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THE THORACICAN BARNACLES (CIRRIPEDIA: THORACICA) OF THE MALTESE ISLANDS AND SURROUNDING WATERS (CENTRAL MEDITERRANEAN)

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ABSTRACT

Thoracican cirripedes collected from the Maltese Islands and their coastal waters were identified. Based on these collections and on a critical review of the literature, a total of 19 species belonging to four families are listed. Eight species are new records. A key to the local species, excluding the doubtful records, is given. Ecological and taxonomic notes on some of the species are also provided.

INTRODUCTION

Records of cirripedes (barnacles) from the Maltese Islands are limited mainly to more or less incidental mention in general studies on the Maltese marine fauna.The earliest record is that of Gulia (1858-1859), who mentioned only one species and gave some information on the morphology of this barnacle and on its habitat. Later, Mamo (in Caruana, 1867) recorded 12 species of barnacles belonging to six genera. However, for some of these records it is not possible to identify to which species the names used by Mamo correspond. Such names include *Balanus intermedius* Phil., *Balanus tulipa* Ranz., *Cineras coriacea* Poli, *Otion auritus* Linnaeus, *Anatifa laevis* Brug. and *Coronula bissexlobata* Blainv. These records are not considered further in the present work.

More recent records are those of Micallef & Evans (1968) in their general list of the Maltese marine fauna. Six species of thoracican barnacles belonging to three families, as well as a species of the Order Rhizocephala (*Sacculina carcini* Thompson) are recorded. Apart from the species name, no other information is given. Micallef & Evans' identifications were based on the semi-popular identification guide of Riedl (1963) and are not considered reliable.

Gramentz (1988), in his study on the epibionts of the turtle *Caretta caretta* in Maltese waters, recorded three species of lepadomorphs and three species of balanomorphs, and provided data on their abundance. Another species of Lepadomorpha was recorded by Lanfranco (1979) as an epibiont of the turtle *Dermochelys coriacea*.

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The present study collects and organizes this scattered information and provides an updated list of published records, confirming some and pointing out possible past misidentifications. Additionally, a large number of barnacles were collected from the seas surrounding the Maltese Islands. These specimens, together with others from a number of collections, were identified, adding previously unreported species to the Maltese list.

MATERIALS

A catalogue of the material examined and details of its provenance are given in the species list which follows. Identification of the species was based mainly on the structure and morphology of the shell and use was made of the key to the thoracican cirripedes of Italian coastal waters by Relini (1980). Difficult species were identified by Prof. Giulio Relini of the University of Genoa, Italy. Previously recorded species, specimens of which have not been seen in this study, are also included in the list, unless there are strong doubts about their actual identity.

The material examined in the present study was collected from the Maltese Islands and surrounding waters by the following persons who are identified by their initials (in parentheses) in the species list: J.A.Borg (JAB), E. Lanfranco (EL), A. Mallia (AM), C. Mifsud (CM), S. Jones (SJ), M. Rizzo (MR), P.J. Schembri (PJS) and P. Vella (PV). Most of the material examined is presently housed in the reference collections of the Department of Biology of the University of Malta.

SPECIES LIST

The following list gives the name of the species, previous records from the Maltese Islands, the material examined during the present study, and general comments where necessary, in that order. The locality and habitat where the specimens were collected, as well as the date of collection are also given where available. All localities mentioned are in the island of Malta unless otherwise stated. A key to the local species is also given.

Family : Chthamalidae Darwin 1854

Euraphia depressa (Poli 1791) [Figure 1A]
[= *Chthamalus depressus* (Poli 1791)]

Chthamalus (lepas) depressus Polii [sic!]: Mamo (in Caruana, 1867)

This species was identified from abundant material collected from the littoral zone of the following shores: Bahar ic-Caghaq; Cirkewwa; Delimara; Marsascala;

Mistra; Qawra; Hondoq ir-Rummien (Gozo); Qbajjar (Gozo); Zewwieqa (Gozo) [all M.R.] 5 specimens: Malta (no other data available) [AM].

Chthamalus stellatus (Poli 1791) [Figure 1B]

Chthamalus (lepas) stellatus Poli [sic!] : Mamo (in Caruana, 1867)
Chthamalus stellatus (Poli) : Micallef & Evans (1968)

This species is widespread in the Maltese Islands and abundant material from the littoral zones of the following shores was examined: Bahar ic-Caghaq; Cirkewwa; Delimara; Gnejna; Kalanka tat-Tumbrell; Manoel Island; Marsascala; Mistra; Qawra; Ta' Xbiex; Wied il-Buni; Hondoq ir-Rummien (Gozo); Qbajjar (Gozo); Zewwieqa (Gozo) [all MR]. A number of specimens from Rdum Rxawn (no other data available) [PV] were also examined.

Chthamalus montagui Southward 1976 [Figure 1C]

New record (?)

Abundant material from rocky shores in the following localities was examined: Bahar ic-Caghaq; Cirkewwa; Delimara; Gnejna; Kalanka tat-Tumbrell; Manoel Island; Marsascala; Mistra; Qawra; Ta' Xbiex; Wied il-Buni; Hondoq ir-Rummien (Gozo); Qbajjar (Gozo); Zewwieqa (Gozo) [all MR]. Since this species is so widespread, it was possibly misidentified in earlier literature.

Although Dando (1987) reported that he had collected this species from Malta, its presence was never confirmed. Dando (1987) stated that the *C. montagui* collected by him were intermediate between 'Atlantic' and 'Mediterranean' forms in the frequencies of phosphoglucomutase alleles. The 'Atlantic' and 'Mediterranean' forms of *C. montagui* differ in the allele ratio of the enzymes phosphoglucomutase and phosphoglycerokinase and there are also slight differences in shell morphology. It has been suggested that two sibling species may be present. According to Dando (1987), the Maltese population is either an odd isolated island population or a third sibling species.

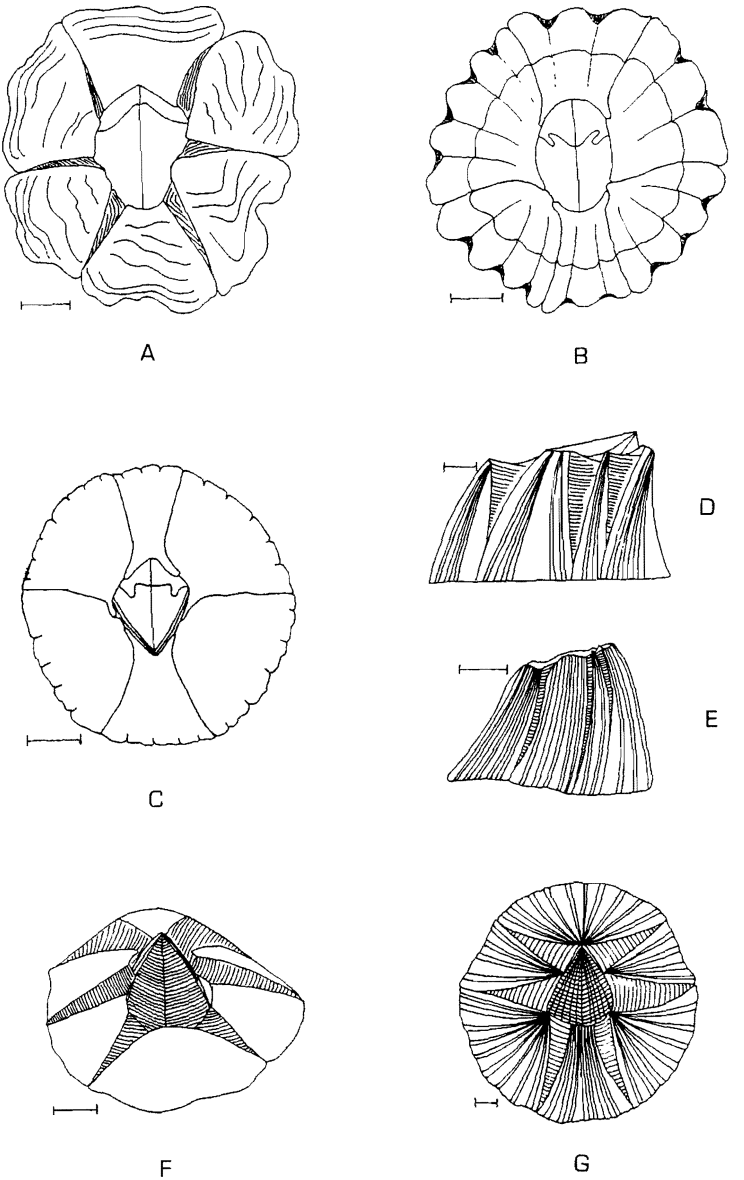

Fig 1: (Scale bar length in brackets) **A,** *Euraphia depressa* (2mm); **B,** *Chthamalus stellatus* (1mm); **C,** *Chthamalus montagui* (1mm); **D,** *Balanus amphitrite amphitrite* (1mm); **E,** *Balanus perforatus* (1mm); **F,** *Balanus trigonus*: form found on *Antipathes* sp. at 300 - 400m depth (5mm); **G,** *Balanus trigonus*: form found on *Pinna nobilis* (1mm). All specimens were drawn from life.

Family : Balanidae Leach 1817

Balanus amphitrite amphitrite (Darwin 1854) [Figure 1D]

Balanus amphitrite Darwin : Micallef & Evans (1968)

numerous specimens: Msida Yacht Marina; attached to boat hull; 1995 [MR].
numerous specimens: Birzebbuga; attached to boat hulls, floating plastic and wood; October 1995 [MR].
3 specimens: Hofra z-Zghira; on rock at 1m depth; April 1996 [SJ].

Balanus perforatus Brugiére 1789 [Figure 1E]

Balanus perforatus Brug. : Mamo (in Caruana, 1867)
Balanus perforatus Brugiére : Micallef & Evans (1968)
Balanus (?) *perforatus* Brug. : Agius *et al.* (1977)

8 specimens: Manoel Island; on wood and iron surfaces; October 1995 [MR].
6 specimens: Malta; on *Mytilus* sp. obtained from the fish market at Marsaxlokk; March 1996 [MR].
1 specimen: Delimara; on floating plastic; (no other data available) [MR].

The specimens from Manoel Island differed slightly in outer appearance from those found on *Mytilus* sp. The former had a small opercular aperture and very narrow radii and alae. Those found as epibionts on *Mytilus* had a relatively large aperture and very wide radii. These two morphs have been reported in the literature (Relini, 1980).

Balanus trigonus Darwin 1854 [Figures 1F and 1G]

New record.

2 specimens: Malta; attached to the shell of *Pinna nobilis* (no other data available).
3 specimens: Malta; attached to bryozoans at 42m depth; 1995 [MR]
21 specimens; 10km off SW Malta; attached to *Antipathes* sp. at 300 - 400m depth; 24 March 1993 [CM]

The specimens found on *Antipathes* differed from the others since they lacked the characteristic ribs on the plates [Fig. 1F]. This was accompanied by differences in the structure of the terga and scuta, such as the absence of pits and the adductor ridge of the scuta in the *Antipathes* epibionts. Although the occurrence of

specimens without scutal pits has been reported in the literature (Relini, 1980), the absence of ribs from the plates and the absence of an adductor ridge from the scuta are not mentioned. Since *Antipathes* sp. was obtained from very deep waters, these differences may be due to the occurrence of distinct ecotypes adapted to deep and shallow waters.

Balanus improvisus Darwin 1854

Balanus improvisus Darwin : Micallef & Evans (1968)

Not recorded during the present study. This species prefers brackish waters (Relini 1980) which is a very rare habitat in the Maltese Islands. It also resembles *Balanus amphitrite amphitrite* and therefore it is likely that it was confused with this much more common barnacle by Micallef & Evans (1968).

Semibalanus balanoides (Linnaeus 1758)

Balanus balanoides Ranzani : Gulia (1858-1859)
Balanus balanoides Ranz. : Mamo (in Caruana, 1867)

Not recorded during the present study. Gulia (1858-1859) states that this species is found attached to wood and other floating objects. However, this barnacle is a Boreoarctic species, found in the littoral zones of Atlantic coasts and on the northern coast of North America (Rainbow, 1984). Thus, this record is almost certainly a misidentification.

Megabalanus tintinnabulum tintinnabulum (Linnaeus 1758) [Figure 2A]

New record.

2 specimens: Malta Dockyards; attached to ship's hull; 1972 [PJS]
2 specimens: Malta Dockyards; attached to ship's hull; 1996 [MR]

Since this species was recorded only from ships' hulls in dockyards, the actual origin of the specimens is not known and probably this species does not form part of the biota of Maltese coastal waters.

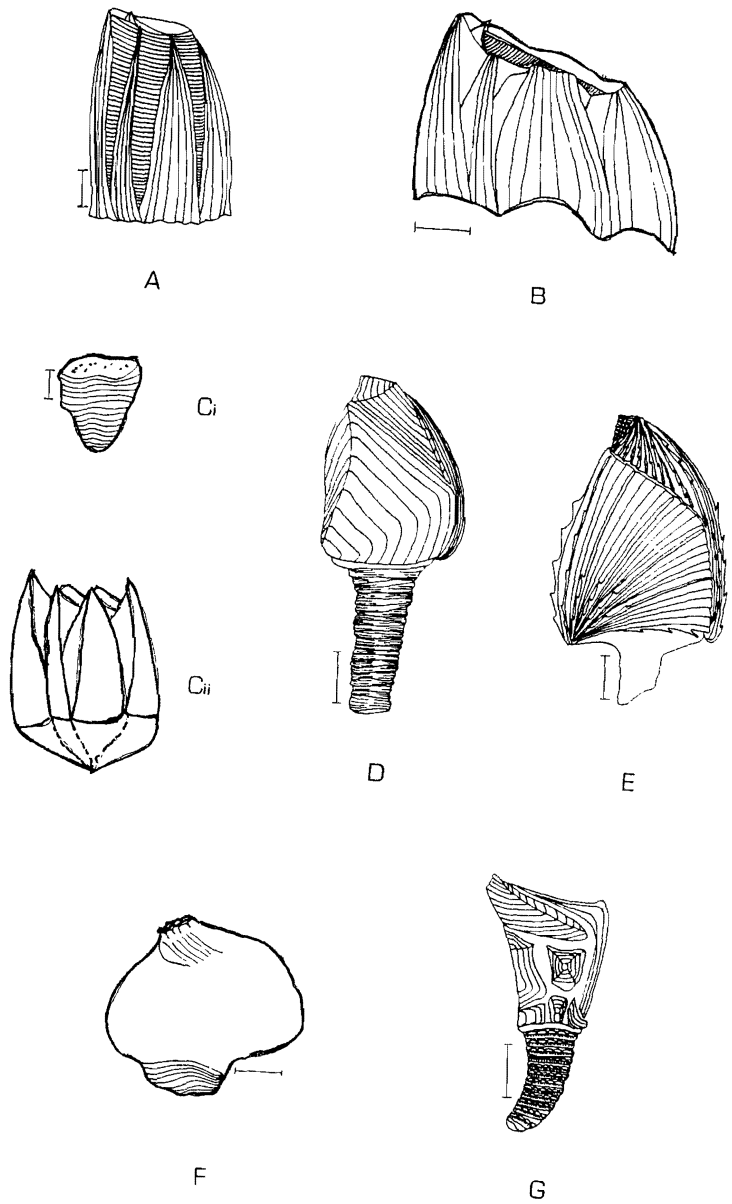

Fig. 2: (Scale bar length in brackets) **A,** *Megabalanus tintinnabulum tintinnabulum* (10mm); **B,** *Megabalanus tulipiformis* (3mm); **Ci,** cup-shaped basis of *Acasta* sp. (2mm); **Cii,** Structure of *Acasta spongites* as adapted from Relini (1980); **D,** *Lepas anatifera* (6mm); **E** *Lepas pectinata* (2mm); **F,** *Paralepas minuta* (1mm); **G,** *Scalpellum scalpellum* (4mm). With the exception of Cii, all figures were drawn from life.

Megabalanus tulipiformis (Ellis 1758) [Figure 2B]

New record.

3 specimens; Malta Dockyards; attached to *Megabalanus tintinnabulum tintinnabulum* fouling ship's hull; 1996 [MR]

As with *Megabalanus tintinnabulum tintinnabulum*, the actual origin of these specimens, found on a ship's hull, is not known, and it is possible that this species does not inhabit Maltese waters.

Acasta* sp.** [probably ***spongites (Poli 1791)] [Figure 2C]

New record.

1 cup-shaped basis; Ras ir-Raheb (western coast of Malta); at 80 - 100m depth; 1986 [CM] (originally identified by J.J. Van Aartsen, Dieren, The Netherlands)

The basis examined did not permit identification of the specimen to species level. However, *Acasta spongites* is the only species of the genus recorded in Italian waters. Also, since this species lives in the osculae of sponges of the genus *Cacospongia* and in *Ircinia variabilis*, both of which are present in Malta (Borg & Schembri, 1996), it is very probable that the cup-shaped basis belongs to *Acasta spongites*.

Chelonibia testudinaria (Linnaeus 1758)

Chelonibia testudinaria (Linné 1758) : Gramentz (1988)
Chelonibia testudinaria (Linné) : Micallef & Evans (1968)
Coronula testudinaria Lamk., with three varieties; var. *aquinquebola;* var. *septemloba;* var. *octoloba* : Mamo (in Caruana, 1867)

Not recorded during the present study. Both Mamo (in Caruana, 1867) and Gramentz (1988) record this species from the carapace of the loggerhead turtle *Caretta caretta*.

Platylepas coriacea Monroe 1979

Platylepas coriacea Monroe, 1979 : Gramentz (1988)

Not recorded during the present study. Reported by Gramentz (1988) from the carapace of the loggerhead turtle, *Caretta caretta*.

Platylepas hexastylos (Fabricius 1798)

Platylepas hexastylos (Fabricius 1798) : Gramentz (1988)

Not recorded during the present study. Reported by Gramentz (1988) from the carapace of the loggerhead turtle *Caretta caretta.*

Stomatolepas elegans (Costa 1838)

Stomatolepas elegans Costa : Lanfranco (1979)

Not recorded during the present study. Reported by Lanfranco (1979) from the carapace of the leatherback turtle *Dermochelys coriacea.*

Family : Lepadidae Darwin 1851

Lepas anatifera Linnaeus 1767 [Figure 2D]

Lepas anatifera L. : Micallef & Evans (1968)
Lepas anatifera Linné : Gramentz (1988)

5 specimens: 60 miles SE Lampedusa; August 1977 [PJS]
1 specimen: Malta; 1971; (no other data available) [PJS]
36 specimens: Ramla tal-Mixquqa; attached to rope; 1995 [EL]
10 specimens: Marsaxlokk; attached to boat mooring ropes; 1995 [MR]
6 specimens: Mistra; attached to fishfarm cages; August 1995 [MR]
8 specimens: Comino; attached to fishfarm cages; 12 March 1994 [JAB]
20 specimens: San Blas (Gozo); beached; September 1988 [AM]

Lepas pectinata Spengler 1851 [Figure 2E]

New record.

numerous specimens: San Blas (Gozo); attached to rope; February 1996 [MR]
numerous specimens: Birzebbuga; on floating plastic; March 1996 [MR]
numerous specimens: Gozo; on floating wood; April 1996 [MR]

Lepas hillii (Leach 1818)

Lepas hillii (Leach 1818) : Gramentz (1988)

Not recorded during the present study. Reported by Gramentz (1988) from the carapace of the loggerhead turtle *Caretta caretta*.

Lepas anserifera Linnaeus 1767

Anatifa striata Brugiére 1789 : Mamo (in Caruana, 1867)

Not recorded during the present study. Mamo's record is not considered very reliable.

Paralepas minuta (Philippi 1836) [Figure 2F]

New record.

9 specimens; Ras il-Wahx; attached to *Stylocidaris affinis* at 100-120m depth; 4 August 1993 [CM]

Conchoderma virgatum (Spengler 1790)

Conchoderma virgatum (Spengler 1790) : Gramentz (1988)

Not recorded during the present study. Reported by Gramentz (1988) from the carapace of the loggerhead turtle *Caretta caretta*.

Family : Scalpellidae Pilsbry 1907

Scalpellum scalpellum *Linnaeus 1767* [Figure 2G]

New record.

4 specimens; 60 miles off Lampedusa at 100m depth; August 1977 [PJS]

KEY FOR THE IDENTIFICATION OF THE THORACICAN BARNACLES OF THE MALTESE ISLANDS

Doubtful species are excluded from the key. Morphological features used are illustrated in Fig. 3.

1. Peduncle present.....2
   Peduncle absent; wall of 6 parietal plates present.....7

2. Capitulum surrounded by 5 plates; peduncle lacks scales.....3
   Capitulum surrounded by 14 plates; peduncle covered with scales.....*Scalpellum scalpellum*

3. Capitulum almost completely covered by plates.....4
   Capitulum only partially covered by reduced plates.....6

4. Capitular plates white and smooth.....5
   Capitular plates very fragile, with pronounced growth lines. Up to 2 filamentary appendages may be present. Scuta lack umbonal teeth.....*Lepas pectinata*

5. Scuta lack umbonal teeth; ample space between carina and scuta. 3 filamentary appendages present.....*Lepas hillii*
   Internal umbonal tooth present, but only on right scutum. 2 filamentary appendages present.....*Lepas anatifera*

6. Capitulum with only 1 pair of reduced scuta; membranous surface of peduncle extends over capitulum, leaving a small orifice at the upper end of the barnacle.....*Paralepas minuta*
   Capitulum covered by a smooth membrane and consists of 5 small widely-separated plates possessing a central umbo. Terga and carina generally rudimentary, and may even be absent. Barnacle with longitudinal striations.....*Conchoderma virgatum*

7. Opercular plates smaller than aperture, so that surrounding membrane is clearly visible.....8
   Opercular plates occupy whole aperture; surrounding membrane not visible.....10

8. Radial lamellae present between internal and external walls of parietal plates.....*Chelonibia testudinaria*
   No radial lamellae.....9

9. Aperture larger than basis; numerous scales on external side of parietal plates.....*Stomatolepas elegans*
   Aperture smaller than basis; each plate with internal midrib.....*Platylepas* spp.

10. Rostrum with alae; carino-laterals absent. Rostro-laterals lack alae. Basis membranous.....16
Rostrum with 2 radii; carino-laterals present. Basis calcareous.....11

11. Plates with parietal tubes.....12
Plates without parietal tubes; basis cup-shaped.....*Acasta* spp.

12. Radii and basis with transverse tubes 13
Radii lacking tubes.....14

13. Spur of tergum very near basiscutal angle; aperture margins strongly toothed.....*Megabalanus tulipiformis*
Spur of tergum near centre of basal margin; aperture margins not toothed.....*Megabalanus tintinnabulum tintinnabulum*

14. Tergum beaked.....*Balanus perforatus*
Tergum not beaked.....15

15. Aperture triangular; plates ribbed. Scutum with prominent growth lines and may posess pits.....*Balanus trigonus*
Plates smooth, with lilac and pink striations, but not ribbed. Scutum lacks pits, but has a characteristic coloured band.....*Balanus amphitrite amphitrite*

16. Shell flattened; angle between median line and joint between terga and scuta much less than 90°. Tergo-scutal membranes coloured dark brown.....*Euraphia depressa*
Angle between median line and joint between terga and scuta about 90°.....17

17. Aperture oval or sub-circular. Joint between terga and scuta intersects median line at about 1/3 of its length and is concave with respect to carina (i.e. has the shape of a ψ).....*Chthamalus stellatus*
Aperture kite-shaped. Joint between terga and scuta intersects median line at less than 1/3 of its length (i.e. is closer to carina) and is concave with respect to the rostrum.....*Chthamalus montagui*

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Fig. 3: (Scale bar length in brackets) **Ai**, The external structure of a stalked barnacle as adapted from Relini (1980). [*CP*, capitulum; *P*, peduncle; *S*, scutum; *T*, tergum; *C*; carina. (5mm)]. **Aii**, Right scutum of *Lepas anatifera* [*S*, scutum; *U*, umbonal tooth]. **B**, Scheme of.....

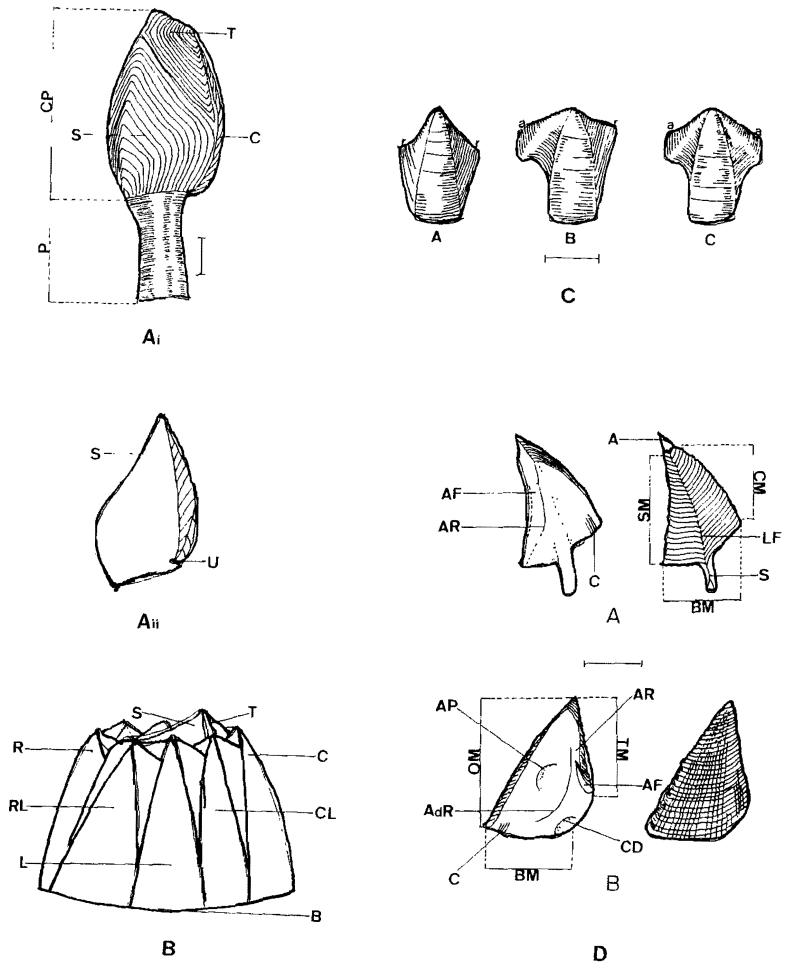

Fig. 3: (Scale bar length in brackets) **A,** The external structure of a stalked barnacle as adapted from Relini (1980). [*CP*, capitulum; *P*, peduncle; *S*, scutum; *T*, tergum; *C*, carina. (5mm)]. **B,** Scheme of a primitive sessile barnacle with 8 parietal plates. [*B*, basis; *C*, carina; *CL*, carino-lateral; *L*, lateral; *R*, rostrum; *RL*, rostro-lateral; *S*, scutum; *T*, tergum]. **C,** The structure of the parietal plates of sessile barnacles as adapted from Relini, 1980. (2mm) [*A*, plate with two radii (r), serving as a rostrum in the balanids and as rostro-laterals in the chthamalids; *B* plate with one ala (a) and one radius, serving as lateral and carino-lateral; *C* plate with two alae serving as carina and rostrum in the chthamalids and as carina in the balanids.]. **D**, The interior and exterior structures of the opercular plates as adapted from Relini, 1980. (2mm) A: Tergum, B: Scutum [*A*, apex; AdR adductor ridge; *AF* articular furrow; *AP*, adductor pit; *AR* articular ridge; *BM* basal membrane; *C* crests for depressor muscle; *CD* cavity for the lateral depressor muscle; *CM* carinal margin; *LF* longitudinal furrow; *OM* occludent margin; *S* spur; *SM* scutal margin; *TM* tergal margin].

DISCUSSION

Excluding those previous records considered unreliable, a total of 19 species of thoracican cirripedes belonging to four families, Chthamalidae, Balanidae, Lepadidae and Scalpellidae, have been recorded from the Maltese Islands and their surrounding waters. The Maltese list may be compared with that of the barnacles found in Italian waters (Relini 1980). In this list the Chthamalidae are represented by 4 species: *Chthamalus stellatus*, *Chthamalus montagui*, *Euraphia depressa* and *Pachylasma giganteum*. Only the latter has not been found in the Maltese Islands, however, this is a rare species, recorded only from the Straits of Messina at a depth of about 200m, and therefore it is unlikely to occur in Maltese waters.

Of the six species of *Balanus* listed by Relini (1980), only three (*B. trigonus*, *B. perforatus*, *B. amphitrite amphitrite*) have been recorded from the Maltese Islands. *Balanus eburneus* and *Balanus improvisus* favour brackish waters and are generally found in estuaries and lagoons. *B. improvisus* has been recorded from Malta by Micallef & Evans (1968), however, owing to this species' habitat preferences, its presence in the Maltese Islands is doubtful. On the other hand, the presence of *Balanus spongicola* is not excluded since this species is generally found in sponges together with *Acasta spongites*.

The genus *Chelonibia* is represented by three species in Italian waters, of which only one has been recorded from the Maltese Islands: *Chelonibia testudinaria*. *Stomatolepas elegans*, *Platylepas hexastylos* and *Conchoderma virgatum* are all listed in Relini (1980); on the other hand *Platylepas coriacea*, which has been recorded by Gramentz (1988), is not found in Italian waters. All species of *Lepas* known from Italian waters have been recorded from the Maltese Islands, except for *Lepas anserifera*. Mamo (in Caruana, 1867) has recorded this species (as *Anatifa striata*), but this record is doubtful.

With one exception, all the species recorded from the Maltese Islands occur also in Italian waters. Italian species which have not been recorded locally include those of habitats that are rare or are not found in the Maltese Islands (i.e. brackish water and lagoons) and species which are generally found as epibionts on organisms such as cetaceans (*Xenobalanus glopicipites*), or on corals. Since these latter species are opportunistic, it is not excluded that they may occur in Maltese waters. Due to their particular habitat, they are expected to be difficult to obtain. This suggests that the list of local barnacles is far from complete.

Thoracican cirripedes are opportunistic and are found attached to many living and non-living substrata. The chthamalids are only found on the littoral zone of rocky

shores. The three local species of shore barnacles (*C. stellatus*, *C. montagui* and *E. depressa*) occupy fairly distinct zones on the shore. *Euraphia depressa* is generally found in the lower part of the supralittoral zone, at higher levels than the other two species (Rizzo, 1996). *C. montagui* and *C. stellatus* are generally found in the mediolittoral zone and overlap in their ranges (Rizzo, 1996). This may explain why *C. montagui* was not previously recorded in spite of its being quite common on local shores: the two species of *Chthamalus* are very similar in morphology and share the same habitat, and *C. montagui* was probably misidentified as *C. stellatus* by previous workers. Although the two species overlap considerably in their ranges, there seems to be a tendency for *C. stellatus* to occupy lower levels on the shore and for *C. montagui* to be more common in the upper levels. Also, *C. stellatus* seems to prefer exposed shores while *C. montagui* tends to be more common in sheltered areas (Rizzo, 1996).

The other species of barnacles are generally found attached to non-living substrata. *Balanus amphitrite amphitrite* was extremely common on floating objects such as wood and plastic, as well as on boat hulls and on mooring ropes. However, it was also found on rocks at 1m depth at Il-Hofra z-Zghira. *Balanus perforatus* was found both as an epibiont on *Mytilus* sp. as well as attached to submerged wood and iron surfaces. On the other hand, *Balanus trigonus* was found only as an epibiont on mollusc shells and corals. The two *Megabalanus* species were found on ship's hulls and therefore they do not necessarily belong to the fauna of Maltese coastal waters.

In general, species of *Lepas* were found attached to non-living floating substrata such as plastic, wood and ropes. However, *Lepas hillii* was only recorded as an epibiont on *Caretta caretta*. Species of the genera *Chelonibia*, *Stomatolepas*, *Conchoderma* and *Platylepas* were also only recorded as epibionts on marine turtles. *Paralepas minuta* was recorded as an epibiont on the sea-urchin *Stylocidaris affinis*.

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RECORDS OF CEPHALOPODS (MOLLUSCA: CEPHALOPODA) FROM MALTESE AND SURROUNDING WATERS (CENTRAL MEDITERRANEAN)

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ABSTRACT

Based on an examination of several collections made in Maltese waters, 20 cephalopods are recorded of which three genera and seven species are reported for the first time from Maltese waters. The identity of some previously dubious records is clarified. Information is given on the material examined during the present study as well as on geographical distribution and habitat preferences of the species. Notes on the diagnostic characters required for accurate identification and details of important diagnostic features are included. All the species recorded are also known from the Strait of Sicily and other areas in the Central Mediterranean. There are very few Maltese records of pelagic species. This is partly a result of the fishing techniques used by local fishermen and partly because cephalopods are only a by-catch in Malta.

INTRODUCTION

Although many species of cephalopod molluscs are sold commercially and they are invariably present in fish markets, little valid scientific information has been published about the Maltese species. In his *Repertorio di Storia Naturale*, Gavino Gulia (1858–1859) mentions two species of cephalopods but offers no information other than the local names. A. A. Caruana, editor of the *Enumerato Ordinata Molluscorum Gaulo–Melitensium* of the deceased G. Mamo, lists nine cephalopods (Mamo in Caruana, 1867). A review of the fauna of the Maltese Islands by Giovanni Gulia (1914) mentions three new records of cephalopods for the Maltese Islands. This work is very interesting in that it includes *Tremoctopus violaceus*, a pelagic species similar in ecology to *Argonauta argo* and *Ocythoe tuberculata*, which is rarely encountered. It has never been recorded since and the possibility that it could have been misidentified is not excluded. Micallef & Evans (1968) record six cephalopods. Some of their records are dubious as the reference work used by these authors to identify their specimens is not a reliable one for identification of cephalopods. Cachia (1973) deals with shelled molluscs collected from local shores and only records *Argonauta argo*, referring to the calcified egg-case of this species that is often washed ashore.

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The most recent work is that of Cachia *et al.* (1993) who published a list of molluscs present in the Maltese Islands, including 12 species of cephalopods. That *Spirula spirula* is included in this list is interesting. This is a mesopelagic species that inhabits the Atlantic, but which has not yet been recorded live from the Central Mediterranean. The only Central Mediterranean records are of shells that often float for some distance after the organism is dead (Guerra, 1993).

Most of the above publications lack essential taxonomic information about the species mentioned; none include illustrations of diagnostic features or guidelines for identification. Some of the records are actually suspect as the identification was based on literature that is not detailed enough for accurate taxonomic study. It is thus clear that a revised, detailed account of the cephalopod fauna of Maltese waters is now due.

Apart from providing such an account, the present work serves to highlight gaps in the knowledge of the Maltese cephalopod fauna and it is hoped that it will serve as a basis for future studies leading to a deeper understanding of the cephalopods of the Maltese Islands.

MATERIALS

The majority of specimens of the smaller and rarer species were obtained from the private collections of amateur and professional researchers. Most of the remaining specimens examined were obtained during visits to the fish markets at Marsaxlokk and at Valletta. Some divers and local amateur fishermen supplied live specimens, egg cases or clusters, and parts from specimens that could not be collected whole. The male hectocotylised arm and the beak were obtained when the whole specimen was not available. Beach combing produced an assorted array of different cuttlebones belonging to the genus *Sepia*.

The collections on which the older published records are based could not be traced and probably no longer exist. The 'previous records' cited here are therefore taken entirely from these publications, none of which contain illustrations.

In total, 114 specimens were examined together with numerous cuttlebones, beaks and eggs. The specimens obtained from the collection of Mr C. Mifsud are coded CM in the species list below. The rest were collected by the authors and are coded TS and PJS.

Identifications were made using the published keys and guides by Guerra (1992) and Bello (1995). Beaks were identified using Clarke's (1986) keys. Some

specimens of Sepiolidae were dissected to examine the light organs as described by Bello (1995).

Specimens are housed in the reference collections of the Department of Biology of the University of Malta and in the private collection of Mr C. Mifsud, Rabat, Malta.

SPECIES LIST

In the following list, each species is followed by previous records from the Maltese Islands, a catalogue of the material examined during the present study, and taxonomic and ecological notes where appropriate, in that order. All localities are situated in the island of Malta unless otherwise stated. Sex of the specimens examined, when known, is indicated by M for males and F for females. The list presented follows the systematic arrangement given by Guerra (1992).

SEPIIDAE Keferstein, 1866.

Sepia officinalis Linnaeus, 1758 [Figures 1G,1P]

Sepia officinalis, L.; Mamo in Caruana, 1867
Sepia officinalis, L.; Micallef & Evans, 1968
Sepia officinalis Linnaeus, 1758; Cachia *et al.*, 1993

1M,2F: Marsaxlokk Fish Market, summer 1995 (TS); several cuttlebones (PJS, CM); 1F: Dahlet il-Fekruna, July 1974 (PJS).

Sepia elegans Blainville, 1827 [Figures 1E,1M]

Sepia elegans Blainville, 1827; Cachia *et al.*, 1993

30 (juv.): Valletta Fish Market, summer 1995 (TS); several cuttlebones (PJS, CM); 4 (juv.): trawled by fishermen at 100/200m, November 1993 (CM).

Sepia orbignyana Ferussac, 1826 [Figures 1A,1F,1N]

New record.
1M: 2 miles off Gnejna (Gozo), 200m (CM); 1 (cuttlebone): 60 miles off SE Lampedusa, 100m, August 1977 (PJS); 1 (cuttlebone): Valletta Fishmarket, February 1988 (PJS); several cuttlebones: Malta, no other data (CM).

SEPIOLIDAE Leach, 1817.

Single individuals of species belonging to the genus *Sepiola* were not dissected to examine the internal structures described by Bello (1995) in his key. This was done to avoid destroying the only available specimens of these species. However, all the specimens were males and their identification, based on the hectocotylised arm, is considered conclusive.

Rossia macrostoma (Delle Chiaje, 1830) [Figures 1B,1O]

New record.

1F: 60 miles off SE Lampedusa, 100m, August 1977 (PJS).

Sepiola ligulata Naef, 1912 [Figures 1C,1H]

New record.

2M: Mdina Bank, 70m, July 1977 (CM).

Sepiola robusta Naef, 1912 [Figure 1I]

New record.

1M: Mdina Bank, 70m, July 1977 (CM).

Sepiola rondeleti Leach, 1817 [Figures 1D,1J]

Sepiola rondeleti, Leach.; Mamo in Caruana, 1867
Sepiola rondeleti Gesner; Micallef & Evans, 1968
Sepiola rondeletii Leach, 1817; Cachia *et al.*, 1993

3 (juv.): Ta' Kanini, January 1976 (CM); 2M: Mdina Bank, 70m, July 1977 (CM); 6?: 60 miles off SE Lampedusa, 100m, August 1977 (PJS); 1 (juv.): Blata Steps, 170m, May 1990 (CM); 1 (juv.): Qammieh, 60m, October 1990 (CM); 2?: trawled by fishermen, 100/200m, November 1993 (CM); Eggs: *Posidonia* meadow, off White Tower, 21m, January 1994 (TS); Eggs: Anchor Bay, April 1995 (CM).

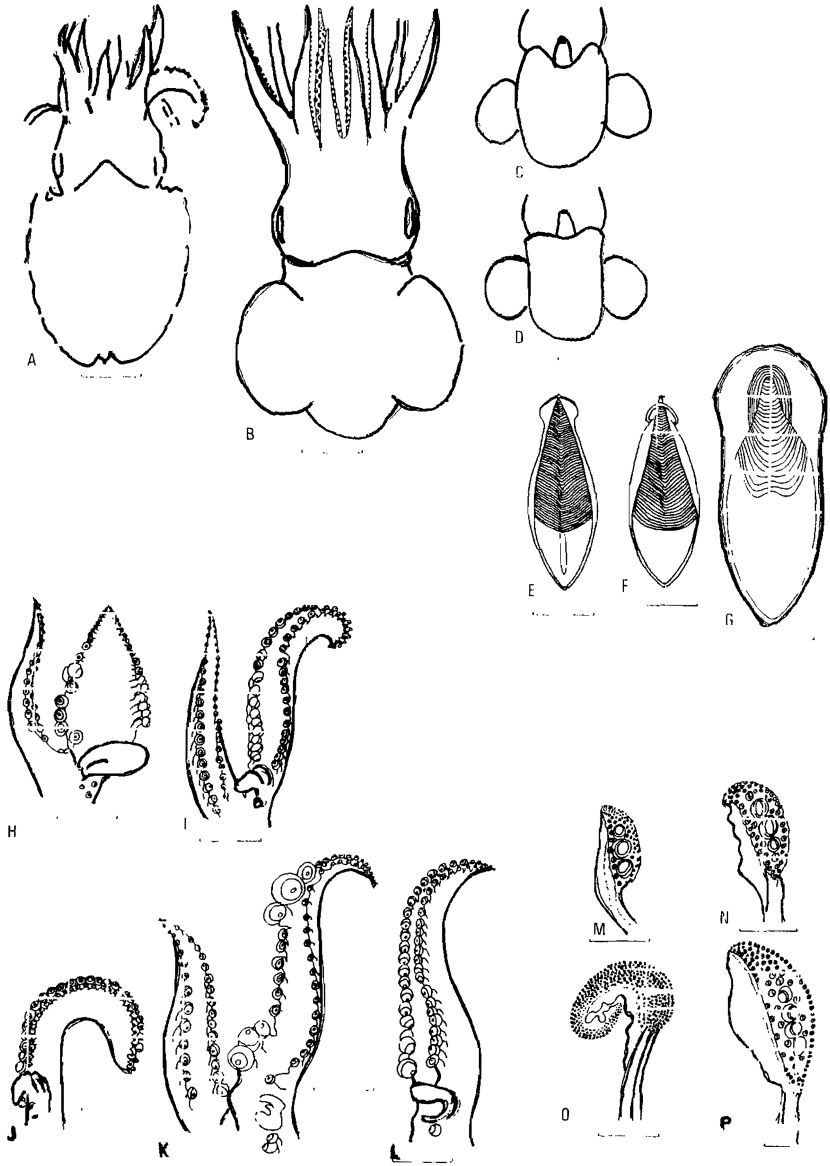

Fig. 1: (Scale bar length in brackets) A, *Sepia orbignyana* (20mm); B, *Rossia macrostoma* (20mm); C, *Sepiola ligulata:* mantle (20mm); D, *S. rondeleti:* mantle (20mm); E, S*epia elegans:* cuttlebone (20mm); F, *S. orbignyana*: cuttlebone (20mm); G, *S. officinalis:* cuttlebone (20mm); H, *Sepiola ligulata*: ligula (8mm); I, *S. robusta*: ligula (8mm); J, *S. rondeleti:* ligula (8mm); K, *S. atalantica:* ligula (8mm); L, *S. intermedia* : ligula (8mm); M, *Sepia elegans:* tentacle club (10mm); N, *S. orbignyana:* tentacle club (10mm); O, *Rossia macrostoma* : tentacle club (10mm); P, *Sepia officinalis:* tentacle club (10mm). (All drawn from life)

Sepiola intermedia Naef, 1912 [Figure 1L]

New record.

1M: Mdina Bank, 70m, July 1977 (CM).

Sepiola atalantica Orbigny, 1840 [Figure 1K]

New record.

1M: Mdina Bank, 70m, July 1977 (CM).

LOLIGINIDAE Orbigny, 1848.

Loligo vulgaris Lamarck, 1798 [Figures 2B,2D]

Loligo vulgaris, Lamk.; Mamo in Caruana, 1867
Loligo vulgaris Lam.; Micallef & Evans, 1968
Loligo vulgaris Lamarck, 1798; Cachia *et al.*, 1993

1 (juv.): 2 miles off Gozo, November 1976 (CM); 4 (juv.): trawled by fishermen, 100/200m, November 1993 (CM); 3F: Marsaxlokk Fishmarket, summer 1995 (TS); 2F: Valletta Fishmarket, summer 1995 (TS).

OMMASTREPHIDAE Steenstrup, 1857.

Illex coindetii (Verany, 1839) [Figures 2F,2G]

Loligo sagittata Lamk.; Mamo in Caruana, 1867
Loligo sagittatus; Gulia, 1912
Illex coindetii (Verany, 1839); Cachia *et al.*, 1993

2M,1F: Valletta Fishmarket, summer 1995 (TS); 2M: Marsaxlokk Fishmarket, summer 1995 (TS).

Todaropsis eblanae (Bell, 1841) [Figures 2E,2G]

New record.
1M: 60 miles off SE Lampedusa, 100m, August 1977 (PJS).

Todarodes sagittatus (Lamarck, 1798) [Figures 2A,2C]

Loligo todarus Delle Chiaje; Mamo in Caruana, 1867.
Todarodes sagittatus (Lamarck, 1798); Cachia *et al.*, 1993

3M: Malta (no other data), November 1993 (CM).

OCTOPODIDAE Orbigny, 1840

Octopus vulgaris Cuvier, 1797 [Figures 2I,2O]

Octopus tuberculatus Blain.; Gulia, 1859
Octopus vulgaris, Lamk.; Mamo in Caruana, 1867
Octopus vulgaris Lam.; Micallef & Evans, 1968
Octopus vulgaris Cuvier, 1798; Cachia *et al.*, 1993

1F: Malta (no other data) (PJS); 1F: Gnejna Bay, 3m, August 1988 (CM); 4F: Marsaxlokk Fishmarket, summer 1995 (TS); 2 (hectocotylus): Valletta Fishmarket, summer 1995 (TS); 10 (hectocotylus, beak): (no other data), summer 1995 (TS).

Octopus macropus Risso, 1826 [Figures 2J,2P]

Octopus ruber Rafinesque.; Mamo in Caruana, 1867
Octopus macropus Risso, 1826; Cachia *et al.*, 1993

2 (hectocotylus): Valletta Fishmarket, summer 1995 (TS).

Scaeurgus unicirrhus (Delle Chiaje, 1840) [Figure 2H]

New record.

1M: Malta (No other data); ?1F: Mdina Bank, 70m, July 1977 (CM).

One adult male specimen wrongly identified as *Octopus vulgaris* was housed in the collection of the Department of Biology of the University of Malta. While it is certain that this specimen was captured in Maltese waters, no other data is available. The other specimen examined was in a bad state of preservation and could not be identified with certainty.

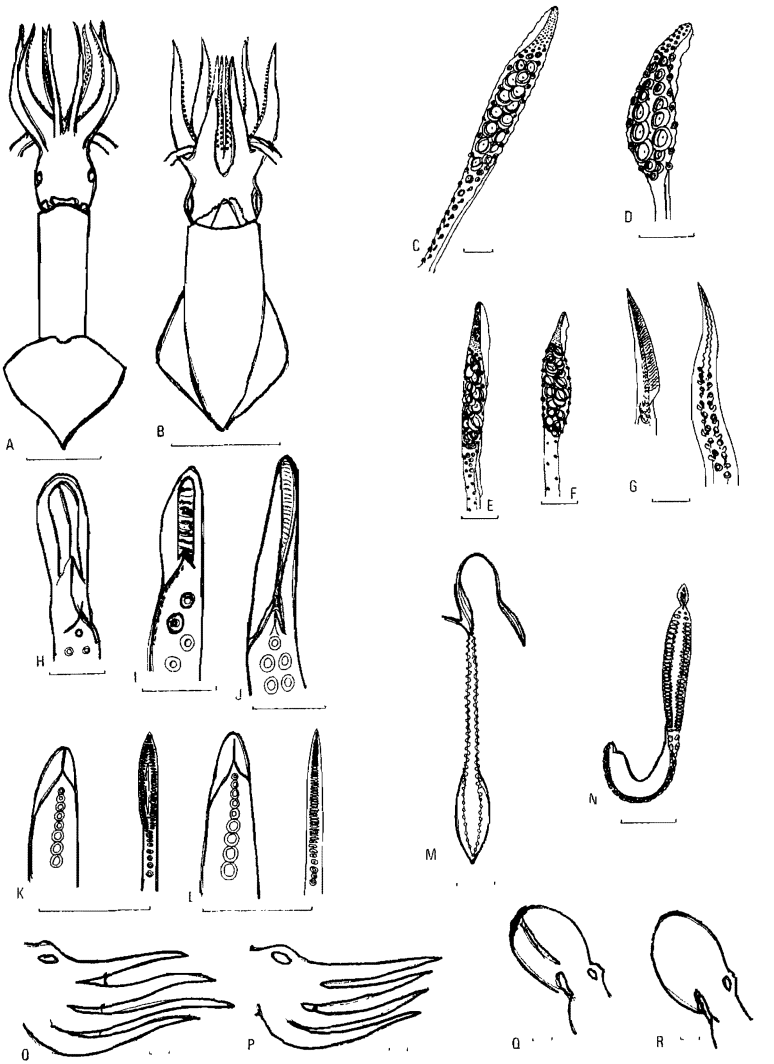

Fig. 2: (scale bar length in brackets) A, *Todarodes sagittatus* (130mm); B. *Loligo vulgaris* (130mm); C, *T. sagittatus:* tentacle club (10mm); D, *Loligo vulgaris*: tentacle club (10mm); E, *Todaropsis eblanae:* tentacle club (10mm); F, *Illex coindetii:* tentacle club (10mm); G, *T. eblanae* (left) and *I. coindetii* (right): hectocotylus (10mm); H, *Scaeurgus unicirrhus:* ligula (10mm); I, *Octopus vulgaris*: ligula (10mm); J, *Octopus macropus*: ligula (10mm); K, *Eledone moschata*: hectocotylus and tentacle (10mm); L, *Eledone cirrhosa*, hectocotylus and tentacle (10mm); M, *Argonauta argo*: hectocotylus (10mm); N, *Ocythoe tuberculata*: hectocotylus (10mm); O, *Octopus vulgaris*: arm length (10mm); P, *O. macropus*: arm length (10mm); Q, *E. cirrhosa*: mantle shape (10mm); R, *E. moschata*: mantle shape (10mm). (All drawn from life except M and N which are after Guerra, 1992)

Eledone cirrhosa (Lamarck, 1798) [Figures 2L,2Q]

New record.

1: 60 miles off SE Lampedusa, 100m, August, 1977 (PJS); 6: trawled by fishermen, March 1995 (CM).

Eledone moschata (Lamarck, 1798) [Figures 2K,2R]

Eledone moschata, Lamk.; Mamo in Caruana, 1867
Eledone moschata (Lamarck, 1798); Cachia *et al.*, 1993

1: Anchor Bay, 60m, July 1993 (CM).

OCYTHOIDAE Gray, 1849

Ocythoe tuberculata Rafinesque, 1814 [Figure 2N]

Philonexis atlanticus; Gulia, 1913
Ocythoë tuberculata Rafinesque; Micallef & Evans, 1968
Ocythoe tuberculata Rafinesque, 1814; Cachia *et al.*, 1993

2F: Malta (no other data) (PJS); 1(juv.): 60 miles off SE Lampedusa, 100m, August 1977 (PJS).

Both adult specimens originally housed in the collection of the Department of Biology of the University of Malta are now lost.

ARGONAUTIDAE Caintraine, 1841

Argonauta argo Linnaeus, 1758 [Figure 2M]

Argonauta argo, L.; Mamo in Caruana, 1867
Argonauta argo L.; Micallef & Evans, 1968
Argonauta argo (Linn.); Cachia, 1973
Argonauta argo Linnaeus, 1758; Cachia *et al.*, 1993

1: Malta (no other data) (PJS).

DISCUSSION

This report confirms the presence of 11 species of cephalopods previously recorded from the Maltese Islands and their surrounding waters (Gulia, 1859; Mamo in Caruana, 1867; Gulia, 1913; Micallef & Evans, 1968; Cachia, 1973; Cachia *et al.*, 1993). Another nine species are recorded here for the first time, increasing the total number of cephalopods known from the Maltese area to 20. We do not consider it appropriate to include *Spirula spirula* (Cachia *et al.*, 1993) in the Maltese list until a whole specimen has been collected from Maltese waters, as the empty internal shell of this species is known to remain afloat and to travel for long distances. *Spirula spirula* is a mesopelagic Atlantic species that only occasionally enters the Mediterranean; whole specimens are sometimes encountered in Moroccan waters, however, the empty shell may be carried by currents as far as the Levantine Sea (Bello, 1990; 1992).

Of the 60 species of cephalopods recorded from the Mediterranean (Bello, 1986; 1992), about 59 are known from the Western Mediterranean, 38 from the Adriatic, and 47 from the Eastern Mediterranean (Mangold & Boletzky, 1988). The Maltese cephalopod fauna includes about 33% of the total cephalopod species present in the Mediterranean. This is quite a low figure when one considers that the islands are situated close to the boundary between the two main basins of the Mediterranean. In the Central Mediterranean, 38 species have been recorded in a census of the cephalopod fauna of the Strait of Sicily (Jereb & Ragonese, 1994); only 12 of these are known from the Maltese Islands. Corresponding figures for the Gulf of Taranto are 28 species recorded (Bello, 1986) of which 16 occur also in Malta, and for the Gulf of Castellamare, 27 species recorded (Bello *et al.*, 1994), of which 12 occur in Malta. Therefore, the Maltese cephalopod fauna includes roughly 45% of the fauna of the Central Mediterranean.

It is thus evident that many of the species known from the Strait of Sicily could also be present in Maltese waters but have not yet been discovered or documented. One reason for this could be the way cephalopods are exploited locally. Cephalopods are captured as by-catches of the commercially important fish species caught by pelagic and bottom trawling and by purse seines. The by-catch is often sold or used by the fishermen themselves without being exhibited at the local fishmarkets, hence it is difficult to monitor these catches. Secondly, comparison of the species list from Maltese waters with that from the surrounding area shows that the local list lacks those species which frequent waters deeper than 100m. One exception is *Todarodes sagittatus* which inhabits depths ranging from 350 to 540 m. However, all the recorded species are known to migrate to shallower waters to reproduce and the greatest catch biomass of cephalopods sold at the Valletta fishmarket each year corresponds to the reproductive seasons for

the various species. Octopuses are generally caught mainly from March to June and, lately, from November to December. Cuttlefish are caught from November to April, and squid from June to August and from November to January. Species not rising to surface waters to spawn are not represented. It is also possible that some species no longer occur in shallow areas perhaps due to over-exploitation. Catche statistics in fact show a decreasing catch-biomass, but this could be due to other reasons, such as the reduction in fishing effort.

The species list provided here is therefore by no means exhaustive. The present work should be considered as a starting point and it will hopefully be improved upon by further research.

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A PRELIMINARY REPORT ON THE MARINE MACROBENTHOS AND THE DEMERSAL FISH FAUNA OF THE ISLAND OF FILFLA (MALTESE ISLANDS, CENTRAL MEDITERRANEAN)

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ABSTRACT

The nature, distribution, and abundance of the main component species of the supralittoral, mediolittoral and upper infralittoral marine macrobenthic assemblages of Filfla were studied during a series of expeditions to the islet between 1990 and 1994. The demersal fish fauna was censused by direct observation. The distribution of sponges was studied along two 2m-wide belt transects laid along a gently sloping and a steep sloping bottom, respectively. In general, the same type of benthic assemblages as found on other exposed rocky coasts in the Maltese Islands occurred at Filfla. However, at Filfla, the littoral zones were compressed, and species richness and abundance in the littoral and sublittoral were generally low compared to other exposed rocky shores in the Maltese Islands. In spite of the extensive infralittoral sandy bottoms present at Filfla, no sea-grass meadows were encountered. Most of these differences are probably attributable to the high exposure, the extensive boulder shores and submarine boulder fields that surround the islet, and to bottom turbulence. Large differences in species composition and abundance of sponges were found between the two transects. *Crambe crambe* and *Agelas oroides* were the most abundant sponges on the steep bottom, while *Sarcotragus spinosula* was the most abundant species on the more gently sloping one. Compared to that of mainland sites, the demersal fish fauna of Filfla was impoverished in terms of both species richness and abundance.

INTRODUCTION

Until recently, the majority of studies on the marine biota of the Maltese Islands either concerned the biology of individual species, or else were taxonomic studies of single groups. Very few qualitative and quantitative studies on species assemblages have been made and most of these concerned littoral and shallow

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water sites (see, for example, Attard & Giglio, 1990; Mallia [A.] 1991; 1993; Mallia [R.], 1993; Vella, 1994, and references therein). Since the early 90's, some information started being collected, mainly as a result of undergraduate and postgraduate research projects at the University of Malta (see, for example, Borg, 1991; 1995; Valentino, 1991; Buttigieg, 1993; Pirotta, 1996), and baseline surveys of the marine infralittoral biotic assemblages of particular areas, commissioned by the Malta Council for Science and Technology (see, for example, Borg & Schembri 1993; 1995b). However, in most cases, the choice of the study area has been conditioned by such criteria as accessibility and convenience for study. Coastal areas with limited or difficult access, and which therefore may be less affected by anthropic activities, have not been studied.

The islet of Filfla lies some 4.4 km to the south of the island of Malta (Fig. 1). It consists of a massive block of rock rising from the sea to a height of some 60m. The islet consists of precipitous cliffs surrounded at their base by screes of fragmented rock made up of pieces ranging in size from massive boulders several metres in diameter, to cobbles, pebbles and smaller fragments. The top of the islet is a karstic plateau just over two hectares in area. Geologically, the islet consists of a stack of Upper Coralline Limestone, an outlier of the principal outcrops of this formation occurring in the western and northern areas of Malta (Pedley, 1987; Oil Exploration Directorate, 1993). This coralline limestone cap overlies some 15m of the Blue Clay formation (Pedley, 1987), however, the strata at the base of the islet are difficult to discern since they are completely covered by masses of broken rock. These screes have been formed partly by natural land-sliding involving the downslope gravitational movement over the wet Blue Clay of rock fractured from the cliff edge, as described by Paskoff & Sanlaville (1978) from elsewhere in the Maltese Islands, and partly by rocks splintered off the cliff sides and edges due to the bombardment which the islet suffered for many decades when it was used as a target by the French, English, Italian and American navies (Farrugia Randon & Farrugia Randon, 1995). The present shoreline of Filfla consists entirely of boulders and smaller-sized fragments (Fig.1) and these screes continue underwater to give submarine boulder fields all around the island (Figs 2 & 3).

To the Southwest of the islet and separated from it by a narrow channel less than 50m wide, are two rocks barely visible above mean sea-level, apparently known as Xiutu z-Zghir and Xiutu l-Kbir (according to Farrugia Randon & Farrugia Randon [1995]; however this should probably be "Xutu" [G. Wettinger, personal communication, 1997]). The larger rock is better known as Il-Blata ta' Santa Marija (Farrugia Randon & Farrugia Randon, 1995). Some 700m to the South of Filfla there is a submerged shoal known as Stork Rock.

The importance of Filfla as a wildlife habitat for terrestrial biota has long been recognised. Important species occurring on Filfla include a large leek of the *Allium ampeloprasum* group, which may be endemic to the islet, the endemic Filfla race of the Maltese wall lizard (*Podarcis filfolensis filfolensis*), two endemic forms of land-snails (*Trochoidea spratti* form *despotti* and *Lampedusa imitatrix* form *gattoi*), and several insect species of biogeographical importance (Schembri *et al.*, 1987; Schembri & Sultana, 1989). The endemic spider *Lepthyphantes melitensis*, first recorded from the mainland in 1987, was also recorded from Filfla in 1990 (Bosmans & Dandria, 1993). However, faunistically, the islet is best known for its seabirds (Sultana, 1993); it supports one of the largest known Mediterranean colonies of the storm petrel (*Hydrobates pelagicus*), the largest local colony of the herring gull (*Larus argentatus michahellis*), and a small colony of Cory's shearwater (*Calonectris diomedea*) (Schembri *et al.*, 1987; Sultana, 1989). For these reasons, it was one of the first sites in the Maltese Islands to be declared a protected area. Legal Notice No. 68 of 1980 *inter alia* established the whole of the island of Filfla as a bird sanctuary, while Act XV of 1988 designated the land area of Filfla as a nature reserve. By means of this Act, all species living on Filfla became completely protected, while access to the island needed the permission of the Minister responsible for the environment and was only granted for scientific and educational purposes.

Government Notice 473 of 1987 and Local Notice to Mariners 16 of 1987 prohibited the berthing or navigation of any craft within an area of one nautical mile radius off Filfla. Additionally, swimming, underwater activities, and any other activities connected with fishing and trawling were also prohibited. Although aimed at preventing the recovery of unexploded ordinance from the seabed around Filfla, this blanket prohibition of all maritime activities round the islet effectively gave an area of sea some 3.14 square nautical miles centred on the islet the status of a marine nature reserve (Schembri, 1994). However, Government Notice 173 of 1990 subsequently permitted fishing vessels to enter the previously prohibited area.

In spite of its natural historic interest and its status as a protected area, no studies on the marine life of Filfla have been made, possibly because access is difficult and fieldwork on the shore and underwater is only possible in very calm weather conditions, which are not frequent around Filfla. The present study was undertaken (1) to collect baseline data on the nature and distribution of the supralittoral, mediolittoral and infralittoral marine macrobenthic assemblages occurring round the islet; (2) to establish which are the dominant species characterising these zones; (3) to compare the species composition of these assemblages with those found in equivalent situations elsewhere in the Maltese Islands.

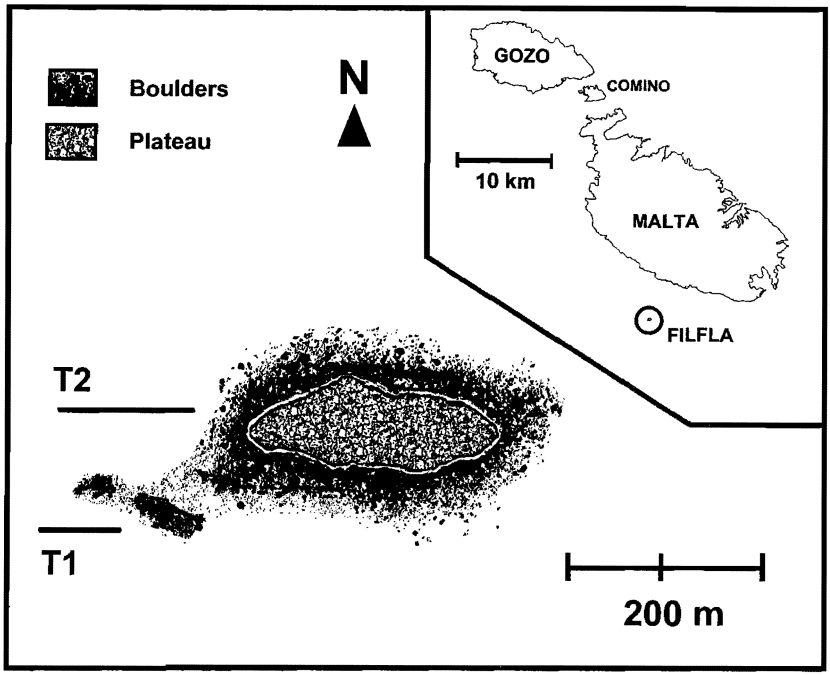

Fig.1: Map of the Maltese Archipelago showing the location of Filfla (inset) and map of Filfla showing the distribution of boulders round the central stack and the location of transects T1 and T2.

MATERIAL AND METHODS

For a general study such as the present one, it was thought appropriate to adopt a survey protocol that allows qualitative and semi-quantitative data to be collected over as large an area as possible. Such a study method has been termed a 'primary survey' by some authors (Earll, 1976; Baker & Crothers, 1987) and involves the direct observation and mapping of benthic habitats and the recording of their component species, where possible supplementing presence/absence data with at least semi-quantitative estimates of the abundance of the more important species (Hiscock, 1987).

Preliminary information on the nature and distribution of the benthic habitats and assemblages around Filfla was obtained during an expedition in August 1990, two others in the summer of 1992, and a fourth in September 1994. The principal aim of the 1990 expedition was to survey the terrestrial biota of the shore around Filfla, while that of the other three expeditions was to study the sponge fauna of the sea around Filfla, to establish whether commercially important species of sponges occurred, and to monitor the general state of health of the sponges round the islet following the outbreak of a sponge disease in the Mediterranean (see Borg & Schembri, 1996). However, data on the type and distribution of the benthic assemblages present, including those of the mediolittoral and supralittoral zones, and on the species composition and abundance of the demersal fish fauna, were also collected during these expeditions.

Littoral surveys

A general survey of the supralittoral and mediolittoral zones round the whole island was made in August 1990 and the shore on the northern side of the islet was studied in more detail during the other expeditions. Data on the spatial extent of the zones and on the species inhabiting them were collected by direct observation. Species were identified *in situ* except for the smaller turf-like algae, specimens of which were taken to the laboratory for microscopical examination.

Sublittoral surveys

At various predetermined points around the islet, SCUBA divers swam underwater along fixed bearings which represented imaginary transects running perpendicular to the shore from mean sea-level to a depth of 35m. The spatial extent of the benthic assemblages encountered, and the main species characterising them, were recorded underwater on slates. Most of the species were identified *in situ* but, where necessary, specimens were collected for later identification in the laboratory. Photographs of the different benthic assemblages and habitats were taken using a Nikonos V underwater camera. Benthic community types were classified according to the Pérès & Picard (1964) system as modified by Pérès (1967; 1982).

Semi-quantitative estimates of abundance of macroalgae on the seabed off the northern coast of the islet were made by measuring percentage cover. Semi-quantitative estimates of the abundance of sponges were made along two belt-transects, T1 and T2, laid by SCUBA divers on the seabed off the western coast of Filfla (Fig. 1). The location of the these two transects was chosen such that

each would cover a different bottom profile, steeply sloping in T1 and more gently sloping in T2 (Figs 2 & 3). Divers swam along the transects and recorded the percentage cover of the different sponge species.

RESULTS

Physical characteristics

The shores of Filfla are very exposed. Exposure was quantified by calculating Thomas' physically-derived exposure index (Thomas, 1986) which gave the following values:

Northern shore	15.79
Eastern shore	14.25
Western shore	19.91
Southern shore	19.53

These values may be compared with those for Il-Ponta ta' San Dimitri, Northwest Gozo (34.54), the most exposed shore in the Maltese Islands, Il-Ponta ta' l-Ahrax, Northwest Malta (18.75), and Il-Ponta l-Kbira in Marsaxlokk Bay (7.75), a site sheltered from the prevailing Northwesterly wind (Mallia [A.], 1991).

At sea-level, Filfla was surrounded by an unbroken boulder scree consisting of fragmented rock derived from the cliff faces and the cliff edges by the processes already described. The spaces between the boulders were packed with smaller sized rock fragments. In general, boulders were angular at the foot of the cliff but become progressively more rounded towards the sea. At sea-level, very large boulders became sparser and rounded boulders, cobbles and pebbles more abundant. The majority of boulders consisted of Upper Coralline Limestone, however, boulders of Globigerina Limestone were very occasionally encountered. The provenance of these is not known since our surveys failed to find any exposures of this formation on the islet. In one or two places on the southern coast, the Blue Clay stratum came within a couple of meters of sea-level before becoming obscured by the overlying boulders. Slope could not be measured except in very general terms since boulders adjacent to each other, and sometimes the same boulder, presented all slopes from horizontal to vertical. In general, the cliff face was practically vertical and, in places, even overhanging, the boulder scree rested at a mean slope of some 45°, and the slope became more gentle at and below sea-level.

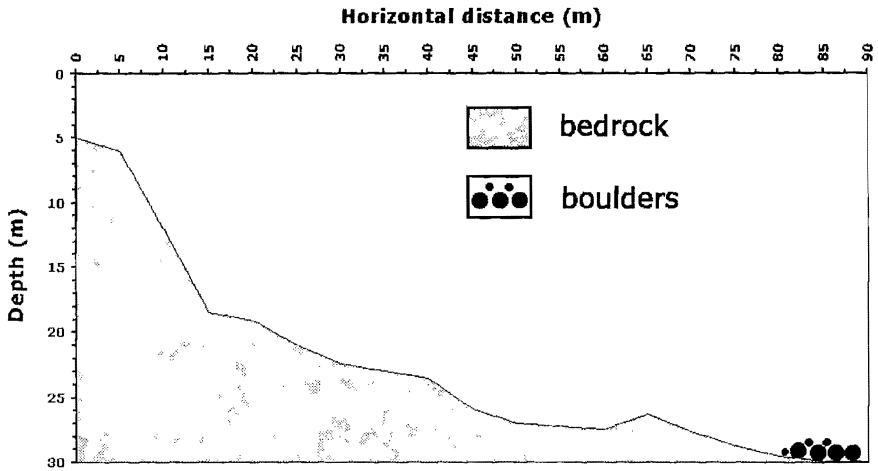

Fig. 2: Bottom profile along transect T1.

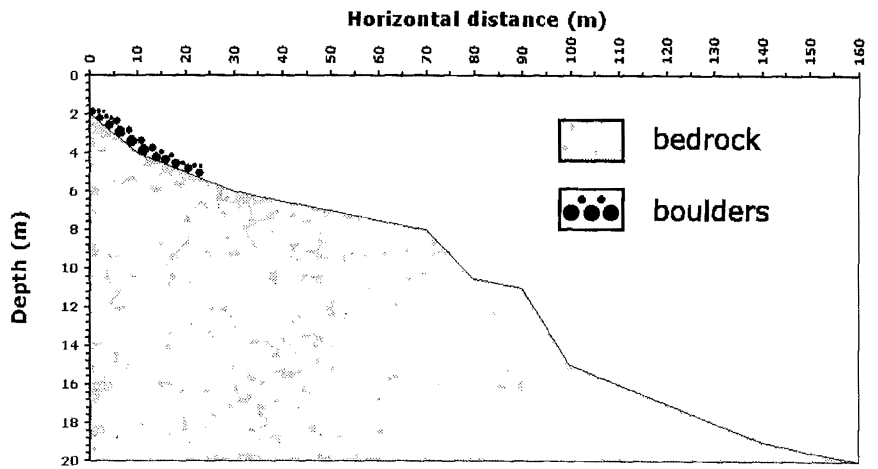

Fig. 3: Bottom profile along transect T2.

The boulder fields continued below mean sea-level for the first 10m or so along the seabed. Boulders became sparser relative to cobbles and pebbles with increasing distance from the land. Beyond the boulder field the bottom consisted of bedrock with accumulations of cobbles and pebbles down to a depth of 20-25 m, where it then became covered with bare sand. Drop-offs were rare inshore.

Away from the shore, the sea bottom around Filfla slopes steeply into deeper waters, except for the area from Filfla to Stork Rock. At a distance of c.400-500m away from the shoreline, depths of 30-45m were measured practically round the whole island. Between Filfla and Stork Rock the bottom is mostly 5-6m deep while Stork Rock itself is 6-7m below the surface. A narrow rocky shoal thus runs in a southerly direction from Filfla to Stork Rock. South of Stork Rock the bottom dips steeply to a depth of more than 50m.

Biological characteristics

Supralittoral and mediolittoral assemblages

The supralittoral extended for a vertical distance of some 4m above mean sea-level, as indicated by the presence of epi- and endo-lithic cyanobacteria. Two 'colour zones' were visible, a yellowish-grey one from mean sea-level to a vertical distance of 2m, and a black zone above that to a vertical distance of 4m. The only supralittoral macrofauna were the littorinid gastropod *Melarhaphe neritoides*, which was present in both 'colour zones' in small numbers, and the isopod *Ligia italica*, which occurred in shady areas up to a height of c.1m above mean sea-level. It is interesting to note that individuals of the Filfla wall lizard, *Podarcis filfolensis filfolensis*, occasionally patrolled the supralittoral but were not observed to feed on either *Melarhaphe* or *Ligia*.

The mediolittoral zone was some 50cm wide on vertical boulder faces and was dominated by macroalgae, the most abundant of which were *Corallina elongata*, *Chondria* spp., *Dilophus* spp. and *Laurencia obtusa*. The most abundant macrofauna were the limpets *Patella rustica, Patella caerulea* and *Patella ulyssiponensis*, and the trochid gastropod *Monodonta turbinata,* with *Patella rustica* forming a distinct band in the upper mediolittoral. Aggregations of the vermitid gastropod *Dendropoma petraeum* were present at mean sea-level on the northern shores. These were sometimes masked by macroalgae. While these aggregations were not as well developed as those found on other shores in the Maltese Islands, they still formed an identifiable crust. Individuals of *D. petraeum* were also present below mean sea level, sometimes in the company of

the larger vermetid *Serpulorbis arenaria*. Other, less abundant, littoral species encountered included the chiton *Lepidochitona corrugata*, the acorn barnacle *Chthamalus stellatus*, the crab *Pachygrapsus marmoratus* and occasional blennies (*Blennius* sp.) which occupied holes in the lower mediolittoral.

The supralittoral and mediolittoral assemblages of Filfla were fairly typical of those found on most exposed rocky shores in the Maltese Islands (see Attard & Giglio, 1990; Mallia [A.] 1991; 1993; Mallia [R.], 1993; Vella, 1994). However, the supralittoral and mediolittoral zones were relatively compressed. The species richness and abundance was also generally lower than for mainland shores. For example, *Melarhaphe neritoides* and *Lepidochitona corrugata* were mainly confined to fissures in the rock in the supralittoral and the upper mediolittoral, respectively. The former species was uncharacteristically present in low abundance when compared to other Maltese shores (see Attard & Giglio, 1990; Mallia [A.] 1991; 1993; Vella, 1994). Additionally, the species richness of mediolittoral macroalgae was low compared to other exposed shores, including that at Ghar Haxixa on mainland Malta, which is situated directly opposite Filfla. Here, the mediolittoral algal zone extended more than two metres upshore from mean sea level and included no fewer than 21 species.

At Filfla, species growing on the outer, more exposed faces of the boulders were lower growing than the same species on the less exposed sides of the boulders, and normally large algae, such as *Laurencia obtusa* and *Cystoseira* sp., exhibited 'dwarf' morphologies typical of wave-swept shores (see Lewis, 1968; Connell, 1972; Keddy, 1983; Denny *et al.*, 1985; Baker & Crothers, 1987)

It is interesting to note that the limpets *Patella rustica*, *Patella ulyssiponensis* and *Patella caerulea* of Filfla attained a larger size compared to individuals of these species recorded from elsewhere in the Maltese Islands. For example, individuals of *P. rustica* from Filfla had maximum shell diameters of ca. 3cm, compared to 2.4cm for the southern coast of Comino, 1.6cm for Mistra, Ghar Lapsi, Qawra and Dahlet ix-Xmajjar (all in Malta), and 1.4cm for Hondoq ir-Rummien (Gozo).

Infralittoral benthic assemblages

The uppermost regions of the infralittoral (mean sea-level to –50cm) consisted of accumulations of cobbles and pebbles surrounding the larger boulders. These were practically devoid of epilithic vegetation except for rare patches of encrusting coralline algae and a very sparse algal turf. The fauna consisted of amphipods and small gastropods (mainly juvenile *Gibbula* spp.) hiding under the cobbles, and of blennies and the crab *Pachygrapsus marmoratus* between the cobbles.

Two main community types were recorded from the upper infralittoral at depths greater than –0.5m: the community of photophilic algae on hard substrata and the community of bare sand. The community of bare sand appeared to have an impoverished epibiota and was not investigated further.

In the community of photophilic algae, the most abundant macroalgae were: *Halopteris scoparia* and *Dilophus* sp. down to depths of –2m; *Dasya elegans, Halopteris scoparia, Dictyopteris polypodiodes* and *Cystoseira* spp. from –3 to –6m; and *Sargassum vulgare, Padina pavonica, Dictyopteris polypodiodes* and *Codium bursa* from –6 to –20m. Small patches of *Peysonnelia squamaria* were encountered in shady conditions, especially below overhangs, from –5 to –20m. Other, less abundant, algae included *Herposiphonia secunda* and *Laurencia obtusa* (lower mediolittoral to upper infralittoral), and *Anadyomene stellata, Liagora distenta, Jania rubens* and *Chondria* sp. (upper infralittoral). The record of *Liagora distenta* is the first for the Maltese Islands (E.Lanfranco, personal communication, 1997).

A list of the most abundant macroalgae and macrofaunal species from the photophilic assemblage recorded during this study, is given in Appendix A.

As for the littoral assemblages, the upper infralittoral assemblages were similar in species composition to those found elsewhere in the Maltese Islands (see for example Borg, 1991; Borg & Schembri, 1995c), except that sea-grass meadows, which are practically ubiquitous round the coasts of the islands at depths from ca.1 to ca.40m, were not encountered during the surveys. However, the abundance of several macrobenthic species was rather low as compared to that recorded in other areas of the Maltese islands.

There was a clear difference in both species composition and the abundance of sponges between the two belt-transects. A larger species richness and abundance was recorded from transect 1 than from transect 2. Furthermore, the species composition of sponges was completely different for the two transects. *Agelas oroides* and *Crambe crambe* were the dominant species along the steeply sloping transect (T1), while *Sarcotragus spinosula* was the dominant species along the more gently sloping transect (T2) (Table 1).

Demersal fish fauna

A list of the species of demersal fish recorded during this study is given in Appendix B. In general, the abundance of certain species appeared to be low, compared to mainland sites.

Table 1. Abundance of Porifera as percentage cover of the total area of bottom within the transect, for transects T1 and T2.

Species	Transect T1		Transect T2	
	Depth	**Cover**	**Depth**	**Cover**
Agelas oroides	24-26 m	+++++		
	29 m	+++++		
Chondrosia reniformis	13-14 m	+++		
Crambe crambe	12 m	++++		
	17 m	+++		
	23-24 m	+++++		
	28-30 m	++++		
Ircinia variabilis	6 m	+	5 m	+
Petrosia ficiformis	30 m	+++		
Sarcotragus spinosula			5 m	+
			8 m	+
			15 m	+

Cover scale:

+	<0.0011%
++	0.0012-0.005%
+++	0.006-0.01%
++++	0.011-0.02%
+++++	>0.02%

DISCUSSION

In general, the same type of littoral benthic assemblages as found on other exposed rocky shores in the Maltese Islands occurred at Filfla (see Mallia [A.], 1991; 1993; Mallia [R.], 1993; Vella, 1994). However, the shores at Filfla were different in that the littoral zones were compressed, species abundances were generally low, vagile macrofauna were sparse and generally confined to crevices, while mediolittoral macroalgae appeared 'dwarfed'. Except for the compressed zones, the other features are probably a result of the exposed nature of the islet, the large quantities of rock fragments of all sizes stacked on top of each other that make up the shore at Filfla, and the almost continual buffeting by waves that it receives. On the other hand, compressed zones are normally associated with sheltered areas and we cannot offer any explanation for this phenomenon at present, although it may have to do with the predominance of vertical and

subvertical faces on the boulders. Mallia [R.] (1993) working on the North-eastern coast of Malta, found compressed and uplifted littoral zones on shores with a gradient of 82°-107° and a Thomas index of 8.9-14.9.

The large size of the patellid limpets at Filfla was also unusual and this is almost certainly due to the reduced exploitation of these gastropods by humans, in contrast to the situation on mainland shores where these animals are collected in large numbers as they are considered a delicacy.

The infralittoral assemblages at Filfla were also similar to those generally occurring in comparable environments off the mainland coasts. However, in spite of the extensive sandy bottoms present at Filfla, no sea-grass meadows were encountered, in contrast to the widespread distribution of such meadows in other parts of Malta where the seabed is predominantly sandy (see Borg & Schembri, 1995a). Again, we are not able to offer any explanation for this at present.

The small differences in the species composition of the benthic assemblages at Filfla, particularly those in the upper reaches of the infralittoral, compared to mainland sites, are probably due to a combination of the exposure and the nature of the substratum, which consists of fields of boulders with smaller fragments in the interstices.

The demersal fish fauna at Filfla was impoverished. In spite of the availability of a large number of crevices provided by the stacked boulders, relatively few species typical of such microhabitats were encountered during the present study, and even those present appeared to occur in low abundances. Such species as grouper *Epinephelus marginatus*, brown meagre *Sciaena umbra*, bearded umbrina *Umbrina cirrosa*, cardinal fish *Apogon imberbis*, and bream *Diplodus* spp., which would abound in boulder fields off the mainland coast, were either rare or absent at Filfla. Although we do not know the reason for this, we suspect that fishing with explosives and spearfishing using SCUBA, which are reported to occur regularly around Filfla, may be contributing factors.

This is the first time that the marine fauna of Filfla has been surveyed. Although preliminary, our data suggest that the peculiar geomorphology of the islet, combined with its exposure and isolation, have given rise to features that are unusual and possibly not found elsewhere in the Maltese Islands. The marine assemblages of Filfla are certainly worthy of further detailed study, even if such studies are likely to take a long time due to difficulties in carrying out fieldwork at such an exposed and inaccessible site. Our results also provide supporting evidence for designating the sea area round the islet as a marine protected area as has already been suggested (Anderson *et al.*, 1992; Schembri, 1994). Such

designation, as well as enforcement of already existing legislation protecting the islet and its surrounding waters, would go a long way towards preventing further negative anthropic impacts on the marine habitats and biota of the islet.

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APPENDIX A List of the more abundant macrobenthic species recorded from Filfla during the present study.

Algae
Amphiroa rigida Lamouroux
Chondria sp.
Corallina elongata Ellis & Solander
Dasya elegans (Mertens) C. Agardh
Jania rubens (L.) Lamouroux
Laurencia obtusa (Hudson) Lamouroux
Peysonnelia squamaria (Gmelin) Decaisne
Liagora distenta (Mertens) C. Agardh
Herposiphonia secunda (C. Agardh) Ambronn
Cystoseira spp.
Dictyopteris polypodiodes Lamouroux
Dilophus (= *Dictyota*) sp.
Halopteris scoparia (L.) Sauvageau
Padina pavonica (L.) Lamouroux
Sargassum vulgare C. Agardh
Anadyomene stellata (Wulfen) C. Agardh
Codium bursa (L.) C. Agardh
Flabellia (=*Udotea*) *petiolata* (Turra) Nizamuddin

Porifera
Agelas oroides (Schmidt)
Cacospongia scalaris (Schmidt)
Chondrosia reniformis (Nardo)
Crambe crambe (Schmidt)
Ircinia variabilis (Schmidt)
Sarcotragus spinosula (Schmidt)

Cnidaria
Astroides calycularis (Pallas)

Annelida
Hermodice carunculata (Pallas)
Sabellidae spp. indet.

Arthropoda
Chthamalus stellatus (Poli)
Balanus sp.
Calcinus ornatus (Roux)
Pagurus anachoretus Risso
Pisa tetraodon (Pennant)
Maja verrucosa H.Milne Edwards

Mollusca
Lepidochitona corrugata (Reeve)
Patella caerulea L.
Patella rustica L.
Patella ulyssiponensis Gmelin
Gibbula spp.
Monodonta turbinata (Von Born)
Melarhaphe (= *Littorina*) *neritoides* (L.)
Dendropoma petraeum (Monterosato)
Serpulorbis arenaria (L.)
Columbella rustica (L.)
Hexaplex trunculus (L.)
Stramonita (= *Thais*) *haemastoma* (L.)
Pinna pernula Chemnitz

Echinodermata
Echinaster sepositus (Retzius)
Ophidiaster ophidianus (Lamarck)
Ophioderma longicaudum (Retzius)
Paracentrotus lividus (Lamarck)

APPENDIX B List of the more abundant demersal fish recorded from Filfla during the present study.

Epinephelus marginatus (Lowe) (=*guaza*)
Serranus scriba (L.)
Mullus surmuletus L.
Mullus sp.
Diplodus spp.
Dentex dentex (L.)
Labrus sp.
Coris julis (L.)
Crenilabrus (= *Symphodus*) spp.
Thalassoma pavo (L.)
Sparisoma cretense (L.)
Gobius sp.
Blennius sp.

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INSECT PESTS ON CAULIFLOWER (*BRASSICA OLERACEA* VAR. *BOTRYTIS*) IN GOZO (MALTESE ISLANDS, CENTRAL MEDITERRANEAN).

Charles Farrugia[1]

ABSTRACT

A total of twenty-two insect species were found feeding on different parts of cauliflower plants (*Brassica oleracea* var. *botrytis*) at some stage of their life cycle. The species are distributed in five insect orders as follows: **Coleoptera** (7), **Lepidoptera** (6), **Homoptera** (6), **Diptera** (2) and **Thysanoptera** (1). After reviewing earlier literature on cauliflower pests in the Maltese Islands, the present work gives a species list, with global distribution and additional notes where appropriate. Six species are recorded for the first time from the Maltese Islands.

INTRODUCTION

Faunistic studies on insects associated with brassica crops have been carried out in several countries, (Bodnaryk, 1991; Brandt & Lamb, 1993; Kirk, 1992; Winfield, 1992). Published work on insects associated with brassica crops grown in the Maltese Islands is rather limited and requires updating. This has encouraged the present author to carry out this work as part of his B.Sc. dissertation (Farrugia, 1995).

During the period September to March 1995, continuous sampling was carried out to determine the insect pests associated with cauliflower plants in a field in Gozo. Essentially, the key pests found on cauliflower are common to all closely related brassica crops; cauliflower was chosen for the study because it is a main crop and has the longest maturation time, thus being most susceptible to insect damage.

Borg (1927) mentions the pests of brassica crops as including *Haltica oleracea* (= *Phyllotreta cruciferae*), *Aleurodes brassicae* (= *Aleyrodes proletella*), *Delia Brassicae* and *Pieris brassicae*.

Saliba (1963) listed the following economically important pests of brassicas:

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Coleoptera: Curculionidae: *Baris coerulescens* Scopoli, *Ceuthorrhynchus quadridens* Panzer, *Otiorrhynchus cribricollis* L.; Chrysomelidae: *Phyllotreta nemorum* L.; Hydrophilidae: *Megempleurus rugosus* Olivier.
Homoptera: Aphididae: *Brevicoryne brassicae* L.
Diptera: Cecidomyidae: *Contarina nasturtii* Kieffer; Muscidae: *Hylemia brassicae* Bouche.
Lepidoptera: Tortricidae: *Laspeyresia leplastriana* Curtis; Noctuidae: *Mamestra brassicae* L., *Mamestra trifolii* Rott., *Phytometra gamma* L.; Pieridae: *Pieris brassicae* L., *Pieris napi* L., *Pieris rapae* L.; Plutellidae: *Plutella maculipennis* Curtis.

Recently the whiteflies *Bemisia tabaci* (Gennadius) and *Aleyrodes proletella* L. were confirmed as serious pests of brassica crops (Mifsud, 1995).

MATERIALS AND METHOD

In order to obtain representative samples of all possible pest species, the area of study was selected on the basis that no pesticides had been recently applied. The area chosen was a field, measuring fifteen by thirty metres, located at Il-Wilga, Ghasri, Gozo. It forms part of a large tract of arable land and is cultivated all the year round; there are no buildings in the immediate vicinity. In mid-august 1994, cauliflower seedlings which had been grown in a typical nursery were planted at 60cm spacing in rows 90cm apart. The crop was watered by drip irrigation and cultivated with the normal processes of weeding and tilling until maturation. All insects examined in this study were collected and reared by the author from this field. Insects were searched for on both upper and lower surfaces of cauliflower leaves, on the roots and stalks, and inside the main stem and leaf petioles. Larval instars of the insects collected were reared to the adult stages prior to identification.

Identification of aphids, thrips and whiteflies was carried out by the author using several keys (Blackman & Eastop, 1984); (Stroyan, 1984); (Kirk, 1992); (Palmer *et al.*,1992); (Mifsud, 1995). Identifications of Coleoptera, Diptera and Lepidoptera were carried out by Dr. Michael Cox, Dr. Martin J. Ebejer and Mr. Paul Sammut respectively.

In the Species List which follows, principle synonyms are cited in square brackets below the species name.

SPECIES LIST

ORDER COLEOPTERA

CHRYSOMELIDAE

Phyllotreta cruciferae (Goeze, 1777)
[*Chrysomela cruciferae* Goeze, 1777]

Material examined: 10 exs., 14/VII/94; 5f, 5m, 15/IX/94; 6 exs., 24/XII/94; 3f, 3m, 23/II/95.
Distribution: Throughout Europe, Cyprus, North Africa to Egypt, Sudan, Ethiopia, Caucasus, Asia Minor and Central and North America including Canada. Its presence in other Mediterranean Islands is doubtful (Douget 1994).
Notes: *P. cruciferae* is especially injurious to plants in the seedbed. Its feeding damage is characteristic of many Chrysomelidae, and results in numerous small pits in the leaf tissue. During severe infestations the growth rate of the plants is significantly reduced (Bodnaryk, 1991). The larvae feed on the roots of the host plant.

Phyllotreta consobrina (Curtis)
[*Haltica consobrina* Curtis, 1837]

Material examined: : 3 exs., 23/IX/94; 1 exs., 1/II/95.
Distribution: Throughout Western Europe, North Africa, and U.K. (Douget, 1994).
Notes: This species is not as common as *P. cruciferae* and only single individuals were occasionally found.

Phyllotreta variipennis Boield

New record.
Material examined: : 20 exs., 15/X/94.
Notes: This species has probably been previously misidentified as *Phyllotreta nemorum* L., which is mentioned by both Borg (1927) and Saliba (1963). The two species are very similar in having a longitudinal yellow band on each elytron. The most apparent distinction is the size difference between the two species, *P. variipennis* being 2.3 - 3.0mm long and *P. nemorum* 1.8 - 2.0mm (Kirk, 1992).

Psylliodes chrysocephala L.

Material examined: : 1 ex., 15/XI/94; 1 ex., 2/II/ 95.
Distribution: Throughout Europe and Scandinavia, Russia, Siberia, Caucasus, Crete, Cyprus, Sicily and Madeira (Douget, 1994).
Notes: The larvae of *P. chrysocephala* feed inside the petioles of cauliflower leaves and inside the main stems of younger plants, where they tunnel through the tissues, leading to a reduction in yield (Ebbe-Nyman, 1952). They can be distinguished from the larvae of *Ceutorhynchus pallidactylus* (see below) by the possession of three pairs of thoracic legs. Adults of this species are rare and were never collected from the field.

CURCULIONIDAE

Ceutorrhynchus pallidactylus (Marsham, 1802)
[*Ceuthorrhynchus quadridens* (Panzer, 1795)]

Material examined: : 1 ex., 12/XI/94; 1 ex., 6/I/95; 1 ex., 2/IV/95.
Distribution: Throughout Europe, Algeria, Morocco and Canada (Hoffmann, 1954).
Notes: The larvae of *C. pallidactylus* cause damage by mining the leaf stalks and the main stems of young cauliflower plants. They are more easily encountered than the adults which only appear for a short period during the breeding season and are often overlooked. Although the species may not seem to cause appreciable damage in larger plants, it was observed that infested young plants often lose their terminal bud while still in the seedbed.

Rhytideres plicatus (Olivier, 1790)
[*Rhytidoderes plicatus* Olivier, 1790]

Material examined: : 1f, 1m, 30/IX/94; 1f, 12/X/94; 3f, 2m, 5/XII/94; 1m, 8/I/95.
Distribution: Throughout Europe and North Africa, Asia Minor, Madeira and Canary Islands.
Notes: Up to 35 larvae have been observed in the roots of a single plant. Wilting and consequent death of infested plants occurs prior to maturation resulting in considerable losses. Thus *R. plicatus* may be regarded as a serious pest. However, populations do not often reach high levels because the soil is normally rotavated immediately after crop maturation. This kills the larvae due to food deprivation and exposure to predators at the soil surface.

Baris coerulescens Scopoli, 1763
[*Baris virens* Olivier, 1790]

Material examined: : 1 ex., 23/II/95; 1 ex., 30/II/95 (found dead).
Distribution: Throughout Europe, North Africa, Syria (Hoffmann, 1954).
Notes: This species was only obtained on two occasions from the foliage of cauliflower and is probably of no economic importance on this crop locally. *B. coerulescens* is reported as a pest in France (Balachowsky & Mesnil, 1936), the larvae developing in the root crown or the tap root (Koubaiti & Lerin, 1992). Two other *Baris* species have been reported from the Maltese Islands (Cameron & Caruana-Gatto, 1907).

ORDER LEPIDOPTERA

PIERIDAE

Pieris brassicae L., 1758

Material examined: : 2f, 23/XII/94; 1f, 2m, 26/II/95; 1f, 5/III/95.
Distribution: From North Africa across Europe and Asia to the Himalayas (Higgins, 1975).
Notes: The larvae of *P.brassicae* are important pests, causing damage by devouring large amounts of foliage, hence reducing productivity. During severe attacks, the whole plant is defoliated, leaving only the stalk and leaf petioles.

Pieris rapae L., 1758
[*Artogeia rapae* (L.,1758)]

Material examined: : 1f, 14/VII/94; 2ff, 29/X/94.
Distribution: Originated in Canada but is now cosmopolitan, (P. Sammut, *pers. comm.*).
Notes: This species is one of the most ravaging pests, both in Malta and worldwide. Although the eggs and larvae of *P. brassicae* are encounterd more often, giving the impression that it is more abundant, *P. rapae* is in fact more common (P. Sammut, *pers. comm.*). This is because *P. rapae* lays its eggs singly, while *P. brassicae* lays large clutches of yellow eggs. Also, its green larvae are less conspicuous than those of *P. brassicae* which are more brightly coloured.

NOCTUIDAE

Autographa gamma (L. 1758)
[*Plusia gamma* L., 1758]

Material examined: : 2 f, 21/XII/94; 1 f, 10/XII/94; 2 m, 1 f, 2/II/95; 1 f, 15/II/95; 1 m, 29/II/95.
Distribution: Common throughout the whole Palaearctic region, except the far East.
Notes: This species is rather polyphagous and attacks many different field crops. As it is a migratory species, its population may fluctuate greatly from year to year, and hence also the damage it causes (P. Sammut, *pers. comm.*).

Noctua pronuba L.,1758
[*Triphaena pronuba* (L., 1758); *Agrotis pronuba* (L., 1758)]

Material examined: : 1 ex., 5/IV/95, 1 m, 10/V/95.
Distribution: Whole Palaearctic region, except far North.
Notes: This species is very widely distributed, and is one of the commonest moths in the Maltese Islands. It feeds on most vegetable crops (P. Sammut, *pers. comm.*) and is regarded as a pest in many countries.

TORTRICIDAE

?Selania leplastriana (Curtis, 1831)
[*Cydia leplastriana* (Curtis, 1831)]

Material examined: : 5 exs., (larvae), 26/X/94; 2 exs., (larvae), 12/X/94.
Distribution: Germany, England, France, Hungary, Italy, North Africa, Malta (Nye, 1975).
Notes: The identification is not definite as adults could not be reared from the larval stages and no mature moths were captured. The larva starts to feed at the terminal bud of the host plant and immediately mines into the tender main stem (Borg, 1932). Consequently the plants lose their apical growth and will not form a curd. The presence of the larvae is indicated by their habit of exuding brown frass through the point of entry, but they frequently cause considerable damage because their presence is not immediately detected.

PLUTELLIDAE

Plutella xylostella (L. 1758)
[*Plutella maculipennis* (Curtis, 1832)]

Material examined: : 2 ex., 12/XI/94; 1 ex., 23/XI/94; 2 exs., 4/I/95; 1 ex., 16/I/95; 1 ex., 20/I/95; 1 ex., 15/III/95.
Distribution: Of European origin but now cosmopolitan (A. Aziz, *pers. comm.*).
Notes: The larva of this moth is rather injurious (Saliba, 1963). Its presence is betrayed by the characteristic feeding patches on the leaf, only the upper epidermis being left untouched. In dry weather, even the remaining upper epidermis breaks, leaving an irregular hole in the leaf (Abro *et al.*, 1992).

ORDER HOMOPTERA

ALEYRODIDAE

Bemisia tabaci (Gennadius,1889)
[*Bemisia gossypiperda* Misra & Lamba, 1929]

Material examined: : 4 exs., 22/I/94; 12 exs., 14/IX/94; 10 exs., 23/X/94; 10 exs., 6/XI/94; 6 exs., 30/XI/94; 6 exs., 12/XII/94.
Distribution: Pan-tropical.
Notes: *B. tabaci* is a very common pest of brassica crops especially during the period when plants are transplanted from the nursery. During heavy infestations, the larvae cover the lower surface of older leaves almost completely.

Aleyrodes proletella (L., 1758)
[*Aleurodes youngi* Hempel, 1901]

Material Examined: : 12 exs., 10/I/94; 7 exs., 17/II/94.
Distribution: Palaearctic region: U.K., Sweden, France, Spain, Czechoslovakia, Germany, Switzerland, Austria, Italy, Yugoslavia, Poland, Hungary, Finland, USSR, Canary Islands, Egypt, Morocco; Ethiopian Region: Kenya, Angola, Mozambique; Neotropical region: Brazil; Pacific region: New Zealand (Mound & Halsey, 1978).
Notes: During the present study this whitefly was very abundant in December, January and February when the population of *Bemisia tabaci* was relatively low. Its population fell sharply with increasing ambient temperature.

APHIDIDAE

Smynthurodes betae Westwood, 1849
[*Triphidaphis phaseoli* Passerini]

New record.
Material examined: : 3 exs., 6/I/95.
Distribution: Widely distributed in Europe from Southern Scandinavia to the Mediterranean; Egypt.
Notes: This species was found on the roots. It is polyphagous, feeding mainly on the cotyledons. In Italy *S. betae* has been recorded from roots of potato and bean crops (Barbagallo & Stroyan, 1982). Only three specimens were recovered and the species probably does not affect the crop owing the small population size. The primary hosts are *Pistacia atlantica* and *P. mutica*, where it lives in galls it induces in the leaves.

Lipaphis erysimi Kaltenbach, 1843

New record.
Material examined: : 2 exs., 19/XI/94; 3 exs., 9/X/94; 1 ex., 10/X/94.
Distribution: Cosmopolitan (Blackman & Eastop, 1984).
Notes: *L. erysimi* is a vector of about ten persistent plant viruses, including Black Ring Spot and Mosaic Diseases of cauliflower. The European form of *L. erysimi* is not normally a pest of *Brassica* crops (Blackman & Eastop, 1984) and during this study it was only noted in small colonies on caulifower.

Brevicoryne brassicae (L. 1758)

Material examined: : 6 exs., 12/X/94; 2 exs., 2/X/94; 3 exs., 26/XII/94.
Distribution: Cosmopolitan.
Notes: The species is a pest of cruciferous plants and is not ant-attended. In Malta it is found all the year round but during the winter its population dwindles drastically. This pest is often found in hundreds on a single leaf. Infested leaves show marked deformation.

Myzus persicae (Sulzer, 1776)

Material examined: : 3 exs., 30/X/94; 1ex., 19/XI/ 94.
Distribution: Probably of Asian origin, now cosmopolitan.

Notes: The pimary host plant of *Myzus persicae* is the peach, *Prunus persicae*, but it can also live on plants in forty other families. It is an important vector of more than a hundred plant viruses (Blackman & Eastop, 1984). On cauliflower it forms numerous small colonies.

CERCOPIDAE

?Philaneus sp.

New record.
Material examined: : 1 ex., 23/X/94; 2 m, 2 f, 10/XI/94.
Notes: The specimens collected are still awaiting definite identification. The species was found living underground where it sucks sap from the roots. It was observed that ants are always in attendance, often constructing their nest around the root system. In one instance, it was observed that a mature adult emerged to the soil surface and followed an ant trail to the roots of an adjacent plant. This insect is probably of no economic importance unless it is capable of transmitting viral diseases. During this study it was found on individual plants, numbering up to sixty on each plant at the time of hatching of the nymphs.

ORDER DIPTERA

AGROMYZIDAE

Liriomyza bryoniae (Kaltenbach, 1858)
[Liriomyza solani (Hering)]

New record.
Material examined: : 1 ex., 12/X/94.
Notes: The larva of this species mines between the epidermal layers of the leaf. It normally infests tomato, *Lycopersicon esculentum,* and was only found once on cauliflower.

Phytomyza horticola Goureau, 1851

New record.
Material examined: : 1 ex., 28/XII/94; 1 ex., 25/I/95; 1 ex., 15/III/95.
Distribution: Whole Palaearctic region.
Notes: This is a very polyphagous species (Spencer, 1972). Up to eight larvae were observed mining a single leaf.

ORDER THYSANOPTERA

THRIPIDAE

Thrips tabaci Lindemann

Material examined: : 6 f, 30/X/94; 4 f, 2/I/95.
Distribution: Neotropic, Nearctic and West Palaearctic regions (Metcalf & Flint, 1962).
Notes: The species is only abundant in warm weather; males are wingless and very rare. Damage is confined to the lower surface of larger leaves which offer more shelter. *T. tabaci* is more damaging to cabbage cultivars, where feeding injury results in a rough, bronzed edema on the leaves inside the head (Hoy & Kretchmann, 1991).

DISCUSSION

The insects associated with brassica crops have a complicated network of interactions. Root (1972) divided insects feeding on collards into strip-feeders that chew plant material (e.g. butterfly caterpillars), 'pit-feeders' that rasp small pit-holes in the leaves (e.g.adult chrysomelids), and 'sap-feeders' that suck the plant's sap (e.g. aphids). Apart from the feeding strategies mentioned by Root, "miners", which feed by boring into plant tissue also occur (e.g. agromyzid larvae).

The relationship between feeding methods, plant parts attacked and stage of life-cycle for the species encountered in the present study is summarised in Table 1.

Brassica pests not encountered during the present study. The moth *Mamestra brassicae* was recorded only once in Malta, as an errant visitor (Borg, 1932). The much commoner *Mniotype deluccai* (Berio, 1976), an endemic species, is very similar and it is highly probable that it was confused with the latter species by Saliba in his work of 1963 (Sammut, *pers. comm.*).

Saliba (1963) mentions two other moths as pests of brassica crops: *Mamestra trifolii* [=*Discestra trifolii* (Hufnegel 1766)] and *Agrotis segetum* (Dennis & Schifferuller, 1775). *D. trifolii*, is rather rare and is not regarded as a pest (Sammut, *pers. comm.*). *A. segetum* is very widespread, the larvae being mainly subterranean where they possibly feed on roots of crop plants. It is known that populations of *A. segetum* fluctuate considerably from year to year (Nye, 1975) and may sometimes reach pest proportions, particularly on crops of *Brassica rupestris*, which this species prefers.

TABLE 1. Feeding relationships of phytophagous insects found on cauliflower. (A, adult; L, larva)

SPECIES	LEAVES	ROOTS	STEM
Phyllotreta cruciferae	Pit-feeders (A)	Strip-feeders (L)	
P. consobrina	Pit-feeders (A)	Strip-feeders (L)	
P. variipennis	Pit-feeders (A)	Strip-feeders (L)	
Psylliodes chrysocephala	Miners (petiole) (L)		
Ceutorhynchus pallidactylus	Pit-feeders (A) Miners (petiole) (L)		Miners (L)
Baris coerulescens	Strip-feeders (A)	Miners (L)	
Rhytideres plicatus	Strip-feeders (A)	Strip-feeders (L)	
Pieris brassicae	Strip-feeders (L)		
P. rapae	Strip-feeders (L)		
Autographa gamma	Strip-feeders (L)		
Noctua pronuba	Strip-feeders (L)		
Plutella xylostella	Strip-feeders (L)		
Selania leplastriana			Miners (L)
Liriomyza bryoniae	Miners (lamina) (L)		
Phytomyza horticola	Miners (lamina) (L)		
Myzus persicae	Sap-feeders (A,L)		
Brevicoryne brassicae	Sap-feeders (A,L)		
Lipaphis erysimi	Sap-feeders (A,L)		
Smynthurodes betaea		Sap-feeders (A,L)	
Bemisia tabaci	Sap-feeders (A,L)		
Aleyrodes proletella	Sap-feeders (A,L)		
Thrips tabaci	Sap-feeders (A,L)		

Borg (1932) recorded *Laspeyresia leplastriana* (= *Selania leplastriana* Curtis) as an important tortricid moth pest occurring on brassicas. The adult of this pest was not found during the present study and so no material was available to confirm identifications of larvae obtained from the damaged stems of cauliflower. Attempts to rear adult moths from the larvae were not successful: instead, the ichneumonid *Venturia canescens*, a well-known parasite of tortricid moths was reared from the larvae.

Important dipterous pests, namely rootflies of the genus *Delia*, were not encountered in the present study although they are known to occur locally (Schembri *et al.*, 1991). At least four rootfly species of have been recorded from the Maltese Islands including: *Delia antiqua* Meig; *Hylemia brassicae* Bouche (Saliba, 1963); *Delia cepetorum* Meade (Cilia, 1973) and *Delia platura* Meigen (Schembri *et al.*, 1991). However, it is known that populations of *Delia* occur

sporadically with much annual variation. This also applies to *Phytomyza rufipes* which, according to Spencer (1972) is a cosmopolitan leafminer of brassica crops (Ebejer, *pers. comm.*).

Both Borg (1927) and Saliba (1963) recorded *Phyllotreta nemorum* as occurring locally. However, as already mentioned, this is probably due to misidentification of *P. variipennis* which is morphologically very similar.

A number of other serious brassica pests have never been recorded from the Maltese Islands and it is important, from the agricultural point of view, to prevent their introduction. These species include the curculionids *Ceutorhynchus pleurostigma* Marsham and *Ceutorhynchus assimilis* Paykull and the chrysomelid *Entomoscelis americana* Brown, (Gerber, 1994).

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THE CHEQUERED BEETLES (COLEOPTERA: CLERIDAE) OF THE MALTESE ISLANDS (CENTRAL MEDITERRANEAN)

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ABSTRACT

The Cleridae of the Maltese Islands are reviewed. Of the six Maltese species, *Tillus unifasciatus*, can be considered as a doubtful record, while two species, *Denops albofasciatus* and *Opilo domesticus*, are here recorded for the first time. Information on global distribution and additional notes are given for each species.

INTRODUCTION

The Cleridae are a moderate-sized family of about 150 genera and 4,000 species worldwide. Both adults and larvae are generally predatory, especially on wood-boring beetle larvae. The larvae of some species are probably ectoparasitic. Adults of certain species are sometimes found on carrion, where they are usually predators of other insects, but may also feed on the decaying meat. The group is particularly important in tropical and sub-tropical regions where species diversity is high.

Four species have hitherto been recorded in the Maltese Islands. Cameron & Caruana Gatto (1907) listed three species: *Tillus transversalis* Charp. [= *Tillodea transversalis* (Charpentier, 1825)], *Necrobia ruficollis* (Fabricius, 1775) and *Necrobia rufipes* (De Geer, 1775). In a semi-popular article, Lanfranco (1971) mentioned *T. transversalis* on *Cynara cardunculus* L. in late spring or early summer. Valletta, (1979), in an article on the insect pollinators of *Cynara cardunculus*, mentioned a fourth species, *Tillus unifasciatus* Fabr. [= *Tilloidea unifasciata* (Fabricius, 1787)]. Cilia (1989) pointed out that this record possibly refers to *T. transversalis*.

Unless otherwise stated, all material was collected by the author and is deposited in his private collection.

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SPECIES LIST

Denops albofasciatus (Charpentier, 1825)

Material examined: MALTA, Ghadira, 16.VII.93, 1 ex., on sandy beach; M'Xlokk, 6.VI.95, 1 ex.

Distribution. Recorded from central and southern Europe; Mediterranean basin (Lohse, 1979). Central European citations are based on old records. Present throughout mainland Italy, Sicily and Sardinia (Luigioni, 1929; Porta, 1929).

Notes. This is a new record for the Maltese Islands. *D. albofasciatus* is an active predator of bostrychid beetle larvae (Lohse, 1979).

Tilloidea transversalis (Charpentier, 1825)

Tillus transversalis Charp.; Cameron & Caruana Gatto, 1907.
Tillus transversalis Charp.; Lanfranco, 1971.

Material examined: MALTA, Tal-Munxar (St. Thomas Bay), 1.VI. 90, 2 exs.; Ghajn Hadid, 23.V.90, 3 exs.; on *Cynara cardunculus*.

Distribution. North Africa, southern Europe, and isolated records from central Europe (southern Slovakia) (Lohse, 1979). Present in central and southern Italy, Sicily, Sardinia and Corsica. (Luigioni, 1929; Porta, 1929).

Notes. This is a rather common species in the Maltese Islands, frequently found on flowers of the Wild Artichoke, *Cynara cardunculus* L.

Tilloidea unifasciata (Fabricius, 1787)

Tillus unifasciatus Fabr.; Valletta, 1979.

Distribution: Western and southern Europe (Lohse, 1979). Present throughout mainland Italy, Sicily, Sardinia and Corsica (Luigioni, 1929; Porta, 1929).

Notes. Not found during the present study. *T. unifasciata* is easily distinguished from *T. transversalis*; however, the possibility that Valletta's record is erroneous cannot be excluded.

Opilo domesticus (Sturm, 1837)

Material examined: MALTA, Kalkara, 1.VIII.93, 1 ex., larva found dead in branches of *Ceratonia siliqua* L.; GOZO, Ramla, 1.X.95, 1 ex., found dead in sand dunes near *Pancratium maritimum* L.

Distribution. Widely distributed in Europe, except northern Europe. Present throughout mainland Italy, Sicily, Sardinia and Corsica (Luigioni, 1929; Porta, 1929).

Notes. This is a new record for the Maltese Islands. *O. domesticus* is a predator of anobiid beetles and of the cerambycid *Hylotrupes* sp. (Lohse, 1979).

Necrobia ruficollis (Fabricius, 1775)

Necrobia ruficollis F.; Cameron & Caruana Gatto, 1907.

Distribution. Cosmopolitan (Lohse, 1979).

Notes. Not found during the present study. Cameron & Caruana Gatto (1907) reported the species as occurring "here and there".

Necrobia rufipes (De Geer, 1775)

Necrobia rufipes DeGeer; Cameron & Caruana Gatto, 1907.

Material examined: MALTA: Zejtun, 15.V.89, 1 ex.; 22.V.89, 1 ex.; 23.VI.89, 2 exs; M'Xlokk, 15.IX.89, 1 ex.; Marsa, 2.XI.93, 1 ex. All specimens found on carrion.

Distribution. Cosmopolitan (Lohse, 1979).

Notes. *N. rufipes* is a common species found throughout the Maltese Islands.

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FURTHER CONTRIBUTIONS TO THE KNOWLEDGE OF THE LONGHORN BEETLES (COLEOPTERA: CERAMBYCIDAE) OF THE MALTESE ISLANDS

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ABSTRACT

Six species of cerambycid beetles are recorded for the first time from the Maltese Islands: *Icosium tomentosum*, *Trichoferus griseus*, *Stenopterus rufus*, *Certallum ebulinum*, *Cerambyx carinatus* and *C. velutinus*. For each species information is provided on global distribution and host plant data for larval development. Notes are given on three additional species which to date were only known from single records, and on two introduced species, one of which, *Phoracantha semipunctata*, is recorded for the first time. The latter is associated with eucalyptus trees and has become naturalised in the Maltese Islands.

INTRODUCTION

The study of longhorn beetles has attracted the attention of a number of Maltese naturalists. Faunistic studies were started in 1894 by Dr Alfredo Caruana Gatto. Some years later he co-authored an important work (Cameron & Caruana Gatto, 1907) entitled "A List of the Coleoptera of the Maltese Islands" which still remains the main catalogue of beetles found in the Maltese Islands. In later years, Prof. John Borg and Dr Louis Saliba contributed a number of papers on the biology of, and damage caused by, cerambycid beetles. These works were cited by Schembri and Sama (1986) who also reviewed the local status of the family, listing a total of 22 species. In a short communication, Mifsud (1993) added a new record for the Maltese Islands.

The present work is intended to provide data on further new records of cerambycids and to comment on some locally rare species. Data on introduced species is also provided. This work also brings the total number of cerambycids recorded from the Maltese Islands to a total of 30 species, one of which, *Phoracantha semipunctata*, a native of Australia, has become naturalised. Unless otherwise stated all material is deposited in Mifsud's private collection.

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New records for the Maltese Islands

Icosium tomentosum Lucas, 1854

Material examined: MALTA, Msida (University Buildings), 14.VII.93, 1 ex., Leg. D. Mifsud; attracted to light.

I. tomentosum is known from North Africa, West Mediterranean basin, Italy, Yugoslavia and Greece. *I. tomentosum tomentosum* is a predominantly western Mediterranean subspecies, while *I. tomentosum atticum* was recorded from Yugoslavia, Greece and mainland Italy (Adriatic coast). The species has never been recorded from Sicily. The Maltese specimen is attributed to the nominate subspecies. The larvae are known to develop in trees of the genera *Juniperus*, *Thuja*, *Cupressus* and *Callitris* (Sama, 1988).

Trichoferus griseus (Fabricius, 1792)

Material examined: MALTA, Kalkara, 26.VII.93, 1 ex., Leg. D. Mifsud; found dead near private garden dominated by the carob tree, *Ceratonia siliqua* L.

T. griseus is known from North Africa, the Iberian Peninsula, southern France, Italy, Yugoslavia, Greece and Canary Islands. It is also frequently recorded from Asia Minor, Caucasus and Transcaucasia but such records could be erroneous (Sama, 1988). The larvae are known to develop in *Ficus* but development in other host plants is not excluded (Sama, 1988).

Stenopterus rufus (Linné, 1767)

Material examined: MALTA, Wied il-Kbir (Qormi), 22.V.95, 3 exs., Leg. & Coll. M.J. Ebejer.

S. rufus is known from Spain, France, Italy, Switzerland, Germany, Austria, Czechoslovakia, Hungary, European USSR, Balearic Islands, Asia Minor, Caucasus, Iran and Syria. The larvae develop in dead wood of *Quercus*, *Castanea*, *Robinia*, *Ostrya*, *Pistacia*, *Ulmus*, *Ficus*, *Prunus* and other trees (Sama, 1988).

Certallum ebulinum (Linné, 1767)

Material examined: MALTA, Wied is-Sewda, 23.IV.76, 1 ex., Leg. & Coll. M.J. Ebejer.

C. ebulinum is known from North Africa (Egypt to Morocco), Spain, Portugal, southern France, central-southern Italy, Greece, Turkey, Iran, Caucasus and Syria. Larvae are known to develop in cruciferous plants such as *Erysinum*, *Sisymbrium*, *Psychine* and *Raphanus* (Sama, 1988).

Cerambyx carinatus Küster, 1846

Material examined: MALTA, Balzan, 10.VII.73, 1 ex., 19.VI.94, 1 ex., 24.VI.94, 1 ex., Leg. & Coll. M.J. Ebejer; on pear tree in private garden.

C. carinatus is a predominantly Balkan species, with records from coastal Yugoslavia and Greece. The larvae are known to develop in *Prunus* spp. (Sama, 1988).

Cerambyx velutinus Brullé, 1832

Material examined: MALTA, no other data. 1 ex., specimen from J.G. Children's sale of 1840. In collection of The Natural History Museum, London.

C. velutinus is known from southern Europe and Asia Minor. Larval development occurs in *Quercus* spp. with a preference for *Q. ilex* (Sama, 1988).

Notes on rare species.

The following three longhorn beetles had previously been recorded from single captures in the Maltese Islands. Two of them, *Gracilia minuta* and *Stenidea troberti*, were also listed as 'very rare locally (?)' in the Red Data Book for the Maltese Islands (Cilia, 1989).

Gracilia minuta (Fabricius, 1781)

Material examined: MALTA, Chadwick Lakes, 19.V.90, 1 ex., Leg. D. Mifsud; Marsascala, 22.V.97, 1 ex., Leg. C. Farrugia.

Prior to the above finds, *G. minuta* was recorded from a single specimen taken in 1976 at Buskett (Schembri & Sama, 1986).

Nathrius brevipennis (Mulsant, 1839)

Material examined: MALTA, Kalkara, 16.VII.93, 4 exs., Leg. D. Mifsud; found in dead branches of *Ceratonia siliqua*. GOZO, Victoria, 20.VI.95, 8 exs., Leg. C. Farrugia; reared from dead branches of loquat (*Eriobotrya japonica* Thunb.). Some material has been deposited at The Natural History Museum, London..

N. brevipennis was previously recorded from a single capture from Marsalforn Valley in Gozo (Mifsud, 1993). The Kalkara record constitutes the first record from mainland Malta. The species can be numerous when found, and is probably a recent arrival expanding its range.

Stenidea troberti (Mulsant, 1843)

Material examined: MALTA, Buskett, 6.IV.96, 1 ex., Leg. D. Mifsud; collected by beating maquis vegetation dominated by *Pistacia lentiscus* L.

S. troberti was previously recorded from a single specimen taken in 1976 at the same locality (Schembri & Sama, 1986).

Introduced species in the Maltese Islands

Cordylomera spinicornis (Fabricius, 1775)

Material examined: MALTA, Ghammieri (Marsa), IV.92, 1 ex., Leg. A. Vella.

C. spinicornis, a native of West Africa, was reported from imported wood at Santa Venera (Schembri, 1975). The present record constitutes its second capture from Malta. The species is collected from time to time in different countries where it is transported in wood, but its naturalization has nowhere been confirmed (G. Sama, *pers. comm.*, 1995).

Phoracantha semipunctata (Fabricius, 1775)

Material examined: MALTA, Siggiewi, 24.IX.94, 1 ex., Leg. D. Dandria; attracted to light; Ghammieri (Marsa), 20.X.95, 1 ex., Leg. D. Mifsud; Balzan, VIII.96, 5 exs., Leg. D. Mifsud; attracted to light in human habitation.

P. semipunctata, a native of Australia, is now widely distributed in eucalyptus plantations in many parts of the world. It was introduced into Italy in the 1950s. The present records are the first for this species in the Maltese Islands. Larval damage in *Eucalyptus* trees (the specific host plant of *P. semipunctata*) was observed locally and the species has already become naturalised, as has happened in other parts of the world where it was introduced..

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Prior to the above finds, *G. minuta* was recorded from a single specimen taken in 1976 at Buskett (Schembri & Sama, 1986).

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