
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, *Otione 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.

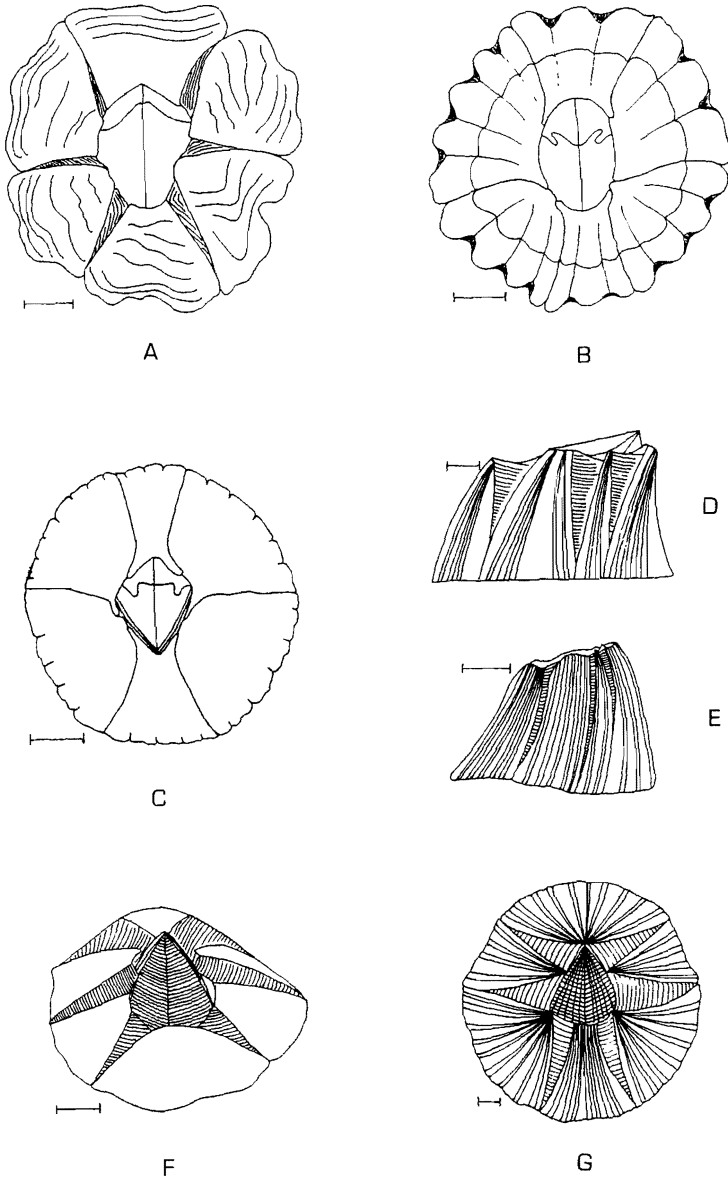


Fig 1: (Scale bar length in brackets) **A**, *Euraphia depressa* (2mm); **B**, *Chthamalus stellatus* (1mm); **C**, *Chthamalus montagui* (1mm); **D**, *Balanus amphitrite amphitrite* (1mm); **E**, *Balanus perforatus* (1mm); **F**, *Balanus trigonus*: form found on *Antipathes* sp. at 300 - 400m depth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

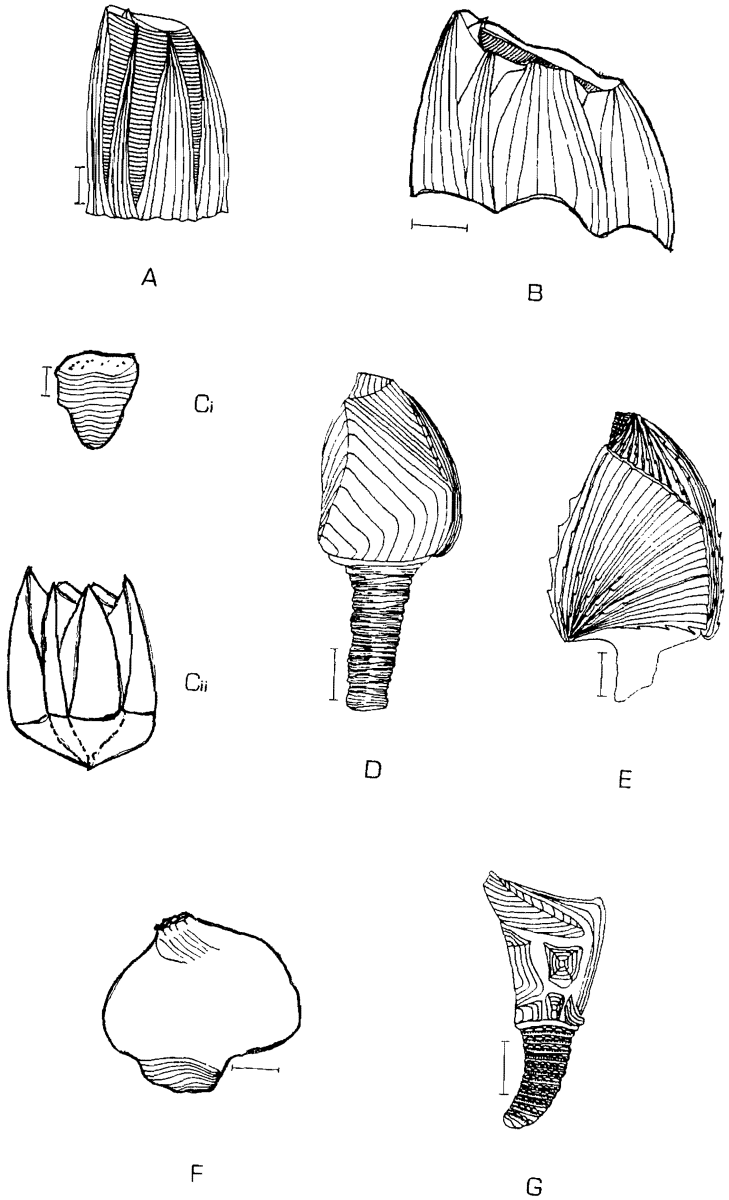


Fig. 2: (Scale bar length in brackets) **A**, *Megabalanus tintinnabulum tintinnabulum* (10mm); **B**, *Megabalanus tulipiformis* (3mm); **Ci**, cup-shaped basis of *Acasta* sp. (2mm); **Cii**, Structure of *Acasta spongites* as adapted from Relini (1980); **D**, *Lepas anatifera* (6mm); **E** *Lepas 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 hexastylus (Fabricius 1798)

Platylepas hexastylus (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 Brugière 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 tubes13
 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 possess 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*

ERRATA CORRIGE

Page 120: First three lines of caption to read:

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.....

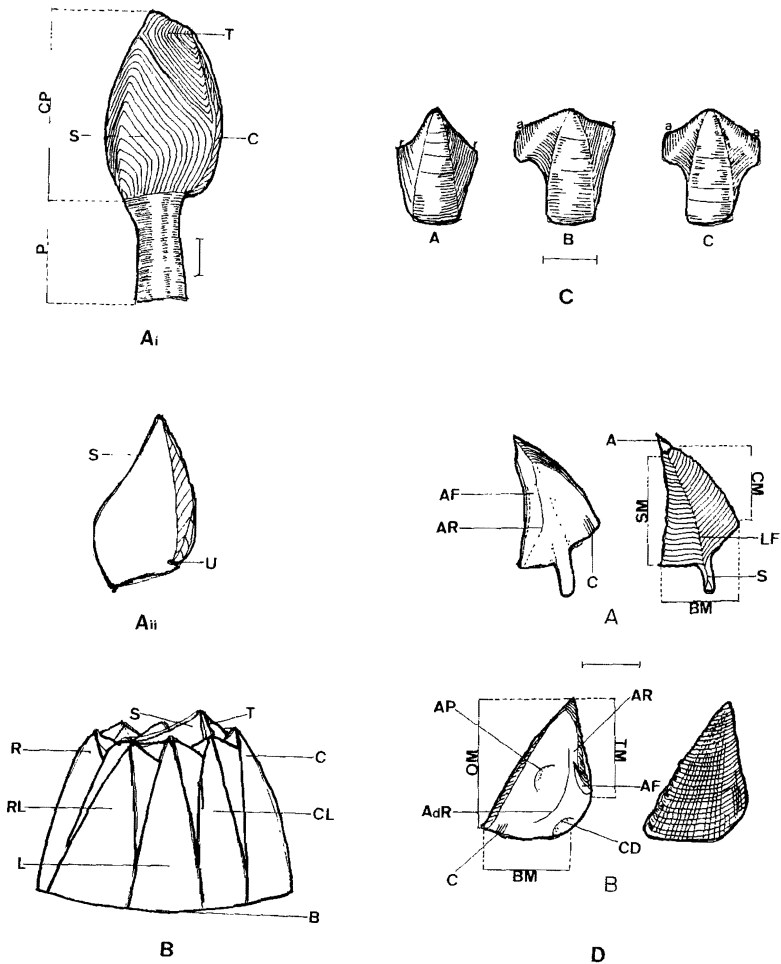


Fig. 3: (Scale bar length in brackets) **A**, The external structure of a stalked barnacle as adapted from Relini (1980). [*CP*, capitulum; *P*, peduncle; *S*, scutum; *T*, tergum; *C*, carina. (5mm)]. **B**, Scheme of a primitive sessile barnacle with 8 parietal plates. [*B*, basis; *C*, carina; *CL*, 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 hexastylus* 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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