October 2001)

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ON THE OCCURRENCE OF *CAPELLA RUBELLA* REUTER (FAMILY BRASSICACEAE) IN THE MALTESE ISLANDS**Darrin T. Stevens**¹**ABSTRACT**

The occurrence of *Capsella rubella* in the Maltese Islands is confirmed for the first time, following doubtful records made more than 70 years ago.

On the 26th January 2001, at Gnien il-Mistrieh (also known as the 'Garden of Repose') in the limits of Floriana, a single plant of the Pink Shepherd's Purse, *Capsella rubella* Reuter [Fam. Brassicaceae, (= Cruciferae)] was observed growing out of the slabs present along the path of the said garden. Upon closer examination, a small population of about 20-30 plantlets of *Capsella rubella* was observed in the adjacent open spaces beneath planted Aleppo Pine trees (*Pinus halepensis* Miller) and close to a planted ornamental *Centaurea* cf. *ragusina*, with reduced competition from other species due to regular clearing of weeds and pine needles in the area.

Capsella rubella is an annual ruderal crucifer, known from Southern Europe and reported from other parts of the Mediterranean region (including North Africa and the Middle East), and naturalised in Central Europe (Greuter *et al.*, 1986; Pignatti, 1982; Polunin, 1969; Tutin *et al.*, 1993). Nevertheless, its exact distribution is not well-known and many records are considered as doubtful (Greuter *et al.*, 1986), probably due to confusion with the related synanthropic and cosmopolitan Common Shepherd's Purse, *Capsella bursa-pastoris* (L.) Medicus (Maltese: *Gargir il-Gemel*), a frequent ruderal species in the Maltese Islands, which *C. rubella* often replaces in arid and exposed localities in the Mediterranean region (Pignatti, 1982).

C. rubella is differentiated from *C. bursa-pastoris*, mostly from its floral characteristics, in that the sepals do not or scarcely exceed the petals, and its fruit, the silicule, whose lateral margins are neither straight nor convex as in *C. bursa-pastoris*, but concave. The samples observed had whitish flowers and silicules with concave lateral margins. The latter are not typical of the species in question, since *Capsella rubella* tends to have purple or reddish-tinged flowers, at least on the margins, although whitish flowers are a known feature within this species (Zángheri, 1976).

The species was considered of doubtful occurrence in the Maltese Islands, since its first and only record from was that of Borg, who described it as "*Capsella bursa-*

pastoris L. var. *rubella* Rent." (sic!), without mentioning any localities and simply stating that it was "frequent with the type, in exposed and arid localities" (Borg, 1927). G. Lanfranco (1969) and Haslam *et al.* (1977) essentially repeat these observations, in the process updating the scientific name to *Capsella rubella*. Haslam *et al.* (1977) proceed further by reporting its distribution range as "Malta, Gozo and Comino" – this distribution range is most probably derived from a misinterpretation of the argument made earlier by Borg (1927), who cites *C. rubella* (for which he gives no localities) as growing with *C. bursa-pastoris* (for which he includes Malta, Gozo, Comino and Cominotto).

Although *Capsella rubella* was reported as frequent from the three main islands of the archipelago, repeated searches made by many subsequent students of the Maltese flora failed to identify any individuals of this species. Moreover, Gulia (1874) does not include *C. rubella* in his work on Maltese Brassicaceae, and similarly, Sommier & Caruana Gatto (1915) fail to mention this taxon in their work on the Maltese flora, neither as a species *per se*, nor as a variant or subspecies of *C. bursa-pastoris*, anomalous omissions if it was as frequent as stated by Borg (1927).

In this respect, since no individuals of *C. rubella* were encountered in the Maltese Islands and no herbarium material possibly attributable to this species has been found in the Argotti Herbarium (E. Lanfranco, pers. comm., 1997), the records by Borg have been considered unsubstantiated, or possible misidentifications for smaller *C. bursa-pastoris* in arid and exposed localities. For this reason, the species was not included as possibly extinct or indeterminate in Lanfranco (1989).

Considering that the taxon is apparently widespread in the Central Mediterranean region, in which it has been confirmed for the neighbouring islands of Sicily and Lampedusa (Bartolo *et al.*, 1988; Pignatti, 1982; Tutin *et al.*, 1993) and Tunisia ("*répandu dans toute la Tunisie*", Pottier-Alapetite, 1979: 222), the absence of *Capsella*

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rubella from the Maltese Islands has often been considered as an anomalous feature.

However, the population observed at Gnien il-Mistrieħ appears very localised in distribution, and other searches in the surrounding grounds have not yielded other specimens of this taxon. This would suggest a relatively recent introduction. Nonetheless, one cannot exclude *a priori* that the species is restricted to an area with regular clearing of vegetation due to its possibly less competitive abilities with respect to the more competitive weeds found in uncleared ground of the area (mainly *Diplotaxis* spp., *Raphanus raphanistrum* s.str., *Capsella bursa-pastoris* and other Brassicaceae; *Mercurialis annua*; *Foeniculum vulgare*; and various Poaceae).

Whilst the species is considered a weed in most of its range, *C. rubella* is currently to be considered as extremely rare and vulnerable, with a restricted distribution in the Maltese Islands. Nonetheless, its occurrence in other areas of the

Maltese Islands cannot be excluded, also considering its ruderal nature and the ease of introduction of seeds from nearby Mediterranean localities.

C. rubella material from Gnien il-Mistrieħ is deposited in the private herbarium of Edwin Lanfranco.

ACKNOWLEDGEMENTS

The author is particularly indebted to Mr. Edwin Lanfranco of the Department of Biology, University of Malta, for confirming the identification of the plants, for reading through the text and providing relevant comments and documentation, to Mr Joe Sultana of the Environment Protection Department for providing access to his copy of the *Flore de la Tunisie*, and to Ms Mary Grace Galea for accompanying me during the visit made to Gnien il-Mistrieħ.

(Accepted 14th October 2001)

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NATIONAL DATABASE ON BIODIVERSITY – A TOOL CONTRIBUTING TO A BETTER UNDERSTANDING OF THE FLORA AND FAUNA OF THE MALTESE ISLANDS

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ABSTRACT

The National Database on Biodiversity (NDB) project was initiated in 1991 within the framework of the Biological Diversity and Genetic Resources Network of the Malta Council for Science and Technology (MCST), in partnership with the Department of Biology of the University of Malta. This project is concerned with the collection and cataloguing of information on Maltese biodiversity and with making this information accessible to a wide range of potential users in the form of a computer database. In the pilot and building phases of the project, data on the flora and fauna of the Maltese Islands was structured in an appropriate format and a customised database with data entry, editing, management and querying facilities was created using Corel® Paradox® 8; the database currently holds some 450 species records and can be expanded to cover the entire range of Maltese species. The problems and opportunities in setting up such a database are discussed.

INTRODUCTION

Biological diversity (biodiversity) is an umbrella term for the sum total of the variety and variability among the living organisms of this planet, the ecological role they perform, and the genetic diversity they contain (Wilson, 1988). One of the major concerns today is the rapid loss of biodiversity, which, although it may take many forms, at its most fundamental and irreversible, involves the extinction of species (McNeely *et al.*, 1990).

To counteract this loss, it is imperative to manage biological resources, but management requires stocktaking exercises as well as monitoring and inventorying of species and populations (Busby, 1997). This in itself creates problems since the number of species that occur in a given locality is not precisely known for many groups of organisms and most figures for species diversity and abundance are only rough estimates (Hawksworth & Kalin-Arroyo, 1995; for Malta, see Schembri, 1992 and Schembri *et al.*, 1999). Moreover, the conservation of biological resources requires information not only on basic taxonomy but also on other factors such as human use, geographical distribution, status, trends, ecological relationships, as well as protection status by virtue of international or regional legislation (see for example McNeely *et al.*, 1990 and Heywood, 1997). Until recently, compiling and disseminating such information would have been a prohibitively expensive and time-consuming task, however

advances in data management technology now make it possible to compile, update and disseminate such databases efficiently and at moderate cost.

The N.D.B. project: Objectives

The National Database on Biodiversity (NDB) project is concerned with the collection, collation and cataloguing of information regarding Maltese biodiversity, giving special attention to those species and local populations that are of particular scientific, ecological and/or conservation importance, and with providing easy access to this data. Once implemented, the database would effectively provide local scientists, environmentalists, environmental managers and other interested parties with a centralised and accessible repository of accurate and up to date information on the species occurring in the Maltese Islands and their surrounding waters.

The significance of the NDB can be seen when realising that most of the information concerning local biodiversity does not yet have any specific physical location (i.e. a library), and is often in the hands of a few interested persons who have accumulated a collection of literature over the years. Thus, it is self evident that once the NDB is fully functional, it will become a key tool contributing to the understanding of local biodiversity, including its variety, ecology and scientific and economic importance, as well as for the co-ordination of local conservation and management efforts, and for assessing

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potential biotechnological and other applications.

The NDB project, initiated in 1991, took on a new significance following the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil in June 1992. One of the results of this conference was the Convention on Biological Diversity. This convention emphasises the need to improve the collection, management and dissemination of scientific information on biodiversity. Malta has recently (December 2000) ratified this Convention, and therefore the NDB project can now effectively become part of Malta's contribution to the global effort to study and conserve biodiversity.

Apart from providing information on Maltese biodiversity to all who require it, other uses of the NDB are expected to be the preparation of synoptic checklists of Maltese biota; the highlighting of deficiencies in the knowledge of particular groups and thus the identification of possible areas for future research; the identification of organisms of economic, cultural or special scientific importance, as well as the identification of species requiring immediate conservation measures. The NDB should also contribute towards Malta's obligation with respect to the Convention on Biological Diversity to document the nation's biodiversity.

Databases, and understanding biodiversity

The 1992 Convention on Biological Diversity recognised that the organisation of data relevant to biodiversity is not merely an academic exercise, but is an essential tool as regards environmental management. This Convention provided the impetus to numerous projects aimed towards the collection and analysis of data regarding different aspects of biodiversity, with the result that today a number biodiversity databanks are available. Examples include:

- The Species 2000 Programme [<http://www.sp2000.org/>]. Originally a joint programme of several scientific unions in association with the Biodiversity Programme of UNEP and with the Clearing House Mechanism of the Convention on Biological Diversity, since 1998 it has been incorporated as a UK company operating as an independent federation with taxonomic database organisations as its members. The aim of Species 2000 is to create a uniform and validated quality index of names of all known species as a practical tool (1) for use in inventorying projects world-wide; (2) as an Internet gateway to species/biodiversity databases world-wide; (3) as a reference system for comparison between different inventories; and (4) as a comprehensive catalogue for checking the status, classification and naming of all species.
- The Global Biodiversity Information Facility (GBIF) [<http://www.gbif.org/>] is an initiative of the Organisation for Economic Cooperation and Development's Megascience Forum Working Group on Biological Informatics, whose purpose is to coordinate the standardization, digitisation and global dissemination of

the world's biodiversity data.

- DIVERSITAS [<http://www.icsu.org/DIVERSITAS>] is an international programme of biodiversity science sponsored by UNESCO and several members of the International Council of Science (ICSU). The goal of DIVERSITAS is to provide accurate scientific information and predictive models of the status of biodiversity and sustainability of the use of the Earth's biotic resources, and to build a worldwide capacity for biodiversity science. One core programme of DIVERSITAS is systematics inventorying and classification.
- The International Working Group on Taxonomic Databases (TDWG) [<http://www.tdwg.org>] was started in 1985 as an international working group to explore ideas on standardization and collaboration between major plant taxonomic database projects. However, it has since expanded its scope to include taxonomic database projects from all biological disciplines. TDWG is affiliated with the International Union of Biological Sciences (IUBS) as the Commission on Taxonomic Databases and members include institutions and individuals responsible for biological databases with taxonomic components.

The level of effort and expense diverted to producing databanks such as the above suggests that the current interest in biodiversity databases is not merely a passing fashion, but is a direct response to an increasing demand for readily accessible, accurate and detailed information.

The data most relevant to a biodiversity database can be classified under three main inter-related categories:

1. **Taxonomic data** i.e. data pertinent to the diversity of species. Individual species may be defined according to a wide variety of criteria, but are frequently considered to consist of individuals between whom there is significant genetic exchange (i.e. sharing in a common gene pool), but which do not interact genetically with members of other gene pools. Such organisms consequently have numerous characteristics in common, such as anatomical, physiological or behavioural traits.
2. **Genetic data** i.e. data on the genetic variation that determines the nature and attributes of individual organisms. The genetic variation within species is part of the evolutionary mechanism that allows different generations of individuals to adapt to changing circumstances. A species that is genetically impoverished is less likely to adapt and is consequently more likely to become extinct should environmental conditions change.
3. **Ecological data** i.e. data on the diversity of ecological communities. This is a very important and vulnerable aspect of biodiversity as it permits the existence of the rich variety of taxonomic and genetic biodiversity. Ecological diversity may be described in terms of

interactions: those with the physical environment within which this diversity survives, and those with other organisms that constitute the biological environment of the species.

Taxonomic data form the backbone of any biodiversity database, as this allows biological diversity to be identified and placed within a hierarchy that can be used for data filing and management purposes. Consequently, the NDB project has so far been oriented mainly towards the collection of such taxonomic data. Information resident within the database is organised in a logical manner with species catalogued in terms of their taxonomic rankings.

Other descriptors used in the NDB include categories concerning ecological, scientific, social and economical significance. This includes details such as Red Data Book status, as well as an estimate of the degree of exploitation and any conservation measures. The information also includes a bibliography, which may be used as a launching point for further in-depth research on the various taxonomic groups catalogued.

The NDB project – pilot and building phases

The NDB was initiated in 1991 within the framework of the Biological Diversity and Genetic Resources Network of the Malta Council for Science and Technology (MCST), in partnership with the Department of Biology of the University of Malta. The MCST has sponsored two Fellowships (each of 2 years duration), and a number of part-time workers with the aim of rendering this database functional.

The development of the NDB was planned to occur in three phases:

1. A **pilot phase** during which the system is designed and tested using data from a few groups of organisms;
2. A **building phase** during which the system is implemented and more data on various groups is entered into the database; and
3. A **consolidation phase** during which the database will be expanded to cover as much as possible of the known biota of the Maltese Islands and the data made available to different users.

The first NDB Fellow was appointed in 1991. The primary task was to produce a prototype database in order to demonstrate the viability of such a project. Sample data entries from four widely separated groups (Orchidaceae - orchids, Orobanchaceae - broomrapes, Cerambycidae - long-horn beetles, and Scombridae - tuna and mackerel) were produced and circulated amongst a wide range of potential users that included NGOs, policy-makers, museum curators, the Government's Environment and Agriculture departments, health workers, industrial firms concerned with biodiversity related subjects such as pest control, and local and foreign experts in the different fields of concern to the database. The feedback received determined the basic format that was to be adopted by the NDB (Mallia & Schembri, 1991). Commercial

database software was adapted to the needs of a local biodiversity database. Specimen data were collected and organised into an appropriate format. When the term of the first Fellowship ended, part-time workers continued further input of data. However, it was realised that in order to assure the success of the NDB project, full time staff were required.

As a consequence of the above, a second Fellowship was awarded in 1996. Owing to rapid developments in the field of information technology (and its potential with respect to biodiversity databases), this second Fellowship was primarily concerned with assessing the best way of updating the software and hardware components of the NDB. The design of a new biodiversity database required an in-depth analysis of database systems, particularly those in use by other projects of a similar nature elsewhere, and their potential with respect to the requirements of the NDB project.

The data resident within the NDB had to be reviewed, given that the project had been dormant for three years. It was noted that the employment of part-timers resulted in the inputted data being inconsistent due to the lack of co-ordination between different input procedures. A new database management system was created using Corel® Paradox® 8. This involved customising the software such that it provided the required querying facilities, together with user-friendly interfaces. The dataset contained within the database was standardised, and a list of keywords (essential for efficient querying facilities) was generated. The final task carried out by the second Fellow was the compilation of a manual regarding the maintenance of the NDB database: *A biodiversity database designed using Corel® Paradox® 8: Guide and manual* (Sant, 1998).

The NDB project – present status and future prospects

At the time that funding for the second Fellowship ran out at the end of 1998, the NDB project had reached the stage of being a fully operational system with some 450 full species records that had been validated and another 300 or so that still required inputting and validation. An example of a typical record is shown in the Appendix. The customised database software was fully functional and allowed data entry, editing, management and querying. The next step is to continue adding records and to make the database accessible to all potential users, possibly by placing it on the Internet. No funds for the third phase have been secured to date and the NDB, which is presently housed at the Malta Council for Science and Technology, is currently dormant.

Nonetheless, work on the cataloguing of local biodiversity that will be complimentary to the NDB project, should this be re-activated, is still being carried out. An example of this is the recently completed database on the Archaeogastropoda (a group of marine molluscs) from Maltese coastal waters produced by Sant (2001). The production of this database involved the pooling of data collected from different sources and from museum specimens. This data was then used to analyse the biogeographic affinities of the local suite of archaeogastropods, and to produce a computerised multiple

entry key that could be used by non-specialists in the group for the identification of specimens.

The future development of the NDB should include the following tasks (not necessarily in the order presented):

1. The continuation of the process of data collection;
2. The validation of the data resident within the database by experts in the field, with a view towards the dissemination of these data;
3. A review of the choice of software to be used for integration of the datasets collected above with other datasets (particularly those forming part of international initiatives);
4. The storage, evaluation and study of distribution data and other spatial information using Geographic Information Systems, as described by Froese & Pauly (1994) and Light (1998).

The linkage of 'traditional' biological data with information on other environmental aspects, such as edaphic, climatic, and socio-cultural data will definitely produce results that would be invaluable to all organisations and agencies interested in environmental management or the implementation of the concept of sustainable development. It is self evident that those individuals and agencies that need this tool should promote its continuation and contribute towards its maintenance.

ACKNOWLEDGEMENTS

The Malta Council for Science and Technology deserves credit for having the foresight to initiate and finance the NDB project even before the requirement for each nation to catalogue its biodiversity was formalised in the Convention on Biological Diversity. Credit is also due to David Mifsud, Miraine Rizzo, Titian Schembri, Darrin Stevens and Graziella Tonna who spent long hours inputting data. PJS thanks the University of Malta Research Committee for supporting his studies on the faunistics of the Maltese Islands.

(Accepted 30th September 2001)

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APPENDIX

Sample National Database on Biodiversity entry for the Maltese freshwater crab *Potamon fluviatile lanfrancoi* to illustrate the structure of the database records. Images are also available as part of the record but are not included here.

SPECIES ID.	<i>Potamon fluviatile</i>
KINGDOM	Animalia
PHYLUM	ARTHROPODA
SUBPHYLUM	Crustacea
CLASS	Malacostraca
SUBCLASS	Eumalacostraca
ORDER	DECAPODA
SUBORDER	Reptantia
SUPERFAMILY	Potamoidea
FAMILY	Potamidae
SUBFAMILY	
GENUS	<i>Potamon</i>
SUBGENUS	
SPECIFIC NAME	<i>fluviatile</i>
AUTHOR (of SPECIES)	(Herbst, 1785)
SUBSPECIES	<i>lanfrancoi</i>
MALTESE NAME	qabru, qobru, granc ta' l-ilma helu, granc ta' l-art
ENGLISH NAME	Maltese freshwater crab
SYNONYMS	<i>Thelyphusa fluviatilis</i> Latreille <i>Potamon edulis</i> (Latreille 1818)
LOCAL DISTRIBUTION	Malta: Wied il-Gnejna, Wied il-Bahrija, Il-Wied ta' l-Imtahleb/Wied Markozz, San Martin (near Wardija), Il-Wied ta' Gordajna Gozo: Wied il-Lunzjata
GLOBAL DISTRIBUTION	Endemic to the Maltese Islands (Malta, Gozo)
LOCAL ABUNDANCE	Rare (localised populations)
IUCN RDB STATUS	NOT LISTED
MALTA RDB STATUS	Endemic; Endangered; Restricted distribution in the Maltese Islands
HABITAT	TERRESTRIAL/FRESHWATER
	Microhabitat: burrows; in crevices Community type: watercourses (slow moving water), agricultural areas
PICTURE	(available)

NOTES

Taxonomy: Authors of subspecies: Capolongo & Cilia (1990). Only species of freshwater crab in the Maltese Islands.

Biogeography: Local populations have been described as a distinct and endemic subspecies. The Maltese population may be a relict of the Plio-Pleistocene between Sicily and Malta.

Conservation: Legally protected (Legal Notice 49 of 1993). Species threatened due to dearth of habitat type in the Maltese Islands and by casual pointless collection.

Behaviour: Generally occupies the banks of streams with thick reed beds and digs burrows up to one metre in depth; burrows may have more than one opening. Small individuals generally keep under stones and in crevices under dense vegetation.

Cultural Importance: named after Guido G. Lanfranco (Capolongo & Cilia, 1990). It used to be consumed by people during periods of fasting. This species appears on the Maltese five-cent coin.

The Bahrija population is the most abundant on Malta, occupying a watercourse of about 350m at its fullest extent. It also used to occur at Marsa and Bingemma, but these populations have now been lost. The only known Gozo population, at Wied il-Lunzjata, used to be more abundant as was the amount of water flowing from the source, but this population has declined in recent years. The species is endangered because of its restricted distribution and the slow reduction or total destruction of the perennial freshwater streams in which it lives. It is also affected by pesticides, urbanization, and indiscriminate collecting.

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VALIDATED BY

Patrick J. Schembri: Dec 1998, updated Sept.2001

POLYPORES RECORDED IN MALTA: ADDITIONS AND UPDATED CHECKLIST

Michael Briffa¹

ABSTRACT

Eight additional species of polypores occurring in Malta and deposited at the author's herbarium are recorded. These are *Inonotus indicus*, *I. cuticularis*, *I. tamaricis*, *Phellinus torulosus* (including an interesting variety), *Coriolopsis aspera*, *Oligoporus balsameus*, *Ganoderma australe*, and *Boletopsis leucomelaena*. Their determination necessitates the cancellation of previous records of *Phaeolus schweinitzii* and *Meripilus giganteus*. *Inonotus indicus* and *Coriolopsis aspera* are new records for Europe. An updated classified checklist of polypores recorded in Malta is also included.

ADDITIONS

Family Hymenochaetaceae

1. *Inonotus indicus* (Mass.) Pieri & Rivoire [= *Aurificaria indica* (Mass.) Reid]

Material examined: 8.11.82, Wied Ghollieqa Malta, under *Ceratonia siliqua*, (MB903); 25.11.82, Ballut tal-Wardija Malta, on roots of *Quercus ilex* (MB622); 4.12.86, Ta Braxia Malta, on roots of *Acacia cyanophylla*, (MB907); 13.12.93, Wied Ghollieqa Malta, under *Ceratonia siliqua*, (MB803); 23.12.94, Imgiebah Malta, on roots of *Ceratonia siliqua*, (MB909); 23.1.95, Buskett Malta, on roots of *Ceratonia siliqua*, (MB910); 29.9.97, Wied Babu Malta, on roots of *Ceratonia siliqua*. (MB918).

Until recently the distribution of this species had been restricted to Southeast Asia, China, and Kenya (Pieri *et al.* 1996). Its occurrence in Malta was first detected by Pieri and Hentic in 1993 when they examined an unidentified specimen (MB903) collected by the Author in 1982. It was subsequently recorded by Pieri & Rivoire (1996) who proposed a new combination by transferring it from the genus *Aurificaria* to *Inonotus*. They also stated that it is a new species for Europe. Subsequent examination of other Maltese material resulted in several unidentified specimens being determined as different forms of this macroscopically very variable species. Ryvardeen, who at first doubted the occurrence of this species in Europe, examined the Maltese material and confirmed its identity. (Pieri pers. com.). A distinguishing characteristic of *I. indicus* is 'the peculiar velutinate appearance of the surface of the pileus which is caused by the very irregular palisade of the very irregular generative hyphae and not by the usual close pile of skeletal ends' (Corner 1991). Additional means of identification of this species is its colour reaction to KOH, the flesh turning red then brown (Pieri pers. com.), and the spores turning olive-brown. Another reagent-test, which has not been

recorded in the literature, is the metachromatic appearance of the endosporium in cresyl-blue. (Hentic pers. com.). Surprisingly, *I. indicus* seems to have been long established in Malta judging by its frequency and widespread distribution on the Island. In Malta it has a sessile or short-stiped, erect habit and always occurs under frondose trees, mainly on the roots of *Ceratonia siliqua* (Fabaceae). Corner (1991) says it is found on fallen logs and is parasitic at the base of living trees, mentioning *Dialium* sp. (Fabaceae).

It appears that the presence in Malta of *Phaeolus schweinitzii* (Briffa & Lanfranco 1986) is very doubtful. Some forms of *I. indicus* have similar looking carpophores and it is probable that these had been mistaken for *P. schweinitzii*. *P. schweinitzii* is associated mainly with coniferous trees. Out of the five published specimens supporting its occurrence in Malta (Briffa & Lanfranco 1986) the only one allegedly collected 'under conifers', (EL276 Buskett 1.1.72 leg. E & G Lanfranco), could in fact have been at the base of a solitary *Ceratonia siliqua* among a population of conifers (E. Lanfranco pers. com.). Moreover, *P. schweinitzii* has larger carpophores and larger greenish yellow pores, 1-2 per mm, while *I. indicus* has smaller brown pores, 4-5 per mm. Microscopically, *P. schweinitzii* has larger, ellipsoid, hyaline spores, thicker hyphae and numerous cystidia, while *I. indicus* has subglobose, thick-walled spores, olive-brown in KOH, thinner hyphae, and no cystidia.

2. *Inonotus cuticularis* (Bull.:Fr.) P. Karst.

Material examined: 22.11.96, Ballut tal-Imgiebah Malta, on main trunk of *Quercus ilex*. (MB913).

In Malta this species is only known from a small oak-wood, Il-Ballut tal-Imgiebah, where it is hosted by an old oak-tree (*Quercus ilex*). It was first collected by the author on 26.11.85 (MB174) and was erroneously published as *Meripilus giganteus* (Pers.: Fr.) P. Karst. (Briffa & Lanfranco 1986). Its imbricate carpophores appear regularly, roughly

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every two years, from a wound at the apex of the main trunk. Fresh material collected on 22.11.96 (MB913) was examined by Hentic and Rivoire and determined as *Inonotus cuticularis*. This species could be easily determined by its spore dimensions ($6 \times 5\mu$), the characteristic branched setae on the surface of the pileus, very variable in form and number, and the 'felt-like' surface of the fresh carpophore. (Hentic pers. com.).

3. *Inonotus tamaricis* (Pat.) Maire

Material examined : 6.2.85, Ramla l-Hamra Gozo (Malta), at base of *Tamarix africana*. (MB900).

This macroscopically and seasonally atypical specimen was identified by Hentic. It has a pseudo stipe (probably an extension of the pileus) and the pileus is dark brown and very hispid. The spores, however, are c. $8 \times 6\mu$, yellow in water, and above all it has a granular core, fitting Ryvardeen's description of this species. Half of the specimen is deposited at Hentic's herbarium (RH9702).

I. tamaricis is well known and frequent in Malta mainly on *Tamarix gallica*. In fact it is conspicuous by its absence from the local literature. However, unlike the specimen examined, the pileus is normally much lighter in colour, and much less hispid, the carpophores appear in Autumn high up the trunk rather than at its base, and they turn black and dry up before February.

4. *Phellinus torulosus* (Pers.) Bourdot & Galzin

Material examined : 23.1.95, Buskett Malta, on fallen log of *Ceratonia siliqua* (MB911); 16.10.95, Buskett Malta, on living remains of *Ceratonia siliqua* (MB912).

MB911 was determined by Moreno, noting its hyaline ellipsoid spores ($4-5 \times 3-4\mu$) and the straight setae which distinguish it from *P. ignarius* which has subglobose amyloid spores. MB912 was determined by Pieri.

4a *Phellinus cf. torulosus*

Material examined: 20.2.97, Wied Babu Malta, on main trunk of *Ceratonia siliqua*. (MB915).

A *Phellinus* species with numerous perennial carpophores, hosted by *Ceratonia siliqua*, was first seen and photographed by E. Lanfranco and the author on 4.3.79 at Wied Babu Malta. Fresh identical specimens were collected by the author from the same living tree on 20.2.97 (MB915). They had a distinctly acute, occasionally undulate margin, small round pores (0.1 mm), short tubes (1-2 mm long), and whitish ellipsoid spores ($4-5 \times 3-4\mu$).

This material was examined by Hentic and Rivoire, who both agreed that its microscopic characteristics correspond to *Phellinus torulosus*. Macroscopically, however, its distinctly acute margin did not fit the description of *P. torulosus* which according to Ryvardeen has an obtuse rounded margin, 2 cm thick. A specimen is also deposited in Hentic's herbarium

(RH.9709). The material was later re-examined by Moreno who agreed to label it *P. cf. torulosus*.

Family Polyporaceae

5. *Corioloopsis aspera* (Jungh) Teng

Material examined: MB902, 15.11.78, Maqluba Malta, under *Ceratonia siliqua*.

The specimen was round, with a diameter of 17cm, and consisted of a central mass of corky, brown trama, from the base of which sprang many proliferating, thin, faintly zonate, fan-like projections of different sizes, c. 1-2 mm thick, bearing hymenia of relatively large, dark brown pores (c. 0.4 mm diam.), with very short tubes (up to 1 mm long). Although the specimen was now old and carried no spores, it was determined by Ryvardeen in November 2001. In a personal communication he says its macroscopical features correspond with this species and so is its typically trimitic hyphal system. *C. aspera* is a widespread species in the paleotropical zone, rather common in Asia and less so in Africa. The specimen is the first record of this species in Europe. Its occurrence in Malta is possibly due to introduction.



Fig. 1 *Phellinus cf. torulosus*

6. *Oligoporus balsameus* (Peck) Gilb. & Ryvarden

[= *Postia balsamea* (Peck) Jülich]

Material examined : 28.11.95, Buskett Malta, on main trunk of *Ceratonia siliqua*. (MB611).

A single imbricate polypore (MB611) one meter up the trunk of a living *Ceratonia siliqua*, reminiscent of *Postia*, was collected at Buskett by A. Bonnici and the author on 28.11.95. It had the following macroscopic features: carpophore forming a few fan-shaped, light greyish brown, smooth, and lightly zonate pilei; white tubes, up to 5 mm long; circular to subangular pores 2 - 4 per mm; white flesh, very soft, contracting and hardening when dry; mild taste. It was examined and determined by Hentic, who made the following remarks: Microscopically the specimen has a monomitic hyphal system with clamp connections. All hyphae are metachromatic in cresyl blue (a characteristic distinguishing the genus *Oligoporus* from *Tyromyces*). The spores are ellipsoid ($4 \times 2.5\mu$), and above all it has numerous cystidia. Of all the species belonging to the genus *Oligoporus* as published by Ryvarden & Gilbertson (1994), *O. balsameus* is the only pileate species with cystidia and ellipsoid spores. Moreover the macroscopic features of the carpophore surface of the specimen generally fit the description of this species [(Ryvarden & Gilbertson, 1994) and (Bourdot & Galzin 1928 = *Coriolus kymatodes* Rost.)]. This species is generally hosted by conifers but also, more rarely, by hard-wood species.

Family Ganodermataceae

7. *Ganoderma australe* (Fr.) Pat. [= *G. adpersum* (Schulzer) Donk]

Material examined : 15.11.94, Ghajn il-Kbira, Malta, on main trunk of *Eriobotrya japonica*. (MB917)

The specimen was determined by Moreno. It is very similar to *G. applanatum*, from which it is easily distinguished by its dark reddish brown context.

Family Thelephoraceae

8. *Boletopsis leucomelaena* (Pers.) Fayod

Material examined: 30.1.85, Buskett Malta, under conifers (MB360).

A terrestrial stipitate species with whitish angular pores, very easy to determine by its unique habit, blackish colour, and warty pale brown spores, irregular in outline.

UPDATED POLYPORE CHECKLIST OF THE MALTESE ISLANDS

The common designation 'polypores' here is mainly limited to parasitic or saprophytic lignicolous species with a porous hymenium, formerly grouped under one family, *Polyporaceae* Freis, excluding the unrelated species of the family *Boletaceae*.

The checklist follows the classification and nomenclature adopted in Ryvarden & Gilbertson (1993-1994), and is based mainly on the records published by Sommier & Caruana-Gatto (1915), which include all previous local records of polypores published by Zerapha (1831), Gulia (1859), Saccardo (1912, 1914 & 1915), and Borg (1899 & 1901). To these are added later records published by Borg (1922), Briffa & Lanfranco (1986), and the ones published in the present work. Both the updated and the recorded nomenclature appear in this checklist.

It should be noted that a few taxa had been listed by Saccardo (1915) at 'form' level, named after their host trees. These could have possibly been endemic forms, having been based on material collected in Malta. They include: *Fomes ribis* f. *tamaricis*, *F. robustus* f. *punicae*, and *F. robustus* f. *amigdali*. Unfortunately, however, in his work Saccardo (1915) failed to describe their distinguishing features, as he did in the case of other endemic taxa, at species level, and so their real taxonomic significance is not known. All infraspecific taxa have therefore been left out in the updated nomenclature. One cannot deny, however, that sometimes polypore species seem to have a tendency to evolve local forms which become specific to their host trees. Other authors, in fact, have published justified descriptions of similar forms. E.g. *Inonotus (Xanthocrus) hispidus* f. *quercus* (sic), and f. *salicum* (sic) in the south of France (Bourdot *et al.* 1928 P.278), *Phellinus robustus* f. *aceris*, in Crimea, and *P. robustus* v. *buxi* f. *atrophaxidis* (sic), in Tadzhikistan (Larsen *et al.* 1990 p.123), and *Phellinus igniarius* f. *alni* (Cetto 1987-1993 V. Nr.2015).

HOMOBASIDIOMYCETES

Polyporaceae

Abortiporus biennis (Bull.:Fr.) Singer = *Polyporus biennis* (Bull.) Fr., on *Olea europea* (Saccardo 1912), (Borg 1922).

Bjerkandera adusta (Willd.: Fr.) P. Karst. = *Polyporus adustus* (Willd.) Fr., on dead wood (Saccardo 1912).

Bjerkandera fumosa (Pers.: Fr.) P. Karst. = *Polyporus fumosus* (Pers.) Fr., on *Citrus* sp. (Borg 1901).

Cerrena unicolor (Bull.: Fr.) Murrill = *Daedalea unicolor* (Bull.) Fr., (Gulia 1859).

Coriopsis aspera (Jungh) Teng, under *Ceratonia siliqua*, (Briffa ! MB902)

Coriopsis gallica (Fr.) Ryvarden = *Trametes hispida* (Baglietto) Fr., on dead *Quercus* wood (Saccardo 1914 & 1915), also an undescribed form: f. *resupinata* (the only description being that implied by its name), on dead *Citrus* wood Saccardo (1915), and on dead wood of *Olea europaea* (Briffa ! MB908).

Note: Cetto (1983-1990 IV No.1588) also mentions a resupinate form of this species (= *Funalia gallica* (Fr) Bond. & Singer)

Gloeophyllum abietinum (Bull.:Fr.) Karst = *Lenzites abietina* (Bull.) Fr., on rotting wood of *Abies* sp. (Saccardo 1912). Note: The genus *Gloeophyllum* includes species with a porous hymenium (e.g. *G. protractum*), lamellate hymenium (e.g. *G. abietinum*), and mixed porous and lamellate hymenium (e.g. *G. sepiarium*).

Gloeophyllum sepiarium (Wulf.:Fr.) Karst. = *Lenzites saepiaria* Fr., on rotting wood of *Larix* sp., rare, (Saccardo 1915)

Grifola frondosa (Dicks.: Fr.) Gray = *Polyporus frondosus* (Dicks.) Fr., on *Ceratonia siliqua* (Borg 1922), (Briffa ! MB904).

Laetiporus sulphureus (Bull.: Fr.) Murrill = *Polyporus sulphureus* Fr. v. *ceratoniae* Risso, on *Ceratonia siliqua* (Borg 1922), (Briffa ! MB655) = *Polyporus ceratoniae* Risso = *P. sulphureus* v. *ceratoniae* Quel, on *Ceratonia siliqua* (Saccardo 1912).

Oligoporus balsameus (Peck) Gilb. & Ryvardeen, on *Ceratonia siliqua* (Briffa! MB611).

Polyporus brumalis (Pers.) Fr., on old branches of *Cistus monspeliensis* (Briffa & Lanfranco 1986). (Briffa ! MB39)

Trametes hirsuta (Fr.) Pilát = *Polyporus hirsutus* Fr., on *Morus alba* and *Punica granatum* (Borg 1922), on fallen log of *Cupressus sempervirens* with unusual colour, (Briffa ! MB620 det. Pieri).

Trametes versicolor (L.: Fr.) Pilát = *Polystictus versicolor* (L.) Fr., on rotting wood (Saccardo 1912), on dead wood (Briffa !).

Hymenochaetaceae

Coltricia cinnamomea (Jacq.) Murrill = *Polyporus cinnamomeus* (Jacq.) Pers., on *Pyrus* spp. (Borg 1922).

Inonotus cuticularis (Bull.:Fr.) P. Karst., on *Quercus ilex* (Briffa ! MB913).

Inonotus hispidus (Bull.: Fr.) P. Karst. = *Polyporus hispidus* (Bull.) Fr., on *Morus alba* (Saccardo 1914), on *Malus* spp. (Borg 1922), on *Morus alba* (Briffa ! MB901).

Inonotus indicus (Mass.) Pieri & Rivoire, mainly on *Ceratonia siliqua* (Briffa ! MB903)

Inonotus obliquus (Pers.:Fr.) Pilát = *Fomes obliquus* (Pers.) Cooke, on *Citrus* spp. (Borg 1901 & 1922).

Inonotus rheades (Pers.) P. Karst. = *Polyporus rheades* Pers., on *Pinus* sp. (Saccardo 1912).

Inonotus tamaricis (Pat.) Maire, on *Tamarix* spp (Briffa ! MB900)

Phellinus ignarius (L.: Fr.) Quél. = *Fomes ignarius* (L.) Gillet., on *Ceratonia siliqua* (Zerapha 1831), *Boletus ignarius* L.), (Gulia 1859 *Polyporus ignarius* (L.:Fr).

Phellinus pomaceus (Pers.) Maire = *Fomes fulvus* Fr. = *F. fulvus* (Scop.) Pat. (according to Cetto II p.531) on *Prunus* spp. (Saccardo 1912), Borg (1922), (Briffa ! MB608).

Phellinus robustus (P. Karst.) Bourdot & Galzin = *Fomes robustus* P. Karst. f. *amygdali* Sacc., on *Prunus amygdalus* (Saccardo 1915), (Borg 1922), and f. *punicae* Sacc., on *Punica granatum* (Saccardo 1915, Borg 1922), on dead stump of *Citrus deliciosa* (Briffa ! MB914) det. by Hentic. However this specimen may also be referable to *P. punctatus* (P. Karst.) Pilát: It has no pileus, and was saprophytic on a Citrus stump.

Phellinus torulosus (Pers.) Bourdot & Galzin, on *Ceratonia siliqua* Briffa ! MB911, including a variety having its carpophores with distinctly acute margin (MB915).

Phylloporia ribis (Schumach.:Fr.) Ryvardeen = *Fomes ribis* (Schumach.) Gillet. f. *tamaricis* Sacc., on *Tamarix gallica* (Saccardo 1915). Sommier & Caruana-Gatto (1915) say this taxon is 'not rare'.

Ganodermataceae

Ganoderma australe (Fr.) Pat., on main trunk of *Eriobotrya japonica*. (Briffa ! MB917)

Ganoderma applanatum (Pers.) Pat., (Briffa & Lanfranco 1986)

Ganoderma lucidum (Curtis: Fr.) P. Karst., (Gulia 1859 = *Polyporus lucidus*), on *Ceratonia siliqua* (Borg 1922); on *Ceratonia siliqua*, *Laurus nobilis*, *Populus alba*, *Fraxinus angustifolia*, *Ulmus minor*, and *Carya olivaeformis* (Briffa ! MB906).

Thelephoraceae (Porous species)

Boletopsis leucomelaena (Pers.) Fayod, under conifers (Briffa ! MB360).

ACKNOWLEDGEMENTS

Thanks are due to Dr. Leif Ryvardeen, mycologist and Professor at the Botany Department of the Blindern Biological Institute Norway, the french polyporologists Max. Pieri of Avignon, B. Rivoire of Orleans, and Rene Hentic of Le Vesinet, and to Dr. G. Moreno, mycologist and Professor of botany at the University of Alcalá de Henares, Spain, for their kind cooperation in examining and determining the material.

(Accepted 26th November 2001)

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ADDITIONS TO, AND A REVIEW OF, THE MIOCENE SHARK AND RAY FAUNA OF MALTA

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ABSTRACT

Bulk sampling sediments and surface picking have increased the number of fossil sharks and rays from the Miocene of the Maltese Islands by 10 species and confirmed another. These are: *Sphyrna arambourgi*, *Rhizoprionodon taxandriae*, *Scyliorhinus* sp, *Chaenogaleus affinis*, *Galeorhinus goncalvesi*, *Triakis angustidens*, *Squatina* sp., *Rhynchobatus pristinus*, *Raja gentili* and *Gymnura* sp. *Hexanchus griseus* was confirmed. The species "*Galeocerdo*" *aduncus* is synonymised with "*G*" *contortus*, and referred to the genus *Physogaleus*. These new records, and a taxonomic revision of the species described previously, increased the Maltese fauna to 24 species, comparable with the Miocene of France and Portugal. This paper is not meant to be an exhaustive review of the fossil selachian and batid fauna of the Maltese Islands but rather for the present we have confined ourselves to revising Menesini (1974).

INTRODUCTION

This paper is the result of a pilot study to investigate the possibilities of extracting a microvertebrate fauna from the Maltese Islands. The results were surprisingly good, and are listed below in the Systematic section. The original fauna of 14 species, after a conservative revision was reduced to 13, to which this study added an additional 11, making 24 species in total.

The fossil sharks' teeth of Malta have been known to the outside world for more than five hundred years (Pogatcher, 1898). They were believed to be a protection against poisoning, and thus were exported from Malta in large numbers during Medieval and Hospitaller times (Zammit Maempel 1989). Originally known as *Glossoptera* ("stone tongues"), *Linguae Melitensis* (Maltese tongues) or *Linguae St Pauli* (St. Paul's tongues), also adder's tongues and serpent tongues (Zammit Maempel, 1975), it was the Danish geologist and anatomist, Niels Steensen, in 1669, who recognised them as sharks' teeth. Sharks' teeth and other Maltese fossils were first illustrated by Scilla (1670) who recognised the relationship between Recent and fossil specimens.

Despite the exposure that Maltese sharks have enjoyed down the centuries, it is remarkable that when they were monographed in the 1970's, only fourteen species were described (Menesini, 1974 – see Table 1)). This contrasts with about fifty species from the Miocene of southern France (Cappetta, 1970), twenty eight from the Miocene of Portugal

(Antunes & Jonet, 1970), or thirty species from the Belgian Miocene (Leriche, 1926).

A closer look at the published Maltese fauna shows that it comprises only large species, principally pelagic lamniforms and large carcharhinids. This is typical of many of the older museum collections, where most of the sharks' teeth they contain were collected by eye from the surface of the outcrop. Indeed, no small teeth at all, i.e. under 5mm, were figured by Menesini (1974).

In this brief report, which reviews the Maltese shark fauna, it is impractical to reproduce the text and figures of Menesini. Thus, the larger, previously described, teeth in the fauna are not figured and the reader must refer to Menesini (1974) in order to fully understand some of the systematic points made below.

The new material (figured in Plates 1 and 2) is deposited at the National Museum of Natural History, Mdina, Malta.

STRATIGRAPHY

The stratigraphic framework used in Fig. 1 is based on that of Pedley (1978) and Rehfeld & Janssen (1995). Seven horizons were sampled (see map at Fig. 2).

1 The Lower Main Phosphorite Conglomerate – C1
(L.M.C.B. Pedley & Bennett 1985); C1 (Rehfeld & Janssen 1995) of Rdum il-Vigarju near Bahrija.

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Table 1. The fauna described by Menesini (1974) with its current names.

Name used in Menesini (1974)	Current name	Vernacular name
<i>Odontaspis acutissima</i> Agassiz 1843	<i>Carcharias taurus</i> Rafinesque 1810	Sand tiger shark
<i>Isurus hastalis</i> (Agassiz 1843)	<i>Cosmopolitodus hastalis</i> (Agassiz 1843)	Spear-toothed shark
<i>Isurus desori</i> (Agassiz 1843)	<i>Isurus oxyrhynchus</i> Rafinesque 1810	Shortfin mako shark
<i>Isurus retroflexus</i> (Agassiz 1843)	<i>Isurus retroflexus</i> (Agassiz 1843)	Mako shark
<i>Isurus benedini</i> (Le Hon 1871)	<i>Parotodus benedini</i> (Le Hon 1871)	none
<i>Lamna cattica</i> (Philippi 1846)	<i>Carcharoides catticus</i> (Philippi 1846)	none
<i>Procarcharodon megalodon</i> (Agassiz 1843)	<i>Carcharocles megalodon</i> (Agassiz 1843)	Mega-toothed shark
<i>Alopias latidens</i> (Leriche 1908)	<i>Alopias latidens</i> (Leriche 1908)	Thresher shark
<i>Alopias exigua</i> (Probst 1879)	<i>Alopias vulpinus</i> (Bonnaterre 1780) <i>Alopias superciliosus</i> (Lowe 1840)	Thresher sharks
<i>Galeocerdo aduncus</i> Agassiz 1843	<i>Physogaleus aduncus</i> (Agassiz 1843)	Tiger shark
<i>Carcharhinus egertoni</i> (Agassiz 1843)	In part: <i>C. falciformis</i> (Bibron 1849) and <i>N. eurybathrodon</i> (Blake 1862)	Requiem shark Lemon shark
<i>Hypopriodon acanthodon</i> (Le Hon 1871)	<i>Negaprion</i> sp. ? <i>N. eurybathrodon</i> (Blake 1862)	Lemon shark
<i>Hemipristis serra</i> Agassiz 1843	<i>Hemipristis serra</i> Agassiz 1843	Snaggletooth shark
<i>Sphyrna prisca</i> Agassiz 1843	<i>N. eurybathrodon</i> (Blake 1862)	Lemon shark

The two *Hexanchus* teeth come from a thin horizon of sub-cm phosphorite intraclasts scattered through the first 10-15 cms of the overlying Middle Globigerina Limestone resting uncomformably on the planed-off surface of the actual Lower Main Phosphorite Conglomerate (C1). Its age has been assigned approximately to the base of the Burdigalian (Mazzei 1985) and it lies on strata of Aquitanian age. The phosphorite conglomerates have been associated with a low-stand in sea-level with strong bottom currents (Carbone *et al.* 1987) but see Rehfeld & Janssen (1995). Their precise age needs further study (Rehfeld & Janssen 1995) as they indicate a still-stand in deposition of an unknown duration. The teeth were collected by scanning the surface outcrop.

2 The glauconitic level in the Blue Clay at Ras il-Pellegrin [referred to as "livello glauconitico a Pettinidi" by Menesini (1974)]. This horizon is only a few metres thick and occurs some 3.5-5.5 metres below the top of the Blue Clay Formation (Pedley 1978). Again there is disagreement as to age: Serravallian-Tortonian (Pedley, 1987), Langhian-Serravallian (Pedley *et al* 1976) but Serravallian by Kienel *et al* (1995) and by Janssen (1999). Di Geronimo *et al* (1981) suggested a circalittoral environment. This horizon has never been formally described. Sample size: 4 kg

3. One of the minor phosphorite conglomerate beds that are found locally at Bahrija. The specimens were found by scanning the weathered surface, not by sieving.

4 The Greensand at Ta' Gordan - Gozo. There is some disagreement on the date of this formation, being assigned to

the later Tortonian by e.g. Pedley (1987), to the Serravallian-Tortonian (see table in Pedley *et al* 1976) and more recently to the Messinian (Kienel *et al* 1995). Pedley *et al* (1976) suggest that it was deposited in a shallow water environment with strong currents. Teeth were collected by surface scanning.

5. The glauconitic level in the Blue Clay at Ras il-Karraba - Malta [see (2) above]. Sample size: 3 kg

6. The Upper Main Phosphorite Conglomerate - Gozo L.M.P.C. "B" of Pedley & Bennett (1985), C2 of Rehfeld & Janssen (1995) of Ras ir-Reqqa (Gozo). This bed separates the late Burdigalian strata of the Middle Globigerina Limestone from the Langhian beds of the Upper Globigerina Limestone (Carbone *et al* 1987) which is also in agreement with the approximate dating of Mazzei (1985). Sample size: 2 kg

7. The glauconitic level in the Blue Clay at In-Nuffara - Gozo [see (2) above]. Sample size: 1kg

METHODS

Excluding the minor phosphorites at Bahrija and the Greensand at Ta' Gordan, bulk samples of sediments were collected, disaggregated and wet sieved to 500 microns. The resulting concentrate was examined with a x10 hand-lens. The localities visited and horizons sampled are given in Table 2. In general, the preservation was better and the yield of determinate teeth more in "Glauconites" (glauconitic silty

Table 2. Sample horizons and localities with significant records.

Sample	Horizon	Locality	Fauna
1	C1 phosphorite	Rdum il-Vigarju between one or two km south of Bahrija, Malta 35°54'30"N:14°20'10"E	<i>Hexanchus</i>
2	Glauconite level in the Blue Clay	Ras il-Pellegrin, Malta 35°55'00" N:14°20'10" E	<i>Carcharhinus</i> , <i>Squatina</i> , <i>Scoliodon Hexanchus</i> <i>Galeorhinus</i>
3	Minor phosphorites in the Middle Globigerina Lmst.	Bahrija about one and a half km south of locality 2, Malta 35°54'00" N:14°20'00" E	<i>Hexanchus Scyliorhinus</i> <i>Carcharhinus</i>
4	Greensand	Ta' Gordan, Gozo 36°4'20" N: 14°14'10" E.	<i>Carcharhinus</i> spp
5	Glauconite level in the Blue Clay	Ras il-Karraba about 1.5km north of Ras il-Pellegrin, Malta 35°55'40" N:14°20'25" E	<i>Carcharhinus</i> , <i>Rhizoprionodon</i>
6	C2 phosphorite	Ras ir-Reqqa, Gozo 36°4'50" N: 14°14'10" E.	<i>Carcharhinus</i> , <i>Rhizoprionodon</i> <i>Sphyrna Triakis Rhynchobatis</i>
7	Glauconite level in the Blue Clay	In-Nuffara, 2.8km E of Rabat, Gozo. 36°2'30"N:14°13'10"E.	Female & male <i>Raja</i> , <i>Carcharhinus Galeorhinus</i> <i>Scyliorhinus Gymnura</i>

clays) than in the phosphoritic horizons, where the teeth were somewhat abraded.

SYSTEMATIC PALAEOLOGY

Being only a pilot study, we are keeping the systematics to a minimum. It is not our intention to modify the taxonomy, nor materially add to the written descriptions of the studied taxa; we do not have sufficient material to accomplish this. However, it is not our intention to perpetuate obvious errors in inconsistencies in the literature so some taxonomic changes are introduced. The synonymies are restricted to immediately relevant texts.

The species listed below are placed in their traditional systematic hierarchy, solely to avoid taxonomic confusion.

Genus *Hexanchus* Rafinesque 1810

Hexanchus griseus (Bonaterre 1788)
Six-gill shark
Plate 1, fig b.

Material: 3 upper teeth.

Provenance: C1 Conglomerate; Rhum il-Vigarju; Blue Clay, Ras il-Pellegrin.

Remarks: For Neogene species of *Hexanchus*, the species *H. gigas* (Sismonda 1857) is usually employed. However, we have been unable to identify any convincing characters, other

than size to separate Recent and Miocene specimens. Upper teeth of *Notorynchus primigenus* Agassiz 1843, tend to be more robust and have less sigmoid crowns than those of *Hexanchus*. It is curious that the, considerably larger, lower anterolateral teeth of *Hexanchus* have not yet been recorded from Malta though a probable specimen has been observed in a private collection. These records confirm the presence of this species in the Miocene of the Islands; it was recorded from the Globigerina Limestone by Adams (1870) solely on the basis of his identification of a tooth figured by Scilla (1670).

Genus *Carcharias* Rafinesque 1810

Carcharias taurus (Bonaterre 1778)
Sandtiger shark

Synonymy: see also Cappetta, 1970.
1970 *Odontaspis acutissima* Agassiz: Cappetta p. 29, Pl. 1, figs 1-22, Pl. 2, figs 1-16
1974 *Odontaspis (Synodontaspis) acutissima* Agassiz: Menesini, p. 127, Pl. 1, figs 1-9.

Material & Provenance: see Menesini (1974)

Remarks: In the 1970's (Menesini, 1974), the genus *Odontaspis* was considered a senior synonym of *Carcharias*. Now they are considered distinct and separate genera (ICZN, 1987 Opinion 1485). We cannot find any characters to separate Miocene examples of *Carcharias acutissima* Agassiz 1844 from the Recent *C. taurus* Rafinesque 1810, and

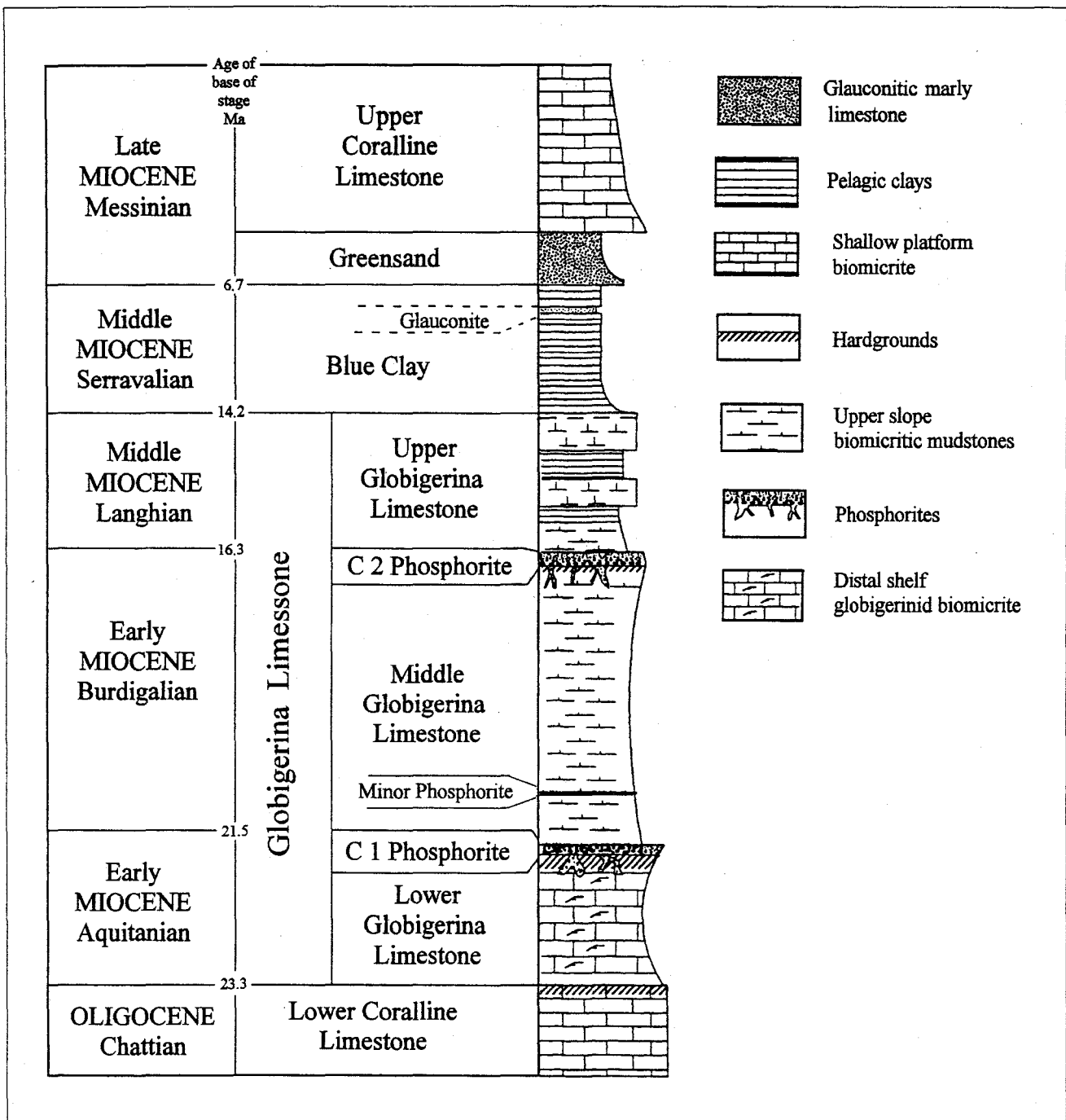


Fig 1. The Maltese stratigraphic column.

so we follow Kemp (1991) and refer to the Miocene examples of the lineage as *C. taurus*. Purdy *et al.* 2001 refer the species *acutissima* to *Odontaspis*, presumably in error. Teeth of *Odontaspis* have unstriated lingual crowns and multiple lateral cusplets, are stout and strongly lingually recurved.

Genus *Cosmopolitodus* Glyckman 1964

Cosmopolitodus hastalis (Agassiz 1843)

Spear-toothed shark

Synonymy: see also Cappetta, 1970.

1970 *Isurus hastalis* Agassiz: Cappetta p. 18, Pl. 5, figs 1-13. 1974 *Isurus hastalis* Agassiz: Menesini, p. 129, Pl. 2, figs 1-13.

2001 *Isurus xiphodon* Agassiz: Purdy *et al.*, p. 119, fig 29.

Material & Provenance: see Menesini (1974)

Remarks: "*Isurus*" *hastalis* Agassiz 1843 is considered to be more closely related to the Recent Great white shark *Carcharodon* than the Mako sharks. Thus the use of the genus "*Isurus*" is inappropriate. Here we follow Glyckman (1964, 1980) and Siverson (1999) and use *Cosmopolitodus* for members of the *Carcharodon* lineage with unserrated teeth.

Purdy *et al* used the name "*Isurus xiphodon*" Agassiz 1843 for teeth traditionally referred to as *hastalis*. Leriche (1926: 399) includes *xiphodon* in his synonymy of *hastalis* and (1926: 407) points out the uncertainty of the origin of the types, now lost, of *xiphodon*. Agassiz (1843) in his plate explanation, states that they are from the "Gypse of the Paris region," – a terrestrial/fluviatile ? Eocene deposit, that certainly yields no sharks. In view of this degree of uncertainty, the nominal species *xiphodon* can only be regarded as a *nomen dubium*.

Genus *Isurus* Rafinesque 1810

Isurus oxyrinchus Rafinesque 1810
Shortfin mako shark

Synonymy: 1974 *Isurus desori* Agassiz: Menesini, p. 131, Pl. 3, figs 1-8.

Material & Provenance: see Menesini (1974)

Remarks: In the teeth of Miocene sharks, there is often little or no morphological difference between the fossil and Recent counterparts. In many cases a fossil name was used because the dentition of the Recent representative of the lineage was poorly known. Both Cappetta (1970, and Menesini (1974) used *Isurus desori* Agassiz 1843. Unfortunately the name *I. desori* has been used both for Oligocene representatives of the *Carcharodon* lineage and for anterior teeth of *Isurolamna gracilis* (Le Hon 1871) [= *Lamna rupeliensis* (Le Hon 1871)]

(Leriche, 1910). Thus, we feel that is preferable to use the senior synonym, which is *Isurus oxyrinchus*, the Recent Shortfin mako shark.

Isurus retroflexus (Agassiz 1843)
Longfin mako shark

Synonymy, Material & Provenance: see Menesini (1974, p. 132-134)

Remarks: The Maltese teeth figured by Menesini (1974, pl. 4, 1-6) are extremely poorly preserved, but two (Pl. 3, figs 7 & 8) are sufficiently intact to be confidently referred to this species.

Genus *Parotodus* Cappetta 1980

Parotodus benedini (Le Hon 1871)

No vernacular name

Synonymy: 1974: *Isurus benedini* Le Hon: Menesini, p. 134, pl. 1, figs 10-17, non figs 14 & 17.

Material & Provenance: see Menesini (1974).

Remarks: Superficially the teeth of this rare pelagic shark resemble those of *Isurus retroflexus*, but the dentition lacks the elongate anterior teeth of *Isurus*, and possesses a much more robust "Otodus-like" root. Oligocene specimens of *Parotodus* were figured by Leriche (1910, plate 16, figs 1-15). Two of these, figs 5 and 6, were referred by Purdy *et al*

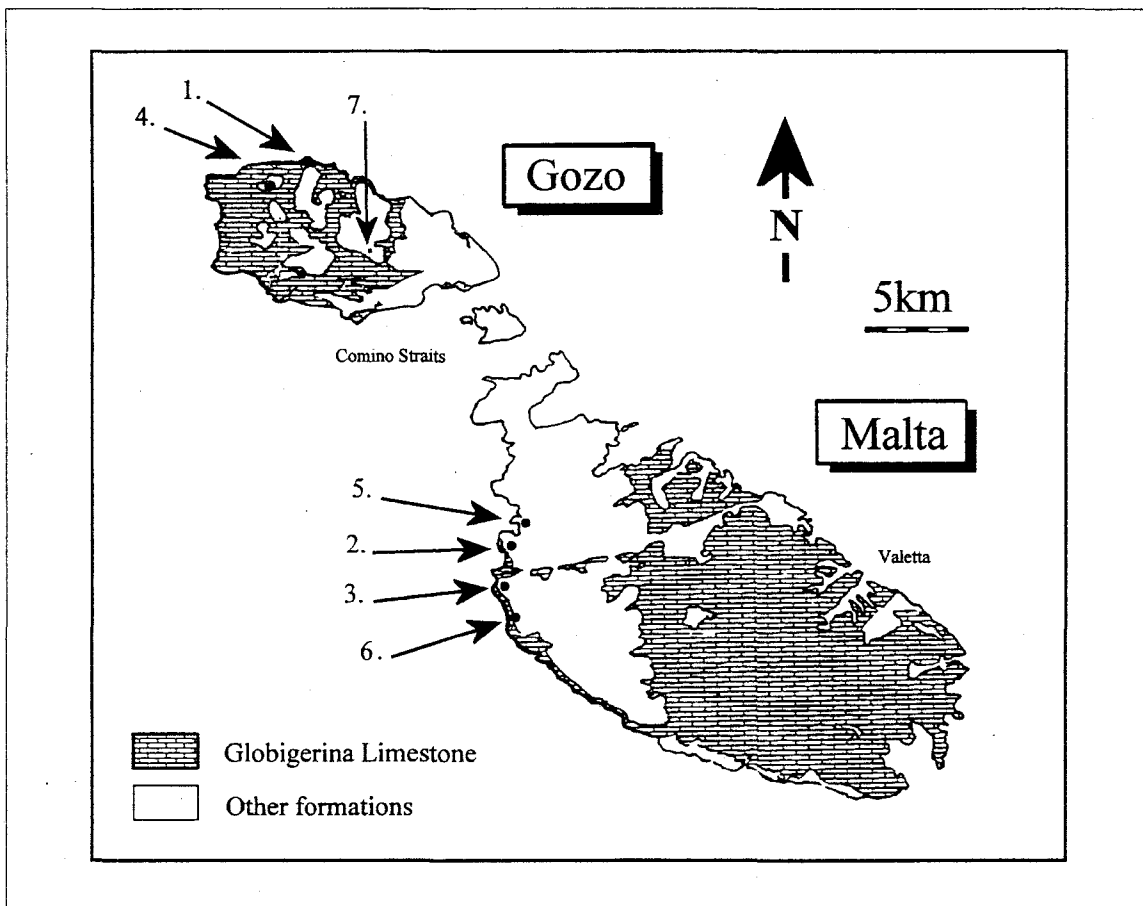


Fig. 2. Map of sample localities

2001 to "*Lamna*" *rupeliensis* [= *Isurolamna gracilis* (Le Hon 1871)]. This is certainly incorrect. The roots of these teeth are quite dissimilar to those of *Isurolamna*, they have no lingual groove, and are quite "Otodus-like". They are however, very similar to the late Eocene species *Parotodus mangyshlakensis* Kozlov in Zhelezko & Kozlov, 1999, which, although it shares many features with *Parotodus benedini*, may prove to be of a separate, and not necessarily closely related, lineage (Siverson pers. com.).

Both Purdy *et al.* and Kent & Powell (1999) reconstruct the dentition of *Parotodus benedini* in the manner of a lamnid; that is with an intermediate tooth. We find this relationship difficult to accept, preferring Otodontidae Glyckman 1964, as suggested by Zhelezko & Kozlov, 1999. The tooth they cite as an "intermediate tooth" closely resembles those found in an upper parasymphysial position in *Cretoxyrhina*, *Otodus* and *Carcharocles* (Shimada 1997, and pers. obs.). The one illustrated by Purdy *et al.* (fig. 23) is relatively much bigger than symphysials of *Cretoxyrhina*. See Siverson (1999) for his comments on "intermediate" and parasymphysial teeth.

One tooth from Malta, figured by Menesini (1974, Plate 1, fig. 17) could be an upper lateral of *Isurus retroflexus*. Another, an incomplete tooth, (Menesini 1974, Plate 1, fig. 14) bears a close resemblance to *Alopias grandis* Leriche 1942. Should this be the case, it would be the first record of this rare species outside the New World. Both these teeth would merit closer examination.

Genus *Carcharoides* Ameghino 1901

Carcharoides caticus (Phillippi 1846)
No vernacular name

Synonymy: 1974 *Lamna catica* (Phillippi 1846) Menesini, p. 135, pl. 1, figs 18-20.
2001 *Triaenodon obesus* (Rüppell 1835) Purdy *et al.*, p. 156, fig. 57, k-n.

Material & Provenance: C1 and the minor phosphorite conglomerates in the lower Middle Globigerina where it is not uncommon; it is extremely rare in C2.

Remarks: *Carcharoides* is a poorly-known, uncommon genus, present in the Neogene of both the Old and New World. The anterior teeth have a sand shark tiger-like appearance, whilst the lateral teeth more closely resemble those of *Lamna*. The crown histology is osteodont, in common with all lamniform sharks. It is very much larger, and only superficially similar to the teeth of *Triaenodon*, to which Purdy *et al.* (2001) refer it. *Triaenodon* is a carcharhinid shark with small teeth with a simple gradient monognathic heterodonty, and an orthodont histology. Teeth of *Carcharoides* are larger, of different proportions and histology, and can be separated into anterior and lateral teeth, while those of *Triaenodon* cannot. The lower lateral teeth of *Triaenodon* often exhibit double mesial lateral cusplets, a feature never recorded in *Carcharoides*. For these reasons we reject the suggestion that *Carcharoides caticus* is a junior

synonym of *Triaenodon obesus* and concur with Cappetta (1987) that it is a lamniform.

Genus *Carcharocles* Jordan & Hannibal 1923

Carcharocles megalodon (Agassiz 1843)
Mega-toothed shark

Synonymy: 1974 *Procarcharodon megalodon* (Agassiz 1843), Menesini, p. 137, pl. 5, figs 1-10, pl. 6, figs 1-9.
2001 *Carcharodon megalodon* Agassiz 1835, Purdy *et al.*, p. 156, fig. 57, k-n.

Material & Provenance: see Menesini (1974).

Remarks: Much has been written and much more needs writing about this most well-known and misunderstood species.

By referring the giant toothed species *megalodon* to the extinct genus *Procarcharodon* the junior synonym of *Carcharocles* Jordan & Hannibal, 1923, Menesini was implying that *megalodon* was not closely related to the Recent Great white shark, *Carcharodon*. This was not the opinion of Purdy *et al.* (2001), who synonymised *Carcharocles* and *Palaeocarcharodon* under *Carcharodon*. This is a relationship we reject, however, a lengthy discussion of this is outside the scope of this paper, so we will restrict our comments to absolute basics.

Much of the confusion surrounding *megalodon* nomenclature involves the difference between a biological and a purely morphological species. In the case of fossil sharks' teeth, often the morphology is all one has, thus separate species have occasionally been described for anterior and lateral teeth. Such was the situation with "*Lamna*" *verticalis* and "*Odontaspis*" *hopei* (see Ward, 1989). Once an artificial tooth set is constructed, or an associated dentition is discovered, these mistakes become apparent. Like many sharks, the dentition of *Carcharocles* changes with the age. In the Miocene, teeth of young individuals of *C. megalodon* have lateral cusps, which are progressively lost with age. These changes, in the lifetime of an individual shark, closely mimic the changes that take place in the *megalodon* lineage. Thus, an adult shark in the late Oligocene will possess similar teeth to a young or adolescent shark in the Late Miocene. This leads to a conflict in nomenclature.

In the Middle Miocene the juvenile dentition of an individual shark may be referred to as *C. angustidens* (Agassiz 1843) or *C. turgidus* (Agassiz 1843) while the teeth retain their lateral cusps. They may be called *C. chubutensis* (Ameghino 1906) *C. polygyrus* (Agassiz 1843) or *C. subauriculatus* (Agassiz 1843), whilst the teeth are losing their denticles, and become *C. megalodon* once the denticles are fully lost. Thus, using purely tooth morphology, a shark may produce teeth of several different "species" during its lifetime. This is a nonsensical situation, but can be remedied by applying a name only to the adult morphology in any one formation; albeit difficult if the material is scarce. This was the

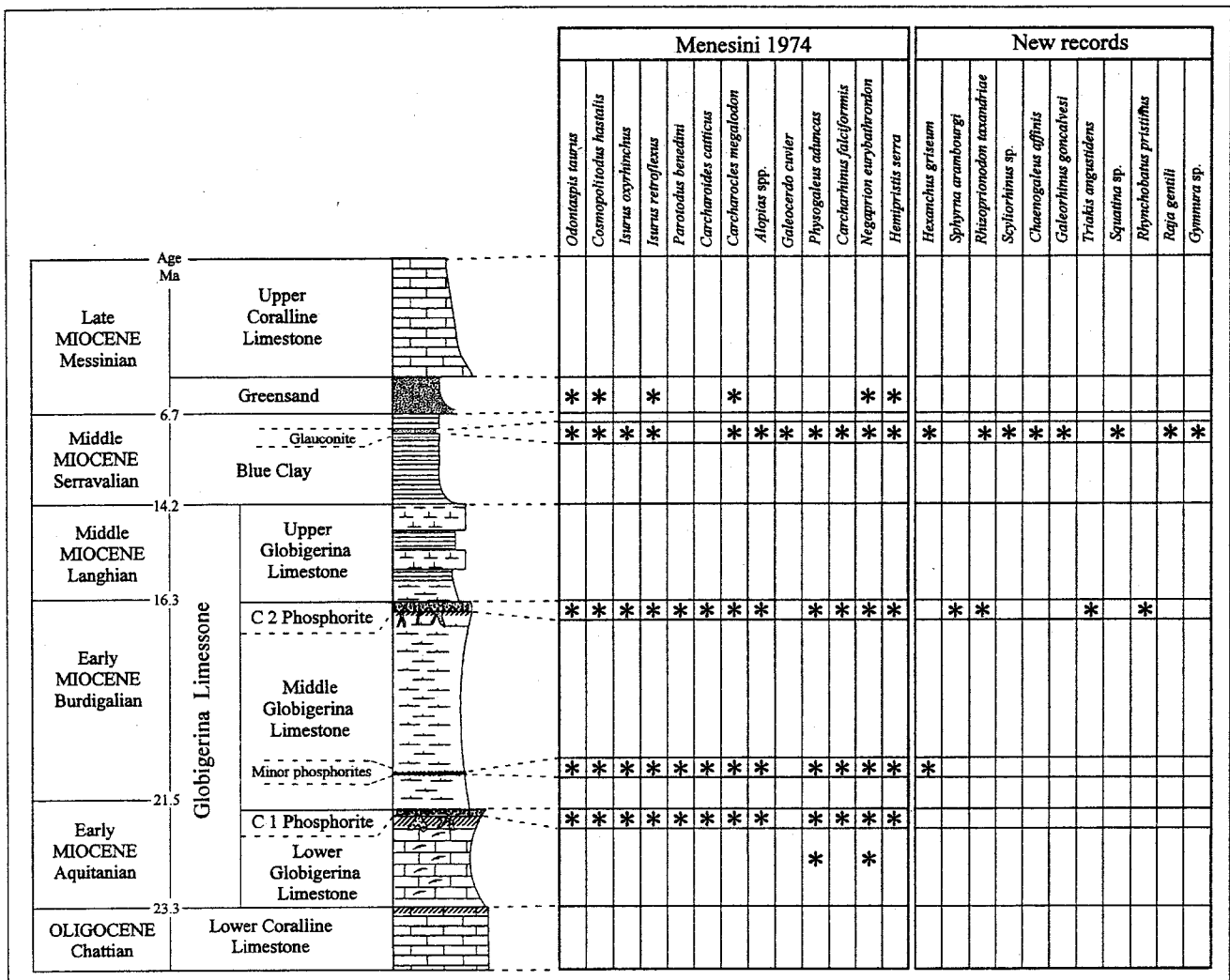


Fig. 3. Provisional distribution of sharks and rays in the Maltese stratigraphical column

enlightened approach taken by Menesini (1974: 137), one of the first palaeoichthyologists to recognise the importance of ontogeny in *megalodon* tooth morphology. She rejected Leriche's assertion, that *megalodon* could only be characterised by the absence of lateral cusps (Leriche, 1926: 418; Menesini, 1974: 138).

When one removes the confusion caused by the plethora of nominal morphospecies, it appears unlikely that there was ever more than one species of *Carcharocles* at any time, worldwide. It is difficult to conceive more than one giant shark in any habitat, and the fossil evidence does not contradict this. Thus, from the development of serrated teeth in the mid-late Ypresian, Early Eocene, to its eventual extinction in the early Pliocene, the *Carcharocles* lineage could be regarded as a single species, or any number of chrono species. Which approach one takes, makes very little difference to our overall concept of *Carcharocles*.

Genus *Alopias* Rafinesque 1810

Alopias sp.
Thresher shark

Material & Provenance: see Menesini (1974).

Remarks: The teeth figured by Menesini (plate 4, 7-14) are fragmentary, and difficult to interpret. The stouter specimens figured as *Alopias latidens* (Leriche 1908) (plate 4, figs 7-11) could represent *Alopias vulpinus*. The more gracile fragments listed as *A. exigua* (Probst 1879) (plate 4, figs 12-14) are most probably those of *Alopias superciliosus*.

A. latidens appears to be a member of an extinct lineage with extremely wide teeth, whereas "*Alopias exigua*" of authors usually appears to be a mixture of *Alopias vulpinus* and *Alopias superciliosus*. It is certainly likely that two, perhaps three, species of *Alopias* were present in the Miocene of Malta. More complete material is needed to confirm this.

Genus *Galeocerdo* Müller & Henle 1837

Galeocerdo cuvier Peron & LeSueur 1822
Tiger shark

Synonymy: 1974 *Galeocerdo aduncus* (Agassiz 1843), Menesini, p. 142, pl. 7, fig. 3, (non 1, 2, 4-6)

Material & Provenance: see Menesini (1974, pl. 7, fig. 3), from the glauconite horizon within the Blue Clay— see Menesini (1974: 123).

Remarks: Of the teeth figured by Menesini, all but this fall into "*Galeocerdo*" *aduncus*/*contortus* grouping, referred below to *Physogaleus*. The teeth figured as *G. aduncas* from the Miocene of southern France by Cappetta (1970, pl. 12) are also *Galeocerdo cuvier*-lineage. Teeth of *Galeocerdo* and (presumed) upper teeth of *Physogaleus* (see discussion below) are difficult to separate from published figures. However, teeth figured as "*Galeocerdo* sp" by Purdy et al. 2001 appear to be a mixture of *Galeocerdo cuvier* and *Physogaleus aduncus*.

Genus *Physogaleus* Cappetta 1980

Physogaleus aduncus (Agassiz 1843) comb. nov.
No vernacular name

Synonymy: 1849 *Galeocerdo contortus* Gibbes, p. 191, pl. 25, figs 71-74.

1904 *Galeocerdo triqueter*, Eastman, p. 89, pl. 32, fig. 12

1942 *Physodon triqueter* Eastman: Leriche, p. 79

1974 *Galeocerdo aduncus* (Agassiz 1843), Menesini, p. 142, pl. 7, figs 1, 2, 4-6, (non 3)

2001 *Megachasma* sp, Purdy et al. p. 105 fig. 21, i-m.

Material & Provenance: see Menesini (1974, p. 142)

Remarks: Apart from *Galeocerdo cuvier* Péron & Lesueur 1822, there are two teeth of *Galeocerdo*-like morphology present in the Maltese material. The first, similar to Recent *Galeocerdo*, with a broad distally directed cusp, and coarsely serrated distal shoulder is normally termed *Galeocerdo aduncas*. The second has a narrower, more apically directed and slightly twisted cusp and finer distal serrations. There is a very large lingual protuberance and a flat basal surface to the tooth. This second morphology is usually referred to as *Galeocerdo contortus* Gibbes. In my experience (DJW), these two morphologies usually occur together, there are no exceptions that I am aware of. It seems reasonable to regard them as either the product of dignathic or gynandric (sexual) heterodonty in a single species. This was also the opinion of Applegate (1978: 59) but rejected by Purdy et al. who regarded them as separate species.

Cappetta (1980: 37) combined three Eocene species, *Physodon secundus* Winkler 1874, *Physodon tertius* Winkler 1874 and *Galeorhinus minor* Agassiz 1835 into a single species of a new genus, *Physogaleus*. This was characterised by a strong dental sexual dimorphism, particularly marked in the anterior files of the lower jaw. Males have strongly mesio-distally compressed lower teeth with tall thin backwardly-directed slightly sigmoidal crowns. Upper teeth are wider and more *Galeorhinus*/*Galeocerdo*-like. Winkler's (1874) types of "*Trigonodus secundus*, two small lower anterior teeth, are not lost, as inferred by Purdy et al 2000, they are present in the collections of the 'Musée royale d'Histoire naturelle de Belgique, in Brussels, and were figured by Leriche (1905, plate 8, figs 10, 11.)

Teeth of "*Galeocerdo*" *aduncus* (including "*G.*" *contortus*) are remarkably similar to those of the Eocene species of *Physogaleus*, sufficiently similar to be referred to

Physogaleus. Both the "*aduncas*" and "*contortus*" morphologies can be seen in middle Eocene teeth of *Physogaleus secundus*. They differ in having fine serrations superimposed on the larger serrae on the distal, and lower half of the mesial cutting edges. This character is present in *contortus*, *aduncus* and *cuvier*. The presence of compound serrae could be interpreted as an important character linking these three nominal species. However, complex serrae have appeared in several relatively unrelated lineages and are occasionally present in species of *Carcharhinus* including *C. plumbeus* (Nando, 1827), *C. leucas* (Valenciennes 1839), *C. obscurus* (Lesueur 1818), *C. perezii* (Poey 1876), *C. falciformis* (Bibron 1839) and *C. brachyurus* (Günther 1870) (Jim Bourdon, written comm.)

In both *Galeocerdo* and *Physogaleus*, the dentition is imbricate. That is, the teeth in the files on either side of a particular position, are slightly labial or lingual to it, and overlap its margins, much like fish scales or roof tiles. In *Galeocerdo* overlap only occurs when the teeth are in occlusal position. However, in *Physogaleus* the imbrication, particularly in the lower jaw, is far more developed. This would suggest that, unlike *Galeocerdo*, that has a wide U-shaped slicing jaw, *Physogaleus* had a more V-shaped, pointed, grasping jaw.

The presumed upper teeth of *Physogaleus aduncus* can be separated from those of the Recent *Galeocerdo cuvier* by their more rounded, less stocky and angular roots, more arcuate, less angular root lobe separation. Purdy et al (2001: 146) regarded "*Galeocerdo*" *aduncas* (regarded as a separate species from *G. contortus*) as a *nomen dubium*. This was because Agassiz's holotype of *G. aduncus* is presumed lost and it is not possible from his figure to distinguish it from young specimens of *Galeocerdo cuvier*. We accept this point, but feel that, with the characters mentioned above, it is easy to separate these two nominal species. Thus, we regard the name *aduncas* as available for the combined species. From a total-dentition perspective, *Galeocerdo* has a broadly homodont dentition, whilst *Physogaleus* has a strongly heterodont dentition, a condition seen on no fossil or Recent species of *Galeocerdo*. The teeth figured as *Megachasma* sp. by Purdy et al (2001: fig. 21, i-m) would appear to be stocky parasymphyseal or symphyseal teeth of the "*contortus*" morphology, referred here to the lower jaw of *P. aduncus*. Many we have examined, as possible *Megachasma*, exhibit fine serrae on the mesial cutting edge.

Genus *Carcharhinus* Blainville 1816

Carcharhinus falciformis (Bibron 1839)
Silky shark

Synonymy: 1974 *Carcharhinus egertoni*, Menesini (1974, plate 7, figs 11-14).

Material as above.

Provenance: Glauconite horizon within the Blue Clay - see Menesini (1974: 123).

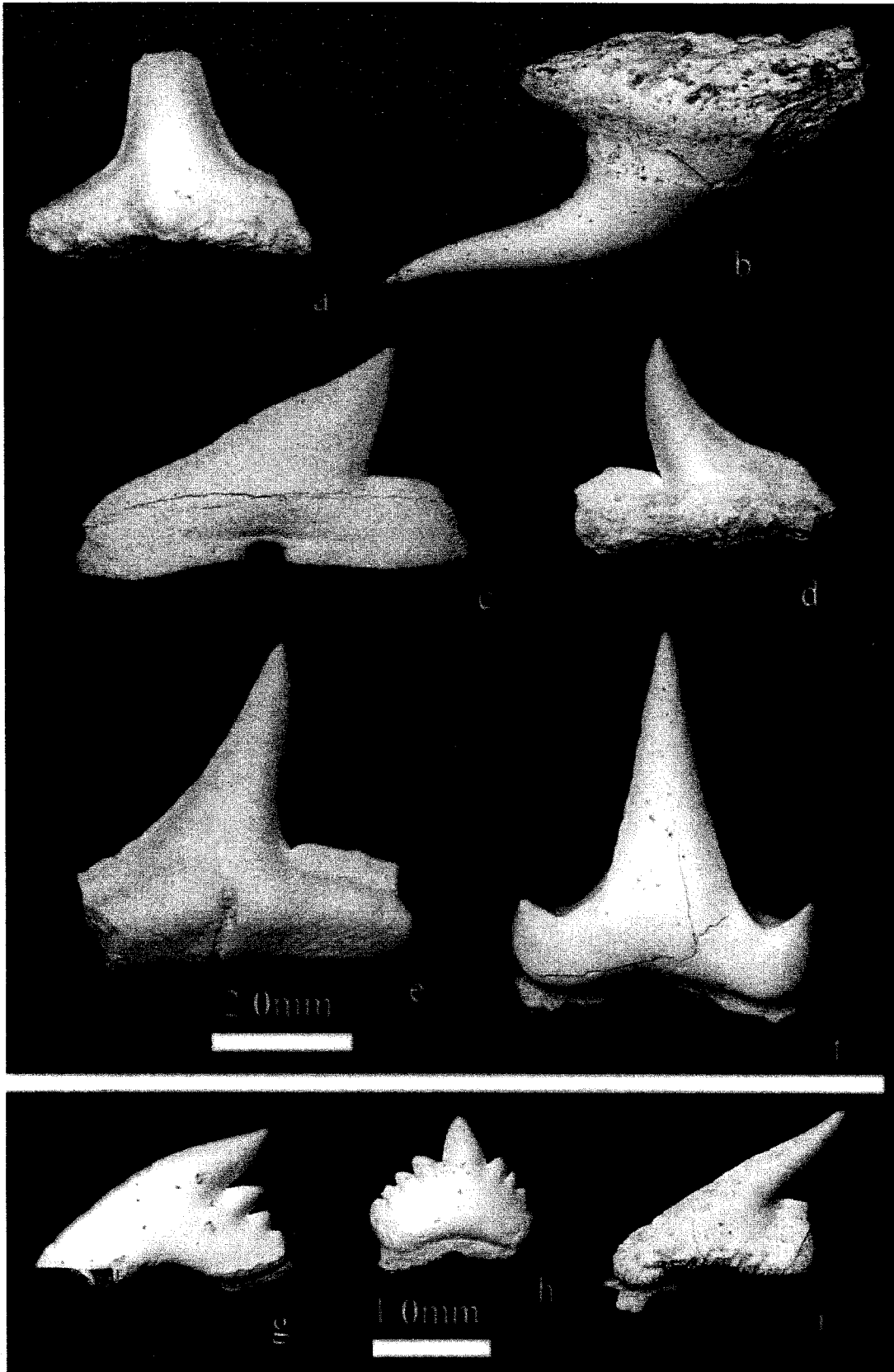


Plate 1. (a) *Squatina* sp.; (b) *Hexanchus griseus*; (c) *Sphyrna arambourgi*; (d, e) "*Rhizoprionodon*" *taxandriae*; (f) *Chaenogaleus affinis*; (g, h) *Galeorhinus gonzalvesi*; (i) *Triakis angustidens*.

Remarks: *Carcharhinus egertoni* Agassiz 1843 tends to be used as a "dustbin" species for Miocene teeth of *Carcharhinus*. Purdy *et al* (2001: 151-152) suggest that one of Agassiz's two type specimens of *Carcharhinus egertoni* is referable to the Recent species *Carcharhinus brachyurus* (Günther 1870) (Agassiz, 1843, pl. 36, fig. 6) and the second to *Carcharhinus leucus* (Valenciennes 1839) (Agassiz, 1843, pl. 36, fig. 7). This is indeed possible, but we feel it more likely that both are teeth of *C. leucus*. The first specimen, appears to be a tooth from the right upper ? 4th or 5th row. Teeth of *Carcharhinus brachyurus* tend to have narrower crowns with a more distinct mesial and distal notch. It is very likely that several other species of *Carcharhinus* are present in the Maltese Miocene.

Genus *Negaprion* Whitley 1940

Negaprion eurybathrodon (Blake 1862)
Lemon shark

Synonymy: 1970 *Negaprion kraussi* (Probst): Cappetta, p. 52, pl. 15, figs 1-10, 12, 14-17 non 11, 13.
1974 *Hypoprion acanthodon* (Le Hon): Menesini, p. 148, pl. 4, figs 15-22.
1974 *Carcharhinus egertoni* (Agassiz): Menesini, p. 144, pl. 7, figs 7-10, 15.
1974 *Sphyrna prisca* Agassiz: Menesini, p. 152, pl. 7, figs 17-19.

Material & Provenance: Menesini (1974, pl. 4, figs 15-22; pl. 7, figs 7-10, 15, 17-19)

Remarks: Purdy *et al* (2001) suggest that the fossil species *Negaprion eurybathrodon* might be the senior synonym of the Recent Lemon shark, *N. brevirostris*. From looking at the Maltese specimens figured by Menesini, and Recent jaws of *N. brevirostris*, this would appear to be quite likely.

Genus *Hemipristis* Agassiz 1843

Hemipristis serra Agassiz 1843
Snaggletooth shark

Synonymy, material & provenance: see Menesini (1974, p. 132-134)

Remarks: *Hemipristis serra* teeth from Malta are quite typical and unlikely to be mistaken for any other species. The teeth of *H. serra* have an orthodont histology, a hollow pulp canal in the centre of the crown surrounded with parallel orthodont fibres, with an osteodentine root. This is the normal condition in carcharhinid sharks and some orectolobiforms. The Recent *H. elongatus* (Klunzinger 1871) is said to have an osteodont crown, the crown filled by osteodentine (Compagno, 1973, pl. 1; 1984: 171.) In fossil and Recent specimens one of us (DJW) has examined, this is usually the case. The trend in Neogene fossil shark studies is to recognise extant species from the Miocene to Recent. Because of these histological differences, we feel that the existing *status quo*; a separate species for the Miocene *Hemipristis* is justified at present.

Genus *Sphyrna* Rafinesque 1810

Sphyrna arambourgi Cappetta 1970
Hammerhead shark
Plate 1, fig c.

Material: one tooth.

Provenance: C2 Phosphorite, Ras ir-Reqqa.

Remarks: The single Maltese tooth falls within the range of variation of those described by Cappetta (1970, pl 19, figs 1-18) as *Sphyrna arambourgi* Cappetta 1970. Of the Recent species examined, these and the Maltese specimen most closely resemble teeth of *Sphyrna lewini* (Griffith & Smith 1834). There is no differentiated mesial heel, a triangular, distally directed crown and low distal cusplet separated from the crown by a distinct notch. The labial crown does not overhang the root. The cutting edge of the crown is unserrated. Teeth of Recent Hammerheads range from having serrated crowns (*S. couadi* Cadinat 1950, *S. tudes* (Valenciennes 1822)), weakly serrated (*S. leweni* (Griffith & Smith 1822), *S. zygena* (Linnaeus 1758)) and unserrated (*S. corona* Springer 1940, *S. media* Springer 1940, *S. tiburo* Recent species with weakly serrated crowns tend only (Linnaeus 1758)), to show fine serrations in larger (= older) individuals (pers. obs. – DJW).

Genus *Rhizoprionodon* Whitley 1929

"*Rhizoprionodon*" *taxandriae* (Leriche 1926)
Sharpnose shark
Plate 1, figs. d, e.

Material: Two teeth.

Provenance: Blue Clay at Ras il-Karraba; C2 phosphorite, Ras ir-Reqqa (Gozo).

Remarks: The morphology of the teeth of *Scoliodon*, *Loxodon*, most species of *Rhizoprionodon* and some unserrated species of *Sphyrna* species are so similar as to be virtually indistinguishable, so the referral of this species to *Rhizoprionodon* is tentative.

Genus *Scyliorhinus* Blainville 1816

Scyliorhinus sp
Catshark
Plate 2, fig. a.

Material: One tooth.

Provenance: Glauconite horizon within the Blue Clay, In-Nuffara, Gozo.

Remarks: The single, incomplete tooth has a crown bearing a series of fine, apically anastomosing striae. There are two mesial lateral cusplets, the larger striated, and a single striated distal cusplet. The root is incomplete. Despite the important work of Herman *et al.*, (1990), in illustrating Recent sharks'

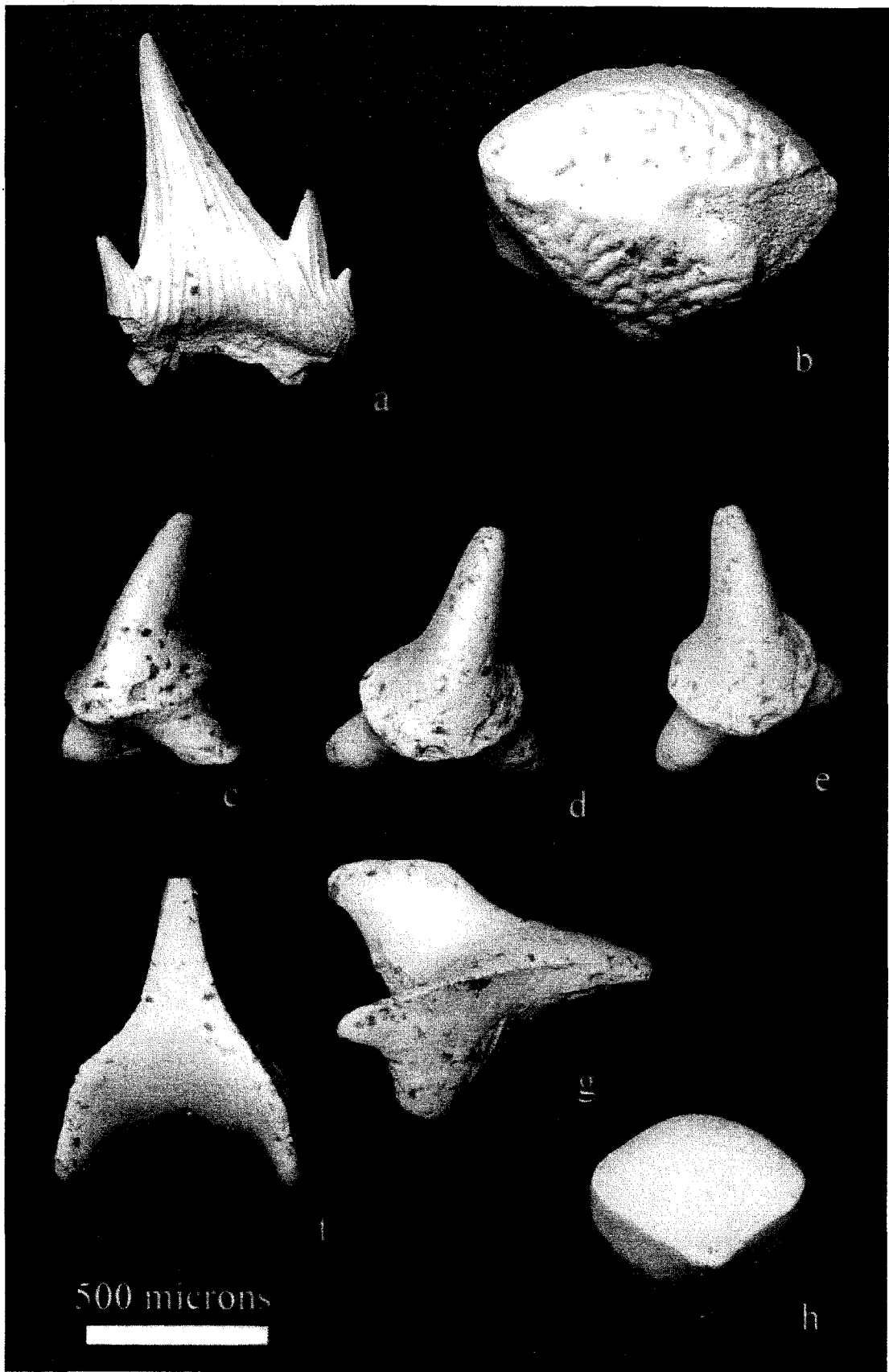


Plate 2. (a) *Scyliorhinus* sp; (b) *Rhynchobatus pristinus*; (c - e, h) *Raja gentili*; (f, g) *Gymnura* sp.

teeth, our knowledge of the specific and generic variation in the family Scyliorhinidae is sparse. This specimen bears a close resemblance to teeth of *Scyliorhinus torazame* (Tanaka 1908) figured by Herman *et al.*, (1990), but could equally belong to several other genera. Its referral to the genus *Scyliorhinus* must be provisional. It is easily separated from the Miocene species *Scyliorhinus distans* (Probst 1879) whose distal cusplets are larger and much more separate from the principal cusp. This tooth appears to be identical to that of *Scyliorhinus* sp. figured by Cappetta & Nolf (1991, pl. 3, fig. 3) from the Early Pliocene of southern France.

Genus *Chaenogaleus* Gill 1862

Chaenogaleus affinis (Probst 1879)

Hooktooth shark

Plate 1, fig. f.

Material: One tooth.

Provenance: Glauconite horizon within the Blue Clay, Nuffara, Gozo

Remarks: *Chaenogaleus affinis* is a fairly common species in the Miocene of the Mediterranean having been recorded from the south of France and Portugal (Cappetta, 1970; Antunes & Jonet, 1970). The upper teeth are *Galeorhinus*-like, with which they are usually confused, but lack a bulge in the enamel of the base of the labial crown. The lower teeth were described as *Scyliorhinus joneti* by Cappetta (1970) (Antunes *et al.*, 1999).

Genus *Galeorhinus* Blainville 1816

Galeorhinus goncalvesi Antunes, Balbino & Cappetta 1999

Tope

Plate 1, figs g, h.

Material: Two teeth.

Provenance: Glauconite horizon within the Blue Clay, In-Nuffara, Gozo and at Ras il-Karraba – Malta.

Remarks: Herman *et al.* (1988) figured teeth of the Recent *Galeorhinus galeus*. The two Maltese teeth correspond very closely with these teeth and those in Recent jaws from the North Sea (DJW Coll.) The specimen in Plate 1 fig. g is a right upper lateral, whilst Plate 1 fig. h is a lower left parasymphyseal tooth.

In *Galeorhinus* parasymphyseal teeth have their crowns directed mesially, not distally. However recently Antunes *et al.* (1999) published a description of a new species of *Galeorhinus*, *G. goncalvesi*, from the late Miocene of Portugal. It is separated from the Recent *G. galeus*, by the rather more inflated labial crown base. The Maltese teeth show this same feature, especially the parasymphyseal, so we have referred the Maltese specimens to this species. Antunes *et al.* (1999) admit that this species is very close to the Recent *G. galeus*, so it may later transpire that it falls within the

intraspecific variation and thus the synonymy of *G. galeus*. It is noteworthy that this temperate species is found in the cooler waters of the late Miocene.

Genus *Triakis* Müller & Henle 1838

Triakis angustidens Cappetta 1973

Houndshark

Plate 1, fig. i.

Material: One tooth.

Provenance: C2 phosphorite, Ras ir-Reqqa.

Remarks: This single small tooth corresponds with those figured by Cappetta (1973: 216, pl 12), from the Early Miocene of southern France, and probably from southern Portugal (Cappetta & Nolf, 1991: 59). It differs from the Early Pliocene *T. costamagnai* Cappetta & Nolf, 1991, by having a more lanceolate cusp and a more plicated labial crown base. Lateral teeth of *T. costamagnai* resemble those of the Recent species *Iago omanensis* (Norman 1939), but differ by the taller, more erect anterior teeth.

Genus *Squatina* Blainville 1806

Squatina sp.

Angel shark

Plate 1, fig a.

Material: one tooth.

Provenance: Glauconite horizon within the Blue Clay, Ras il-Pellegrin, Malta.

Remarks: Cappetta (1970: 77) used the species, *Squatina subserrata* Münster 1846 for specimens from southern France. The single *Squatina* tooth from Malta falls within the range of specific variation of *S. subserrata*, recorded from the Miocene of southern France (Cappetta, 1970: 77). However it also falls within the range of specific variation of almost all other Cenozoic species of *Squatina*. There are three Recent species of *Squatina* inhabiting the Mediterranean, whose teeth to are inseparable (DJW pers. obs.). Accordingly we feel that there is little value in appending a species that cannot be confidently separated from others within the genus.

Genus *Rhynchobatus* Müller & Henle 1837

Rhynchobatus pristinus (Probst 1877)

Guitarfish

Plate 2, fig. b.

Synonymy: 2001 *Rhinobatos* sp. Purdy *et al.* fig. 7d (prob. non e)

Material: One tooth.

Provenance: C2 phosphorite, Ras ir-Reqqa.

Remarks: *Rhynchobatus pristinus* is a common species in the Miocene of the Mediterranean area (Cappetta 1987: 134).

It is also common in the Miocene of N. Carolina, USA where it was figured as *Rhinobatos* sp. by Purdy *et al.* 2001. In teeth of *Rhinobatos*, the enameloid of the occlusal surface is usually smooth and there is a large lingual uvula, whereas in *Rhynchobatus*, the occlusal surface is usually ornamented with enameloid granules and the uvula is small and triangular.

Genus *Raja* Linnaeus 1758

Raja gentili Joleaud 1912

Skate

Plate 2, figs. c-e, h.

Material: Two teeth.

Provenance: Glauconite horizon within the Blue Clay, Nuffara, Gozo

Remarks: The two Maltese specimens of *Raja* correspond reasonably well with the somewhat battered teeth figured by Leriche (1927, pl. 5, figs 16-18) as *Raja gentili*. The low-crowned female tooth (Plate 2, fig. h) also corresponds well with those figured by Cappetta (1970, plate 20, figs 28-31) from southern France. A second species similar to *Raja olisiponensis* (Jonet 1968), from the Portuguese Miocene, (originally described as *Narcine*), is recorded from the Pliocene of southern France by Cappetta & Nolf, 1991. The tall-crowned male teeth are similar to those of *Raja gentili*, however the female teeth are quite different, possessing a wide, slightly domed, occlusal surface and a small lingually directed cusp reminiscent of the fossil rhinobatoid genus *Squatirhina*.

Genus *Gymnura* Van Hasselt 1823

Butterfly ray

Gymnura sp.

Plate 2, figs. f, g.

Material: One tooth.

Provenance: Glauconite horizon within the Blue Clay, Nuffara, Gozo

Remarks: Teeth of *Gymnura*, are common in the Miocene of southern France, although because of their small size, they are not usually recorded. They were described and figured, as *Pteroplatea*, a junior synonym, by Cappetta (1970: 102, pl. 20, figs 17-25).

Genus *Myliobatis* Cuvier 1817

Myliobatis sp.

Eagle ray

Material: One fragmentary tooth in the collections of the Department of Palaeontology of the Natural History Museum, London, listed by Woodward (1889:120) number 1862. A large specimen is exhibited at the National Natural

History Museum at Mdina; a second, a third and a fourth are known in separate private collections and a fifth tooth is in the private collection of the second author (CGB).

Provenance: Unknown: "... from the island of Gozo"; the second and third teeth both come from the lowermost Upper Coralline Limestone of Gnejna ; the fourth from C2 at Bahrija; the fifth tooth from the Greensand at Rdim il-Hmar.

Remarks: Teeth of *Myliobatis*, are extremely uncommon in the Miocene of Malta, despite their large size. In collections of isolated teeth of "*Myliobatis*" it is often possible to find teeth of the rays *Pteromylaeus* and *Rhinoptera*. Adams (1870) lists *Myliobates toliapicus* as occurring in the Greensand, the Blue Clay and in the Lower Coralline and with some doubt as to identification at genus level, from the *Globigerina*.

PALAEOECOLOGY

The larger species of lamniforms (*Carcharocles*, *Cosmopolotodus*, *Isurus Parotodus* and *Alopias*) as well as some carcharhinids (*Hemipristis*) are pelagic species and have a global distribution in the Miocene. With the limited material at our disposal, it is difficult to say anything significant about the smaller shark and ray species recovered. They are consistent with Miocene faunas elsewhere and, with their small numbers tell us little about the environment, other than that it was warm temperate to sub-tropical and relatively productive.

No deepwater species have been found, i.e. *Isistius*, *Centrophorus*, *Deanea Hepranchias* *Megascyliorhinus* or *Megachasma* which is consistent with deposition on a relatively shallow carbonate platform. One thing that is quite interesting, and cannot be immediately explained, is the great scarcity of *Myliobatis* and *Aetobatis* tooth-plates and the lack of *Rhinoptera* and *Plinthicus* material. The absence of small *Manta* ray teeth, which are common in southern France, could be a collecting artefact. Devil ray teeth are small and may turn up in future samples

CONCLUSIONS

By bulk sampling and by taxonomic revision, the fossil sharks and rays from the Miocene of Malta has been increased from 13 to 24 species in total. Several genera, *Alopias* and *Carcharhinus* in particular, would benefit from a closer examination and could certainly yield more species. The fact that most of the small batoids and some of the smaller carcharhinid sharks are represented by single specimens shows that more intensive bulk sampling would be most valuable. This was only intended to be a feasibility study, however the results were so promising that it was thought important to publish the results as they stood, and then proceed with a more comprehensive investigation.

The Maltese fossil shark and ray fauna recovered is very similar to that recorded from southern France by Cappetta (1970) and Portugal (Jonet, 1966; 1968; 1978; 1981). This is

principally because there are very few comparable shark and ray faunas where the smaller elements, particularly rays, have been described. The Miocene fauna of North Carolina (Purdy *et al.*, 2001) contains many pelagic elements in common with the Maltese fauna, particularly the larger lamniforms (*Carcharocles*, *Parotodus* and *Alopias*) as well as some carcharhinids (*Hemipristis*). It is likely that many of the smaller sharks and rays will prove to be different, reflecting the current pattern of species distribution.

ACKNOWLEDGMENTS

We would like to thank Mr Arie W. Janssen (Xewkija, Gozo) for assistance in the field and for help with the stratigraphy

and bibliography. Dr Noel Morris (NHM, London) also kindly helped procure photocopies of some of the more obscure references. Mr Jim Bourdon (Croton-on-Hudson, USA) contributed to the discussion on *Physogaleus* and shared with me some of his knowledge of *Carcharhinus*. Dr Mikael Siverson (University of Lund, Sweden) assisted us with some of the more controversial systematics. The scanning electron micrographs were made with the assistance of Dr. Ian Skipper, University of Greenwich. The manuscript was greatly improved by the comments of the Editor and anonymous reviewer(s) whose time and efforts are greatly appreciated

(Accepted 20th December 2001)

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SHORT COMMUNICATIONS

New records for the Maltese flora: *Pancratium foetidum* Pomel (Family: Amaryllidaceae)**Edwin Lanfranco^{1*} and Hubert J. Spiteri²**

The genus *Pancratium* is represented in the Maltese flora by *P. maritimum* L., typical of coastal sands. This was first recorded by Zerafa (1831). Brenner (1838) records *P. illyricum* L. from sandy beaches (presumably Ramla) in Gozo. In this he was followed by Grech Delicata (1853) who cites both species and giving the latter from Ramla in Gozo, and as flowering in August/September. But, as Sommier & Caruana Gatto (1915) correctly state, true *P. illyricum* flowers in spring and is not a sand-dwelling species. The record of *P. illyricum* can therefore be attributed to confusion with *P. maritimum*, a typical species of coastal sands which flowers in summer.

On the 30th September 1963, one of us (HJS) encountered an unusual *Pancratium* in Mellieha Bay and collected some material for cultivation. This however failed to flower regularly, the last flowerings being in 1995 and 2001. This species has now been identified as *P. foetidum* Pomel, native of NW Africa, from Morocco to Libya (El Gadi, 1978). Although this latter species is vegetatively similar to *P. maritimum*; so that the two species are indistinguishable in the field when not in flower/fruit, they can be readily separated when flowering/fruitletting. Thus the flowers of *P. foetidum* are considerably smaller than those of *P. maritimum* while the flowers are ill-smelling in contrast with the fragrant flowers of *P. maritimum*. In Malta, *P. foetidum* flowers mainly in Late September and October while *P. maritimum* flowers mainly in summer with only a brief overlap in the flowering period between the two species. *P. foetidum* has stamens about equal to the coronal teeth while in *P. maritimum* these are longer. The fruit in *P. foetidum* is oblong in contrast to the subglobular fruit of *P. maritimum* and carries much smaller seed.

It is unlikely that this species is introduced and it has probably been overlooked because of the identical vegetative habit and rarity of flowering. The original site from where the plants were collected no longer exists since a road has been constructed right through. Nevertheless, since it is easily overlooked, it is not unlikely that it still exists in the wild. Since there is material in cultivation, it is possible to plan a recovery program to reintroduce it in the wild.

Live material is deposited in the collection of HJS while herbarium material is deposited in the private herbarium of EL.

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(Accepted 30th October 2001)

New records for the Maltese flora: *Centaurea acaulis* L. (Family: Asteraceae)**Rita Buttigieg³ and Edwin Lanfranco^{1*}**

Centaurea acaulis L. is native to Tunisia and Algeria (Pottier-Alapetite, 1981) and is also known to occur in Lampedusa, one of the Pelagian Islands, 210km south of Sicily, 128 km from the Tunisian coast (Bartolo et al. 1988) and 150 km from Malta (Sommier, 1908), and in the north of Spain (Guinea Lopez & Ceballos Jimenez, 1974). In the February of 2001, one of us (RB)

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encountered a population of this species in leaf on the Nuffara plateau in Gozo. This flowered in the second week of April (Buttigieg, 2001). This population occurred in a rocky steppe community. The chief accompanying species were *Oxalis pes-caprae* (which had dried up by the time *C. acaulis* was in flower), *Psoralea bituminosa*, *Stipa capensis*, *Carlina involucreta*, *Mercurialis annua*, *Silene colorata*, *Calendula arvensis*, *Convolvulus althaeoides*, *Lagurus ovatus*, *Sonchus oleraceus*, *Ferula communis* and *Galactites tomentosa*, thus a mixture of typical steppic elements and opportunistic species of disturbed ground indicating the somewhat degraded nature of the site. The soil in the area where *C. acaulis* was found was alkaline with a pH of 8.1, the highest recorded on the plateau, the minimum recorded being 7.7 (Buttigieg R., *op. cit.*). Although confined to this part of the plateau, the population was quite large, including over a hundred flowering individuals as well as numerous non-flowering specimens and covering an area of some 30m². The impression was that the population must have been established for a considerable time.

The first record for Lampedusa was provided by Sommier (*op. cit.*), who states that it was brought to his attention in 1907 but to have been introduced about twenty years before that date. Although the extra-African populations are reputed to be introduced (Sommier, *op.cit.*, Guinea Lopez & Ceballos Jimenes, *op. cit.*), it is possible that in the case of the Maltese islands and Lampedusa the relatively recent appearance may be a case of natural range extension due to the close proximity to Tunisia where it is common (Pottier-Alapetite, *op.cit.*). It may also have been introduced with bird-seed imported from Tunisia for use by trappers.

A voucher specimen is deposited in the private herbarium of EL.

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(Accepted 30th October 2001)

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