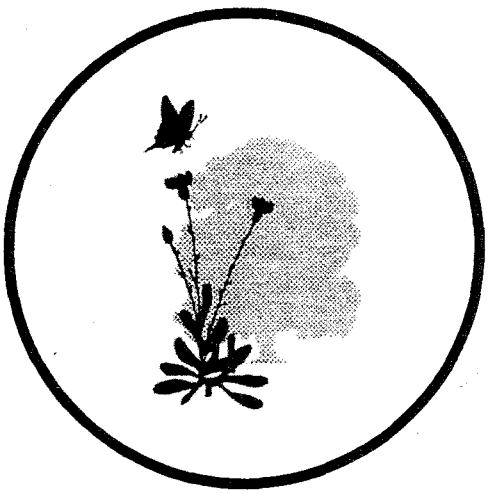
THE CENTRAL MEDITERRANEAN NATURALIST



Nature Trust (Malta)

VOLUME 4 PART 1 MALTA, 2003 - 2004

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2003 - 2004

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Nature Trust (Malta)

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

The merger resulted in the formation of Nature Trust (Malta) which was officially launched by His Excellency the President of the Republic on Friday, 8th January 1999. In June 2001, another organisation, the Marine Life Care Group also joined Nature Trust (Malta). The aims of Nature Trust (Malta) are to enhance public awareness and appreciation of the rich biodiversity of the Maltese Islands through educational campaigns, conservation schemes and research projects.

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

Special thanks to Dr. A.W. Janssen, Prof. P.J. Schembri and the Entomological Society of Malta.

EDITOR: DAVID DANDRIA

TYPESETTING AND LAYOUT: DAVID DANDRIA

PRINTED AT COLOUR IMAGE, MGARR, MALTA

Price: Lm3.00

The Central Mediterranean Naturalist	4(1): 1-33	Malta: December 2003

FOSSILS FROM THE LOWER GLOBIGERINA LIMESTONE FORMATION AT WARDIJA, GOZO (MIOCENE, AQUITANIAN), WITH A DESCRIPTION OF SOME NEW PTEROPOD SPECIES (MOLLUSCA, GASTROPODA)

Arie W. Janssen

ABSTRACT

Phosphatised fossil assemblages of four samples from the Lower Globigerina Limestone Formation at Wardija (SE Gozo, Malta) were analysed, with special emphasis on holoplanktonic molluscs (Gastropoda: Heteropoda and Pteropoda). The upper sample (sample 4) is from the lower main phosphorite level (C 1), samples 1 to 3 are respectively from c. 3 m, 5 m and 7.50 m above the base of the Lower Globigerina Limestone. Phosphatised faunal elements were separated from the limestone sediment by formic acid treatment.

The fossil assemblages yielded a surprising number of species new for the Maltese Archipelago, or even new to science. Comparison with other holoplanktonic mollusc assemblages, especially those from the Aquitaine Basin in France demonstrates that there is a certain resemblance with the Chattian fauna of *e.g.* St. Etienne-d'Orthe (*Spoelia torquayensis*, *Vaginella* ? *tricuspidata*), but the presence of some other species, such as *Gamopleura melitensis* and *Vaginella sannicola* indicate that the age of the Lower Globigerina Limestone presumably is Early Aquitanian.
Samples 2-3 yielded also a comparatively rich assemblage of benthic molluscs (especially small-sized gastropods), most of which are illustrated here (Pls 1-3). The holoplanktonic molluscs are illustrated on Pls 3-4.

The following species are introduced: *Heliconoides vanderweideni* sp. nov., *Bowdenatheca miocenica* sp. nov., *Clio* (s. lat.) *ghawdexensis* sp. nov., and *Edithinella bonaviai* sp. nov.

Note: This paper is a revised and extended version of Internal Report nr. 161 of the Nationaal Natuurhistorisch Museum Naturalis (Palaeontology Department - Cainozoic Mollusca), at Leiden, the Netherlands, dated 13 April 2001.

INTRODUCTION

Fossils in the Maltese Globigerina Limestone Formation are predominantly found as phosphoritic casts. Two main phosphorite levels separate the three subdivisions of this formation (Rehfeld & Janssen, 1995) and a varying number of subordinate levels containing phosphoritic nodules or clasts is present in the Middle and Upper Globigerina Limestone. Up to now such subordinate occurrences were not yet known from the Lower Globigerina Limestone, of Aquitanian age, below the main phosphoritic level C1, separating the Lower and Middle Globigerina Limestone.
Mr Charles Galea Bonavia (Attard, Malta), however, drew my attention to a locality, where a level bearing phosphorites is present below C1, and he was kind enough to demonstrate the site during a visit in October 2000. Further details on this section were observed on February 7, 2001, at that time also two additional levels with small phosphorites were found below C1, more samples were collected and a concise description of the section was made.

Abbreviations used in this paper:

MNHN:	Musée National d'Histoire Naturelle, Paris, France.
NHMM:	Natural History Museum, Mdina, Malta
RGM:	Nationaal Natuurhistorisch Museum 'Naturalis', Leiden, The Netherlands (Palaeontology Department, Cainozoic Mollusca), formerly Rijksmuseum van Geologie en Mineralogie.
H:	shell height
W:	shell width
H/W-ratio:	shell height/shell width x 100

[1] Nationaal Natuurhistorisch Museum Naturalis, P.O. Box 9517, 2300 RA, Leiden, The Netherlands; currently: 12, Triq tal-Hamrija, Xewkija VCT 110, Gozo, Malta. ariewjanssen@waldonet.net.mt; website: http://sites.waldonet.net.mt/ariewe/

LOCALITY

The locality is situated at Wardija, near Wardija Point, on the extreme SW corner of the island of Gozo, at coordinates UTM 268.886 (Fig. 1).

At this place the C1 phosphorite level crops out as a significant harder level on top of the Lower Globigerina Limestone, which in turn overlies the Lower Coralline Limestone, rising from the sea as a high (>125 m) vertical cliff. Situated close to the studied site is a Punic-Hellenistic "sanctuary" (Buhagiar, 1988), a deep excavation in the top of the Lower Globigerina Limestone, roofed by the solid sediment of the C1 phosphorite level. Above C1 a small portion of Middle Globigerina Limestone may still be present, but was not observed.

The eroded coastal Miocene sediments are unconformably overlain in this area by presumably Holocene sediments (grey sandy clay) up to a thickness of some 6 meters, that especially in their basal part contain a terrestrial mollusc fauna yielding species in an assemblage hardly or not differing from the actual living fauna. An overview of the locality is given in Fig. 2

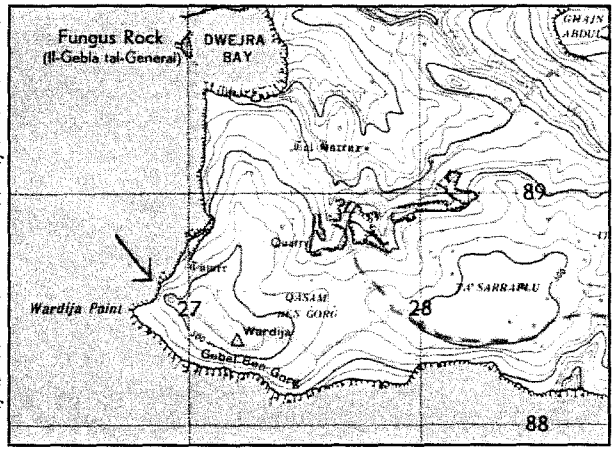

Fig. 1. Situation of sample locality, at Wardija, near Wardija Point, Gozo, Malta.
(Topographical map of Malta 1 : 25.000)

The thickness of the Lower Globigerina Limestone could not be measured accurately but is estimated to be c. 11 m. Several thin layers of concentrated fossil material are present below the base of C1. Most of this fossil material consists of non-phosphatised fragments of irregular sea urchins, but three levels below C1 also contain small phosphorite concretions. Each of these three levels yielded pteropods: even in the field internal casts of *Vaginella sannicola* could be recognised, as well as some rare specimens of *Gamopleura melitensis*.

The same Lower Globigerina Limestone is intensively quarried for building stone, at a distance of less than 1 km (indicated on the map of Fig. 1).

DESCRIPTION OF SECTION

11.25 - 11.50 m Phosphorite concentration with many corals and specimens of the pteropod *Gamopleura melitensis* (main phosphorite level C1) (sample 4) (top level visible in Figs. 2 and 5).

7.50 - 11.25 m yellowish to light yellowish-brown limestone (Fig. 4), with some burrowing; in the basal 25 cm dispersed small phosphorite concretions (sample 3), rare pectinids, the pteropods *Vaginella sannicola* (common) and *Gamopleura melitensis* (rare), and some specimens of the bivalve *Pycnodonte* (Fig. 5). At c. 8 and 9.50 m thin levels (few cm only) of abundant echinoid fragments, without visible phosphorite. Some larger and isolated burrows are completely filled with echinoid fragments (one visible in Fig. 4). Burrows from the overlying C1 reach the base of this level. The top of this limestone-part is indurated (Fig. 5).

5 - 7.50 m light yellowish-brown limestone with many burrows, and dispersed echinoids and pectinids. At the base a concentration of pectinids and some small phosphorite concretions (sample 2).

3 - 5 m light yellowish brown, burrowed limestone with dispersed echinoids and pectinids. At the base a concentration of pectinids (mainly *Amussiopecten*) and some small phosphorite concretions (sample 1). Burrows into the underlying level clearly visible because of differences in colour (Fig. 3).

0 - 3 m Light yellowish limestone overlying Lower Coralline Limestone, basal 2 m inaccessible in vertical cliff.

Microtectonic features (< 0.50 m) are visible in the upper 5 m of this section.

MATERIAL AND METHODS

Sample weights: sample 4 - 3.8 kg; sample 3 - 9.8 kg; sample 2 - 4.9 kg; sample 1 - 4.2 kg.

Fig. 2. Overview of Wardija locality. (February 2001)

Fig. 3. Boundary at c. 3 m. Note burrows into the underlying sediment. Pectinid concentration and some small phosphorites just above the boundary. (February 2001)

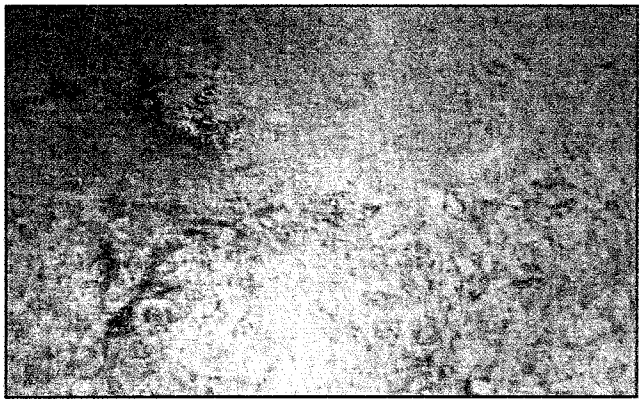

Fig. 4. Boundary at c. 7.5 m. Note burrow filled with echinoid fragments. (February 2001)

Fig. 5. Top of section with C1 as upper-most level. Base of hammer is on the boundary at c. 7.50 m. (February 2001)

The limestone of all four samples was reduced in size to pieces of c. 4 cm at the most and subsequently treated with diluted formic acid for 24 hours, after which the remaining residue was washed with tap water, the clay fraction carefully and repeatedly removed by decantation, and the fraction < 4 mm separated. This treatment was repeated several times (varying from 5 times for sample 4 to 7 times for sample 3) until no more limestone could be dissolved by the acid in the coarse fraction. The remaining residues < 4 mm were given a final formic acid treatment and washed several times with tap water, subsequently dried and fractionated using a standard set of sieves, with 90 μm as the finest mesh. Inspection of the residues was executed using a Wild M5 binocular microscope. Undissolved limestone pieces were inspected with a watchmaker's lens. Drawings were made by the author, using a *camera lucida* device.

Sample 3 was the most difficult, and the least successful to treat (some 4 kg of the limestone was not dissolved) because of a high clay content.

LISTS OF SPECIES

Below the fossil contents of samples 1 to 4 is specified. All benthic material mentioned here is housed in the Cainozoic Mollusc Collection of the Nationaal Natuurhistorisch Museum Naturalis, at Leiden, the Netherlands (RGM registration numbers). The holoplanktonic molluscs are in the same collection, but temporarily housed in Xewkija, Gozo. Illustrations of many benthic molluscs are given, but the holoplanktonic molluscs are important for a chronostratigraphic assignment, for which reason this fossil group is given special attention in the systematical part following the lists of species.

Sample 1. The large number of small bony fish skeleton parts and the virtual absence of Foraminifera in the residue of this sample are especially striking . The fraction < 250 μm contains glauconite. The benthic mollusc assemblage resembles that of sample 3, the bivalve Carditidae sp. is common in this sample.

RGM 429.982	Protozoa	Foraminifera	indet.	c. 25
RGM 429.983	Annelida		indet.	many
RGM 429.984	Porifera	sponges	indet.	3
RGM 429.985	Coelenterata	Anthozoa	indet.	c. 10 fragments
RGM 429.986	Crustacea	Decapoda	indet.	18 fragments
RGM 429.987	Bryozoa	lunulitiform	indet.	2 colonies, many zooecia
RGM 429.988		incrusting	indet.	2
RGM 429.989	Echinodermata	Echinoidea, Irregularia	indet.	5 fragments
RGM 429.990		Asteroidea	indet.	5 ossicles
RGM 429.991		Crinoidea	indet.	1 fragment
RGM 429.992	Mollusca	Bivalvia	Nuculidae sp.	2/1
RGM 429.993			Nuculanidae sp. 1	6/1
RGM 429.994			Lucinidae ? sp.	3/1
RGM 429.995			Carditidae sp.	20/1
RGM 429.996			*Corbula* sp.	1/1
RGM 429.997			indet.	6/2
RGM 429.998		Scaphopoda	Dentaliidae sp.	many
RGM 429.999			*Cadulus* sp.	5
RGM 457.000			Siphonodentaliidae sp.	5
RGM 457.001		Gastropoda	*Scissurella* sp.	3
RGM 457.002			*Circulus* sp.	2
RGM 457.003			Naticidae sp.	3
RGM 457.004			Xenophoridae sp.	2 fragments
RGM 457.005			*Mitrella* ? sp.	1
RGM 457.006			Nassariidae sp.	10
RGM 457.007			*Vexillum* ? sp.	5 damaged
RGM 457.008			Marginellidae sp. 1	1
RGM 457.009			Olividae ? sp.	1
RGM 457.010			Neogastropoda sp. 1	2
RGM 457.011			Neogastropoda sp. 2	8
RGM 457.012			Epitoniidae sp.	18
RGM 457.013			Pyramidellidae sp. 2	1 fragment
RGM 457.014			*Retusa* sp.	18
RGM 457.015			*Volvulella* sp.	3
RGM 457.019			*Heliconoides tertiaria* (Tate, 1887)	4
RGM 457.020			*Limacina valvatina* (Reuss, 1867)	1
RGM 457.021			*Limacina* an *L. gramensis* (Rasmussen, 1968)	1
RGM 457.022			*Spoelia torquayensis* A.W. Janssen, 1990	1
RGM 457.023			*Clio* (s. lat.) *ghawdexensis* sp. nov.	6

RGM 457.024			*Gamopleura melitensis* A.W. Janssen, 1995	2 fragments
RGM 457.025			*Vaginella sannicola* A.W. Janssen, 1990	13
RGM 457.016			Gastropoda non det. 8	6
RGM 457.017			Gastropoda non det. 10	1
RGM 457.018			Gastropoda indet.	many
RGM 457.026	Pisces	Chondrichthyes	Elasmobranchii indet.	5 teeth
RGM 457.027			Elasmobranchii indet.	8 dermal scales
RGM 457.028		Teleostomi	teeth & skeleton parts	many
RGM 457.029	Pisces ?		coproliths	many
RGM 457.030	residues		sorted residue	1
RGM 457.031			unsorted residue	1

Sample 2

The residue of this sample contains in the coarser fraction many pieces of undissolved limestone, whereas in the finer fractions (< 250 μm) a considerable part of the residue consists of glauconite and unphosphatised echinoderm fragments, that survived the formic acid treatment. These finer fractions yield very few fossils (*e.g.* strikingly low numbers of globigerinids), and were only partly sorted out. Among the holoplanktonic molluscs *Clio ghawdexensis* sp. nov. is especially interesting. One further fragment of this species was recorded from sample 4.

RGM 429.911	Protozoa	Foraminifera	indet.	1
RGM 429.912	Coelenterata	Anthozoa	indet.	17 fragments
RGM 429.913	Annelida		indet.	16 fragments
RGM 429.914	Porifera	sponges	indet.	1
RGM 429.915	Crustacea	Decapoda	indet.	15 fragments
RGM 429.916		Cirripedia	*Scalpellum* sp. (not phosphatised)	1 fragment
RGM 429.917		Ostracoda	indet.	20/1
RGM 429.918	Echinodermata	Echinoidea	Irregularia	many fragments
RGM 429.919		Asteroidea	indet.	many ossicles
RGM 429.920		Crinoida	indet.	1fragment
RGM 429.921		Crinoida ?	indet.	8 fragments
RGM 429.922	Bryozoa	lunulitiform	indet.	1 colony, many zooecia
RGM 429.923		incrusting	indet.	4 colonies
RGM 429.924		incrusting	indet.	4 colonies, 9 zooecia
RGM 429.925	Mollusca	Bivalvia	Nuculanidae sp. 1	61/1
RGM 429.926			Nuculanidae sp. 2	4/1
RGM 429.927			Nuculanidae sp. 3	1/1
RGM 429.928			*Nucinella* sp.	1/1
RGM 429.929			Carditidae sp.	1/2
RGM 429.930			Lucinidae sp. 2	1/1
RGM 429.931			*Corbula* sp.	6/2

RGM 429.932			*Xylophaga* sp.	1/2
RGM 429.933			indet.	4/1
RGM 429.934		Scaphopoda	Dentaliidae sp.	many
RGM 429.935			*Pseudantalis* sp.	3 fragments
RGM 429.936			*Cadulus* sp.	13
RGM 429.937			Siphonodentaliidae sp.	17
RGM 429.938		Gastropoda	*Scissurella* sp.	10
RGM 429.939			Cerithiidae sp.	1
RGM 429.940			Naticidae sp.	6
RGM 429.941			Naticidae ? sp.	2
RGM 429.942			Calyptraeidae sp.	3
RGM 429.943			Xenophoridae sp.	1
RGM 429.944			*Atlanta* sp.	1, 4 fragments
RGM 429.945			Nassariidae sp.	14
RGM 429.946			*Vexillum* ? sp.	1
RGM 429.947			Marginellidae sp. 1	11
RGM 429.948			Marginellidae sp. 3	6
RGM 429.949			Neogastropoda sp. 2	2
RGM 429.950			Neogastropoda sp. 3	9
RGM 429.951			Epitoniidae sp.	14
RGM 429.952			*Ringicula* ? sp.	1
RGM 429.953			Actaeonidae sp. 2	1
RGM 429.954			*Retusa* sp.	9
RGM 429.955			*Volvulella* sp.	2
RGM 429.955			*Volvulella* sp.	2
RGM 429.956			*Cylichna* sp.	6
RGM 429.957			Philinidae sp.	1
RGM 429.962			*Heliconoides tertiaria* (Tate, 1887)	c. 50
RGM 429.964			*Heliconoides vanderweideni* sp. nov.	5
RGM 429.963			*Limacina valvatina* (Reuss, 1867)	5
RGM 429.965			??*Limacina* an *L. gramensis* (Rasmussen, 1968)	1 fragment
RGM 429.966			*Bowdenatheca miocenica* sp. nov.	2
RGM 429.967			*Spoelia torquayensis* A.W. Janssen, 1990	33
RGM 429.968			*Spoelia torquayensis* ? A.W. Janssen, 1990	1
RGM 429.969			*Clio* (s. lat.) *ghawdexensis* sp. nov.	c. 40 fragments
RGM 429.970			*Clio* (s. lat.) *ghawdexensis* sp. nov.	6 fragments
RGM 429.971			*Edithinella bonaviai* sp. nov.	many
RGM 429.972			*Gamopleura melitensis* A.W. Janssen, 1995	10 fragments

RGM 429.973			*Vaginella sannicola* A.W. Janssen, 1990	68
RGM 429.974			*Vaginella* ? *tricuspidata* Zorn & Janssen, 1993	3 fragments
RGM 284.003			*Vaginella* ? *tricuspidata* Zorn & Janssen, 1993	1 fragment
RGM 284.004			*Vaginella* ? *tricuspidata* Zorn & Janssen, 1993	1 fragment
RGM 429.975			*Sphaerocina* sp. nov. ?	2 fragments
RGM 429.958			Gastropoda non det. 8	9
RGM 429.959			Gastropoda non det. 10	1
RGM 429.961			Gastropoda indet.	many
RGM 429.960			Gastropoda non det. div.	6 umbilical moulds
RGM 429.976	Pisces	Chondrichthyes	Elasmobranchii sp. (teeth)	4
RGM 429.977			Elasmobranchii sp. (dermal scales)	15
RGM 429.978		Teleostomi	teeth & skeleton parts	many
RGM 429.979	Pisces ?		coproliths	many
RGM 429.980	residues		sorted residue	1
RGM 429.981			unsorted residue	1

Sample 3:

Material for this sample was collected on two occasions, viz. October 2000 and February 2001, both from the same level, but at places several tens of meters apart. From the formic acid residues it is obvious that there are local differences in this level: the October sample yields in the finer fractions large numbers of globigerinids, which in the other sample are far less abundant. The same is true for glauconite. The February sample contains fair amounts of small limonite particles, which may be a weathering product of the glauconite. The fossil contents (apart from the foraminifera) of both samples does not differ substantially and was not kept separate. Sample 3 yielded only small phosphorites, most of them being fossils. Several non-phosphatised echinoid fragments did not dissolve during the formic acid treatment.

Especially striking in sample 3 is the variation in the benthic molluscs. Although they are all small to very small specimens (just one specimen reaches more than 1 cm) the number of species is strikingly high. As the preservation as internal moulds is quite good it wasdecided to give outline illustrations of most of these molluscs (see Pl. 1-3), as hardly anything is known about this fossil group in this area. Identification, however, had to remain at family or genus level at best. Several holoplanktonic molluscs from this sample are illustrated on Pl. 3-4.

The material includes abundant internal moulds of mainly benthic Foraminifera (unsorted in one collection item). This material, only partly picked from the residues, might offer excellent possibilities for a specialist to study foraminiferal internal structures. To a lesser degree this is also true for other fossil groups (e.g. Bryozoa).

A surprising number of holoplanktonic molluscs was present in sample 3. The material includes several species as yet unknown from the Maltese Archipelagoas well as several species new to science. This material offers interesting aspects considering the age assignment, which will be discussed later.

RGM 429.788	Protozoa	Foraminifera	non det.	many
RGM 429.789	Porifera	(sponges)	non det.	7
RGM 429.790	Annelida		non det.	c. 25
RGM 429.791	Coelenterata	Anthozoa	non det.	c. 25 fragments
RGM 429.792	Echinodermata	Echinoidea, Irregularia	non det.	many fragments

RGM 429.793	Echinodermata	Asteroidea	non det.	c. 30 ossicles
RGM 429.794	Crustacea	Decapoda	non det.	13 fragments
RGM 429.795		Ostracoda	non det.	15/1
RGM 429.796	Bryozoa	incrusting	colonies	10
RGM 429.797		lunulitiform	colonies & zooecia	many
RGM 429.798	Mollusca	Bivalvia	Nuculidae sp.	7/1
RGM 429.799			Nuculanidae sp. 1	356/1
RGM 429.800			Nuculanidae sp. 2	9/1
RGM 429.801			*Nucinella* sp.	8/1
RGM 429.802			*Bathyarca* sp.	2/1
RGM 429.803			Montacutidae sp.	2/1
RGM 429.804			Lucinidae sp.	/1
RGM 429.805			Lucinidae ? sp.	2/1
RGM 429.806			*Kelliella* ? sp.	2/1
RGM 429.807		Scaphopoda	*Pseudantalis* sp.	5 fragments
RGM 429.808			Dentaliidae sp.	many fragments
RGM 429.809			*Cadulus* sp.	5
RGM 429.810			Siphonodentaliidae sp.	25 fragments
RGM 429.811		Gastropoda	*Scissurella* sp.	many
RGM 429.812			Lepetellidae sp.	1
RGM 429.813			*Solariella* sp.	7
RGM 429.814			Trochidae sp.	1
RGM 429.815			Trochacea sp. 1	1
RGM 429.816			Trochacea sp. 2	4
RGM 429.817			Trochacea sp. 3	1
RGM 429.81°			*Circulus* sp.	2
RGM 429.81°			*Atlanta* sp.	1
RGM 429.820			*Atlanta* sp.	19 (incl. fragments)
RGM 429.821			Rissoacea sp.	7
RGM 429.822			Archaeogastropoda sp. 1	3
RGM 429.823			Archaeogastropoda sp. 2	12
RGM 429.824			*Trivia* sp.	2
RGM 429.825			Naticidae sp. 1	1
RGM 429.826			Naticidae sp. 2	3
RGM 429.827			Naticidae sp. div.	c. 25
RGM 429.828			Naticidae ? sp.	35
RGM 429.829			*Eulima* sp.	fragments
RGM 429.830			Xenophoridae sp.	12
RGM 429.831			Muricidae sp.	20
RGM 429.832			*Mitrella* sp.	6
RGM 429.833			Buccinidae sp. 1	1

RGM 429.834	Mollusca	Gastropoda	Buccinidae sp. 2	2
RGM 429.835			Nassariidae sp.	many
RGM 429.836			*Vexillum* ? sp.	12 fragments
RGM 429.837			Cancellariidae ? sp.	11
RGM 429.838			Marginellidae sp. 1	many
RGM 429.839			Marginellidae sp. 2	3
RGM 429.840			Marginellidae sp. 3	10
RGM 429.841			Marginellidae sp. 4	c. 30
RGM 429.842			Turridae sp. 1	1
RGM 429.843			Turridae sp. 2	1 fragment
RGM 429.844			Epitoniidae sp.	c. 20 fragments
RGM 429.845			Neogastropoda sp. 1	1
RGM 429.846			Neogastropoda sp. 2	c. 20
RGM 429.847			Neogastropoda sp. 3	4
RGM 429.848			Actaeonidae sp. 1	1
RGM 429.849			Actaeonidae sp. 2	1
RGM 429.850			*Ringicula* ? sp.	5
RGM 429.851			Pyramidellidae sp. 1	4
RGM 429.852			Pyramidellidae sp. 2	2 fragments
RGM 429.853			Retusidae sp. div.	many
RGM 429.854			*Volvulella* sp.	8
RGM 429.855			*Cylichna* sp.	many
RGM 429.856			*Roxania* sp.	9
RGM 429.857			*Haminea* sp.	2
RGM 429.858			Philinidae sp.	5
RGM 429.858			Philinidae sp.	5
RGM 429.874			*Heliconoides tertiaria* (Tate, 1887)	1
RGM 429.875			*Heliconoides tertiaria* (Tate, 1887)	many
RGM 429.872			*Heliconoides vanderweideni* sp. nov.	1
RGM 429.873			*Heliconoides vanderweideni* sp. nov.	6
RGM 429.878			*Heliconoides vanderweideni* sp. nov.	1
RGM 429.879			*Heliconoides vanderweideni* sp. nov.	16
RGM 429.876			*Limacina valvatina* (Reuss, 1867)	1
RGM 429.877			*Limacina valvatina* (Reuss, 1867)	24
RGM 429.880			*Limacina* an *L. gramensis* (Rasmussen, 1968)	1RGM 429.881
RGM 429.881			*Limacina* an *L. gramensis* (Rasmussen, 1968)	9

RGM 429.883	Mollusca	Gastropoda	*Bowdenatheca miocenica* sp. nov.	1
RGM 429.884			*Bowdenatheca miocenica* sp. nov.	11 fragments
RGM 429.882			*Styliola subula* (Quoy & Gaimard, 1827)	1 fragment
RGM 429.885			*Spoelia torquayensis* A.W. Janssen, 1990	1
RGM 284.010			*Spoelia torquayensis* A.W. Janssen, 1990	1
RGM 284.011			*Spoelia torquayensis* A.W. Janssen, 1990	1
RGM 429.886			*Spoelia torquayensis* A.W. Janssen, 1990	c. 40 fragm.
RGM 429.887			*Clio* (s. lat.) aff. *saccoi* Checchia-Rispoli, 1921	1
RGM 429.888			*Clio* (s. lat.) aff. *saccoi* Checchia-Rispoli, 1921	2
RGM 429.889			*Clio* (s. lat.) ? sp.	1 fragment
RGM 429.890			*Edithinella bonaviai* sp. nov.	1 fragment
RGM 429.891			*Edithinella bonaviai* sp. nov.	1 fragment
RGM 429.892			*Edithinella bonaviai* sp. nov.	many fragments
RGM 429.893			*Gamopleura melitensis* A.W. Janssen, 1995 ?	1 juv.
RGM 429.894			*Gamopleura melitensis* A.W. Janssen, 1995	10
RGM 429.895			*Vaginella sannicola* A.W. Janssen, 1990	many (hundreds)
RGM 429.896			*Vaginella ? tricuspidata* Zorn & Janssen, 1993	7 fragments
RGM 429.897			*Sphaerocina* sp. nov.	1 fragment
RGM 429.898			*Sphaerocina* sp. nov.	1 fragment
RGM 429.899			*Peraclis* sp.	1
RGM 429.900			Gymnosomata sp. 1	1
RGM 429.901			Gymnosomata sp. 1	5
RGM 429.902			Gymnosomata sp. 2	1
RGM 429.859			non det. 1	1
RGM 429.860			non det. 2	8
RGM 429.861			non det. 3	1
RGM 429.862			non det. 4	1
RGM 429.863			non det. 5	3

RGM 429.864	Mollusca	Gastropoda	non det. 6	1
RGM 429.865			non det. 7	1
RGM 429.866			non det. 8	4
RGM 429.867			non det. 9	1
RGM 429.868			non det. 10	1
RGM 429.869			non det. 11	1
RGM 429.870			non det. 12	1
RGM 429.871			indet.	many fragments
RGM 429.903	Pisces	Chondrichthyes	Elasmobranchii indet., teeth	10
RGM 429.904			Elasmobranchii indet., dermal scales	12
RGM 429.905		Teleostomi	indet. (teeth + skeleton parts)	many
RGM 429.906	Pisces ?		coproliths	many
RGM 429.907	fossils or phosphorites ?			many
RGM 429.908	residues		unsorted residue October 2000	1
RGM 429.909			unsorted residue February 2001	1
RGM 429.910			sorted residue	1

Sample 4

The fraction > 4 mm of this sample contains many coarse phosphorite concretions up to 50 mm Ø. Specimens of ahermatypic corals and the pteropod *Gamopleura melitensis* are very common. Finer fractions consist for the greater part of coral fragments, isolated during the washing procedure. Fractions < 250 μm yield hardly any useful fossils (very small numbers of foraminifers) and only restricted parts were picked. The fraction < 125 μm contains some glauconite.

RGM 429.748	Foraminifera		indet.	c. 25
RGM 429.749	Porifera	Spongia (?)	indet.	2
RGM 429.750	Annelida		indet.	48
RGM 429.751	Coelenterata	Anthozoa	*Flabellum* sp.	1
RGM 429.752			ahermatypic corals	many
RGM 429.753	Echinodermata		Regularia & Irregularia	16 fragments
RGM 429.754		Irregularia	*Echinocyamus* sp.	1
RGM 429.755		Asteroidea	indet.	5 ossicles
RGM 429.756			Ophiuridae sp.	10 ossicles
RGM 429.757	Crustacea	Decapoda	indet.	1 fragment
RGM 429.758	Bryozoa	incrusting	indet.	3 specimens
RGM 429.759			indet.	9 fragments
RGM 429.760	Brachiopoda		Terebratulidae sp.	1/1
RGM 429.761	Mollusca	Bivalvia	Nuculanidae sp.	12/1
RGM 429.762			*??Barbatia* sp.	1/2
RGM 429.763			Pectinidae sp.	1 fragment
RGM 429.764			Cardiidae sp.	1/2

RGM 429.765	Mollusca	Bivalvia	indet.	7/1, 7/2
RGM 429.766		Scaphopoda	Dentaliidae sp.	22 fragments
RGM 429.767		Gastropoda	*Emarginula* sp.	1
RGM 429.768			*Calliostoma* sp.	1 damaged
RGM 429.769			*Xenophora* sp.	5, 3 fragments
RGM 429.770			Fasciolariidae sp.	1
RGM 429.771			Marginellidae sp.	1
RGM 429.772			*Cylichna* sp.	1 damaged
RGM 429.773			*Heliconoides tertiaria* (Tate, 1887)	57
RGM 429.774			*Heliconoides vanderweideni* sp. nov.	7
RGM 429.775			*Limacina* an *L. gramensis* (Rasmussen, 1968)	14
RGM 429.776			*Styliola subula* (Quoy & Gaimard, 1827)	1
RGM 429.777			*Spoelia torquayensis* A.W. Janssen, 1990	1
RGM 429.778			*Clio* (s. lat.) *ghawdexensis* sp. nov.	1 damaged
RGM 429.779			*Gamopleura melitensis* A.W. Janssen, 1995	322
RGM 284.001			*Gamopleura melitensis* A.W. Janssen, 1995	1
RGM 429.780			*Vaginella sannicola* A.W. Janssen, 1990	166
RGM 429.781			*Vaginella sannicola* A.W. Janssen, 1990	1 protoconch
RGM 429.782			indet.	many
RGM 429.783	Pisces	Chondrichthyes	Elasmobranchii indet.	c. 13 teeth
RGM 429.784			Elasmobranchii, dermal scales	1
RGM 429.785		Teleostomi	indet.	c. 45 teeth
RGM 429.786	Pisces ?		coproliths	c. 30
RGM 429.787	unsorted residue < 250 µm			1

List of fossils

The Ophiuridae ossicles are not phosphatised, but anyhow did not dissolve by the formic acid treatment. The Fasciolariidae specimen was found as an external cast in a piece of undissolved limestone. Part of the phosphatised fossils (especially the asteroid ossicles, *Vaginella sannicola*, *Gamopleura melitensis* and some other species) show distinct signs of transportation.

SYSTEMATICAL DESCRIPTION OF HOLOPLANKTONIC MOLLUSCS

1881 (year in roman)	the cited reference contributes to the knowledge of the taxon
*	first valid introduction of the taxon
.	responsibility for the identification is accepted by the present author
(no symbol)	responsibility for the identification not accepted by present author, but there is no reason for doubt
?	in the opinion of the present author there is reason to doubt the identification
v	the original material of this reference was studied by the present author.

Symbols used in the lists of synonyms in this chapter are those of Richter (1948):

Phylum Mollusca Linné, 1758

Class Gastropoda Cuvier, 1797
Superorder Caenogastropoda Cox, 1959
Order Sorbeoconcha Ponder & Lindberg, 1997
Suborder Hypsogastropoda Ponder & Lindberg, 1995
Infraorder Littorinimorpha Golikov & Starobogatov, 1975
Superfamily Carinarioidea Blainville, 1818
Family Atlantidae Rang, 1829

Genus *Atlanta* Lesueur, 1817

Type species: *Atlanta peroni* Lesueur, 1817 (Recent).

***Atlanta* sp.** (Pl. 3, fig. 15a-b)

Description -- Small dextral gastropod with tight first whorls, elevated to a low cone. After this protoconch the whorl expands widely, and becomes flattened and carinated at the periphery. In a frontal view the early whorls are just visible. The aperture is elongated cordiform, just very slightly indented by the penultimate one. The base of the shell is flattened, with a central umbilicus, in which the penultimate whorl is visible. On the apical side of the shell some distant growth undulation are visible on the ultimate part of the body whorl, strongly curved in apertural direction.
Material Sample 2 (1 specimen, 4 fragments, RGM 429.944), sample 3 (20 specimens and fragments, RGM 429.819-20).
Discussion Specimens of the genus *Atlanta* are not rare in sample 3. As all other molluscs they are preserved as internal phosphoritic moulds, which means that any original external ornament of the shell has disappeared. Identification at species level is therefore not attempted. In the actual fauna from the various oceans species of *Atlanta* are common, and represented by numerous very similar species. As fossils were described: *Atlanta cordiformis* Gabb, 1873, from the (?) Late Miocene of Santo Domingo. It resembles the Recent *A. inflata* Souleyet, 1852 so strongly that they might very well be synonyms. Furthermore, from the Pliocene of Jamaica: *A. diamesa* Woodring, 1928, which seems to be closely related to the Recent *A. peroni* (Lesueur, 1817).

Superorder Heterobranchia Gray, 1840
Intraorder Euthyneura Spengler, 1881
Order Thecosomata Blainville, 1823
Suborder Euthecosomata Meisenheimer, 1905
Superfamily Limacinoidea Gray, 1847
Family Limacinidae Gray, 1847 (see the recently proposed classification for this family in Janssen, 2003).
Genus *Heliconoides* d'Orbigny, 1836

Type species: *Heliconoides inflata* (d'Orbigny, 1836) (Recent)

***Heliconoides tertiaria* (Tate, 1887)** (Plate 3, fig. 16a-b)

v. 1887 *Spirialis tertiaria* spec. nov., Tate, p. 196, non pl. 20, fig. 12a-c = *Heliconoides inflata* (d'Orbigny, 1836).
? 1891 *Spirialis atlanta* Koen. -- Trabucco, p. 10 (non von Koenen).
v. 1897 *Limacina tertiaria*, Tate (sp.) -- Harris, p. 19 (partim ?).
1903 *Limacina tertiaria* Tate -- Dennant & Kitson, p. 94.
1965 *Spiratella tertiaria* - Curry, p. 368.
1981 *Spirialis tertiaria* Tate -- Curry, p. 38.
1982 *Spiratella tertiaria* Tate -- Bernasconi & Robba, p. 215.
v. 1990 *Limacina tertiaria* (Tate, 1887) -- Janssen, p. 19, pl. 3, figs. 1-10, pl. 4, figs. 1-6, pl. 11, figs. 1-2.
v. 1995 *Limacina tertiaria* (Tate, 1887) -- Janssen, p. 24, pl. 1, figs. 8-10.

Description *Heliconoides tertiaria* is a small (diameter c. 1 mm) sinistral gastropod with a flat to slightly concave apical side showing all whorls. The number of whorls is about three, the first 1½ of them are slightly raised, and usually visible in a frontal view. The aperture is large and oval, protruding below the base of the penultimate whorl. The apertural margin of the body whorl is suddenly widened in adult specimens, as a reinforcing structure. The base is rounded and has a distinct umbilicus, which is usually filled with matrix.

Material Sample 1 (4 specimens, RGM 457.019), sample 2 (c. 50 specimens, RGM 429.962), sample 3 (many specimens, RGM 429.874-5), sample 4 (57 specimens, RGM 429.773).
Discussion *Heliconoides tertiaria* initially was described from the Australian Miocene (Batesfordian to Bairnsdalian = roughly Langhian). The first specimens recorded from the Mediterranean (various localities in Italy, see Janssen, 1995, who also mentioned specimens from Malta) are all of Langhian age. In the meantime the species was also recognised in deposits of the same age in SW France. A somewhat older, but closely related species was described from the Early Miocene of New Zealand, *viz. Heliconoides ferax* (Laws, 1944) (as *Spiratella ferax*), differing only slightly from *H. tertiaria.*

The present specimens from Wardija do not differ from specimens higher in the Globigerina Limestone, and are no doubt conspecific, they do not show the characteristics of *H. ferax*. These are the first records of Early Miocene age in the Mediterranean.

***Heliconoides vanderweideni* sp. nov.** (Pl. 3, figs. 17a-b, 18a-c)

Diagnosis Shell globose, slightly higher than wide, spire with convex tangents. Apertural margin with a slightly oblique reinforcing fold that is interrupted at two thirds of its height. Some specimens with a more depressed spire are included in this species.
Holotype RGM 429.878, Pl. 3, fig. 17a-b.
Type locality Wardija, near Wardija Point, on the extreme SW corner of the island of Gozo, Maltese Archipelago; at coordinates UTM 268.886 (Fig. 1).
Stratum typicum Lower Globigerina Limestone Formation, c. 7.50 -7.75 m above base, in yellowish to light yellowish-brown limestone, with some burrowing and dispersed small phosphorite concretions (sample 3); Miocene, Aquitanian.
Derivatio nominis This species is named after Wim van der Weiden, retiring director of the National Museum of Natural History 'Naturalis', Leiden, the Netherlands, who in a few years time succeeded in integrating two separate museums into one truly (inter)national institute, to realise magnificent newly built premises inclusive of a fabulous exhibition, and to motivate a constantly increasing staff to perform more than everybody thought possible.
Description Shell sinistral, slightly higher than wide, with c. three convex whorls that increase gradually in width. The general shell form is globose, with convex tangents, as the younger whorls attach below the middle of the preceding whorl. All whorls are separated by distinct sutures. The base of the shell is convex, and distinctly umbilicate, the umbilicus usually is filled with matrix. The apertural margin of the available internal moulds shows a strengthening device consisting of an internal thickening or fold of the shell (the difference cannot be seen on internal moulds, but a fold seems more probable than a thickening), that at c. two thirds of its height is interrupted. At this place the apertural margin is slightly carinated in frontal view. In some specimens of the available material (Pl. 3, fig. 18a-c) the spire is distinctly lower, which makes the shell even more globular. The apertural structure, however, indicates that they belong to the same species indeed.
Paratypes Sample 2 (5 specimens, RGM 429.964); sample 3 (7 specimens, RGM 429.872-3; 17 specimens, RGM 429.878-9); sample 4 (7 specimens, RGM 429.774).
Discussion The presence of apertural reinforcements distinctly refers this species to the genus *Heliconoides*. A related species, as yet undescribed, is known from the Late Oligocene of St. Etienne d'Orthe (France, Aquitaine Basin). This species, of which specimens in shell preservation are available, remains slightly smaller, and the apertural margin has an oblique and uninterrupted fold. The specimens with a depressed spire resemble the Paratethys species *Limacina andrussowi* (Kittl, 1886) (compare Janssen, 1984, pl. 2, figs. 2-9; with lectotype designation). In this species, however, the whorls are attached above mid-height of the preceding whorl, and apertural structures are absent. Still, juvenile specimens of the present species, in which the aperture is not yet completely developed may resemble *L. andrussowi* strongly.

Genus *Limacina* Bosc, 1817

Type species: *Limacina helicina* (Phipps, 1774) (Recent)

***Limacina valvatina* (Reuss, 1867)** (Pl. 3, fig. 19a-b)

Description The shell is sinistral, and usually more or less as high as wide, with straight tangents along its spire. There may be as many as 6 rounded whorls, rather convex, and regularly increasing in diameter. The base of the shell is also rounded, with a narrow central umbilicus. The aperture is semicircular, usually c. half as high as the complete shell. There are no apertural reinforcements.
Material Sample 1 (1 specimen, RGM 457.020); sample 2 (5 specimens, RGM 429.963); sample 3 (25 specimens, RGM 429.963-4).

Discussion This species has its main distribution in the northern Atlantic realm and is predominantly known from the North Sea and Central Paratethys basins, where it occurs from the Late Oligocene to the Late Miocene. Its H/W-ratio (height/width x 100) is rather variable, and ranges from c. 80 to 110. From the Mediterranean it is known from the Middle Miocene of Gargano and Salentino (Italy) and the Maltese archipelago, usually as dwarf individuals. The present material from Wardija, however, comprises well-developed specimens with a typical H/W-ratio of c. 100.

***Limacina* sp. an *L. gramensis* (Rasmussen, 1968)** (Pl. 3, fig. 20a-b)

Description The sinistral shell has c. 6 convex whorls, separated by distinct sutures. The height/width-ratio is difficult to estimate, as only juvenile or incomplete adult specimens are available, but in general will equal about 150. The whorls increase gradually and regularly in width, and attach below the middle of the preceding whorl, resulting in a conical shell with straight tangents. The aperture has no reinforcement structures, and is relatively small.
Material Sample 1 (1 specimen, RGM 457.021); sample 2 (1 fragment, RGM 429.965); sample 3 (10 specimens, RGM 429.880-1); sample 4 (14 specimens, RGM 429.775).
Discussion This species resembles strongly the northern European species *L. gramensis* (Rasmussen, 1968), occurring during the Late Miocene, a distinctly younger evolutionary stage of *L. valvatina* (see Gürs & Janssen, 2002), which indicates that the present material, being considerably older, cannot be considered to be conspecific. As no distinguishing characteristics can be observed I decided to indicate this material, for the time being, as *Limacina* sp. an *L. gramensis* (Rasmussen, 1968). *L. gramensis* from the Central Paratethys demonstrates irregular growth when reaching the adult stage (see Janssen & Zorn, 1992).

Superfamily Cavolinioidea FISCHER, 1883
Family Creseidae RANG, 1828

Genus *Bowdenatheca* Collins, 1934

Type species: *Bowdenatheca jamaicensis* Collins, 1934 (Pliocene)

***Bowdenatheca miocenica* sp. nov.** (Pl. 3, fig. 22a-d)

Diagnosis Slender, straight, initially round, later dorso-ventrally flattened shell with two margin-parallel furrows developing on the ventral side, the right one stronger than the left.
Holotype RGM 429.883, Pl. 3, fig. 22a-d.
Type locality Wardija, near Wardija Point, on the extreme SW corner of the island of Gozo, Maltese Archipelago; at coordinates UTM 268.886 (Fig. 1).
Stratum typicum Lower Globigerina Limestone Formation, c. 7.50 -7.75 m above base, in yellowish to light yellowish-brown limestone, with some burrowing and dispersed small phosphorite concretions (sample 3); Miocene, Aquitanian.
Derivatio nominis This species is named after the Miocene age of the samples.
Description Just fragmentary specimens of this species were found. They are conical, apical angle c. 13°, with a circular transverse section in the oldest available shell part, becoming dorso-ventrally flattened towards the aperture. On one side (presumably ventral) two grooves develop in the apertural half of the shell. The right one of these is stronger than the other, which results in an oval apertural transverse section, showing a strong and a weak indentation.
Paratypes Sample 2 (2 specimens, RGM 429.966); sample 3 (11 specimens, RGM 429.884).
Discussion Although nothing is known yet on its protoconch morphology it is believed that this species fits best in the family Creseidae because of its initially round and later flattened transverse section. There is a fair resemblance with *Bowdenatheca jamaicensis*, a species described from the Caribbean Pliocene, but subsequently also recorded from the Mediterranean Messinian and Pliocene (Zorn, 1997; Janssen, 1998), and, with some doubt, from Japan (as *Bowdenatheca* sp., in Ujihara, 1996). *B. jamaicensis* has a similar outline, but is slightly curved lengthwise. Instead of the two furrows this species demonstrates but a slight ventral swelling There is a certain similarity with *Clio ghawdexensis* sp. nov., described below, but in that species the shell is more slender and flattened right from the beginning. Also the two grooves are of the same strength and lay closer to the sides.

Genus *Styliola* GRAY, 1850

Type species: *Styliola subula* (QUOY & GAIMARD, 1827) (Recent)

***Styliola subula* (Quoy & Gaimard, 1827)** (Pl. 3, fig. 21a-b)

Description Specimens of this species are easily recognisable by their straight conical shell form and the presence of an

oblique furrow running from near the apex to the aperture.
Material Sample 3 (1 fragment, RGM 429.882); sample 4 (1 specimen, RGM 429.776).
Discussion *Styliola subula* is a long ranging species known from the Late Oligocene (Chattian) onwards, and still occurring in tropical and subtropical seas nowadays.

Family Cuvierinidae van der Spoel, 1967

Genus *Spoelia* A.W. Janssen, 1990

Type species: *Spoelia torquayensis* A.W. Janssen, 1990 (Oligocene)

***Spoelia torquayensis* A.W. Janssen, 1990** (Pl. 3, figs. 23a-d, 24, 25a-c)

*v 1990 *Spoelia torquayensis* sp. nov., Janssen, p. 42, pl. 7, figs. 1-5.

Description This surprisingly abundant species mainly occurs in samples 2 and 3. In spite of its fragmentary condition is can easily be recognised by its conical shell form, the apical part of which is slightly curved, with a round transverse section. On both sides of the shell squarish lateral carinae develop, that disappear already before reaching the aperture of adult specimens, where the transverse section becomes regularly elliptical. From material in shell preservation (Chattian of Aquitaine, France) it is known that the aperture is reinforced by a weak fold, which is obliquely positioned in a lateral view. Protoconchs of this species were not found previously at Wardija.
Material Sample 1 (1 specimen, RGM 457.022); sample 2 (34 specimens, RGM 429.967-8); sample 3 (3 specimens, c. 40 fragments, RGM 284.010-1, RGM 429.885-6); sample 4 (1 specimen, RGM 429.777).
Discussion *Spoelia torquayensis* was initially introduced from Late Oligocene deposits in southern Australia and equally old sediments in the Aquitaine Basin (France). In the meantime it was also recognised in boulders of Chattian age (so-called 'Sternberger Gestein') in the North Sea Basin.

Family Clioidae van der Spoel, 1967

Genus *Clio* Linné, 1767

Type species: *Clio (Clio) pyramidata* Linné, 1767 (Recent).

Subgenus ?

***Clio* (s. lat.) *ghawdexensis* sp. nov.** (Pl. 4, figs. 1a-d, 2a-d, 3a-c, 4a-c, 5a-c, 6)

Diagnosis Extremely slender, straight, biconvex, dorso-ventrally flattened shell with two margin-parallel furrows developing on one side.
Holotype RGM 429.970, Pl. 4, fig. 1a-d.
Type locality Wardija, near Wardija Point, on the extreme SW corner of the island of Gozo, Maltese Archipelago; at coordinates UTM 268.886 (Fig. 1).
Stratum typicum Lower Globigerina Limestone Formation, c. 7.50 -7.75 m above base, in yellowish to light yellowish-brown limestone, with some burrowing and dispersed small phosphorite concretions (sample 3); Miocene, Aquitanian.
Derivatio nominis This species is named after the island of Gozo, Malta (= Għawdex in Maltese language), where the type locality is situated.
Description This new species is represented by quite a number of fragments, from which an almost complete reconstruction could be composed, apart from the embryonal parts and the aperture, which were not found. The complete shell has a straight elongated conical form with an apical angle of just 7° and is dorso-ventrally flattened. The earliest shell part available has a dorso-ventral diameter of about half the shell width and a gradually curved ventral side, whereas the dorsal side shows a week central carina, which disappears at a shell width of c. 0.4 mm. Here the transverse section of the shell is biconvex. At a shell width of c. 0.7 mm two margin parallel furrows or grooves appear, becoming stronger towards the aperture. In the largest available fragment the furrows are still present. Because of these grooves the transverse section becomes biconvex, with the ventral part considerably wider than the dorsal. In the largest fragment the aperture has a width of 1.32 mm, and a dorso-ventral diameter of 0.5 mm. Reconstruction demonstrates that complete specimens reach a shell height over 1 cm.
Paratypes Sample 1 (6 fragments, RGM 457.023); sample 2 (c. 45 fragments, RGM 284.005-9, RGM 429.969), sample 4 (1 fragment, RGM 429.778).
Discussion Nothing similar has been described as yet, but a closely related species is known to me from the Late Oligocene of the Aquitaine Basin (SW France). In that species, to be published soon (Janssen, in prep.), the general shell form resembles strongly the juvenile specimens from Wardija. The sides of the shell, however, are developed as squarish carinae, whereas

they are rounded in the Gozitan species. In the available material from France no margin-parallel grooves are seen, but the apertural width of the largest specimen is only 0.6 mm. In this material in shell preservation the embryonal shell is present. It consists of two swellings caused by a double constriction. The tip swelling (protoconch I) is slightly higher than wide, and rounded. It may be expected that the protoconch of *C. ghawdexensis* is of a similar morphology.
It is as yet unclear to which subgenus this new species might belong. It is interesting to note that this species, relatively common in samples 1 and 2, is absent from sample 3. Apparently it became extinct after deposition of the level at c. 5 m. The single specimen from sample 4 no doubt is reworked.

***Clio* (s. lat.)** aff. ***saccoi* Checchia-Rispoli, 1921** (Pl. 3, fig. 26a-c)

Description Shell triangular, dorso-ventrally compressed, with ventral side somewhat more convex than dorsal side. Typical are two narrow lateral flattened zones developing after the apical shell part, which still has a circular transverse section. These zones are more clearly defined on the ventral side. The aperture is oval, c. twice as wide as high, with the flattened zones clearly separated next to the rounded carinae.
Material Sample 3 (3 specimens, RGM 429.887-8).
Discussion *Clio saccoi* was originally described from the Langhian of Gargano (Italy) and subsequently found in many localities of the same age in the Mediterranean, inclusive of the Maltese Upper Globigerina Limestone. The restricted material from Wardija is considerably older and might represent a forerunner species. In the absence of better preserved specimens, inclusive of the embryonal shell parts, I have to refrain from introducing a new taxon.
Clio (Nudiclio) chadumica Korobkov, 1966, might represent a forerunner species of the *C. saccoi*-complex. It is equally a compressed triangular species with separated lateral flattened zones, but its apical angle is considerably smaller than in *C. saccoi*. It was introduced from Oligocene (Rupelian) deposits in the Caucasus (Prearal area, compare Korobkov, 1966, p. 91, pl. 3, figs. 10-18).

Recently (Janssen, 2000), I overlooked the fact that Korobkov (1966, p. 90) designated *Clio pedemontana* (Mayer, 1868) type species of his subgenus *Nudiclio*. This species is related to a group of Oligocene to Recent *Clio* species characterised by the possession of transverse ornament on both ventral and dorsal sides combined with some longitidinal elements, which I proposed to concentrate in the subgenus *Balantium* Children, in Gray, 1823 [type species *Clio (Balantium) recurva* (Children, in Gray, 1823) - Recent]. *Clio pedemontana*, however, differs from this group by the absence of the longitudinal elements, for which reason I included it only in *Balantium* with a query. Should it be decided that *C. pedemontana* belongs in a separate subgenus, than the name *Nudiclio* should be used, otherwise *Nudiclio* is a junior subjective synonym of *Balantium*. Species like *C. saccoi*, however, do not possess transverse ornament and belong to yet another, still unnamed subgenus.

***Clio* (s. lat.) ? sp.** (Pl. 3, fig. 27a-b)

Description A single fragment of an unknown *Clio* (?)-species was found. Apical and apertural parts are missing. The shell is conical, dorso-ventrally somewhat flattened, and has two sharp lateral carinae. Both sides are convex but towards the carinae the surfaces become very slightly concave. Where light reflects on its shiny surface it can be seen that these concave parts bear very thin and distant, somewhat irregular transverse lines, that disappear towards the centre of the shell.
Material Sample 3 (1 fragment, RGM 429.889).
Discussion Nothing similar has ever been before me. The specimen somewhat resembles the internal mould of a *Diacria* apical spine, in which case the transverse lines could represent the wrinkles caused by shell metamorphosis. That genus, however, has not been found yet in deposits of this age. The present specimen also has no trace of any longitudinal ornament as seen for example in *Diacria trispinosa* (Blainville).

Family Cavoliniidae Fischer, 1883
Genus *Edithinella* A.W. Janssen, 1995

Type species *Edithinella undulata* (Gabb, 1873) (Miocene)

***Edithinella bonaviai* sp. nov.** (Pl. 4, fig. 7a-d, 8a-d)

Diagnosis Straight *Edithinella* species with an apical angle of c. 17°. Ventral and dorsal surfaces convex. Initial shell part with circular transverse section, flattened in apertural direction. Lateral furrows developed as weak depressions close to the margins of the dorsal shell part, transverse ornament absent. Protoconch as yet unknown.
Holotype RGM 429.890, Pl. 4, fig. 7a-d.
Type locality Wardija, near Wardija Point, on the extreme SW corner of the island of Gozo, Maltese Archipelago; at coordinates UTM 268.886 (Fig. 1).

Stratum typicum Lower Globigerina Limestone Formation, c. 7.50 -7.75 m above base, in yellowish to light yellowish-brown limestone, with some burrowing and dispersed small phosphorite concretions (sample 3); Miocene, Aquitanian.
Derivatio nominis This new species is named after Mr Charles Galea Bonavia, of Attard, Malta, who demonstrated the Wardija locality to me.
Description The shell is vaginelliform, straight, and elongated triangular in frontal view, with an apical angle of c. 17°. The initial shell part has a circular transverse section, becoming more flattened towards the aperture. Close to the aperture the shell width is c. 1.6 times the dorso-ventral diameter. Weak lateral furrows are developed all along the sides, becoming more clearly defined in the younger part of the shell. In the part close to the apex these furrows are weak, and therefore the sides look more or less carinated. Later on the furrows develop more to one, presumably the dorsal side of the shell. There is no trace of transverse ornament.
Material Sample 2 (many specimens, RGM 429.971); sample 3 (many fragments, RGM 429.891-2).
Discussion It is with some hesitation that I assign this species to the genus *Edithinella*, as some of the main characteristics, such as transverse ornament and a longitudinally curved shell, are not present, which makes this species look like a *Vaginella*, especially in its basal part. Therefore apical fragments are sometimes difficult to recognise. In the more apertural fragments the two furrows are always evident, and exclude *Vaginella.* Protoconchs of any *Edithinella* species are as yet unknown. The only true *Vaginella* species, occurring in the present samples are *V. sannicola* and *V.* ? *tricuspidata*, both of which have different apical angles, which makes a distinction evident.

The only *Edithinella* species known to me from the Maltese strata so far are *E. varanica* (Sirna, 1968), known from the Upper Globigerina Limestone Formation (Langhian), above the C2 main phosphoritic level and the Blue Clay Formation (Serravallian), and *E. caribbeana* (Collins, 1934), found in the basal Green Sand Formation, as reworked elements from an eroded and completely disappeared deposit of Tortonian age (Kienel *et al.*, 1995).

Genus *Gamopleura* Bellardi, 1873

Type species *Gamopleura taurinensis* (Michelotti, 1847) (Miocene)

Gamopleura melitensis **A.W. Janssen, in Rehfeld & Janssen, 1995** (Pl. 4, fig. 9a-c, 10a-c)

1982 'Qanneb' - *Hyalaea* sp., Zammit-Maempel, p. 11, pl. 1, fig. 6.
1987 *Cavolinia* -- Carbone et al., p. 45.
*v1995 *Gamopleura melitensis* Janssen sp. nov., Rehfeld & Janssen, p. 103, pl. 20, figs. 1-4, pl. 21, figs. 1-5

Description Only internal moulds are available, occcasionally with some remnants of the actual shell preserved. This species is of moderate size (H to c. 8 mm), cavoliniform, bilaterally symmetrical along a plane through the apex and the aperture, perpendicular to the dorsal and ventral sides. Both ventral and dorsal shell parts are convex. The ventral side remains lower than the dorsal one and is therefore relatively wider and slightly more convex, somewhat flattened below the ventral apertural margin. The apertural margin of the dorsal shell part is overhanging the ventral part (lateral view). Ventral and dorsal shell parts join on a connate, threadlike produced carina surrounding the shell and are only interrupted at aperture and apex, leaving no lateral slits as seen in *Cavolinia* or *Diacria.* The larval shell is shed, and the opening is closed with a small septum. No wrinkles are seen close to the apex, as present in most *Cavolinia* and/or *Diacria* species. The shell's outline (frontal view) is rounded rectangular, with straight and practically parallel lateral margins. The lower margins left and right of the slightly protruding septum are in line. Transitions between the posterial and lateral margins, and between these and the aperture are gradually rounded.

The aperture is positioned anteriorly and faces ventrally as a result of the difference in height of ventral and dorsal shell part. The ventral margin is straight and is recurved as a strengthening device. Externally the dorsal margin is reinforced by an apertural rim, which is only rarely preserved. The ornament of the dorsal side consists of two oblique radial furrows in the apertual half of the shell. Occasionally both ventral and dorsal parts show a vague transverse striation that when visible on the ventral side has a weak adapical inclination in the centre.
Material Sample 1 (2 fragments, RGM 457.024); sample 2 (10 fragments, RGM 429.972); sample 3 (10 specimens, ? 1 juvenile, RGM 429.893-4); sample 4 (322 specimens, RGM 284.001, RGM 429.779).
Discussion Most available specimens from Wardija are either damaged or have severe traces of transportation, so many of the above described details are difficult to see. Up to now this species was predominantly known from the Maltese C1 main phosphorite level, in which it is an extremely common species. As many specimens from that horizon demonstrate distinct traces of transportation it was clear already that they are for a great deal reworked from an older level. This has now indeed been demonstrated: all three levels below C1 bearing phosphorite clasts (samples 1-3) yielded specimens of this species. *Gamopleura melitensis*, the only pteropod with a vernacular Maltese name (Zammit-Maempel, 1982; see

synonyms) has not yet been recorded from outside the Maltese Archipelago, which considering its abundance there is at least curious. The type species of *Gamopleura*, *G. taurinensis* (Michelotti, 1847), is known from Burdigalian (?) deposits in the Turin Hills (Italy)(see Janssen, 1995, p. 130). A single specimen of this latter species, also of Burdigalian age, is known from the Aquitaine Basin (France) (Janssen, in prep.).

An apparently very juvenile cavoliniid specimen (pl. 4, fig. 10a-c) was found in sample 3. It is a widely triangular specimen dorso-ventrally curved and compressed, with a slightly globular protoconch, that unfortunately is not completely preserved. Protoconchs of *Gamopleura* are unknown to date, as they are shed in adult specimens, so this might be the first one known. By its swollen initial shell it resembles more closely the protoconchs of *Diacria* and/or *Diacrolinia* than those of *Cavolinia*. As *Gamopleura melitensis* is the only related species found in these samples it seems most likely that this is a very juvenile specimen of that species indeed. If this is the case it would imply that shell metamorphosis in this species does take place, in spite of the absence of wrinkles in the basal part of the adult shell.

Genus *Vaginella* Daudin,1800

Type species: *Vaginella depressa* Daudin, 1800 (Miocene)

***Vaginella sannicola* A.W. Janssen, 1990** (Pl. 4, fig. 11a-d)

1921 *Clio (Vaginella) depressa* Daudin -- Checchia-Rispoli, p. 15, fig. 6 (non Daudin).
1968 *Vaginella depressa* Daudin, 1800 -- Sirna, p. 424, fig, 12a-b (non Daudin, excl. syn.)
1979 *Vaginella* aff. *depressa* Daudin, 1800 -- d'Alessandro et al., p. 86, text-figs. 23-24.
v. 1980 *Vaginella eligmostoma* Tate -- d'Alessandro & Robba, p. 623, pl. 63, figs. 4-5; pl. 64, figs. 1-5 (non figs. 6-7 = *V. depressa* Daudin); pl. 65, figs. 1-3 (non Tate).
1982 *Vaginella depressa* Daudin -- Bernasconi & Robba, p. 215 (partim, non Daudin).
*v. 1990 *Vaginella sannicola* sp. nov., Janssen, p. 69, pl. 9, figs. 7-9.
v. 1995 *Vaginella sannicola* Janssen, 1990 -- Janssen, p. 155, pl. 12, fig. 5a-c.

Description The shell is small (H < 4 mm), barely more than twice as high as wide, shaped as a miniature amphora, bilaterally symmetrical on a plane perpendicular to dorsal and ventral sides. Specimens retaining their protoconch are as yet unknown. Both dorsal and ventral shell parts are convex, especially in the base, and the shell becomes flattened towards the aperture. A preapertural constriction is sometimes indicated, but absent in most specimens. Weak but distinct lateral carinae are present in the basal part of the shell, but disappear upward.

The aperture is elongated elliptical, always less wide than the maximal shell width which is situated at mid height, or slightly lower. Two weak folds are present on ventral and dorsal apertural margins, situated closer together on the ventral side.
Material Sample 1 (13 specimens, RGM 457.025); sample 2 (68 specimens, RGM 429.973); sample 3 (several hundreds of specimens, RGM 429.895), sample 4 (166 specimens, 1 protoconch (?), RGM 284.002, RGM 429.780-1).
Discussion This species is very common in main phosphorite level C1, and the present research also demonstrates its common occurrence in levels below C1. It was originally described, however, from limestones in Gargano (Italy), the age of which is still disputed (d'Alessandro & Robba, 1980), but in my opinion is Langhian. This seems to agree with a possible recurrence of this species in the Upper Coralline Limestone, which I hope to document in a forthcoming paper.

***Vaginella* ? *tricuspidata* Zorn & Janssen, 1993** (Pl. 4, figs. 12, 13a-c)

? *v 1993 *Vaginella tricuspidata* sp. nov., Zorn & Janssen, p. 63, pl. 1, pl. 2, figs. 1-5; pl. 3; pl. 4, figs. 1-5.
? v 2002 *Vaginella* aff. *tricuspidata* -- Gürs & Janssen, p. 124, tab. 7.

Description Shell vaginelliform, medium-sized, elongate, transverse section almost cylindrical in the apical part, dorso-ventrally flattened towards the aperture, bilaterally symmetrical. In front view the apical part is slender conical, near to the apertural part of the shell the sides become parallel. There is no preapertural constriction, and therefore the greatest width of the shell is at the aperture.

In the Wardija material the larval shell is for the greater part preserved in just one specimen. It is elongately globose, separated from the teleoconch by a clear constriction and deviates slightly in ventral direction from the shell's long axis. Two weak lateral carinae are seen in the basal part of the shell, that disappear gradually at c. mid height.

The aperture (not preserved in the Wardija specimens) is elliptical, but a bit widened in its central part (apertural view). Two weak folds parallel to the shell's long axis run from the dorsal apertural margin in apical direction over a short distance. Three small cusps ornament the dorsal margin.The ventral margin is almost straight, slightly lower than the dorsal one. Close to the ventral apertural margin the shell is slightly inflated in its centre.
Material Sample 2 (5 fragments, RGM 284.003-4, RGM 429.974); sample 3 (7 fragments, RGM 429.896).
Discussion This species was described originally from the Late Oligocene (Chattian) of SW France and Hungary, and was subsequently also recorded from sediments of the same age in the North Sea Basin. A further record from the Early Miocene in the North Sea Basin could only be identified as *V.* aff. *tricuspidata.* Also the present material, exclusively in a fragmentary state, shows the elongate shell form of *Vaginella tricuspidata*, but the ultimate proof that we are indeed dealing with this species, i.e. the presence of three cusps on the dorsal apertural margin, could not be demonstrated in the Wardija samples because of internal mould preservation. Therefore I prefer to apply this name here with a query.

Family Sphaerocinidae Janssen & Maxwell, in Janssen, 1995

Genus *Sphaerocina* Jung, 1971

Type species: *Sphaerocina formai* (Audenino, 1897) (Miocene)

***Sphaerocina* sp. nov. ?** (Pl. 4, fig. 14a-d)

Description Just a few fragments were found of what apparently is a *Sphaerocina* species. These are conical, strongly bent internal moulds, their maximal dimension is slightly more than 2 mm. The ventral (convex) side is gradually curved, whereas the dorsal (concave) side has a longitudinal swelling, which is not exactly in the middle, but a bit shifted to the left side.
Material Sample 2 (2 fragments, RGM 429.975); sample 3 (2 fragments, RGM 429.897-8).
Discussion These fragments resemble *Sphaerocina formai* (Audenino, 1897), described from the Langhian of the Turin Hills (Italy), but also occurring at many other places (southern Italy, Sicily, Malta, Carribbean, New Zealand). The age of all these localities seems to be Langhian, the Maltese specimens (not yet recorded in the literature) originate from the Upper Coralline Limestone. As the Wardija specimens are few, and very incomplete, and as their age seems to be considerably older I prefer to list them in open nomenclature. They might represent a yet undescribed species. Another species of this genus (compare Janssen, 1995, p. 164) is known, but not yet described, from the Late Oligocene Marnes de St. Etienne-d'Orthe, in SW France. Furthermore some specimens of an undoubtedly new *Sphaerocina* species were collected from Pliocene deposits at Pangasinan, Philippines (RGM collections, as yet unpublished).

Suborder Pseudothecosomata Meisenheimer, 1905
Superfamily Peraclidoidea Tesch, 1913
Family Peraclididae Tesch, 1913
Genus *Peraclis* Forbes, 1844 (emend. Pelseneer, 1888)

Type species: *Peraclis reticulata* (d'Orbigny, 1836) (Recent)

***Peraclis* sp.** (Pl. 4, fig. 15)

Description A single internal mould was found. It is slightly over 1 mm high, sinistral, and has almost three whorls. The first whorl is planispiral and therefore the shell has a blunt apex. The last two whorls attach far below the periphery of the preceding ones, resulting in convex whorls and deep sutures. The aperture is simple, without any strengthening devices, and rounded elliptical in front view. A columellar seam is not detectable with any certainty on this phosphoritic mould. The surface of the whorls is smooth, without a trace of subsutural crests, as frequently seen in *Peraclis*.
Materia*l* Sample 3 (1 specimen, RGM 429.899).
Discussion This specimen shows some resemblance with *Peraclis lata* (Krach, 1979) (compare Janssen & Zorn, 1993, p. 210, pl. 5, fig, 4; pl. 6, fig. 1), described from the Badenian of Poland. That species, however, is more thick-set, with a distinctly lower H/W-ratio, and demonstrates clear subsutural crests. As just one specimen is available from Wardija we have to wait for additional material, before it can be introduced as a new species.

Order Gymnosomata Blainville, 1823

The Gymnosomata are so-called 'naked' pteropods, as the adult animal has no shell. The embryonic shell, presumably present in all species, is shed shortly after hatching (Lalli & Conover, 1976). Such embryonic shells have only been described as yet for a restricted number of Recent species. Quaternary fossil specimens in shell preservation were

recorded for the first time by van der Spoel & Diester-Haas (1976).Two Miocene species, as yet unidentified, are recorded here for the first time from the Wardija samples, but much more material, also belonging to other species, is available from many Mediterranean Miocene localities from which fossils in phosphoritic internal mould preservation are available. This material deserves a special biometric study by means of SEM imaging.

Gymnosomata sp. 1 (Pl. 4, fig. 16)

Description Very small (H less than 0.3 mm), conical internal moulds of the larval shell. The initial part (embryonic shell) is an elliptical globe with rounded tip, separated by a clear constriction from the younger, postembryonic part, with is conical, with an apical angle of c. 23°. The transverse section of both parts is circular.
Material Sample 3 (6 specimens, RGM 429.900-1).
Discussion Considering the size and the shape of the present specimens they cannot represent the embryonal shell of one of the pteropod species. There is a remote resemblance with the larval shell of a gymnosomatous species, *viz. Clione limacina* (Phipps, 1774) (compare Lalli & Gilmer, 1989, p. 198, fig. 69). In that species, however the embryonic shell is not elliptical, but rather pointed, whereas the postembryonic part, separated by a less obvious constriction, has a wider apical angle and an elliptical transverse section.

Gymnosomata sp. 2 (Pl. 4, fig. 17)

Description Very small (H c. 0.15 mm), internal mould of the larval shell. The embryonic shell is globular in frontal view, slightly higher than wide. The postembryonic shell part is separated by a distinct constriction. It does not reach half the height of the initial globe and has an apical angle of c. 40°. In both shell parts the dorso-ventral diameter is less than the shell width, resulting in an elliptical aperture.
Material Sample 3 (1 specimen, RGM 429.902).
Discussion The present specimen shows a distinct relationship with the Recent gymnosomatous species *Paedoclione doliiformis* Danforth, 1907, as described *e.g.* by Lalli & Conover (1976, p. 241, fig. 5). The embryonic shell illustrated by them has a height of c. 0.2 mm in which the initial part is less globular, and the constriction between embryonic and post-embryonic shell is less obvious. Only one specimen was found in sample 3 of Wardija, but very similar, if not identical specimens were collected in large numbers from the Upper Globigerina Limestone Formation of Malta and Gozo. The same is true for many samples of similar age from Italy (Gargano, Salentino, Sicily, all unpublished, RGM collection).

AGE ASSIGNMENT USING HOLOPLANKTONIC MOLLUSCA

The holoplanktonic mollusc material extracted from the four Wardija samples yielded some surprises: several species were encountered that are new for the Cainozoic of the Maltese Archipelago, and a number of species are even new to science. The following species were collected:

Name	Sample 4	Sample 3	Sample 2	Sample 1
Atlanta sp.	-	20	5	-
Heliconoides tertiaria (Tate, 1887)	57	many	50	4
Heliconoides vanderweideni sp. nov.	7	25	5	-
Limacina valvatina (Reuss, 1867)	-	26	5	1
Limacina sp. an *L. gramensis* (Rasmussen, 1968)	14	10	1	1
Bowdenatheca miocenica sp. nov.	-	12	2	-
Styliola subula (Quoy & Gaimard, 1827)	1	1	-	-
Spoelia torquayensis A.W. Janssen, 1990	1	43	34	1
Clio (s.lat.) *ghawdexensis* sp. nov.	1	-	46	6
Clio (s. lat.) aff. *saccoi* Checchia-Rispoli, 1921	-	3	-	-
Clio (s. lat.) ? sp.	-	1	-	-
Edithinella bonaviai sp. nov.	-	many	many	-
Gamopleura melitensis A.W. Janssen, 1995	322	11	10	2
Vaginella sannicola A.W. Janssen, 1990	167	many	68	13
Vaginella ? *tricuspidata* Zorn & Janssen, 1993	-	7	5	-
Sphaerocina sp. nov. ?	-	2	2	
Peraclis sp.	-	1	-	-
Gymnosomata sp. 1	-	6	-	-
Gymnosomata sp. 2	-	1	-	-

Several of these species are long-ranging in time. *Styliola subula* is known from the Late Oligocene onwards and is still found living. *Limacina valvatina* is known from the central Paratethys and the North Sea Basin, ranging from Late Oligocene to Late Miocene. *L. tertiaria* is known from the Early to Middle Miocene of Australia, Aquitanian to Langhian from the Mediterranean, and Langhian from the Aquitaine Basin (this latter occurrence still unpublished).

Clio ghawdexensis sp. nov. is closely related to a new species, also from the Chattian of the Aquitaine Basin. Indicators for a Chattian age are *Spoelia torquayensis*, know from the Late Oligocene of Australia, the Aquitaine and the North Sea basins, and *Vaginella* aff. *tricuspidata*, which is known from the Late Oligocene of Aquitaine, Hungary and the North Sea Basin. A doubtful record is from the Early Miocene in the North Sea Basin.

Clio aff. *saccoi* might be identical with *C. saccoi*, which so far is only known from the Mediterranean Langhian. Gymnosomata sp. 1 and 2, or at least very similar forms, are found also in higher portions of the Maltese Globigerina Limestone of Langhian age, as well as in Italian deposits of similar age. *Sphaerocina* sp. resembles an as yet undescribed species known from the Late Oligocene of Aquitaine, but on the other hand might be a juvenile form of *Sphaerocina formai*, which is known from the Langhian (Caribbean, New Zealand, Mediterranean).

Vaginella sannicola up to now is exclusively known with certainty from the Mediterranean Aquitanian, as most of the Langhian localities in Italy where this species was recorded from (Gargano, Salentino) up to now were considered to represent reworked faunas (d'Alessandro & Robba, 1980). Still, this species is also know from the Sicilian Ragusa Formation and the Maltese Upper Globigerina Limestone, which indeed are Langhian in age. *Heliconoides vanderweideni* sp. nov., *L.* sp. an *L. gramensis*, *Bowdenatheca miocenica* sp. nov., *Clio ghawdexensis* sp. nov., *Edithinella bonaviai* sp. nov. and *Peraclis* sp. are new or presumably new, and only known from the present samples. Summarizing, the ranges of the various species are given in the table below:
A certain similarity is found between the present assemblages and the one found in for example the Late Chattian locality

Species	Chattian	Aquitanian	Burdigalian	Langhian	younger
Atlanta sp.	-	+	+	+	+
Heliconoides tertiaria	-	+	+	+	-
Heliconoides vanderweideni sp. nov.	-	-	-	-	-
Limacina valvatina	+	+	+	+	+
Limacina sp. an *L. gramensis*	-	-	-	-	-
Bowdenatheca miocenica sp. nov.	-	-	-	-	-
Styliola subula	+	+	+	+	+
Spoelia torquayensis	+	-	-	-	-
Clio (s. lat.) *ghawdexensis* sp. nov.	-	-	-	-	-
Clio (s. lat.) aff. *saccoi*	-	-	-	?	-
Clio (s. lat.) ? sp.	-	-	-	-	-
Edithinella bonaviai sp. nov,	-	-	-	-	-
Gamopleura melitensis	-	+	-	-	-
Vaginella sannicola	-	+	-	?	-
Vaginella ? *tricuspidata*	+	?	-	-	-
Sphaerocina sp. nov.	-	-	-	?	-
Peraclis sp.	-	-	-	-	-
Gymnosomata sp. 1	-	-	-	+	-
Gymnosomata sp. 2	-	+	-	+	-

of St. Etienne-d'Orthe, in the Aquitaine Basin. In the French assemblage, however, common species of Wardija, such as *Gamopleura melitensis, Vaginella sannicola, Heliconoides tertiaria, H. vanderweideni* or *Edithinella bonaviai* are not found, nor are these species recorded from the Aquitanian deposits in France. This might indicate a depositional hiatus between the Chattian and Aquitanian sediments in SW France, and some of the Chattian holoplanktonic mollusc species (*Spoelia torquayensis, Vaginella tricuspidata)* might range into the Early Aquitanian. A common species occurring in the French Aquitanian is *Vaginella depressa* Daudin, 1800, which so far in the Maltese Archipelago is known only from the Middle Globigerina Limestone (unpublised). These considerations lead to the supposition that the Lower Globigerina Limestone Formation is of Early Aquitanian age.

PLATES

Plate 1. Benthic Mollusca

Bivalvia (figures 1-11, 13: X 12½, fig. 12: X 6; a = dorsal view, b = frontal view).

Fig. 1. Nuculidae sp., sample 3, RGM 429.798.
Fig. 2. Nuculanidae sp. 1, sample 3, RGM 429.799.
Fig. 3. Nuculanidae sp. 2, sample 3, RGM 429.800.
Fig. 4. Nuculanidae sp. 3, sample 2, RGM 429.927.
Fig. 5. *Nucinella* sp., sample 3, RGM 429.801.
Fig. 6. *Bathyarca* sp., sample 3, RGM 429.802.
Fig. 7. *Kelliella* ? sp., sample 3, RGM 429.806.
Fig. 8. Lucinidae sp., sample 3, RGM 429.804.
Fig. 9. Lucinidae ? sp., sample 3, RGM 429.805.
Fig. 10. Montacutidae sp., sample 3, RGM 429.803.
Fig. 11. Carditidae sp., sample 2, RGM 429.929.
Fig. 12. *Corbula* sp., sample 2, RGM 429.931.
Fig. 13. *Xylophaga* sp., sample 2, RGM 429.932.

Scaphopoda (figures 14-20, X 12½; a = frontal; view, b = lateral view).

Figs.14-17. Dentaliidae sp., sample 3, RGM 429.808.
Fig. 18. *Pseudantalis* sp., sample 3, RGM 429.807.
Fig. 19. *Cadulus* sp., sample 3, RGM 429.809.
Fig. 20. Siphonodentaliidae sp., sample 3, RGM 429.810.

Gastropoda (figures 26, 35, X 6; other figures X 12½; a = apical view, b = frontal view).

Figs.21-22. *Scissurella* sp., sample 3, RGM 429.811.
Fig. 23. *Solariella* sp., sample 3, RGM 429.813.
Fig. 24. Trochacea sp. 1., sample 3, RGM 429.815.
Fig. 25. Trochacea sp. 2., sample 3, RGM 429.816.
Fig. 26. Trochacea sp. 3, sample 3, RGM 429.817.
Fig. 27. *Circulus* sp., sample 3, RGM 429.818.
Fig. 28. Rissoacea sp., sample 3, RGM 429.821.
Fig. 29. Archaeogastropoda sp. 1, sample 3, RGM 429.822.
Figs.30-31. Archaeogastropoda sp. 2, sample 3, RGM 429.823.
Fig. 32. Cerithiidae sp., sample 2, RGM 429.939.
Fig. 33. Calyptraeidae sp., sample 2, RGM 429.942.
Fig. 34. Xenophoridae sp., sample 3, RGM 429.830.
Fig. 35. Xenophoridae sp., sample 3, RGM 429.830.
Fig. 36. *Eulima* sp., sample 3, RGM 429.829.

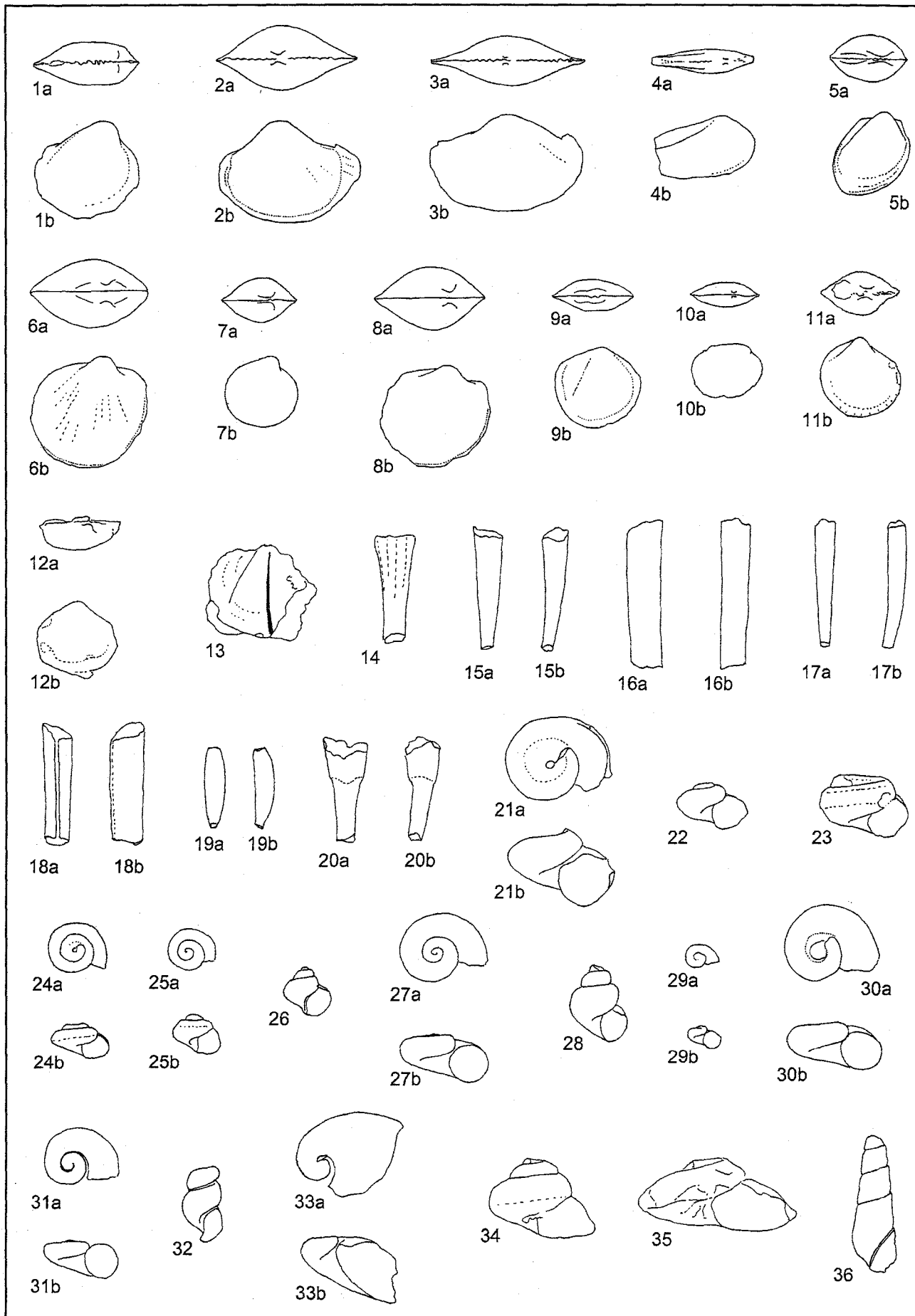
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Plate 2. Benthic Gastropoda

All figures X 12½, a = apical view, b = frontal view.

Fig. 1. *Trivia* sp., sample 3, RGM 429.824.
Fig. 2. Naticidae sp. 1, sample 3, RGM 429.825.
Fig. 3. Naticidae sp. 2, sample 3, RGM 429.826.
Figs. 4-5. Naticidae sp. div., sample 3, RGM 429.827.
Fig. 6. Muricidae sp., sample 3, RGM 429.831.
Fig. 7-8. *Mitrella* sp., sample 3, RGM 429.832.
Fig. 9. Buccinidae sp. 1, sample 3, RGM 429.833.
Fig. 10. Buccinidae sp. 2, sample 3, RGM 429.834.
Figs.11-12. Nassariidae sp., sample 3, RGM 429.835.
Fig. 13. *Vexillum* ? sp., sample 3, RGM 429.836.
Fig. 14. Cancellariidae ? sp., sample 3, RGM 429.837.
Fig. 15. Marginellidae sp. 1, sample 3, RGM 429.838.
Fig. 16. Marginellidae sp. 2, sample 3, RGM 429.839.
Figs.17-18. Marginellidae sp. 3, sample 3, RGM 429.840.
Fig. 19. Marginellidae sp. 4, sample 3, RGM 429.841.
Fig. 20. Turridae sp. 1, sample 3, RGM 429.842.
Fig. 21. Turridae sp. 2., sample 3, RGM 429.843.
Fig. 22. Neogastropoda sp. 1, sample 3, RGM 429.845.
Figs.23-26. Neogastropoda sp. 2, sample 3, RGM 429.846.
Fig. 27. Neogastropoda sp. 3, sample 3, RGM 429.847.
Fig. 28. Pyramidellidae sp. 1, sample 3, RGM 429.851.
Fig. 29. Pyramidellidae sp. 2, sample 3, RGM 429.852.
Figs.30-31. Epitoniidae sp., sample 3, RGM 429.844.
Fig. 32. Actaeonidae sp. 1, sample 3, RGM 429.848.
Fig. 33. Actaeonidae sp. 2, sample 3, RGM 429.849.
Figs.34-35. *Ringicula* ? sp., sample 3, RGM 429.850.
Figs.36-40. Retusidae sp. div., sample 3, RGM 429.853.
Fig. 41. *Volvulella* sp., sample 3, RGM 429.854.
Figs.42-43. *Cylichna* sp., sample 3, RGM 429.855.
Fig. 44. *Roxania* sp., sample 3, RGM 429.856.
Fig. 45. *Haminea* sp., sample 3, RGM 429.857.
Fig. 46. Philinidae sp., sample 3, RGM 429.858.

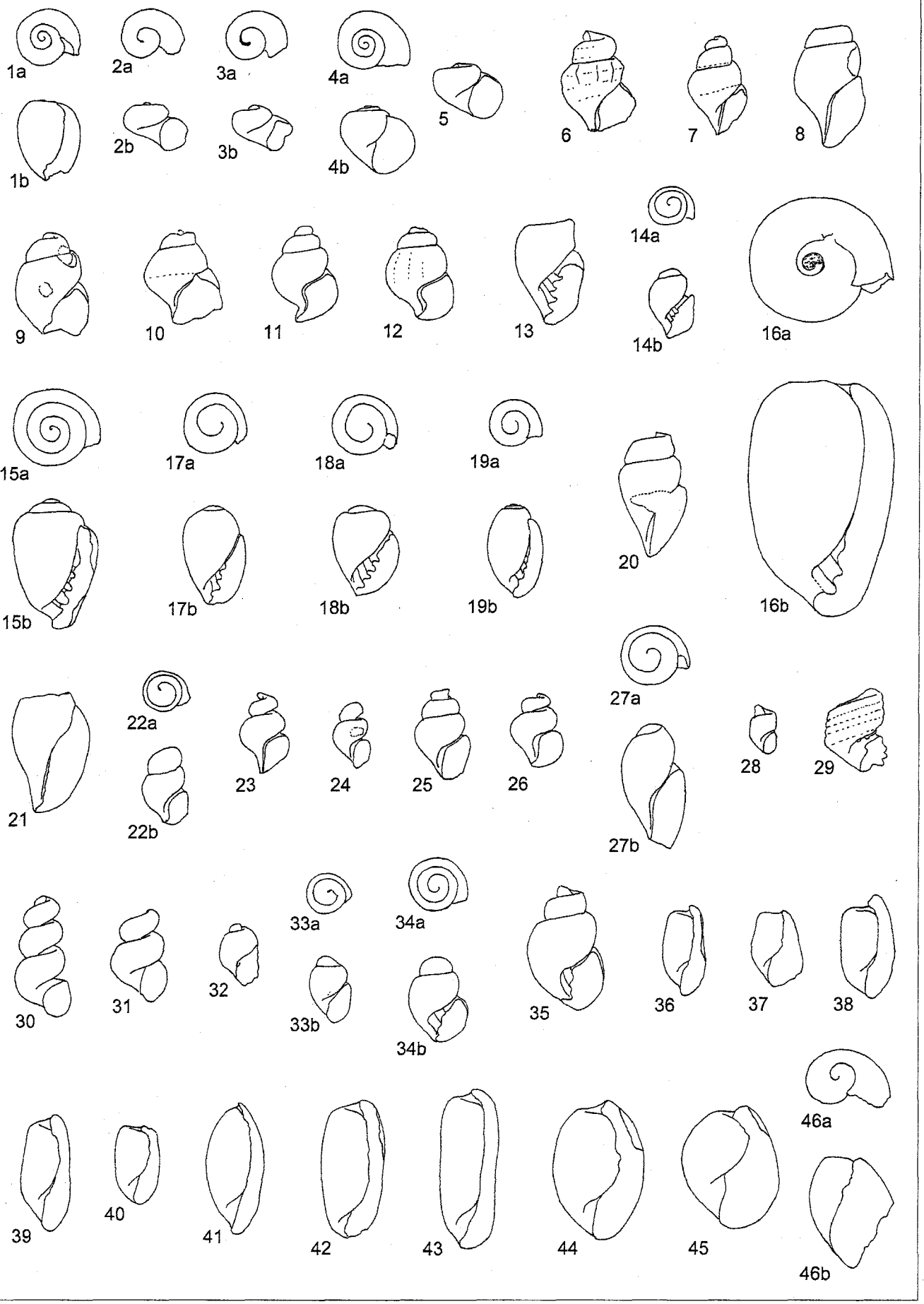
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Plate 3. Benthic and holoplanktonic Gastropoda

Benthic Gastropoda (all figures X 12½, a = apical view, b = frontal view).

Fig. 1. Gastropoda non det. 1, sample 3, RGM 429.859.
Figs. 2-3. Gastropoda non det. 2, sample 3, RGM 429.860.
Fig. 4. Gastropoda non det. 3, sample 3, RGM 429.861.
Fig. 5. Gastropoda non det. 4, sample 3, RGM 429.862.
Fig. 6. Gastropoda non det. 5, sample 3, RGM 429.863.
Fig. 7. Gastropoda non det. 6, sample 3, RGM 429.864.
Fig. 8. Gastropoda non det. 7, sample 3, RGM 429.865.
Fig. 9. Gastropoda non det. 8, sample 3, RGM 429.866.
Fig. 10. Gastropoda non det. 9, sample 3, RGM 429.867.
Fig. 11. Gastropoda non det. 10, sample 3, RGM 429.868.
Fig. 12. Gastropoda non det. 11, sample 3, RGM 429.869.
Fig. 13. Gastropoda non det, 12, sample 3, RGM 429.879.
Fig. 14. Gastropoda indet., umbilical mould, sample 2, RGM 429.960.

Holoplanktonic Gastropoda

Fig. 15 *Atlanta* sp., sample 3, RGM 429.819; a: apical view, b: frontal view.
Fig. 16. *Heliconoides tertiaria* (Tate, 1887), sample 3, RGM 429.874; a = apical view, b = frontal view; X 25.
Fig. 17. *Heliconoides vanderweideni* sp. nov., holotype, sample 3, RGM 429.878; a = apical view, b = frontal view, X 25.
Fig. 18. *Heliconoides vanderweideni* sp. nov., paratype (depressed form), sample 3, RGM 429.872; a: apical view, b: frontal view, c: lateral view; X 25.
Fig. 19. *Limacina valvatina* (Reuss, 1867), sample 3, RGM 429.876; a: frontal view, b = lateral view; X 25.
Fig. 20. *Limacina* sp. an *L. gramensis* (Rasmussen, 1968), sample 3, RGM 429.880; a: frontal view, b: lateral view; X 25.
Fig. 21. *Styliola subula* (Quoy & Gaimard, 1827), sample 4, RGM 429.776; a: apertural view, b: frontal view, X 25.
Fig. 22. *Bowdenatheca miocenica* sp. nov., holotype, sample 3, RGM 429.883; a apical view, b: frontal view, c: apical view, d: lateral view; X 12½.
Fig. 23. *Spoelia torquayensis* A.W. Janssen, 1990, sample 3, RGM 429.885; a: apertural view, b: frontal view, c: apical view, d: lateral view; X 12½.
Fig. 24. *Spoelia torquayensis* A.W. Janssen, 1990, sample 3, RGM 284.010; lateral view; X 12½.
Fig. 25. *Spoelia torquayensis* A.W. Janssen, 1990, sample 3, RGM 284.011; a: apertural view, b: lateral view, c: apical view; X 12½.
Fig. 26. *Clio* (s. lat.) aff. *saccoi* Checchia-Rispoli, 1921, sample 3, RGM 429.887; a: apertural view, b: frontal view, c: lateral view; X 12½.
Fig. 27. *Clio* (s. lat.) ? sp., sample 3, RGM 429.889; a: apertural view, b: frontal view; X 25.

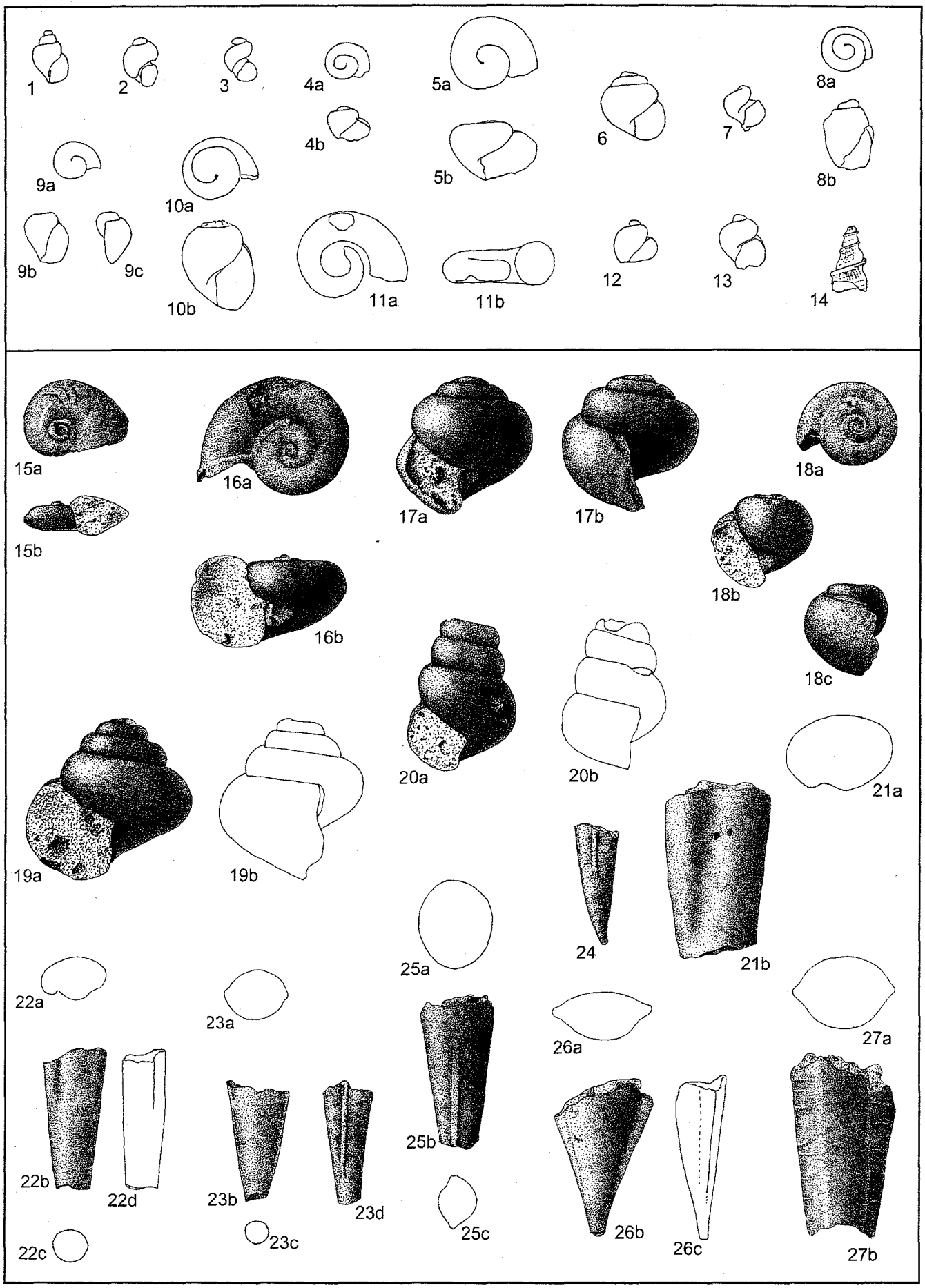
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Plate 4. Holoplanktonic Gastropoda

Fig. 1. *Clio* (s. lat.) *ghawdexensis* sp. nov., holotype, sample 2, RGM 429.970; a: apertural view, b: frontal view, c: apical view, d: lateral view; X 12½.

Figs. 2-6. *Clio* (s. lat.) *ghawdexensis* sp. nov., paratypes, sample 2, RGM 284.005-9; a: apertural view, b: frontal view, c: apical view, d: lateral view; X 12½.

Fig. 7. *Edithinella bonaviai* sp. nov., holotype, sample 3, RGM 429.890; a: apertural view, b: frontal view, c: apical view, d: lateral view; X 12½.

Fig. 8. *Edithinella bonaviai* sp. nov., paratype, sample 3, RGM 429.891; a: apertural view, b: frontal view, c: apical view, d: lateral view; X 12½.

Fig. 9. *Gamopleura melitensis* A.W. Janssen, 1995, sample 4, RGM 284.001; a: ventral view, b: dorsal view, c: lateral view; X 6.

Fig. 10. *Gamopleura melitensis* A.W. Janssen, 1995, juvenile ?, sample 3, RGM 429.893; a: ventral view, b: dorsal view, c: lateral view; X 12½.

Fig. 11. *Vaginella sannicola* A.W. Janssen, 1990, sample 4, RGM 284.002; a: apertural view, b: ventral view, c: lateral view, d: dorsal view; X 6.

Fig. 12. *Vaginella* ? *tricuspidata* Zorn & Janssen, 1993, sample 2, RGM 284.003; lateral view; X 12½.

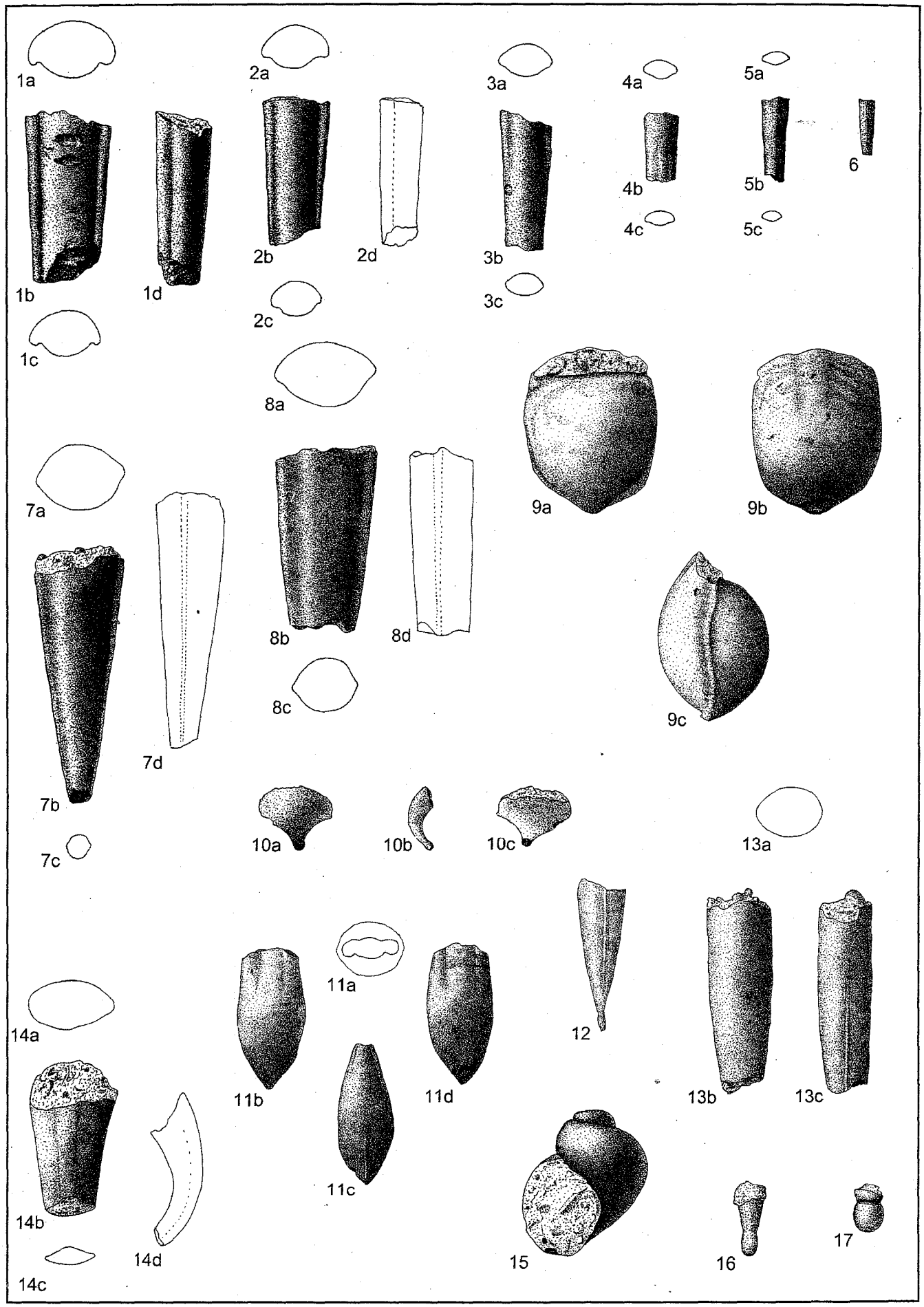
Fig. 13. *Vaginella* ? *tricuspidata* Zorn & Janssen, 1993, sample 2, RGM 284.004; a: apertural view, b: frontal view, c: lateral view; X 12½.

Fig. 14. *Sphaerocina* sp. nov. ?, sample 3, RGM 429.897; a: apertural view, b: dorsal view, c: apical view, d: lateral view; X 25.

Fig. 15. *Peraclis* sp., sample 3, RGM 429.899; frontal view; X 25.

Fig. 16. Gymnosomata sp. 1, sample 3, RGM 429.900; frontal view; X 50.

Fig. 17. Gymnosomata sp. 2, sample 3, RGM 429.902; frontal view; X 50.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ACKNOWLEDGEMENTS

The author is grateful to Mr Charles Galea Bonavia (Attard, Malta) for guidance in the field and fruitful discussions. Mr Pierre Lozouet (Musée national d'Histoire naturelle, Paris, France) made collections in his care available to me and donated specimens to the RGM collections. My wife Edith Janssen-Kruit and my son, Michiel J. Janssen, assisted during the field work. Mr Frank P. Wesselingh (Nationaal Natuurhistorisch Museum Naturalis, Leiden, the Netherlands) and an anonymous referee critically read the manuscript .

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(Accepted December 2003)

The Central Mediterranean Naturalist	4 (1): 35 - 40	Malta: December 2003

ON SOME ALIEN TERRESTRIAL AND FRESHWATER GASTROPODS (MOLLUSCA) FROM MALTA

Constantine Mifsud[1], Paul Sammut[2] and Charles Cachia[3]

ABSTRACT

Nine species of gastropod molluscs: *Otala lactea* (O. F. Müller, 1774); *Cernuella virgata* (da Costa, 1778); *Cochlicella barbara* (Linnaeus, 1758); *Oxychilus helveticus* (Blum, 1881); *Succinea putris* (Linnaeus, 1758); *Oxyloma elegans* (Risso, 1826); *Helisoma duryi* Wetherby, 1879; *Planorbarius corneus* (Linnaeus, 1758); and the limacid slug *Lehmannia valentiana* (A. Férussac, 1822) are recorded for the first time as alien species from local plant nurseries. For each species a short description and notes on distribution and ecology are given.

INTRODUCTION

The land and fresh water Mollusca of the Maltese Islands have been recently well treated by Giusti *et al.* (1995). However, during the last twelve years many non-indigenous plants, shrubs and trees, both decorative species and fruit trees, have been imported from Europe either to embellish local gardens or roadsides or for agricultural purposes. It occurred to the authors that there is the possibility that alien species of molluscs might have been introduced accidentally with these imported plants. This is not a completely new phenomenon. For example, *Pomatias elegans* and *Discus rotundatus* occur at San Anton Gardens were they were probably alien introductions due to human activities (Thake, 1973).

During recent research to assess the status of some of the endemic molluscs of the Maltese Islands, with special emphasis on the Limacidae, areas where imported plants are stocked were searched for any alien species. This resulted in the discovery of several alien species of terrestrial and freshwater snails, a few of them alive. Most of these species were found in private nurseries belonging to different local plant and flower importers.

MATERIALS AND METHODS

Several visits to plant nurseries were carried out by the authors during winter and spring of 2002/3. Searches were made on the trunks of imported trees, at the bases of flower pots, on the foliage of plants and in leaf litter found amongst the pots. Live specimens and empty shells were collected and later cleaned for examination and identification. On subsequent examination it was noticed that amongst the collected material, which also included local species, there were a few shells and live specimens which seemed new to the Maltese malacofauna.

The species *Otala lactea* was previously recorded from Malta from shells discarded by ships' crews over 120 years ago (Feilden 1879). Two species, *Helisoma duryi* Wetherby, 1879 and *Oxyloma elegans* (Risso, 1826) were already previously cited by Giusti *et al.* (1995). The former as Recent at Wied il-Luq at Buskett, although not recorded for a long time now, and the latter from fossil material collected from Wied tal-Bahrija. A third species, *Cernuella virgata* (da Costa, 1778) is known from the Maltese Islands from a few shells present in two foreign collections (Mienis, 1989; Beckmann, 1992) but has not been recorded for almost a hundred years. Three specimens of *Lehmannia valentiana* (Férussac, 1822) were recorded from a hotel at Msida in April 1986 (Beckmann, 2003). Most probably these originated from some imported plants used to embellish the hotel gardens. All the other alien species are recorded from the Islands for the first time. All collected material is deposited in the authors' collections.

Abbreviations used: CM. - Constantine Mifsud (Rabat, Malta); PS. - Paul Sammut (Rabat Malta); CC. - Charles Cachia (Qormi, Malta); CS. - Charles Sammut (Rabat, Malta); coll. - collection.

[1] 4, Shepherds' Str., Rabat RBT 02, Malta (kejdon@waldonet.net.mt)
[2] 'Fawlkner' Dingli Rd., Rabat RBT 07, Malta (farfett@onvol.net)
[3] 1, A/1. St. Catherine Str., Qormi QRM 04, Malta (chcachia@maltanet.net)

SPECIES LIST

Family Helicidae

Subfamily Helicinae

***Otala lactea* (O. F. Müller, 1774)**

Otala lactea (live)

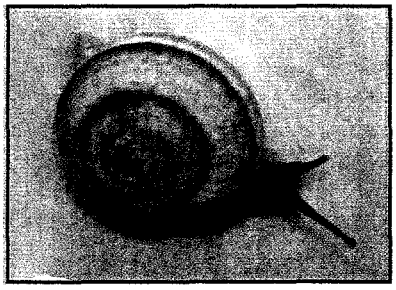
Material studied: 7 live specimens and 5 shells (coll. CM); 1 live specimen (coll. CC); 10 shells (coll. PS); 4 shells (coll. CS). All material collected from "Flower Power" plant nurseries, Mosta.

Shell helicoidal rather depressed and thin walled, with 4-5 whorls. There is no sculpture, but the whorls are ornamented with spiral, wide, brown bands which are usually interrupted with white coloured growth lines. Outer lip thin, and stiffened by the reflected edge. There is no umbilicus and the columellar callus and the shell interior are coloured dark brown or black. The animal has a dark grey or black head and body with the underside of the foot yellow.
Size of shell: height = 20mm., width =35mm.

The several empty shells and live specimens were found amongst the flowerpots and attached to the walls of greenhouses belonging to the 'Flower Power' plant nursery, near Mosta. Giusti *et al.* (1995) include *Otala lactea* with the doubtful species for the Maltese Islands adding, that Feilden's record could represent a misidentified *Eobania vermiculata* (O. F. Müller, 1774). The species could be confused with the local *Cantareus aspersus* (Müller, 1774) because of the coloration of the shell and with *Eobania vermiculata* (O. F. Müller, 1774) because of the flared outer lip. It may have been introduced with plants imported from Spain. *Otala lactea* has a distribution ranging from Southern Portugal, Southern Spain, the Balearic Islands and Morocco in North Africa. Elsewhere, including in northern Europe, this is a common greenhouse pest which has also reached the American continent.

Subfamily Hygromiinae

***Cernuella virgata* (da Costa, 1778)**



Cernuella virgata (live)

Material studied: 1 live specimen (coll. CM); 1 shell (coll. PS).

Shell globular with a high spire and from 5-6 convex whorls. Sutures moderately deep, growth lines opisthocline. Umbilicus narrow, sometimes partly covered by the columellar callus. Aperture round, stiffened by an internal rib or ridge. The shell colour is very variable but is usually white or cream with dark brown spiral bands.
Size of shell: height = 10mm., width = 25mm.

One aestivating specimen and a freshly dead shell were found by one of us (PS) attached to the trunk of an olive tree originating from Portugal and donated to the National Natural History Museum at Mdina. The species was also recorded previously from these Islands by Mienis (1988) from three specimens belonging to the former Wintle collection housed at the mollusc collection of the Zoological Museum at the Hebrew University of Jerusalem and originally collected from Valletta by Despott. In the O. von Moellendorff collection housed at the Senckenberg Museum in Frankfurt there are five shells of this species collected from Malta "in the last [19th.] century" (Beckmann, 1992). It is also known from fossil material from Gozo (Giusti *et al.*1995). The species has a Mediterranean and Western European distribution but has also been recorded from the British Isles, Belgium and the Netherlands.

Subfamily Ciliellinae

***Cochlicella barbara* (Linnaeus, 1758)**

Cochlicella barbara (live)

Material studied: 2 live specimens and 1 shell (coll. CM); 1 shell (coll. CC); 1 shell (coll. CS). All material collected from Zammit Nurseries, Qormi.

Shell an elongated cone of 7-8 slightly convex and thick whorls. It has a white basic colour and is ornamented with brown spiral bands or patches. Fresh shells have a thin yellow periostracum. The protoconch is brownish. The growth lines are opisthocline and rough, sometimes resembling axial ribs. The sutures are shallow. The umbilicus is

partly hidden by the columellar callus. The aperture is elliptical and the outer lip is thin and lacks a varix. The animal is greyish-blue in colour. Size of shell: height = 10mm., width = 5mm.

The two live specimens and the two empty shells were found among the leaf litter near flower pots at Zammit Nurseries, Qormi. This is a Mediterranean species usually found near the sea shore, especially on dunes. Here it may have been introduced with plants imported from France, where it seems to be very common. Besides the Mediterranean, the species has been found in Northern France, England (Torquay) and Belgium.

Family Zonitidae

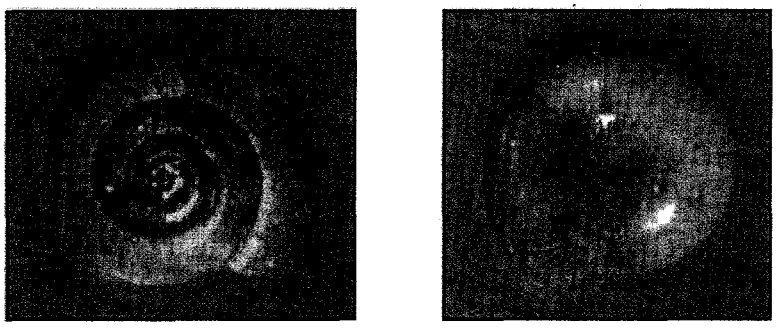
Subfamily Oxychilinae

***Oxychilus helveticus* (Blum, 1881)**

Material studied: 1 live specimen (coll. CM). From 'Flower Power' plant nurseries, Mosta.

Shell small, discoidal, with about 5 slightly convex whorls, enlarging regularly. The whorls are very slightly keeled, glossy brownish-yellow in colour and transparent with some slight white touches near the umbilicus. The umbilicus is very narrow. The animal is bluish-grey in colour with black mantle edges. Size of shell: height = 1.8mm., width = 5mm.

This small (5mm), live specimen was found between the leaves of the orchid *Cymbidium* sp. imported from plant nurseries in Holland. In the literature, (Kerney & Cameron 1987) it is stated that the species reaches a size of 8-10mm and that it emits a strong garlic smell if disturbed. This is a NW. European species, ranging from Southern Britain, Ireland, France and Belgium.



Oxychilus helveticus (left: dorsal and right: ventral view)

Family Succineidae

***Succinea putris* (Linnaeus, 1758)**

Material studied: 10 live specimens and 10 shells (coll. CM); 5 shells (coll. PS); 12 live specimens and 5 shells (coll. CC); 6 shells (coll. CS). All material collected from Zammit Nurseries, Qormi.

Shell fragile, transparent, with three rapidly enlarging and slightly rounded whorls. The last whorl forming about two thirds of the shell height. Suture shallow and there is no umbilicus. Aperture wide with rounded outer lip. The whorls are greenish brown with a black apex when fresh. The body of the animal, which can also be observed through the transparent shell, is dark grey.
Size of shell: height =12mm., width = 6.5mm

Succinea putris (live)

The numerous live specimens and empty shells were found in leaf litter amongst flower pots at Zammit Nurseries. The specimens we found were small, up to 12mm, but the species, according to Kerney and Cameron (1987) is said to occasionally reach 24mm. It has a European and Siberian distribution and inhabits wet situations such as marshes and margins of rivers. Our specimens may have been attached to water plants imported from Europe.

Oxyloma elegans **(Risso, 1826)**

Oxyloma elegans

Material studied: 2 shells (coll. CM). From Zammit Nurseries, Qormi.

Shell fragile, transparent, with three rapidly enlarging whorls. The whorls are only lightly rounded or nearly flat. Aperture elliptical, rather narrow and with a sharp outer lip. There is no umbilicus and fresh shells are transparent. Old shells are opaque yellowish-brown with a dark apex. The animal (not observed) has a greyish head with longitudinal white stripes, while the base of the foot is white (Fechter *et al.*, 1990). Size of shell: height = 16mm., width = 7mm.

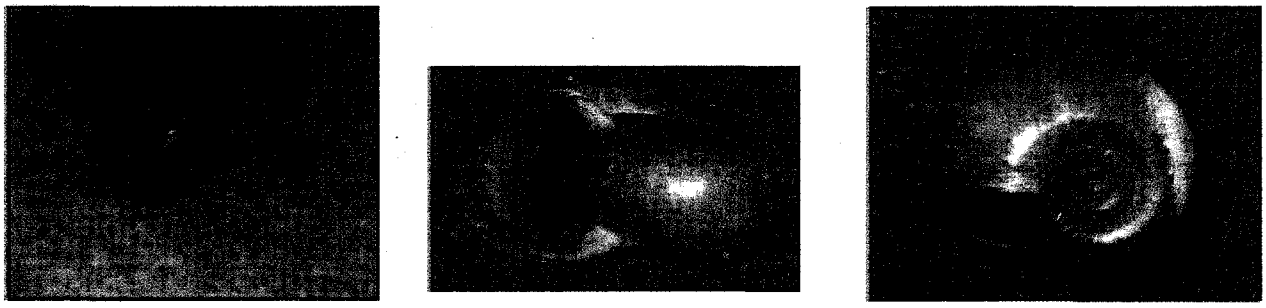
The two fresh empty shells were found in leaf litter amongst flower pots at Zammit Nurseries. The species has the same ecology as *Succinea putris* and has a European and Asian distribution. This species has only been previously recorded for these Islands from fossil material collected from Wied tal-Bahrija (Giusti *et al.* 1995).

Family Planorbidae

Helisoma duryi **Wetherby, 1879**

Material studied: 15 live specimens (coll. CM); 10 live specimens (coll. PM); 3 live specimens (coll. CC). All material collected from Zammit Nurseries, Qormi.

Shell sinistral and planorbid, the whorls being coiled in the same plane. There are from 4-5 rounded and rapidly expanding whorls, usually carinated at the top. Aperture semicircular with a sharp outer lip, the top of which extends above the other whorls. Columella slightly convex with a wide callus. Growth lines opisthocline and evident. Umbilicus wide and deep. Sutures also very deep, especially on the base. Shell external colour is light brown while the inside is white, especially in old shells. The animal has an orange coloration. Size of shell: height = 10mm., width = 25mm.



Heliosoma duryi (left: live, centre: apertural view and right: dorsal view)

A population of this species, which lives and feeds on freshwater plants, was recorded by Giusti *et al.* (1995) from Wied il-Luq at Buskett. Although this species is extinct in the wild from the Maltese Islands, large populations have thrived in ponds at San Anton gardens and the Argotti gardens for at least the past 30 years. We include it here because we found many specimens of various growth stages in garden pools, and because of its growing frequency in local private aquariums, garden pools and reservoirs, which are embellished with imported water plants. The species, whose origin is the southern part of the USA, has spread to all parts of the globe and is presently listed as cosmopolitan.

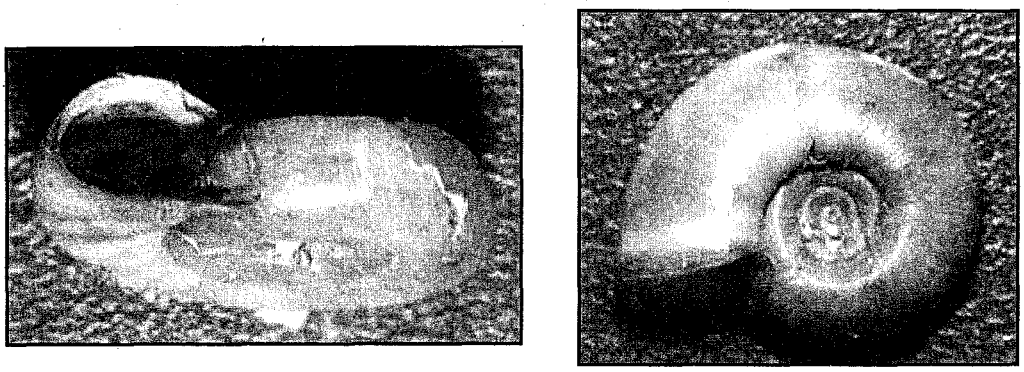
Planorbarius corneus **(Linnaeus, 1758)**

Material studied: 15 live specimens and 5 shells (coll. CM); 8 live specimens (coll. PS); 25 live specimens (coll. CC). All material collected from Zammit Nurseries, Qormi.

Shell sinistral and planorbid, the whorls being coiled in the same plane. There are from 4-5 rounded and regularly expanding whorls which are sometimes carinated slightly at the top. Aperture semicircular, elongated laterally and with a sharp outer lip. The top of the aperture is nearly in line with the other whorls, while its base extends well below the other whorls. Umbilicus narrow and deep. Sutures deep. The shell colour is greyish when fresh but soon fades to opaque white. The animal has a bluish-grey coloration.
Size of shell: height = 7mm., width = 20mm.,

This species is very similar to the preceding species and also lives and feeds on freshwater plants. However, besides the differences in the morphology of the soft parts, the shell is evidently much flatter and has a different coloration. It seems

to be also frequently introduced with imported aquarium plants. Many specimens of various growth stages were found on water plants in an outdoor pond at Zammit Nurseries and also in private aquaria. The species has a European and western Asian distribution.



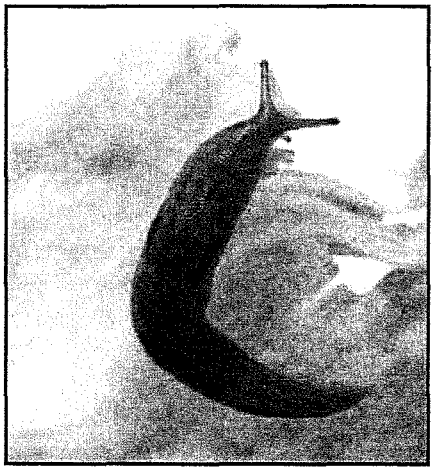
Panorbarius corneus (left: apertural view and right: dorsal view)

Family Limacidae

***Lehmannia valentiana* (A. Férussac, 1822)**

Material studied: 2 live juvenile specimens (coll. CM). Collected from Zammit Nurseries, Qormi.

Small slug, greyish with translucent yellow patches. It also has two lateral darker bands on each side of the mid-line, behind the mantle and with a pair of bands on the mantle forming a lyre pattern. There are also a few interrupted bands on the back end of the body at the tail. The animal is rather soft and gelatinous. The keel is short, slightly paler than body. The genitalia in these juvenile specimens were not studied. Unfortunately the two specimens succumbed to the intense summer heat before reaching maturity. Size of animal: length = 30mm.



Lehmannia valentiana

The two juveniles were found under flowerpots at Zammit Nurseries. This Iberian species is a well-known greenhouse and garden pest all over Europe. It is known to have spread as far as New Zealand, Mexico and British Columbia.

DISCUSSION

These sporadic records of alien species seem to be confined solely to private gardens and agricultural business concerns and therefore, at least for the time being, do not seem to pose a threat to the indigenous fauna or to local agriculture, even if some of these alien species are notorious pests. Searches for these same alien species in areas outside the indicated places of discovery have so far proved fruitless. Moreover, no newly hatched juvenile specimens of the terrestrial alien species cited here were found inside the nurseries.

In our opinion however, the presence of an alien species of slug, well known for its devastating damage to agricultural products, is of some concern. While snails are generally easily noticed and measures to eradicate them can be taken, slugs on the other hand are usually nocturnal in their habits and their presence can only be assessed with difficulty. Luckily most of the larger European slugs cannot survive the local summer climatic conditions and are probably unobtrusively eliminated. Finally, we would like to point out that this list of alien species is not exhaustive. Empty shells of at least four other species of hygromiids were also found, but these are still under study.

ACKNOWLEDGEMENTS

We would like to thank Mr. Charles Sammut of Rabat for making his collection available for study and Mr. Karl-Heinz Beckmann of Ascheberg-Herbern, Germany for providing pertinent literature and for his help in the identification of *Lehmannia valentiana.*

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(Accepted 8th October 2003)

The Central Mediterranean Naturalist	4 (1): 41 - 46	Malta: December 2003

SILVANIDAE AND LAEMOPHLOEIDAE (COLEOPTERA: CUCUJOIDEA) FROM THE MALTESE ISLANDS (CENTRAL MEDITERRANEAN)

David G. H. Halstead[1] and David Mifsud[2]

ABSTRACT

The Silvanidae and Laemophloeidae of the Maltese archipelago are reviewed, based on literature records and, where available, examination of voucher material, as well as the study of additional material collected in recent years. A total of five species of Silvanidae are included of which, *Airaphilus nasutus* Chevrolat, 1860 and *Oryzaephilus mercator* (Fauvel, 1889) represent new records for the Maltese Islands. *Silvanus lewisi* Reitter, 1876, a tropical species, was collected alive from under bark of logs imported from Cameroon (intended for the timber industry). Six species of Laemophloeidae are also recorded from the Maltese Islands, of which, *Placonotus testaceus* (Fabricius, 1787), *Cryptolestes capensis* (Waltl, 1834), *C. pusilloides* (Steel & Howe, 1952) and *Leptophloeus juniperi* (Grouvelle, 1874) represent new records for the Maltese Islands. The record of *Leptophloeus hypobori* (Perris, 1855) by Cameron & Caruana Gatto (1907) was found to be incorrect as their material is *Cryptolestes capensis* (Waltl, 1834).

INTRODUCTION

The Silvanidae and Laemophloeidae are two relatively small families of beetles, with around 500 and 400 described species, respectively. Silvanidae are small to medium-sized beetles that have elongate-ovate or elongate, and moderately to strongly depressed bodies. The pronotum may have the lateral margins coarsely or finely serrate, or a row of obvious setae may be present at the sides. The anterior angles of the pronotum are frequently produced to form a prominent tooth or lobe. These pronotal characters are often indicative of the family.

Laemophloeidae are small to very small beetles, usually strongly depressed - appearing very flat - but sometimes sub-cylindrical. Unlike silvanids they have sublateral lines (carinae or grooves) on the pronotum and often on the head. Until the early 1990's, Laemophloeidae were placed as a subfamily of Cucujidae and, in the more distant past, Silvanidae were also regarded as being part of that family. The separate family status of both of these taxa is now well established.

Silvanidae commonly occur under bark of dead trees or in leaf litter where they principally feed on moulds and fungal spores, and dead plant material. Some species are said to be facultative predators. Laemophloeidae are also found under bark and in the galleries of scolytids. They are thought to be mainly mould feeders but are also predaceous in their natural habitats, and can be cannibalistic. Beetles belonging to both families, including certain species of *Oryzaephilus*, *Ahasverus* etc., (Silvanidae) and *Cryptolestes* (Laemophloeidae), are well known pests of stored products, infesting stored cereals, their products and a wide range of other commodities. These genera have been distributed throughout the world by commerce.

To our knowledge, the only references in which records of Silvanidae and Laemophloeidae are included from the Maltese Islands, are to be found in the following publications. In a work entitled "Common beetles of the Maltese Islands", Caruana Gatto (1893) cited "*Silvanus surinamensis* L." and "*Laemophloeus pusillus* Schr." and commented that these are "unfortunately almost constant guests of all grain and wheat stores". In a list of Coleoptera published in 1907 by Malcom Cameron and Alfredo Caruana Gatto (Cameron & Caruana Gatto, 1907) eight names were included under the family heading of "Cucujidae", but only four of these are referable to Silvanidae and Laemophloeidae. Luigioni (1929), in his work on the Italian Coleoptera, merely repeated their records. Andres (1916), published a list of Lepidoptera, Hemiptera and Coleoptera which he had collected from these islands during a period of almost two years that he spent in Malta as a prisoner of war. In this list he included a record of "*Silvanus surinamensis* L." from stored sugar.

[1] 57 Meadow Way, Old Windsor, Berks, SL4 2NY, United Kingdom.
[2] Ministry for Rural Affairs and the Environment, Department of Plant Health, Agricultural Research & Development Centre, Ghammieri, Marsa CMR 01, Malta. david.a.mifsud@gov.mt

MATERIAL AND METHODS

Depositories for material examined include the following institutions and private collections:

BMNH The Natural History Museum, London, UK;
CHU private collection Halstead, UK;
CMM private collection, Mifsud, Malta;
FSCA Florida State Collection of Arthropods, USA.

The present work was undertaken to provide an overview of the Silvanidae and Laemophloeidae that occur in the Maltese Islands. Where possible, examination of the material recorded in the list of Cameron & Caruana Gatto (1907) was undertaken. The beetle material collected around the early 1900s from the Maltese Islands (presumably collected by Malcom Cameron and/or Alfredo Caruana Gatto), of which a substantial amount is conserved in the BMNH, is labelled as "Cameron Coll. B.M. 1936-555". This material is often accompanied by a unique reference number, which corresponds to a number in Cameron's private notes and in which the following information (partially or fully) may be included: date of collection, name of the species, name of person who identified it, locality name and ecological data. In the present work, the data as written in the private notes of Cameron is recorded between square brackets following his reference number. Cameron and Caruana Gatto also make reference to material collected in Malta between 1874-6 by Commander James John Walker (J.J.W.), and this is also conserved in the BMNH and labelled "G.C. Champion Coll. B.M. 1927-409". In their list, the basis on which the species names are included is indicated; those based on examination of material are asterisked or specifically noted as "Coll. J.J.W.", others as "*teste* J.J.W.". No precise locality or any other data is given for the Walker material, and there is none on the specimens except "Malta". Just 12 specimens referable to the 1907 list were found in the BMNH. Additional material of Silvanidae and Laemophloeidae was collected from the Maltese Islands between 1989 and 2003 (over 200 specimens), mainly by the second author. Most of the material was collected from the island of Malta but specimens were also collected on the nearby island of Gozo. The classification and species sequence follows the checklist of the Italian fauna (Angelini *et al.*, 1995). For each species, earlier cited references (works which repeated earlier references are not included e.g. Luigioni, 1929), material examined, global distribution and additional notes where relevant, are included.

CHECKLIST OF MALTESE SILVANIDAE AND LAEMOPHLOEIDAE

Silvanidae

***Airaphilus nasutus* Chevrolat, 1860**
***Ahasversus advena* (Waltl, 1834)**
***Oryzaephilus mercator* (Fauvel, 1889)**
***Oryzaephilus surinamensis* (Linnaeus, 1758)**
***Silvanus lewisi* Reitter, 1876**

Laemophloeidae

***Placonotus testaceus* (Fabricius, 1787)**
***Cryptolestes capensis* (Waltl, 1834)**
***Cryptolestes ferrugineus* (Stephens, 1831)**
***Cryptolestes pusilloides* (Steel & Howe, 1952)**
***Cryptolestes pusillus* (Schönherr, 1817)**
***Leptophloeus juniperi* (Grouvelle, 1874)**

ANNOTATED LIST OF SPECIES

Identification keys for species regularly found associated with stored products (8 of the 11 listed) are provided in Halstead (1993).

SILVANIDAE

Airaphilus nasutus Chevrolat, 1860

Material examined: Gozo: Ramla, 8.xii.2002, 2 exs., at the base of dying plants in a coastal sand dune habitat, leg. D. Mifsud (CMM).

Distribution: Mediterranean Region.

Notes: New record for the Maltese Islands. The coastal sand dune habitat, from which these specimens were collected, is locally vulnerable. In general, little is known about the biology of *Airaphilus* species. In various parts of the Old World, to which this genus belongs, other species have been found in haystacks, dune grass and damp meadows.

Like a few other *Airaphilus*, *A. nasutus* has greatly reduced wings. On one occasion, a single specimen of *A. nasutus* was intercepted in the UK on currants from Greece (unpublished record), perhaps indicating the possibility of spread by commerce.

***Ahasversus advena* (Waltl, 1834)**

Common Name: Foreign Grain Beetle.

Previously recorded from Malta as "*Cathartus advena* Waltl" by Cameron & Caruana Gatto, 1907: 395.

Material examined: Malta: 1ex., G. C. Champion Coll. B.M. 1927-409 (BMNH); Salina, 19.vii.1989, 1 ex., leg. D. Mifsud (CMM); Għadira, 23.v.1990, 1 ex., leg. D. Mifsud (CMM); Msida, Tal-Qroqq, 25.xi.1994, 1 ex., leg. C. Farrugia (CMM); Zejtun, 22.x.1997, 1 ex., leg. D. Mifsud (CMM); Buskett, 12.ii.2000, 26 exs., in decaying hay and vegetation, leg. D. Mifsud (CHU, CMM); Wied tal-Isqof, 16.vii.2002, 1 ex., attracted to UV light traps, leg. D. Mifsud (CMM).

Distribution: Cosmopolitan.

Notes: *A. advena* is frequently found in stored grains, nuts (including copra and groundnuts), beans, etc. It is a mould feeder requiring some factor which is not present in foodstuffs that are entirely free from moulds or yeasts. Thus its presence is usually indicative of damp storage conditions that allow growth of moulds etc. In open fields, this species is often found in or under decaying haystacks.

***Oryzaephilus mercator* (Fauvel, 1889)**

Common Name: Merchant Grain Beetle.

Material examined: Gozo: Ramla, 1.x.1995, 2 exs., at the base of coastal sand dune vegetation, leg. D. Mifsud (CMM).

Distribution: Virtually cosmopolitan. Except in artificially heated premises, *O. mercator* has not become established in cooler, temperate countries.

Notes: New record for the Maltese Islands. This is an interesting record adding support to the suggestion (see notes on *O. surinamensis*) that the leaf litter type of habitat is a natural one for *Oryzaephilus* species. *O. mercator* is a common pest of stored products although less important than the Saw-toothed Grain Beetle. It infests a wide range of commodities but is most frequently found as a pest of oil seeds and their derivatives.

***Oryzaephilus surinamensis* (Linnaeus, 1758)**
(including *_O. surinamensis_ var. _bicornis_ Erichson, 1846 - see notes below)

Common Name: Saw-toothed Grain Beetle.

Previously recorded from Malta as "*Silvanus surinamensis* L." by Caruana Gatto, 1893: 449; Cameron & Caruana Gatto, 1907: 395; and Andres, 1916: 58.

Material examined: Malta: 5166 [= August 1901, *Silvanus surinamensis*, E.R. (determined by E. Reitter) Malta (on board)], 3 exs., M. Cameron Coll. B.M. 1936-555 (BMNH); Zejtun, 26.ix.1989, 28 exs., in raisins, leg. D. Mifsud (CMM); Chadwick Lakes, 19.v.1990, 1 ex., leg. D. Mifsud (CMM); Buskett, 9.xi.1993, 3 exs., under bark of *Fraxinus angustifolia*, leg. D. Mifsud (CMM), same locality but 11.i.1996, 1 ex., in leaf litter under *Pistacia* sp., leg. D. Mifsud, same locality but 13.i.1999, *16 exs., leg. D. Mifsud (CMM); Marsa, Għammieri, 7.xii.1993, 1 ex., under bark of *Eucalyptus* sp., leg. D. Mifsud (CMM), same data but 9.xii.1993, 1 ex. (CMM), same data but 28.xii.1993, *2 exs. (CMM); Marsa, 31.v.1995, 2 exs., near stored grains, leg. D. Mifsud (CMM); Luqa, Marina Milling, 3.x.1995, *22 exs., near stored barley, leg. D. Mifsud (CMM); Balluta, Wardija area, limits of San Pawl il-Baħar, 23.ii.2000, *4 exs., in leaf litter under *Quercus ilex*, leg. D. Mifsud (CMM); Ballut ta' l-Imgiebaħ, limits of Selmun, 23.ii.2000, 5 exs., in leaf litter under *Quercus ilex*, leg. D. Mifsud (CMM); Zejtun, 13.iv.2002, 3 exs., sifting leaf litter under *Ceratonia siliqua*, leg. D. Mifsud (CMM); Bidnija, 8.ix.1996, *3 ex., leg. D. Mifsud (CMM), same data but 23.ii.1997, 1 ex., (CMM), same data but 30.ix.1997, 1 ex., (CMM), same data but 1.iv.2002, 1 ex., (CMM).

Distribution: Cosmopolitan in association with stored food products.

Notes: Cameron & Caruana Gatto (1907) recorded this species as common throughout the year. *O. surinamensis* is a very common and economically important pest of stored products throughout the world. It attacks many commodities including dried fruits and oil seeds, but is especially common on cereals and cereal products.

There are three strains of this beetle, Small Strain - found in the Far East; Normal Strain; and Horned Strain, *O. surinamensis* var. *bicornis* Erichson, common in the Mediterranean Region. The Horned Strain can be recognised only by the presence of backwardly curved horns that are of variable development and occur on the front of the head of larger males of the strain. Series of specimens in the above list denoted by an asterisk contain males with horns.

In the field, this species has occasionally been recorded from under bark and it has been suggested that humus, fallen seeds and dead plant material in general may be a more important natural habitats for species of *Oryzaephilus* (Halstead, 2000). The above records from leaf litter show that this type of habitat is utilized by *O. surinamensis*.

***Silvanus lewisi* Reitter, 1876**

Material examined: Malta: Zebbug, 3.v.1994, 2 exs., under bark of logs imported from Cameroon, leg. D. Mifsud (CMM).

Distribution: Widely distributed in tropical regions of the Old World (and possibly also occurs in South America).

Notes: New record for the Maltese Islands. The two specimens cited above where found alive under bark of very large logs imported from Cameroon and intended for the timber industry. So far, in Malta there have been no records of this tropical species in the wild. This species is sometimes found in small numbers on stored products (e.g. desiccated coconut), timber and dunnage imported to various countries, particularly from the Orient but also, as in this case, from Africa.

LAEMOPHLOEIDAE

***Placonotus testaceus* (Fabricius, 1787)**

Material examined: Malta: Rabat, Tal-Virtu, 16.xi.1996, 1 ex., in *Laeteporus sulphureus* on *Ceratonia siliqua*, leg. D. Mifsud (CMM); Fawwara, 4.ix.2001, 1 ex., in branches of *Ficus* sp., leg. D. Dandria (CMM); Wied tal-Isqof, 16.vii.2002, 2 exs., attracted to UV light traps, leg. D. Mifsud (CMM); Ħal-Farrug, limits of Qormi, 5.i.2003, 11 exs., under bark of dead branches of *Ceratonia siliqua*, leg. D. Mifsud (CHU, CMM), 33 exs., same data as before but 26.ii.2003 (CMM).

Distribution: Palaearctic.

Notes: New record for the Maltese Islands. *P. testaceus* is a common species on mainland Europe and has been recorded from beneath the bark of various trees, including, *Tilia*, *Fagus*, *Corylus*, *Aesculus*, *Quercus*, *Ulmus* etc., and also from the galleries of various scolytids including, *Scolytus*, *Drycoetes* and *Pteleobius*.

***Cryptolestes capensis* (Waltl, 1834)**

Previously recorded from Malta as "*Laemophloeus hypobori* Perr." by Cameron & Caruana Gatto, 1907: 395 (misidentification).

Material examined: Malta: 2 exs., G.C. Champion Coll. B.M. 1927-409 (BMNH); 3 exs., 8076 [= May 1903, *Laemophloeus hypobori*, Imtaħleb, (?) (illegible) faggots], M. Cameron Coll. B. M. 1936-555 (BMNH); 3 exs., M.C., v.1903/4, M. Cameron Coll. B.M. 1936-555 (BMNH); Luqa, 18.x.1989, 2 exs., under bark of *Acacia* sp., leg. D. Mifsud (CMM); Delimara, 25.x.1989, 1 ex., under bark of *Acacia* sp., leg. D. Mifsud (CMM); Għajn Riħana, 1.viii.1993, 3 exs., between leaf-sheaths and the stem of the reed, *Arundo donax* L. and possibly in association with *Aclerda berlesii* Buffa (Coccoidea, Acleridae), leg. D. Mifsud (CMM); Buskett, 12.ii.2000, 5 exs., leg. D. Mifsud (CMM), same locality but 19. ii.2002, 1 ex., in bracket fungus, leg. D. Mifsud (CMM); Baħrija, 20.iv.2002, 3 exs., leg. D. Mifsud (CMM); Ħal-Farrug, limits of Qormi, 5.i.2003, 1 ex., under bark of a dead branch of *Ceratonia siliqua*, leg. D. Mifsud (CMM); Girgenti, 17. v.2003, 2 exs., reared from dead branches of *Morus* sp., leg. D. Mifsud (CMM).

Distribution: Europe (most common in the South), western Central Asia and Africa (North and probably also South Africa).

Notes: New record for the Maltese Islands but previously, erroneously recorded as *Laemophloeus hypobori* Perr. by Cameron & Caruana Gatto (1907).

C. capensis occurs in flour and provender mills but it is regarded as of minor significance as a pest. It has also been found on almond residues in the UK, and on carobs imported to the UK from Portugal.

***Cryptolestes ferrugineus* (Stephens, 1831)**

Common Name: Rust-red Flour Beetle

Previously recorded as "*Laemophloeus ferrugineus* Steph." by Cameron & Caruana Gatto, 1907: 395.

Material examined: Malta: Delimara, 25.x.1989, 3 exs., under bark of *Acacia* sp., leg. D. Mifsud (CMM); Marsa, Għammieri, 28.xii.1993, 2 exs., under bark of *Eucalyptus* sp., leg. D. Mifsud (CMM); Marsaskala, 5.v.1998, 1 ex., leg. D. Mifsud (CMM); Wied tal-Isqof, 2.viii.2002, 1 ex., attracted to UV light trap, leg. D. Mifsud (CMM); Ħal-Farrug, limits of Qormi, 26.ii.2003, 5 exs., under bark of dead branches of *Ceratonia siliqua*, leg. D. Mifsud (CHU, CMM).

Distribution: Cosmopolitan.

Notes: *C. ferrugineus* was recorded by Cameron & Caruana Gatto (1907) as a very common species throughout the year. However, no material attributed to this species from the Maltese Islands was found in the BMNH collections. This species is a very common pest in granaries. It attacks various commodities but is most often found infesting stored cereal grains. In tropical countries it is also commonly found on oilseeds and cocoa beans. In the field, this cold hardy species is well known from under bark, particularly of *Quercus* but also of *Fagus*, *Pinus* etc.

***Cryptolestes pusilloides* (Steel & Howe, 1952)**

Material examined: Malta: Zejtun, 16.xii.1989, 1 ex., leg. D. Mifsud (CMM).

Distribution: Widespread in stored products but most frequently found in the Southern Hemisphere. In Africa it is commonest in the south. It occurs in Portugal where it was probably introduced from Mozambique. The knowledge of the distribution of this species is largely based on storage records. It has been suggested that it may have originated in Australia.

Notes: New record for the Maltese Islands. This species requires warm and moist conditions for development. Although it mainly infests cereals, it has been found infesting a vast range of commodities, including such exotic items as dried aniseed, chilli pods, mushrooms and seaweed from the Orient.

***Cryptolestes pusillus* (Schönherr, 1817)**

Common name: Flat Grain Beetle.

Previously recorded as "*Laemophloeus pusillus* Schr." by Caruana Gatto, 1893: 449.

Material examined: Malta: Zejtun, 5.vi.1989, 1 ex., leg. D. Mifsud (CMM); Marsa, Ħal-Borg, 3.x.1995, 2 exs., in flat hard wheat storage, leg. D. Mifsud (CMM).

Distribution: Widely distributed throughout the world on stored products, although predominantly a tropical species. It is commonest in wet tropical and warmer temperate regions and unable to survive in unheated premises in cooler temperate parts of the world.

Notes: This species was recorded by Caruana Gatto (1893) but his record was not repeated in the coleoptera list of 1907 (Cameron & Caruana Gatto, 1907). *C. pusillus*, occurs on a wide range of stored cereals and other commodities in the warmer parts of the world. In the cooler parts of the world it is most frequently found on cereals and cereal products.

***Leptophloeus juniperi* (Grouvelle, 1874)**

Material examined: Malta: Dingli, 14.ii.2000, 21 exs., under bark of a large chopped branch of a cultivated (?) *Prunus*, leg. D. Mifsud (CHU, CMM, FSCA); Wied tal-Isqof, 16.vii.2002, 2 exs., attracted to UV light trap, leg. D. Mifsud (CHU, CMM), same data but 2.viii.2002, 1 ex. (CMM).

Distribution: Central and Southern Europe.

Notes: New record for the Maltese Islands. This species has been recorded from under the bark of several trees etc., including *Juniperus*, *Cupressus*, *Thuja*, *Morus*, *Ulmus*, *Ficus* and *Olea*, in the galleries of scolytids. In some cases it has been recorded as feeding on the larvae of these beetles.

The species of *Leptophloeus* can be quite difficult to identify. Karner (1996) examined the genital characters of four species found in Central Europe and produced useful genitalia illustrations for distinguishing *L. juniperi*.

ACKNOWLEDGEMENTS

The first author would like to thank both Michael Thomas (FSCA) and Michael Karner for help with the identification of *L. juniperi*. Michael Karner kindly sent specimens of this species for study. The second author is grateful for access to The Natural History Museum under the SYS-RESOURCE programme (made available by European Union funding) for the study of historical material of Maltese coleoptera housed in the said institution. He particularly wishes to thank the following colleagues for their help while at the Museum: Christopher Lyal, Roger Booth, Martin Brendell and Max Barclay. We are also most grateful to David Dandria and Charles Farrugia who donated some of the material included in this study.

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(Accepted 25th October,2003)

The Central Mediterranean Naturalist	4(1): 47 - 48	Malta: December 2003

MEDLYCOTT'S DRAWINGS OF MALTESE NATURAL HISTORY

Joe Sultana[1] and John J. Borg[2]

In 1861William Tallack wrote: "William C. P. Medlycott, Esq., an English gentleman, who spends a part of almost every winter in Malta, has also devoted much careful observation to its birds and ichthyology. He has drawn a series of very accurate coloured representations of the fish and crustaceans of the island, which, if published would be a valuable contribution to the natural history of Europe" (Tallack, 1861). Thirty-two years later, this paragraph was partly quoted by J. H. Cooke (1893), who added the question "Can any of our readers inform us of the whereabouts of these drawings?" The aim of this note is to bring to light the whereabouts of Medlycott's drawings, with the hope that someone in future may find the time and resources to make an in-depth study of them.

Sir William Coles Paget Medlycott (1831-1887) was the 3rd Baronet of the Medlycott family who lived in the famous Ven House in Sherborne. He was a naturalist and a Fellow of the Zoological Society. He used to visit Malta frequently to study and draw its Natural History and also to hunt and collect birds. He was a great friend of Charles Augustus Wright, a British pioneer of Maltese ornithology, who for several years was the Editor of the *The Malta Times and United Service Gazette.*

W.C.P. Medlycott's main published contribution to Maltese Natural History is an appendix (X) entitled "Notes on the Geology, Botany, and Natural History of Malta" in *Malta: Past and Present* (Seddall, 1870). He also published an undated catalogue of birds entitled "Catalogue of the Birds of Malta with their English and Maltese Names". This was printed only for private circulation in 1860, according to a handwritten note on Charles A. Wright's personal copy. A blank space was left after each species so that notes could be written on the catalogue.

In the course of carrying out research for the publication *Maltese Ornithology*, which is in preparation, one of the authors (JS) discovered Medlycott's drawings at the Natural History Museum in London. After W.C.P. Medlycott's untimely death at the age of 56 years, the drawings finally passed on to his youngest brother The Reverend (Sir) Hubert James Medlycott. In 1954 the latter's son, Sir Hubert Mervyn Medlycott, who was a professional soldier, donated all the sketches, together with some manuscripts, to the Natural History Museum in London.

Medlycott had already visited Malta at the age of 22 when he started drawing pencil sketches and water-colour drawings of plants and animals. Plate 1 (a) to (f) shows some examples of his drawings. Apart from visiting Malta frequently, he also traveled to several other countries including North America where he made a similar collection of sketches and water-colour drawings of plants, birds and fishes.

ACKNOWLEDGEMENTS

We thank Joe Attard Tabone for providing us with some of the literature referred to, Sir Mervyn Tregonwell Medlycott for giving us invaluable information regarding the Medlycott family, Alison Harding, Librarian , and Gillian Cornelius, Cataloguer, of the Natural History Museum at Tring for helping us in our research at the Library, and Dawn Hathaway of the Image Resources Department at the Natural History Museum, London for giving us permission to photograph and publish some of the sketches.

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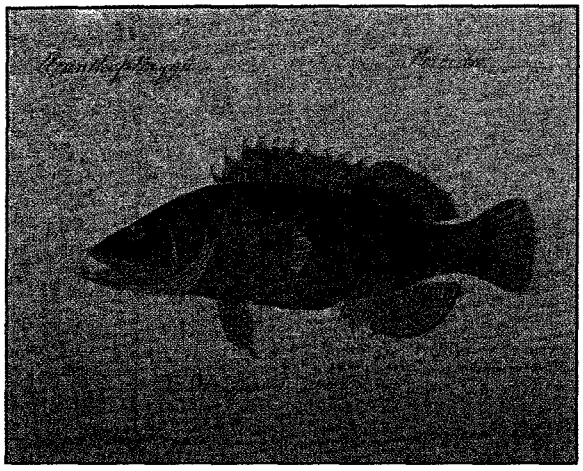
(Accepted 19th October 2003)

[1] Dar ta' Gajdoru / 3, Gajdoru Street, Xaghra, Gozo XRA 104, Malta. joesultana@maltanet.net
[2] The National Museum of Natural History, Mdina, Malta john.j.borg@gov.mt



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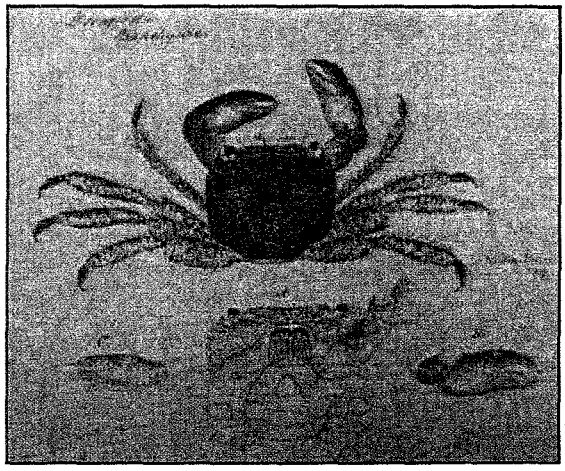

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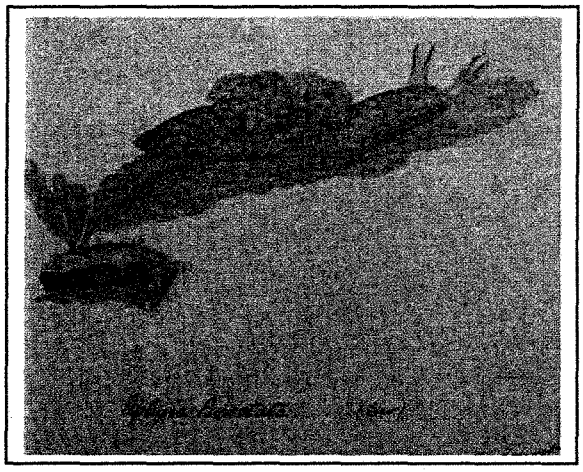

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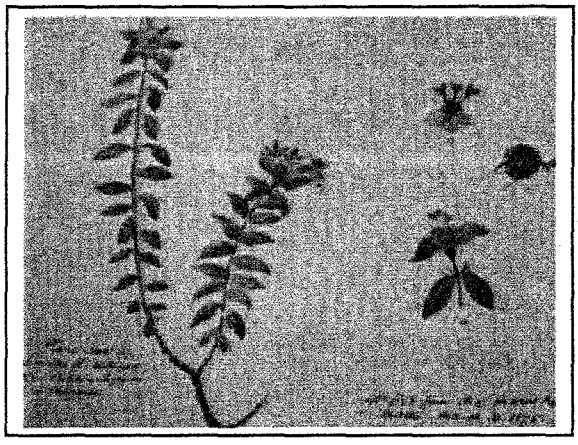

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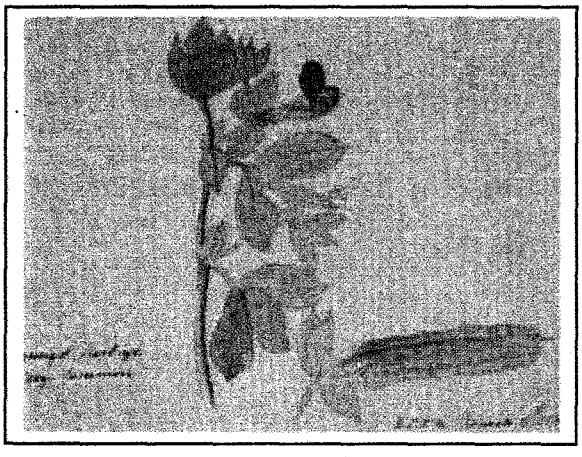

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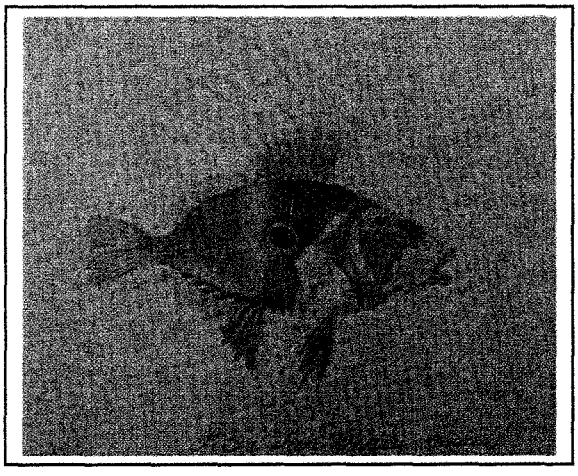

(f)

Plate 1. (a) Water-colour drawing of Painted Comber, *Serranus scriba*; (b) An ink drawing of the Mediterranean Shore Crab, *Pachygrapsus marmoratus*; (c) Water-colour painting of a sea hare, *Aplysia punctata;* (A hand-written note under the painting reads " a very common mollusk in the harbour amongst the beds of *Zostera marina* and on the stones and seaweeds in shallow water where the ground is muddy".) (d) Water-colour drawing of the Maltese Spurge, *Euphorbia melitensis* (drawn from a specimen from Wied Babu in March 1875); (e) Water-colour painting of Winged Pea, *Lotus tetragonolobus (Tetragonolobus purpueus)*; (f) Water-colour painting of John Dory, *Zeus faber* painted in Malta on 5 January 1857.

The Central Mediterranean Naturalist	4(1): 49 - 50	Malta: December 2003

ARENIPSES SABELLA (HAMPSON, 1901) AND *MYELOIS CIRCUMVOLUTA* (FOURCROY, 1785) (INSECTA: LEPIDOPTERA: PYRALIDAE) NEW TO THE LEPIDOPTEROFAUNA OF THE MALTESE ISLANDS.

Paul Sammut[1]

ABSTRACT

The pyralid moths *Myelois circumvoluta* and *Arenipses sabella* are here recorded for the first time for the Maltese Islands. Notes on the biology of the larvae and habits of the adults are included.

INTRODUCTION

Since the publication of *Il-Lepidoptera* (Sammut 2000), a number of lepidopterous insects belonging to different families have been found in the Maltese Islands. Of these, some records have been or are being published (e.g. Sammut, 2003; Sammut *et al.*, 2003; Mifsud *et al.*, 2003; present work). From the large family Pyralidae, a single female specimen of *Arenopsis sabella* (Hampson, 1901) and a male specimen of *Myelois circumvoluta* (Fourcroy, 1785) were recorded at light from Rabat by the author. The specimens are in the author's collection.

SPECIES-LIST

Family: Pyralidae
Sub-Family: Galleriinae

Arenipses sabella (Hampson, 1901)

Material Examined: MALTA (1♀), Rabat 14. ix. 2003, at light, leg. P. Sammut. (Fig. 1)

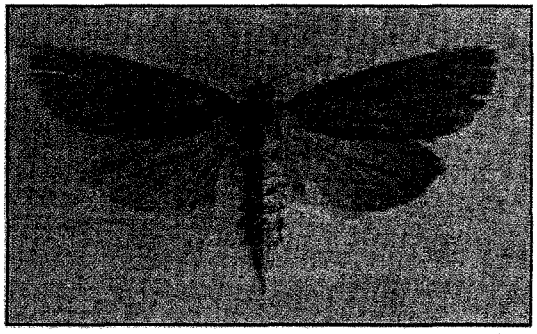

Fig. 1 *Arenipses sabella*, ♀

This North African species is practically unknown in Europe (Speidel, 1996). It has been recorded from the British Isles on only two occasions: a female bred from a larva found on May 3, 1917 feeding on dates and another female captured at Canterbury, also believed to have come from imported dates (Goater, 1986). *Arenipses sabella*, a native of North Africa and the Middle East, is a serious pest of the date palm, attacking both the inflorescence and the fruit.

The eggs are white and laid in small masses, either on the mature fruit or on the inflorescence. When they hatch, the larvae feed on the flowers and developing fruits. The moth produces two broods and is on the wing during May-June and again during September. Eggs produced by the second brood hibernate as small larvae.

I propose the Maltese name "Bahrija Zghira tat-Tamal" after the foodplant of the larva.

Sub-Family: Phycitinae

Myelois circumvoluta (Fourcroy, 1785)

Material Examined: MALTA (1♂), Rabat 30. vi. 2002, at light, leg. P. Sammut. (Fig. 2)

The species is known from practically all Europe, including European Russia and Turkey (Speidel, 1996). The larva is known to feed on Compositae such as *Carduus*, *Cirsium* and *Onopardon*, preferring the larger plants (Beirne, 1954; Parenti, 2000). Locally the larval food plant has not been identified. It feeds in late summer on the heads of thistles,

[1] 'Fawkner', Dingli Road, Rabat, RBT 07. farfett@onvol.net

boring its way to the pith of the stem and producing extensive galleries. In spring, after hibernation, it cuts an exit hole in the dry stem and pupates in a delicate cocoon near the hole (Goater, 1986).

The moth is single brooded and flies in July. By day it rests with the wings tightly wrapped round the body, after the manner of footmans of the genus *Lithosia* (Lepidoptera, Arctiidae). It is occasionally attracted to light.

I propose the Maltese name "Ermellin tax-Xewk" after its English equivalent "Thistle Ermine".

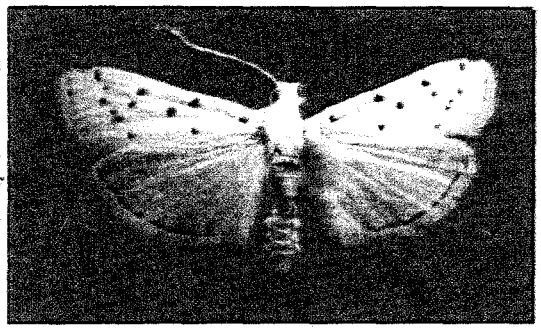

Fig. 2 *Myelois circumvoluta*, ♂

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(Accepted 17th October 2003)

The Central Mediterranean Naturalist	4(1): 51 - 54	Malta: December 2003

NEW RECORDS OF NOCTUIDAE (LEPIDOPTERA) FROM THE MALTESE ISLANDS

Paul Sammut[1], Alexei Sammut[2], Aldo Catania[3], Anthony Seguna[4] & Denis Magro[5]

ABSTRACT

Six species of Noctuidae (Lepidoptera) are reported for the first time from the Maltese Islands. These are *Heteropalpia acrosticta* (Pungeler, 1903), *Araeopteron ecphaea* (Hampson, 1914), *Chilodes maritima* (Tauscher, 1806), *Mormo maura* (Linnaeus, 1758), *Spudea ruticilla* (Esper, [1791]) and *Aporophila australis* Boisduval, 1829. Distribution, habits of adults and larval host plant are included. A Maltese name is proposed for each of the six species.

INTRODUCTION

In the family Noctuidae more than 25,000 species have been described worldwide. In Europe this family is represented by 23 subfamilies, over 200 genera and about 1,250 species (Nowacki & Fibiger, 1996). In the Maltese Islands, the Noctuidae represents the largest family of Lepidoptera, being represented by 19 subfamilies, 81 genera and 144 species (Sammut, 2000). New species of Noctuidae are being described continuously or discovered in countries where they had not been previously recorded. This work is intended to record six species new to the Maltese lepidopterous fauna.

MATERIAL AND METHODS

Material has been collected "at light" or in "light traps" and on "wine ropes". In the case of "at light", a 125W mercury vapour lamp run off a 650W petrol generator, was placed in front of a vertically held white linen sheet. Moths were then hand picked off the sheet. In "light traps", the source of light was a 15W Actinic light. Moths attracted to this light hit a vertical perspex vane and eventually fall in the trap consisting of a large cylindrical container lined on the inside with sheets of egg-packing cardboard which greatly increases the surface on which the moths can roost without damaging themselves. Light traps were usually left running all night. In the morning the trap was opened and the desired specimens were hand picked. Unwanted specimens were tipped amongst tall foliage to reduce predation by birds.

Sugaring, consisting of painting vertical strips, about one metre long and 10 cms wide, on to tree trunks with a brew of boiled beer, treacle and molasses was used, with some success, in the 1950's by Dr. Carmelo Delucca, Anthony Valletta and H.M.Darlow, especially to attract *Catocala elocata* Esper. The first author has used the same sugaring method but with little success. Recently Mr. Ernst Selling from Sweden introduced us to "wine ropes". These consist of short pieces of rope, each about one metre long, dipped in a solution of boiled wine and sugar and hung on to tree trunks.

The material collected at light or on "wine ropes" was killed by placing it in a domestic freezer for about 12 hours, relaxed, pinned, prepared and left to dry for a minimum of seven days.

The following abbreviations have been used in the text:

CAC – private collection, Aldo Catania (Zebbug, Malta);
CAS – private collection, Anthony Seguna (Naxxar, Malta);
CJA – private collection, Jonathan Agius (Zabbar, Malta);
CPS – private collection, Paul Sammut (Rabat, Malta);
CDM – private collection, Denis Magro (Qrendi, Malta).

[1] 'Fawkner', Triq Had-Dingli, Rabat RBT 07, Malta. farfett@onvol.net
[2] 'Fawkner', Triq Had-Dingli, Rabat RBT 07, Malta. crow@onvol.net
[3] 'Rama Rama', Triq Gdida fi Triq il-Kandlora, Zebbug, Malta. catania.am@bigfoot.com
[4] 'Redeemer', Triq l-Emigrant, Naxxar, Malta. lepseg@kemmunet.net.mt
[5] 'Bamberg Cottage' Triq Sant Anna, Qrendi ZRQ 07, Malta.

ANNOTATED SPECIES LIST

Subfamily: Catocalinae

***Heteropalpia acrosticta* (Pungeler, 1903)** Fig. 1

Material examined:
MALTA (1♀) Zurrieq, Blue Grotto-Wied Babu, 6.vi.2002, leg. A. Magro. (CDM).

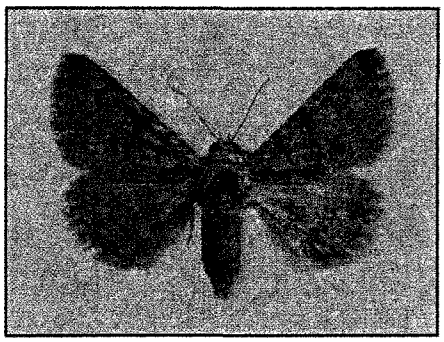

Fig.1: *Heteropalpia acrosticta*

The species is new not just for the Maltese Islands but for the whole of Europe (M. Honey, *pers. comm.*). It is known to occur in India, Afghanistan, Sudan, Saudi Arabia, Syria and Algeria. (Seitz, 1914; Wiltshire 1990). The larva is known to feed on species of *Acacia* (Wiltshire, 1990).

For this species we propose the Maltese name "Bahrija ta' l-Akacja" after the name of the food plant of its larva.

Subfamily: Acontiinae

***Araeopteron ecphaea* (Hampson, 1914)** Fig. 2

Material examined:
MALTA, (1♂) Buskett, Wied il-Luq 6.vii.2001 leg. P. Sammut. (CPS); (2♂♂,1♀), same data, leg. A. Seguna. (CAS); (1♀) Dingli Cliffs 13.vii.2001 leg. P. Sammut. (CPS); (1♀) Wied tal-Bahrija 15.viii.2001 leg. A. Seguna. (CAS); (1♀) Wied ta l-Isqof (limits of Rabat) 16.vii.2002 leg. A. Catania leg. (CAC); (1♀) Wied il-Qlejgha (limits of Rabat) 9. vii.2003 leg. J.Agius. (CJA); (1♀) Buskett, Wied il-Luq 10.vii.2003 leg. P. Sammut. (CPS); (2♂♂) Buskett, Wied il-Luq, 17.vii.2003 leg. P. Sammut. (CPS); (2♀♀) Wied tal-Bahrija 5.viii.2003 leg. P.Sammut. (CPS).

All the material cited above was taken at light.

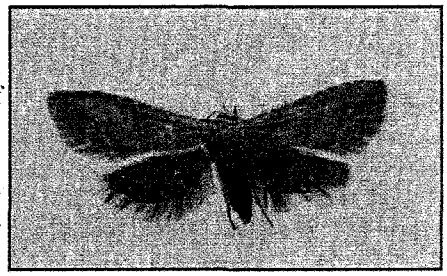

Fig.2: *Araeopteron ecphaea* (wingspan: 12mm)

Araeopteron ecphaea is a small acontiine moth which barely exceeds a wingspan of 10mm. The way in which it hold its wings while resting is more reminiscent of a small geometrid than a noctuid.

This Ethiopian species, originally described by Hampson from Baro, Nigeria is now known also from Congo, Malawi and Namibia. From the East Palaearctic it is known from Turkey and the Arabian Peninsula while from the West Palaearctic it is known from Greece, mainland Spain and Mallorca (Fibiger & Agassiz, 2001; Requena, 2002). It has also been recently discovered in Sicily and Calabria, Italy (M. Fibiger, *pers. comm.*).

Little is known about the biology and early stages of this species. It appears to be multiple brooded. Locally it flies between June and August but on the continent it has been recorded also in May and September. It appears to prefer habitats situated in or close to moist areas. Locally all specimens except the record from Dingli Cliffs, were recorded close to "widien" (small water courses). The species is attracted to light. Locally both 15W actinic light and 125W mercury vapour lamps were used to collect this species.

For this new record we propose the Maltese name "Bahrija tal-Widien"

Subfamily: Hadeninae

***Chilodes maritima* (Tauscher, 1806)** Fig. 3

Material Examined:
MALTA, (1♀) Bahrija 15.v.1999 leg. A. Seguna. (CPS).

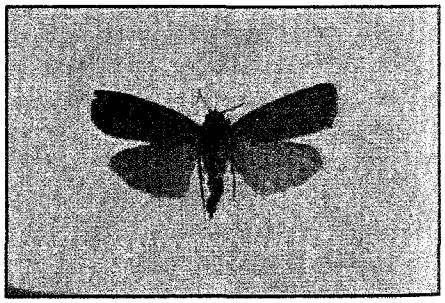

Fig. 3: *Chilodes maritima*

Chilodes maritima (Tauscher) is known from all over Europe except Portugal, Corsica, Sardegna and Sicily. Outside Europe it is also known from Turkey (Nowacki & Fibiger, 1996). The species is single brooded and on the wing from mid-June to mid-August, inhabiting inland and coastal reed-beds (Skinner, 1986). The larva is ochreous with fine dark and light longitudinal lines. The head and

thoracic plate are brown. It is said to feed on vegetable matter and on larvae and insects which creep into reed-hollows (Seitz, 1914). In captivity the larva is known to feed on meat fat (Skinner, 1986).

For this species we propose the vernacular Maltese name "Bahrija tal-Qasba Irqiqa".

***Mormo maura* (Linnaeus, 1758)** Fig. 4

Material Examined:
MALTA, (1 ♀) Buskett, Wied il-Luq 24.vi.2003, at sugar, leg. P. Sammut, A. Seguna & J. J. Borg. (CPS).

The species is known from practically all of Europe and Turkey (Nowacki & Fibiger, 1996). It is also known from Armenia, Asia Minor, Palestine and W. Turkestan (Seitz, 1914). It is single brooded and on the continent it flies from July till September. It is generally associated with shaded and damp river banks and stream beds. The upper part of Wied il-Luq where the species was taken fits exactly the habitat description of this large and beautiful noctuid. It is not attracted to light but readily comes to "sugar". During the day it is said to hide in crevices, old houses and damp caves (Skinner, 1986).

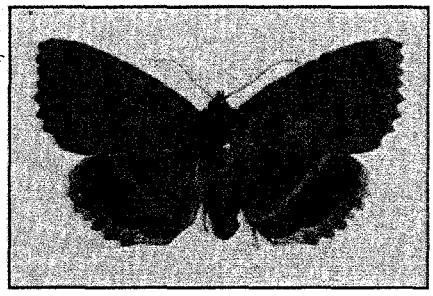

Fig.4: *Mormo maura* (wingspan: 73mm)

The Wied il-Luq specimen was attracted to "wine ropes" and it was discovered on the "rope" at about 10.30 pm. The larvae are known to feed from September till May on a variety of plants such as blackthorn, hawthorn, elm, sallow and birch. Although some of these plants occur at Buskett, the local larval foodplant has not been identified.

We propose the Maltese name "L-Ghagusa" for this species, after its English equivalent "The Old Lady .

***Spudea ruticilla* (Esper, [1791])** Fig. 5

Material Examined:
MALTA, (1 ♂) Rabat, 12.iii.2000 leg. A. Sammut. (CPS).

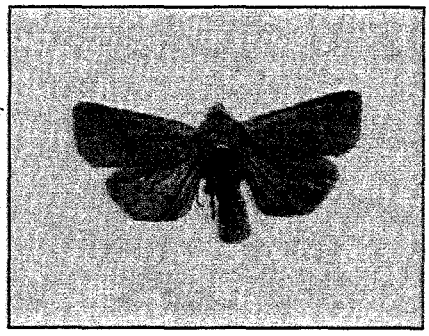

Fig.5: *Spudea ruticilla* (wingspan: 28mm)

The species is univoltine and its flight period is usually March till April. It is known to be attracted to both light and sugar. The species is characteristic of Mediterranean and sub-Mediterranean oak forests and xerotheric, warm mixed oakwoods. It occurs along the western Mediterranean from the Atlas mountains to the Balkans, becoming rarer in north Europe. Outside Europe, it is known only from Morocco and Algeria. (Ronkay *et al.*, 2001).

The caterpillar is known to feed on *Quercus* and overwinters as a pupa. The local larval food plant is not known, but is most likely *Quercus ilex*.

For this species we propose the Maltese name "Bahrija tal-Pil Ahmar" after the transliteration of the species name *ruticilla*.

***Aporophila australis* Boisduval, 1829 Fig. 6**

Material Examined:
MALTA, (1 ♂) Zebbug, 2.xi.2000, at light, leg. A. Catania. (CAC).

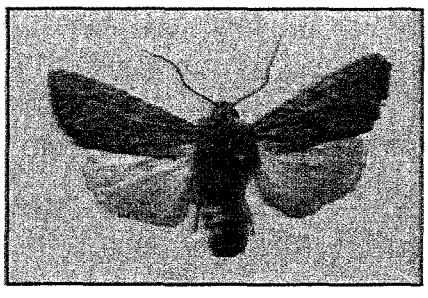

Fig. 6: *Aporophila australis* (wingspan: 33mm)

Three species in the genus *Aporophila*, had been previously recorded from Malta: *Aporophila nigra* (Haworth, 1809) and *Aporophila canescens* (Duponchel, 1826) both quite common and widely distributed locally, and *Aporophila chioleuca* (Herrich-Schäffer, 1848) considered to be rare and with a locally restricted distribution (Sammut, 2000). *Aporophila australis* Boisduval, 1829, is the fourth species from the genus to be recorded locally.

This Mediterranean-Asiatic species is known from the Netherland, England, Ireland, Belgium, France, Spain, the islands of Sicily, Sardegna and Corsica, mainland Italy, Yugoslavia, Bulgaria, Romania, Albania, Greece, Crete and

Turkey. It is also recorded from Morocco, Asia Minor and Syria (Nowacki & Fibiger, 1996).

The species is single brooded and flies from August till November. It is attracted to both light and sugar. The larva feeds from October till May on *Cichorium, Poa annua, Silene maritima, Geranium* and other plants (Ronkay *et al.*, 2001). Locally the larval host plant has not been determined.

For this species we propose the Maltese name "Aporofila tan-Nofsinhar".

ACKNOWLEDGMENTS

The first author would like to thank Mr. Ernst Åke Selling of Norsborg, Sweden for suggesting the use of 'wine ropes'; Dr. Martin Honey of the Natural History Museum, London and Dr. Michael Fibiger of Søro, Demark for their help with the identification of some of the material reported in this study; Dr. Pedro del Estal of the Univesidad Politecnica, Madrid and Dr. Axel Hausmann of the Zoologische Staatssammlung München for making literature on *Araeopteron ecphaea* available. We would also like to thank Mr. Jonathan Agius of Zabbar, Malta for making his material available for study and Dr. David Mifsud of Zejtun, Malta for his critical review of the text.

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(Accepted 17th October 2003)

The Central Mediterranean Naturalist	4(1): 55 - 59	Malta: December 2003

MIGRATION OF THE PAINTED LADY *VANESSA CARDUI* L. (LEPIDOPTERA) IN THE ISLAND OF MALTA (CENTRAL MEDITERRANEAN)

Mark-Anthony Falzon[1]

ABSTRACT

A number of records (including six previously unpublished ones) of the Painted Lady *Vanessa cardui* L., 1758 migrating over the Maltese Islands, are compiled and compared. In particular, a migration that took place in spring 2003 is documented in detail; passage details and weather measurements are given which may shed light on the patterns of migration of this species.

INTRODUCTION

The Painted Lady *Vanessa cardui* L. 1758 is a cosmopolitan species and one of the most widely distributed butterflies in the world. It is distributed throughout Europe, Asia, Africa, North America, and Central America. It is known to engage in exceptionally large migrations: in the eastern United States, for instance, it is not a permanent resident but quasi-periodically migrates there from the deserts of the southwestern U.S. and northern Mexico (Opler and Krizek 1984; Scott 1986, as cited on http://www.public.iastate.edu/~mariposa/species.html).

V. cardui migrations are also well documented in Europe. In Belgium, for example, a southern airflow between 15 and 17 May 2002 resulted in several reports of migrating butterflies. Again, in mid-June, a sub-tropical airflow brought with it regular reports of active migration across the country. There were daily sightings of constant passages in a NNE'ly direction (as reported on http://trekvlinders.members.easyspace.com/).

VANESSA CARDUI MIGRATION IN THE MALTESE ISLANDS

V. cardui is one of the commoner species of butterfly in the Maltese Islands and breeds widely on a range of foodplants notably thistles *Asteracae*-tribe-*Carduae*, Borage *Borago officinalis*, and Mallow *Malva*, *Lavatera* sp. (Valletta 1971, Sammut 2000). Most authors who have written about the butterflies of the Maltese Islands comment that the species migrates regularly over the islands. The sole exception is Borg (1932), who describes the Painted Lady as 'very common' but does not note any migratory movements for the species. He does so for other species, however, notably for the 'white butterflies' (*Pieris brassicae* L. 1758, *Pieris rapae* L. 1758): "They also migrate over long distances, and in spring enormous batches of these pests arrive regularly over the sea from the SE when the winds are favourable. Alighting on the rocks and cliffs of the coast, they soon spread over both islands in search of suitable food plants to oviposit. Sometimes they fail to reach their destination and fall into the sea forming large froth-like patches on its surface" (ibid.: 2). One should point out that Valletta (1952) refers to one such migration of 'countless thousands' of 'whites' on 29 March 1952; at Wied Inċita he described them as trying to "take shelter among the vegetation and in crevices in the rocks. Many of them which alighted to sip moisture from the mud at the edges of ponds were blown on to the water by the strong hot wind, and thousands of dead bodies were floating on the surface" (ibid.: 279).

Noting the migratory behaviour of *V. cardui*, Valletta (1971: 42) holds that "we in Malta see large numbers of this species just for a few days and then they disappear altogether as they continue their migratory urge to other countries." Sammut (2000) also lists the species, together with the Red Admiral *Vanessa atalanta* L., 1758, as migratory in spring and autumn. Throughout its range *V. cardui* is known to be a more irregular and sporadic migrant than *V. atalanta* (Ford 1975), which also means that passages of the former species tend to be more spectacular.

To date there are published records of seven local passages from 1948 to 1989. Table 1 presents all known records to date of *V. cardui* migration in the Maltese Islands; it includes these published records as well as other previously unpublished ones kept by the present author.

[1] "Posidonia", America Street, Naxxar NXR 05, Malta.

TABLE 1 Instances of *V. cardui* migration recorded in the Maltese Islands, 1948 – 2003.

DATE	LOCALITY OBSERVED	NUMBERS COUNTED*	NOTES	SOURCE
17.08.48	Not specified	'unusually big numbers'	*Gegenes pumilio*, a new species for Malta, taken	Valletta 1948, cited in Sammut 1989
02.07.50	Marsascala	ca. 250	Observed from a yacht offshore, flying NW towards land	Dannreuther 1951, cited in Sammut 1989
27/28.03.52	Mriehel	'Thousands'	Attempting to roost in Oleander bushes	Valletta 1952
11.04.52	Wied is-Sewda	'Thousands upon thousands'	All feeding on Thistles	Valletta 1952
4/5.04.69	Various	'large numbers'		Valletta 1974
30.09.69	Various	'huge numbers'		Valletta 1974
10.87	Valletta and Sliema	'very large numbers'	'Huge clouds' observed flying in from the sea	M. Sammut (pers. comm.)
10.88	Delimara	Unspecified	Flying in from the sea	M. Sammut (pers. comm.)
24/25.04.89	Fawwara Rabat	1500, 2800 **	Flying in from the sea from the direction of Filfla at Fawwara	Sammut 1989
06.10.92	St. Elmo Pt.	60+	Noted flying about, a.m.	Present author
11/12.10.92	Għajn Żejtuna, Naxxar Xemxija	2500, 30, 450	All observed at Għajn Żejtuna in good condition	Present author
01.03.95	Qammieħ	'Hundreds'	Flying in from the sea, a.m.	Present author
31.05/01.6.03	Various	Various counts	See present work	Present work

** These figures represent numbers actually observed; many of these migrations would have involved far greater numbers.*
*** In this case, at Fawwara, 50 individuals per minute were counted crossing a 20m stretch of wall; at Rabat, 400 individuals were noted flying over in 7 minutes.*

As shown in Fig.1, records to date indicate that October is the month with the highest frequency (4 records) of migration, followed by April (3 records) and March (2 records).

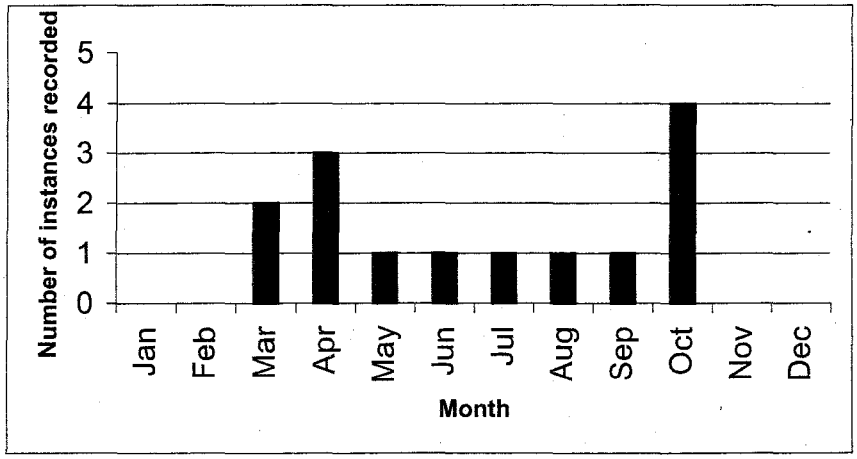

Fig. 1 Frequency of recorded instances of *V. cardui* migrations, 1948 - 2003, by month.

The behaviour of the species during migration is not well documented locally and further study is required. However, many of the published as well as the previously unpublished records mention the fact that substantial numbers of butterflies are often observed resting and/or feeding on various species of flowering plants. Valletta (1952) refers to 'thousands' resting in Oleander *Nerium oleander* bushes at Mriehel during the passage of 27 March 1952. He also mentions that during that passage and that of 11 April of the same year, many butterflies took the opportunity to oviposit; he found a number of larvae on thistles at Mriehel and Wied is-Sewda, many of which were parasitised by *Apanteles* sp. - a hymenopterous Braconid which typically parasitises high percentages of larvae of various species of Lepidoptera, notably *Pieris brassicae* and *P. rapae* (Ford 1975 and pers. obs.)

THE MAY – JUNE 2003 MIGRATION

This paper reports on a reasonably well-documented instance of *V. cardui* migration, which took place on 31 May and 1 June 2003. The following notes were collected from a number of field observers; all observations are to be considered reliable.

Usual numbers of *V. cardui* were around on the morning and early afternoon of 31 May. However, 'an abundance' of Small White *Pieris rapae* was noted at Salina, and a Golden Danaid (or Plain Tiger) *Danaus chrysippus* L., 1758 was seen at Xemxija.

On the evening of 31 May, at 2030, 'several hundred thousand' individuals *V. cardui* were seen flying from the SW towards Ta' Xbiex. Around the same time, another observer noted 'larger than usual numbers' at St. Julian's. A couple of hours later about 100 individuals were seen at a street light in Żebbuġ. At 0300 on the night of 31 May – June 1, about 250 were seen at a single street light in Pieta'; the same observer noted that many more were at street lights in the area and he estimated that at least 2500 were present along one short street.

The following morning, migration was again evident. Several hundred dead butterflies were noted floating in the sea at Ta' Xbiex, with many more squashed on the surrounding roads. The present author counted hundreds of *V. cardui* flying in a NNE'ly direction while driving from Naxxar to Marsaxlokk from 0720 to 0745; most were seen in the central area of the island and none were seen at Marsaxlokk / Delimara. Driving back from Marsaxlokk at 0845 only very few individuals were spotted but at 1030 many hundreds were noted resting and feeding on flowering *Lantana camara* shrubs at Vittoriosa – most were in good condition. A strong passage was reported at Dingli between 0700 and 0800; about 8 – 10 butterflies were counted flying past per second in a northerly direction, making the total counted about 32 000. A 'heavy migration' in an ENE direction was noted while driving from Santa Luċija to Għadira between 0730 and 0800, with exceptionally high numbers at Mriehel and Mosta; no unusual numbers were reported at Għadira. Another observer noted thousands (*ca.* 5000) while driving from Iklin to Ċirkewwa between 0700 and 0730; he reported that they were absent beyond St. Paul's Bay. A similar pattern was observed at St. Julian's, with 'hundreds per minute' flying over early on Sunday morning and more along the coast road, but less as the observer drove northwards and none at Ċirkewwa. On the same morning, higher numbers than usual were noted at Buskett and at Baħrija; at the latter place many were observed feeding on flowering Thyme *Thymus* sp. with up to 8 individuals per shrub. On the afternoon of 1 June, 50 – 80 were noted on *L. camara* shrubs at Rabat. Table 2 summarises these data.

In sum, this particular passage may have involved two passages, a heavy but localised one on the evening of 31 May and an equally substantial one which lasted till about 0800 on 1 June. It is also possible that these were in fact two ends of one passage that continued throughout the night. My estimate, which is probably very conservative, is that at least hundreds of thousands of butterflies were involved. It is interesting to note that observers (including the present author) in the extreme south and north of the island failed to note migrating butterflies; moreover, two observers on Gozo did not notice unusual numbers for the given duration (J. Sultana, J. Vassallo, pers. comm.). The migration followed the central axis of the island in a SW - NE direction

The fact that the species, as well as the closely-related Red Admiral *Vanessa atalanta* L., 1758, often fly toward hilltops and along ridgetops, trails, cliffs, and similar visually-prominent features is well established (Scott 1992, Benvenuti *et al.* 1996, as cited in http://www.public.iastate.edu/~mariposa/species.html). It is quite likely that flocks of *V. cardui* approaching the Maltese Islands from the South tend to fly over the high ground and seacliffs along the south/western stretches of the coastline – indeed, the observations at Dingli tend to support this view. This would explain why on this particular day butterflies were noted flying in a consistent direction along a central SW – NE axis, rather than spreading out across the islands. In what may be related behaviour, the present author has often noted higher than usual numbers of these species at the hilltop at Ġordan, Gozo.

Following the main passage of 31 May – 1 June, smaller passages were reported during subsequent days. On the morning of 9 June, between 0735 and 0805, *ca.* 100 *V. cardui* were noted flying over Blata l-Bajda and a passage was noted at Sliema; that afternoon, 'higher than usual' numbers were observed at Dwejra, Malta. The following day, on the afternoon

of 10 June, *ca.* 100 were observed flying North in singles, at Luqa airfield. On 13 June, at Ta' Ċenċ, Thyme bushes were teeming with *V. cardui*; while 'an abundance' was noted around St. Aloysius' College, Birkirkara. On 22 June, small numbers of *V. cardui* were noted flying towards land at Pembroke.

Table 2. Observations of *V. cardui* migration on 31 May and 1 June 2003.

DATE	TIME	LOCALITY	OBSERVATION	OBSERVER
31.05	evening	Ta' Xbiex	Several hundred thousand flying NE	J.J. Borg
	evening	St. Julian's	'Larger than usual' numbers noted	P. Portelli
	late evening	Żebbuġ	ca. 100 individuals at a street light	S. Suda
01.06	0300	Pieta`	2500+ (probably many more) around street lights	I. Balzan
	early morning	Ta' Xbiex	Several hundred dead individuals noted	J.J. Borg
	0720 to 0745	Central Malta	Hundreds noted flying in a NNE'ly direction	M.A. Falzon
	0700 to 0800	Dingli	8 – 10 per second flying in a northerly direction	D. Attard
	1030	Vittoriosa	Several hundred feeding and resting on *L. camara*	M.A. Falzon
	0730 to 0800	Central Malta	'Heavy migration' in an ENE direction	D. Cachia
	0700 to 0730	Central Malta	ca. 5000 seen flying past	O. Cardona
	early morning	St. Julian's	Hundreds per minute flying past in a northerly direction	P. Portelli
	morning	Buskett and Baħrija	'Higher than usual' numbers observed, especially at Baħrija	A. Casha
	morning	San Anton (Attard)	Hundreds, many dead or visibly weak	M. Sammut
	afternoon	Rabat	50 – 80 on *Lantana camara*	J.J. Borg

FACTORS AFFECTING MIGRATION PATTERNS

At this point one may attempt to link migration and weather variables. Such an exercise must at best be tentative, since there are no systematic records that would allow hypotheses correlating weather and migration to be established and tested statistically. Valletta (1952) gives some weather variables (presumably daily averages) for the passage of 27 March of that year. The temperature rose from 10°C on 25 March, to 21°C on 26 March, and up to 29°C on 29 March. The wind changed direction to SSW and its speed increased from 2 knots on 26 March to 24 knots on 29 March. Sammut (1989) reports that, for the passage of 24 – 25 April 1989, the wind 'during these two days' was slight to moderate ENE. Table 3 presents a selection of weather variables for the passage of 31 May – 1 June 2003. Since this is the best-monitored migration to date, hourly measures of weather can in this case be compared to the sequence of passage as recorded by various observers in various places.

Table 3. Hourly measures of weather variables recorded between 1445 on 31 May 2003 and 1045 on 1 June 2003.

31st May 2003				1st June 2003			
TIME (local)	**TEMP. (° C)**	**WIND SPEED (knots)**	**WIND DIRECTION (°)**	**TIME (local)**	**TEMP. (° C**	**WIND SPEED (knots)**	**WIND DIRECTION (°)**
1445	24.6	7	240	0045	19.2	2	170
1545	24.9	5	230	0145	18.5	0	-
1645	23.9	5	220	0245	17.6	0	-
1745	24.0	5	210	0345	17.7	1	180
1845	24.1	2	230	0445	18.2	3	180
1945	22.9	3	020	0545	17.1	0	-
2045	21.0	5	020	0645	17.7	0	-
2145	20.5	2	040	0745	20.0	0	-
2245	19.9	0	-	0845	22.9	3	070
2345	19.3	0	-	0945	23.3	10	100
Mean Pressure for the period =1013.8hPa (1013.3 – 1014.5hPa)				1045	23.9	6	100

Interestingly, one notes that the recorded onset of migration, that is late afternoon / early evening of 31 May, coincided with a complete shift in wind direction, from 230° (WSW) at 18H45 to 020° (NNE) at 19H45.

In sum, passages of *V. cardui* in the Maltese Islands appear to be regular, broadly seasonal, and possibly related to wind speed and direction. There is much scope for local systematic long-term research on the migration of *Vanessa* sp., and Lepidoptera in general, in the Maltese Islands.

ACKNOWLEDGEMENTS

This paper is partly a result of an email asking for information that was circulated to several birdwatchers and other field naturalists on 1 June 2003. I am indebted to the following for supplying me with information: D. Attard, J. Attard-Montalto, I. Balzan, J.J. Borg, D. Cachia, A. Casha, O. Cardona, J.P. Fiott, R. Galea, P. Portelli, M. Sammut, S. Suda, J. Sultana, and J. Vassallo. Thanks also go to Edwin Lanfranco for his guidance on botanical nomenclature. *The Entomologist's Record* kindly supplied me with copies of Valletta's early papers. I am also grateful to Mr. Saviour Porter, Chief Meteorological Officer, Meterorological Office, Malta International Airport, for making available the meteorological records.

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(Accepted 4th December 2003)

The Central Mediterranean Naturalist	4(1): 61 - 64	Malta: December 2003

NOTES ON THE STATUS, DISTRIBUTION AND MORPHOLOGY OF THE PYGMY WHITE-TOOTHED SHREW *SUNCUS ETRUSCUS* (MAMMALIA, INSECTIVORA, SORICIDAE) IN MALTA

John J. Borg[1]

ABSTRACT

The Pygmy White Toothed Shrew *Suncus etruscus* is one of 19 terrestrial mammal species occurring in the Maltese Islands. Because of their secretive and mostly nocturnal behaviour, very little specific studies have been done on the Maltese mammalian fauna. This note gives a brief account on the present status and distribution of the Pygmy White Toothed Shrew as well as measurements from a sample of 11 specimens.

INTRODUCTION

The Pygmy White-toothed Shrew *Suncus etruscus* (Savi, 1822) has a south Palaearctic-Maghrebian distribution, ranging from Portugal and Morocco to Arabia, Asia Minor, Caucasus, Turkmenistan and Tajikistan. It has also been reported from the Himalayas and South-west China and it occurs also in savannahs and on mountains south of the Sahara (Contoli 2000). In Europe it is restricted to the Mediterranean basin, including many islands (Libois & Fons 1999) such as Sicily, Sardinia and the smaller islands of Asinara, Favignana, Pantelleria and Lampedusa (Contoli 2000).

ORIGIN OF THE MALTESE POPULATIONS

Suncus etruscus is a species of an ancient Tertiary element of hot-arid climates present in most Mediterranean islands (Contoli, 2000). In the Maltese Islands *Suncus etruscus* is believed to be a coloniser of the post-quaternary as from excavations carried out in Ghar Dalam other Quaternary sites only the presence of one shrew species, *Crocidura cf. esuae* (= *C. sicula* Hutterer 1991) was revealed (Bate 1935, Storch 1970).

Contoli (2002) suggested that island colonisation in the Mediterranean by *S. etruscus* was aided by humans.

EARLY RECORDS

The first mention of this shrew from the Maltese Islands, albeit an ambiguous one, is that by Gulia (1914) regarding a male specimen listed as *Crocidura suaveolens* which was caught by G. Despott at Ta' Brolli, limits of Ghaxaq in the early 1900s. As previously noted by Lanfranco (1969) and Schembri & Schembri (1979), Despott's record did not include the relevant authority for the species reported (i.e. either Pallas or Blasius). If the authority was the former then it would have been *C. russula*, but if it were Blasius, then it would have been synonymous with *Suncus etruscus*.

Bate (1935) gave the following account "in 1925 Mr. Despott has most kindly sent me two recent shrews from Malta and the neighbouring island of Gozo. An examination of the two skulls showed the specimen from Malta to be an example of the tiny *Pachyura etrusca* (= *Suncus etruscus*) and that from Gozo of *Crocidura russula*". The donation of two shrews *Crocidura micrurus* (= *Crocidura microurus* = *Crocidura leucodon* (Hermann, 1780) and *Pachyura entrusca* (= *etrusca*) = *Suncus etruscus)* to the Natural History Section of the National Museum are mentioned in the Curator's Report of 1927-28. The following year, Despott (1929) lists a *Pachyura etrusca* Savi = *S. etruscus* as taken from the village of Rabat, Malta.

OBJECTIVE OF THE STUDY

The Pygmy White toothed Shrew has never been studied locally and references to the species are rather vague or inaccurate. Furthermore no biometrics from Maltese specimens have been published so far. The objective of this note is to present an updated account on the status and distribution of *Suncus etruscus* as well as to give biometrics of this species based on Maltese specimens.

[1] National Museum of Natural History, Vilhena Palace, Mdina. e-mail: john.j.borg@gov.mt

MATERIALS AND METHODS

The diminutive size and the nocturnal habit of the Pygmy White-toothed Shrew makes it a very difficult species to observe and study. With the use of Longworth, Sherman and pit traps during a five year period (1997-2001) trapping mice namely *Apodemus sylvaticus* and *Mus domesticus* in order to establish distribution and habitat overlap of the two species (J.J. Borg in prep), not a single specimen of *Suncus etruscus* was ever caught. On the other hand, the ever-increasing population of cats present in the countryside as well as in suburban and urban areas provided an adequate sample for examination. All the morphological data presented in this work is derived from cat kills. The biometrical data is taken from 11 specimens and the following measurements were taken: head and body length, tail and hind foot. A Vernier calliper was used and measurements were taken to the nearest 0.5mm.

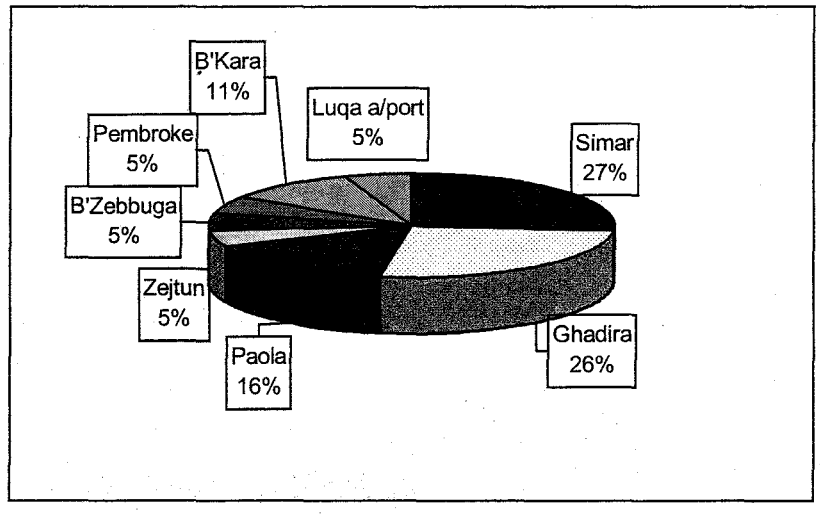
After being measured and duly examined, all specimens were wet preserved and reposited in the National Museum of Natural History, Mdina.

DISTRIBUTION

After examining all the available records, Lanfranco (1969) rather hastily concluded that *Suncus etruscus* is the only species of shrew in the Maltese Islands. Subsequent authors (Schembri & Schembri 1979, Schembri 1985, Libois & Fons 1999 and Baldacchino & Schembri (2002) have all recorded this species as present on Malta as well as on Gozo, possibly following Lanfranco's authority. Baldacchino (1996) states that it is not known from Gozo. A number of small sized shrews (immature individuals of *Crocidura sicula*?) taken by a cat in Xaghra are thought to be *S. etruscus* (Cassar, L.F. Pers. Comm). Unfortunately no specimens are available for specific confirmation. From two campaigns of live trapping on Gozo the first by Vogel *et al* in 1989 and from 1997 to 2001 (rodent distribution) by the present author, no *Suncus etruscus* specimens were trapped. Studies on the diet of Barn Owls *Tyto alba* from one locality in Gozo from 1977 to 1992 failed to produce any *S. etruscus* remains (Schembri & Cachia-Zammit 1979, Borg & Cachia-Zammit 1986-87 & 1994). Sultana (1970) also failed to find traces of *Suncus etruscus* in Barn Owl pellets from another site in Gozo.

Although by no means abundant, this shrew has a widespread distribution in Malta. It has been recorded from a variety of habitats, and specimens have been collected from coastal, rural, suburban as well as urban areas. The distribution presented in this work is biased towards those localities with a higher cat population and the human's disposition to report such cat kills. The highest number of specimens was reported from Ghadira and is-Simar Nature Reserves (Fig. 1).

Fig. 1 Localities where specimens of *S. etruscus* where taken



PERIOD OF ACTIVITY

The Mediterranean climate of hot dry summers and mild, cold, wet winters favours shrew activity for almost 12 months of the year. However no records exist for the months of February, July and December. There appear to be two peak periods of activity, March in Spring and October in autumn (Fig.2). This is explained by the fact that in March shrews wake up from their torpidity and in October they are preparing to go into lethargy therefore needing to accumulate as much body fat as possible. In the spring of 2003 after a short spell of warm weather, which lasted two days, the temperature plummeted down with dire consequences for small insectivorous mammals. Four Etruscan Shrews were found dead along the footpath of the Ghadira Nature Reserve after failing to find adequate food.

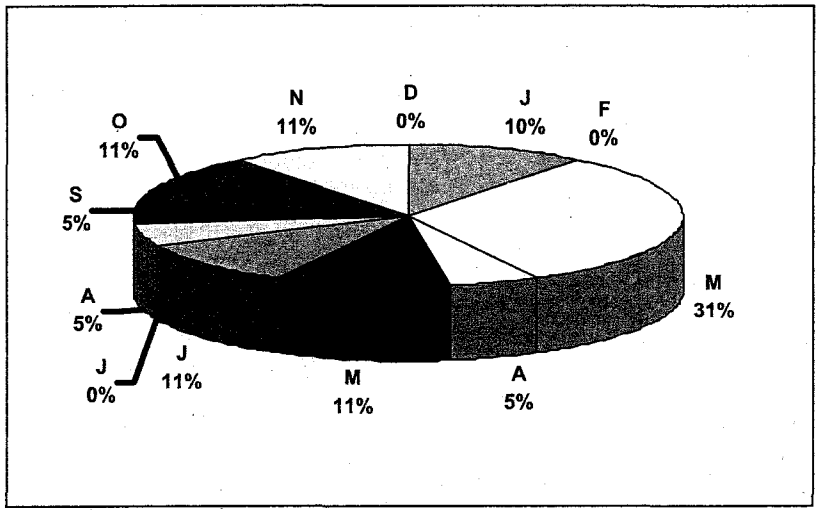


Fig 2. Monthly observations of *Suncus etruscus* in Malta.

MEASUREMENTS

This species is known for its geographical and clinal variation, as has been reported from Spanish populations, with northern specimens being larger than those from the south (Libois & Fons 1999). The Sardinian specimens of *S. etruscus pachyurus* are larger than those found in the rest of southern Europe (Contoli 2000).

The present analysis is based upon the measurement of eleven *S. etruscus* from Malta. The general trend shows that Maltese shrews are slightly smaller in size than their European counterparts with smaller hind feet (6.8 - 7.8 mm) and tails (21.5 - 26.1 mm) while the head and body length (36.5 - 46.5 mm) although smaller on average, were comparable to those from other countries (Table 1). Skulls measured 15.1 - 21.2 mm with an average of 19.3 mm, the ear length ranged from 4 - 6 mm, averaging 5.2 mm. There is a possibility that the reduced size of the hind feet and tail found in Maltese specimens is due to the fact that some individuals were not yet fully grown.

Table 1. Biometric comparison of Maltese and non-Maltese *S. etruscus*.

Study	H/b	Hind feet	Tail
Toschi 1959 (Italy)	35-52mm	7-8mm	25-29mm
Van den Brink 1959 (general)	36-52mm	7-8mm	24-29mm
Lekagul & McNeely 1977 (Thailand)	35-50mm	7-9mm	25-30mm
Macdonald & Barrett 1993 (UK)	35-52mm	7-8mm	24-30mm
Present work (Malta)	36.5-46.5mm	6.8 -7.8mm	21.5 -26.1mm

CONCLUSION

From the information gathered to date there seems to be no definite evidence that the Pygmy White Toothed shrew is present on Gozo or any of the smaller islands of the Maltese Archipelago. On Malta it has been reported in a variety of habitats including urban habitats; it is therefore at risk from the increasing number of feral cats. This analysis demonstrated that the sample of Maltese shrews analysed showed relatively smaller biometrics than the European *S. etruscus*. A reduction (or increase) in size is usually a characteristic feature of fauna living on offshore islands.

ACKNOWLEDGEMENTS

My sincere thanks go to Professor P. Vogel (Lausanne, Switzerland), Professor Patrick J. Schembri (University of Malta) and Mr. L.F.Cassar for their views and comments on the Gozo shrews. I am also grateful to Marlon Briffa, Michael Grima and Mario Gauci for providing some of the material for this study.

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(Accepted 27th November 2003)

The Central Mediterranean Naturalist	4 (1): 65 - 69	Malta: December 2003

ON THE INTRODUCTION OF *PARANTHRENE TABANIFORMIS* (ROTTEMBURG, 1775) IN MALTA (INSECTA: LEPIDOPTERA: SESIIDAE)

David Mifsud[1], Charles Farrugia[2] and Paul M. Sammut[3]

ABSTRACT

The introduction of *Paranthrene tabaniformis* (Rottemburg) in the Maltese Islands, an insect that is mainly associated with poplar trees (*Populus* sp.), is documented. Brief information is provided on the moth family Sesiidae with particular reference to the biology of *P. tabaniformis*. A brief overview of Maltese Sesiidae is included; previous records of *Bembecia scopigera* (Scopoli) were found to be incorrect as this material is *B. albanensis tunetana* (Le Cerf).

INTRODUCTION

A very important valley system in the Maltese Islands is that of Wied il-Qlejgħa (popularly known as Chadwick Lakes) which is connected to Fiddien and Ta' L-Isperanza Valley. This important valley complex receives an abundant supply of freshwater during the wet season and consequently the area supports a large variety of plants and animals associated with freshwater and moist habitats, which are otherwise rare in the Maltese Islands. In 1997, the then Ministry for Agriculture and Fisheries embarked on an ambitious project entitled "Rehabilitation of Wied il-Qlejgħa Valley". The project was funded by the Fourth Italian Financial Protocol. The main objectives of the entire project were (i) to increase the potential re-charging of the underground water table by encouraging water penetration into the ground, reduction of water losses and maximisation of the water-holding capacity of existing dams; (ii) the conservation and production-restoration of the agricultural land alongside the watercourse by ensuring availability of water for irrigation, reduction of agricultural soil losses and the reconstruction of structural retaining walls which had collapsed due to instability effects; (iii) the rehabilitation of the valley ecosystem, giving attention to the ecological characteristics of the valley system and (iv) the enhancement of the tourist and recreational potentials of the valley in harmony with its unique natural characteristics.

In December 2002, some Mediterranean trees and shrubs (namely *Ceratonia siliqua*, *Populus alba*, *Myrtus communis*, *Teucrium fruticans* and *Vitex agnus-castus*) were donated by an institution in Southern Italy to the Government of Malta for the embellishment of the Fiddien area as part of the rehabilitation project of Wied il-Qlejgħa. Following the interception of some immature insects on parts of this consignment (by the first two authors), the mentioned plants were put under quarantine. On the 25th of February 2003 the plants (still under quarantine) were inspected again, and gall-like protrusions were observed along some branches of *Populus alba* trees. Careful dissection of these branches revealed the presence of a lepidopterous caterpillar (Fig. 1) that was actively feeding in the tender branches and main stems of young *Populus* trees.

MATERIAL AND METHODS

Branches and main stems of the mentioned *Populus* trees, which were suspected to host this lepidopterous larva, were taken to the laboratory. Careful dissection of these infected branches was undertaken to search for the presence of larvae and pupae. Other new and healthy branches of *Populus* were cut, and small holes were drilled in these branches into which the live caterpillars, which had been previously found, were introduced to complete their development. These new branches hosting the caterpillars were enclosed in plastic containers (with fine net mesh tops) for the possible emergence of the adult moth so as to allow species identification. Material has been conserved in the private collections of the authors. The entire consignment of the imported *Populus alba* trees was destroyed by fire.

RESULTS AND DISCUSSION

Two adult moths emerged and these were identified as *Paranthrene tabaniformis* (Rottemburg, 1775) (Fig. 2) known by

[1] Ministry for Rural Affairs and the Environment, Department of Plant Health, Agricultural Research & Development Centre, Għammieri, Marsa, Malta. david.a.mifsud@gov.mt

[2] C/2, Perry Court, Birkirkara Road, St. Julians SLM 013. carmel_farrugia@hotmail.com

[3] 2 'Fawkner', Triq Had-Dingli, Rabat RBT 07. farfett@onvol.net

the common English name of Dusky Clearwing. The Maltese name of 'Baħrija Zunzan tal-Luq' is here proposed.

Material examined: Malta: Marsa, Għammieri, 25.ii.2003, 8 mature larvae and one pupa (in branches of imported trees of *Populus alba*) from which 2 adult moths emerged between the 20.iv. and 27.iv.2003, leg. C. Farrugia and D. Mifsud.

Family Sesiidae: *Paranthrene tabaniformis* belongs to the moth family Sesiidae commonly referred to as clearwing moths. They are represented world wide by about 1,200 described species, of which about a hundred are present in Europe. Four species are known to occur locally and Table 1 provides host plant and distributional data (after Laštůvka & Laštůvka, 2001) of these species.

Clearwing moths exhibit Batesian mimicry, reflected not only in their characteristic morphology but also in their behaviour such as flight and other movements. They mimic a number of species of the order Hymenoptera (e.g. wasps, bees and sawflies), and often the precise taxon mimicked can be immediately recognised. European sesiid moths are diurnal; they fly during the day and are very active in the sunshine. Most species are oligophagous, that is, they are able to complete their development on related species of host plants. Strict monophagy (development on just one host plant) or polyphagy (development on unrelated host plants) is rare. Females of most species lay between 100-150 eggs on stems, leaves or new shoots. In general, species of Sesiidae have maggot-like endophagous larvae, which feed for one or two years (rarely up to four years). Larval development takes place either in the stems, branches, trunks or roots of trees and shrubs, or in the crowns and roots of low shrubs. In general larvae of species associated with low shrubs and which pupate in the roots, construct silken exit tubes leading to the surfaceof the ground from which the adult moths eventually emerge.

Table 1 The four Maltese sesiid species

Scientific name	Host plants	Distribution
Synanthedon myopaeformis (Borkhausen 1789)[1]	Under bark of Maloidea (*Malus, Sorbus, Crataegus, Pyrus* spp., *Eriobotryia japonica* Thunb., *Hippophae rhamnoides L.*)	W. Palaearctic: the nominotypical ssp. in central, W, E, parts of S Europe; ssp. *typhiaeformis* in SE France, Corsica and Italy from Liguria to Campania; ssp. *cruentata* in Calabria, Sicily and Malta; ssp. *graeca* in Greece.
Bembecia albanensis (Rebel, 1918)[2]	In roots of *Ononis* spp., *Psoralea bitumenosa* L. and *Hedysarum caoronarium* L.	W. Palaearctic: W, central, S and E Europe; ssp. *kalavrytana* in Greece and Crete; ssp. *tunetana* in S Italy, Sicily, Malta and Tunisia; ssp. *psoraleae* in Iberian peninsula and S France and ssp. *albanensis* in other parts of the European range.
Chamaesphecia aerifrons (Zeller, 1847)[3]	In roots of *Calamintha nepeta* L., *Satureja* spp., Thymus spp., *Lavandula* spp., *Mentha* spp. and *Origanum* vulgare L.	Atlantico-Mediterranean: SW Europe, in central Europe known only from SW Germany and SW Switzerland; N. Africa. In Sardinia and Corsica as ssp. *sardoa*; in other parts of its range as the nominotypical ssp.
Chamaesphecia anthraciformis (Rambur, 1832)[4]	In roots of *Euphorbia* spp.	W. Mediterranean: Corsica, Sardinia, Sicily, S and central Italy, Malta and N Africa.

[1] This species was previously recorded from Malta as "*Sesia cruentata* Mann." by Delucca (1949) from a specimen taken from either Attard or St. Paul's Bay and another specimen captured from Birkirkara. Both Valletta (1973) and Sammut (2000) recorded this species as "*Synanthedon cruentata* (Mann.)". Valletta (1973) stated that '... it has been taken from Attard, B'Kara and Ghammieri during the months of May-June'. Sammut (2000) recorded the species from Rabat and Buskett (besides other localities mentioned in the earlier literature) .

[2] Previously recorded by Laštůvka & Laštůvka (2001). Previous records of *Bembecia scopigera* Scop. (Valletta, 1984; Sammut, 2000) from Malta (Wardija, Wied Qirda, Wied il-Ghasel, Wied Qannotta and Wied Incita) were found to be incorrect as this material is *B. albanensis tunetana* (Le Cerf, 1920) (Laštůvka, Z., *pers. comm.*, 2003). The ssp. *tunetana* is often considered as a distinct species and it is included as such in the Fauna Europea Project (Laštůvka, Z., *pers. comm.*, 2003).

[3] Recorded by Valletta (1984) as *Chamaesphecia* sp. near *cerifrons* Z. [misspelling of specific name] from near Slugs Bay, Mellieha.

[4] This species was originally recorded by Caruana Gatto (1925) from Msida were he stated that this specimen could be '... una forma assai vicina alla *S. Anthraciformis* Rbr. o qualche specie affine ...'. Valletta (1973) recorded this species from B'Kara, Naxxar and Mtahleb.

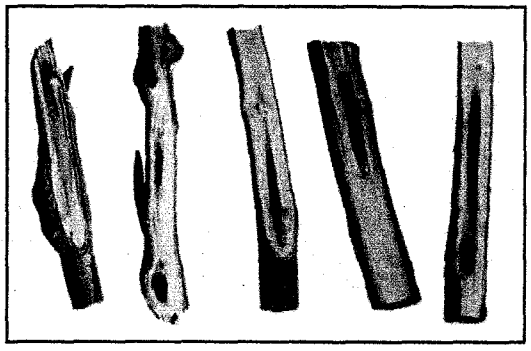

Photo A. Zammit

Fig. 1. Dissected branches from the imported Populus alba trees, showing larvae and damage caused by larvae of Paranthrene tabaniformis.

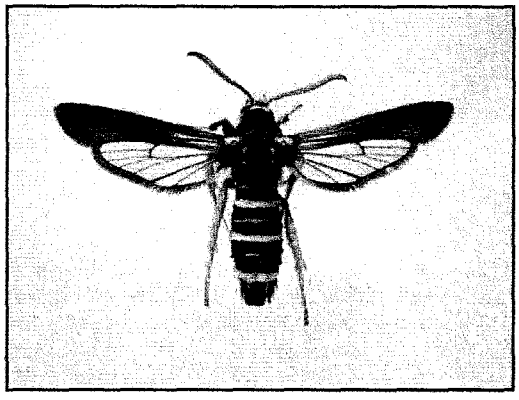

Photo P.M. Sammut

Fig. 2. Adult of Paranthrene tabaniformis.

Photo P.M. Sammut

Fig. 3. Empty pupal case of Paranthrene tabaniformis after emergence of the adult moth.

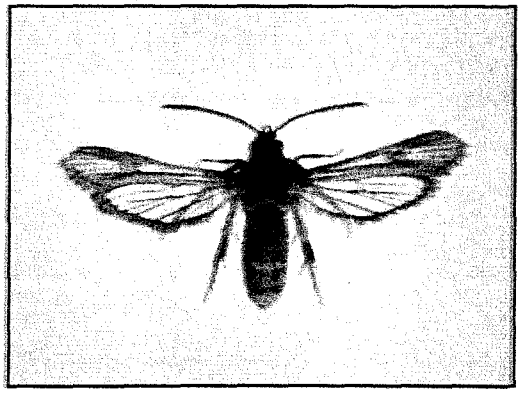

Photo P.M.Sammut

Fig. 4. Adult of Bembecia albanensis tunetana (Le Cerf, 1920).

On the other hand, larvae of the wood-feeding species bore to the outer surface of the host tree, leaving a thin membrane of bark to distinguish the prospective exit hole. After the emergence of the adult, the empty pupal cases protrude from these holes and often remain *in situ* for several months (Fig. 3).

Some European species of Sesiidae can often cause economic losses by regular damage to their host plants, namely fruit, ornamental and forest trees. Some examples include *Synanthedon tipuliformis* (Clerk, 1759) on currants, *S. myopaeformis* (Borkhausen, 1789) on apple trees and *Pennisetia hylaeiformis* (Laspeyres, 1801) on raspberries.

Biology of *Paranthrene tabaniformis*: In Europe, adults of *P. tabaniformis* occur from the end of May until August. The adult moths rest on twigs or foliage of the host plants, which are usually *Populus* species and very occasionally *Salix* species. The eggs are usually laid in the afternoon, and according to the mode of oviposition, different patterns of larval development may follow (Fibiger & Kristensen, 1974; Laštůvka, Z. *pers. comm.*, 2003):

1) Eggs are laid on twigs or suckers of the host plant. Freshly emerged larvae borrow in the bark and in the wood. They live in old galls (e.g. made by *Saperda populnea*) or they cause a similar gall; in their second year, they produce a short central tunnel in the twig;
2) Eggs are placed in bark crevices on trunks and branches from ground level up to the top of a tree, usually in injured or diseased places (e.g. tumors). The emerged larvae borrow in the bark and in the wood. They live in tunnels in the wood similarly as in (i);
3) Eggs are placed in bark crevices of very young trees, relatively near to ground level. After hatching, larvae burrow in the wood and in the roots. They produce a tunnel in the central part of trunks or in roots in which they pupate after the second hibernation. The attacked tree can perish if invaded by several larvae;
4) Eggs are placed on stumps of host trees. The larvae borrow in the wood of stumps or in the wood of stump suckers. The development continues as in previous cases.

The larva of *P. tabaniformis* does not produce a cocoon. It pupates in its tunnel usually after the second hibernation (one year development is exceptional) in a chamber with a thin lid. The pupa is covered only by a thin layer of bark. In Central and Southern Europe the damage of this species to poplars may be of considerable economic significance. The species is most easily located by searching for the characteristically shaped galls on suckers or on finger-wide young trees of *Populus*.

Distribution: *P. tabaniformis* is widely distributed in the Holarctic Region (present almost throughout Europe, North Africa and in large parts of Asia). The nominotypical form is present in South, Central and parts of Northern Europe whereas the spp. *synagriformis* (Rambur, 1866) is present in South Eastern France, Sardinia and in the Iberian Peninsula. In southern Italy, in Sicily and Sardinia they occur as intermediate forms , to which the specimens introduced to Malta belong.

Short description of adult *P. tabaniformis*: Wingspan 20-38 mm; proboscis present; tegula black (sometimes with short yellow border caudally, or with yellow spots caudally. Antennae light brown to black. Forewing light to dark brown without transverse cells distally. Metathorax brown to black sometimes with 2 small yellow spots and yellow rings. Abdominal segments 2, 4, 6 and sometimes 7 with yellow rings (yellow rings on all segments in ssp. *synagriformis* and in intermediate forms).

Differential diagnosis: The genus *Paranthrene* is characterised by bipectinate antennae in the males; opaque forewings, transparent basally and/or apically and valve with specialised furcate hairs dorsally.

P. tabaniformis can be readily distinguished from its congeners in Europe by the following combination of morphological characters: tegula without yellow border up to patagium, black or with yellow spots or with short yellow posterior border; metathorax without a V-shaped yellowish coloration; antennae nearly as long as one half of forewing; proboscis normal, dark brown or black; forewing without transparent cells distally; male antenna distinctly pectinate; patagial collar black or yellow only laterally.

As to the four sesiid species that occur in the Maltese Islands, *P. tabaniformis* can only be superficially confused with *Bembecia albanensis tunetana* (Fig. 4) from which it is however readily distinguished by the entirely opaque forewings (very slight transparency often found at base and exceptionally some distal transparent cells are present). In *B. albanensis*, the transparent area on forewings is large and oval in shape with a characteristic light to dark brown margin present along entire forewing margin and with yellow or orange colouration apically.

CONCLUSIONS

The imported Poplar trees were intended to be planted along the walking pathway in the Fiddien area. The western bank

of Fiddien is characterised by a number of indigenous trees such as *Populus alba* (which represent a self-regenerating population) and *Salix alba*. The latter tree is represented by stock originating from the male individual of *Salix alba* located at Gnien il-Kbir (near Buskett). Both *Populus alba* and *Salix alba* (but also *Salix pedicellata* which is also represented in the area but more towards Chadwick Lakes) are listed in Schedule 1 of Strictly Protected Trees (Tree and Woodland Protection Regulations - Legal Notice 12 of 2001).

The protection of these trees is mainly concerned with direct damage, dumping of poisonous substances, uprooting of trees, fire, vandalism, etc. However, such trees should also be protected from the accidental introduction of alien organisms (e.g. *Paranthrene tabaniformis*), which could be potentially damaging if they become locally established. A notable example was the recent accidental introduction and establishment of the longhorn beetle, *Phryneta leprosa* (Fabricius, 1775) which is attacking trees of *Morus nigra* (also included under Schedule 1 of the Tree and Woodland Protection Regulations); this beetle is the main cause of death of the mentioned tree in the South-Western parts of Malta (Mifsud & Dandria, 2002).

ACKNOWLEDGEMENTS

We would like to express our thanks to Dr. Michael Fibiger (Søro, Denmark) for confirming the identification of *P. tabaniformis* and Dr. Zdeněk Laštůvka (Brno, Czech Republic) for confirming the identity of *Bembecia albanensis* and for reviewing the present work. We are also obliged to Mr. Matthew Tabone for supplying the original phytosanitary certificates of the mentioned consignment where these *Populus* trees were included. We are grateful to Mr. David Dandria for his constructive suggestions.

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(Accepted 3rd December, 2003)

The Central Mediterranean Naturalist	4(1): 71 - 104	Malta: December 2003

REVISION OF THE RECORDS OF SHARK AND RAY SPECIES FROM THE MALTESE ISLANDS (CHORDATA: CHONDRICHTHYES)

Titian Schembri[1], Ian K. Fergusson[2] and Patrick J. Schembri[1]

ABSTRACT

Records of sharks and rays from Maltese waters published in the scientific literature were critically evaluated by examining and accurately identifying specimens caught by fishers, seen by the authors and those kept in museum collections. Photographs of caught specimens but which were not preserved were also considered. Out of 37 species of sharks and 26 species of rays recorded from Malta, 24 sharks and 14 rays along with another two sharks, whose presence is a distinct probability although not encountered during this study, were authenticated. Other records have yet to be confirmed by actual specimens. Published records are discussed individually and indices of historic and recent abundance are assessed.

INTRODUCTION

The need for compiling an accurate inventory of the species that occur in a given region, as the basis for the implementation of management initiatives including conservation and food production, is practically self-evident and has often been emphasized (e.g. , see reviews in McNeely *et al.* , 1990; SA2000, 1994; Bisby, 1995). This philosophy is now entrenched in the Convention on Biological Diversity (1992) (Glowka *et al.* , 1999).

Located centrally in the Mediterranean Sea, between its western and eastern basins, the Maltese Islands afford a well-placed sampling point for the region's ichthyofauna. From as early as the 18th Century, naturalists, fishers and enthusiasts have compiled lists of the fish fauna of the Maltese Islands and while many such lists are now available, none are really satisfactory from a faunistic point of view. This is because all include a number of species that very probably do not actually form part of the Maltese fauna, partly as a result of doubtful records that have been cited from one publication to another without confirmation, and partly because records have been accepted on hearsay or on very flimsy evidence (Schembri, 2001). There is also the possibility that species that once existed or regularly entered Maltese waters no longer do so.

Clearly, there is a contemporary need to critically review all records of fish from waters around the Maltese Islands and this is particularly true for elasmobranchs, for a number of reasons. Firstly, many species of this group are top predators, widely distributed but relatively scarce and therefore not often encountered. Secondly, because of their size and difficuties with preservation, the larger species tend not to be well-represented in museums or other collections. Thirdly, similar species, such as 'requiem' or 'whaler' sharks of the genus *Carcharhinus,* tend to be confused with each other, particularly if they are not positively identified by a detailed examination of actual specimens.

In order to address this problem, a long-term study of the fish fauna of the Maltese Islands was carried out in which the evaluation of previous records was sought by examining and accurately identifying specimens caught by fishers, seen by the authors or kept in museum collections. Photographs of caught specimens but which were not preserved were also considered. The present work reports on the selachimorph (sharks) and rajimorph (rays and skates) elasmobranchs and is the result of four years of field and laboratory study.

HISTORICAL PERSPECTIVE

There are a number of early publications on the fish, including Chondrichthyes, of the Maltese Islands. Most are general descriptive accounts of Maltese fisheries, reports on the economic status of local fisheries issued by the Maltese authorities and others of a primarily culinary nature that are not useful for faunistic purposes. The first scientific work on fish is the list drawn up by Pehr Forsskål in his posthumously published '*Descriptiones Animalium*' (Forsskål, 1775),

[1] Department of Biology, University of Malta, Msida MSD06, Malta

[2] BBC Bristol, Broadcasting House, Whiteladies Road, Bristol, England BS8 2LR, U.K.

where under the heading '*Catalogus Piscium Melitensium a Medico Doctissimo Communicatus*', 114 Maltese fish (and two cetaceans), including 13 Chondrichthyes, are listed under their scientific names (pp. 18-19). For some, the Maltese vernacular name is also given. Although Forsskål does not give the name of his informant, this is generally held to be the Maltese physician Giorgio Giovan Battista Locano (Gulia, 1909a; Despott, 1919; Zammit Maempel, 1994). Another early publication that uses scientific names, and gives their vernacular equivalent in several languages, is that of specimens observed in local fish markets, produced by Gaetano Trapani, which includes eight species of sharks and the same number of rays (Trapani, 1838). Although scientific names are used, many of these seem to be inaccurate and difficult to assign to species as presently understood.

Gavino Gulia was the first to publish important scientific data together with the lists of species he collected. In his *Tentamen Ichthiologiae Melitensis* (Gulia, 1861a) and its translation *Pesci di Malta* (Gulia, 1861b), he gives a classified list of fish occurring in Maltese waters with occasional notes on coloration, abundance, distribution and taxonomy, as well as the description of new species (none of Chondrichthyes, however). This work is the first comprehensive scientific account of Maltese fish and lists 186 species including 27 of Chondrichthyes. It includes a general discussion on the fish fauna of the Maltese Islands, and indices. This was followed by his *Repertorio di Storia Naturale* (Gulia, 1858-59), in which he attempts to describe all animal and plant species recorded from the Maltese Islands and gives scientific names and some taxonomic and biological information. In this work, Gulia includes a section on the fish of Malta under the title '*Index Methodicus Melitensium Piscium*' (pp. 221-229). Essentially this is the same list published in his '*Tentamen*' less most of the biological data but with some additions, including one to the Chondrichthyes, bringing their total to 28 species. Gulia continued to add new records to his list of Maltese fish in notes published in the local scientific journal '*Il Barth*'. One such note concerned the elasmobranchs and enumerated 33 species (Gulia, 1872). He also contributed a list of local fish in Pietro Paolo Castagna's account of Malta (Castagna, 1888), however giving Maltese names only. Other authors, both local (for example, Medlycott, 1870) and foreign (for example, Carus, 1889-93) used Gulia's lists as a basis for their compilations.

Around the same period, George Gustave Crispo-Barbaro published his *Fishes of Malta*, which is a more or less faithful copy of Trapani's catalogue, however, unlike its predecesssor, it does not give scientific names. Three editions of this work were published, with 160 species (Crispo-Barbaro, 1885) listed in the most recent one.

With the start of the 20th Century the study of Maltese ichthyology became more scientific. Several Maltese naturalists became interested in accumulating a complete, detailed account of the local fish fauna. Napoleon Tagliaferro recorded the occurrence of the Sharksucker *Echeneis naucrates* which attaches itself to sharks (Tagliaferro, 1893), but without any mention of 'host' species. Giovanni Gulia, son of Gavino, published an encyclopaedic list of local flora and fauna (Gulia, 1889-90), a popular list of fish as they occur month by month in local waters (Gulia, 1905), a bibliography of the main publications on the vertebrate fauna (including fish) of the Maltese Islands (Gulia, 1909a) and also added several species to the ever-growing list of local fish including the Devil Ray *Mobula mobular* (Gulia, 1909b) and the Rabbit-fish *Chimaera monstrosa* (Gulia, 1909c). However, Giovanni Gulia seems to have obtained his information mainly from his colleagues' unpublished notes and from previous publications and it is doubtful which species he actually collected or confirmed himself.

Most notable are the works of Giuseppe Despott, who was superintendent of fisheries and later curator of the natural history section of the Malta national museum. His publication entitled '*The Ichtyiology of Malta*', originally published in parts in the local journal *Archivium Melintense* and then collated in the form of a booklet (Despott, 1919), gives a list of 272 species including 47 Chondrichthyes with short notes on each, mainly on abundance, occurrence, fisheries and commercial value. A valuable bibliography of works on local fish is included, as are indices to scientific, English, Italian and Maltese names; taxonomic and other scientific data in this work are very limited, however. Amongst his other works and reports on fish and fisheries, Despott also published the first documented capture of a Basking Shark (*Cetorhinus maximus*) in Maltese waters (Despott, 1930).

In 1961, Joseph Barbara, then with the Department of Fisheries, issued a guide in an attempt to standardise the names given to Mediterranean fish caught locally; this list includes 219 species of which 45 are Chondrichthyes (Barbara, 1961). It is clear from his introductory comments that Barbara was giving the vernacular Maltese names to species known to occur in the central Mediterranean, without any regard as to whether these species actually formed part of the Maltese fauna or not. A linguistic study of the Maltese names of fish and other marine animals and related terminology was published by Aquilina (1969), but this is of little faunistic value.

A milestone work was the comprehensive scientific catalogue of local fish by Guido Lanfranco, first published in 1958 as '*A complete guide to the fishes of Malta*' with a second and third edition with revisions in 1965 and 1974, respectively, and currently available as a fourth edition, again with revisions, under the title '*The fish around Malta*' (Lanfranco, 1993). This latest edition gives a systematically arranged list of 288 species including 51 Chondrichthyes, with colour plates, scientific and local nomenclatures as well as a brief description of the diagnostic features of each family and a description

of the coloration of each species and occasionally other notes. However, the author did not collect all the species recorded himself, but also included species on the basis of second-hand information from fishers, naturalists or others (G. Lanfranco, personal communication 2001). Since these informants were not trained ichthyologists and since Lanfranco did not verify all identifications himself, some records must be considered as doubtful or unconfirmed. Lanfranco also contributed the section on fish in both Maltese (Sultana, 1995) and English (Sultana & Falzon, 1996) versions of a popular publication on the wildlife of the Maltese Islands published by the (then) Environment Protection Department. These works include 120 colour paintings of fish, including a selection of 18 elasmobranchs, with an accompanying text that gives brief descriptions and some short notes on the biology of the species.

Another recent compilation on the fish of the Maltese Islands is that by Farrugia Randon & Sammut (1999) under the title of '*Fishes of Maltese Waters*'. This provides a classified list of species with scientific and vernacular names and basic data about distribution and biology. Methods of capture used in local and foreign fisheries are discussed in detail and other information on culinary and market value is also provided. The authors themselves collected some of the species claimed as part of the local fauna while others were observed at the local fish markets; furthermore, some species were included on the basis of information supplied by fishers and other persons as well as on reports in previous publications. Although some 60 species of Chondrichthyes are mentioned in this work, there is no critcal evaluation of the records and it is not always clear which are considered to form part of the local fauna and which are not. Essentially the same material less the information on fisheries, market value and culinary aspects was published by Sammut (2001) under the title '*Mediterranean sea fishes*'. On the other hand, Farrugia Randon (2001) published a work in Maltese entitled '*Il-hut ta' Malta*' that is mainly concerned with the fishing industry and fishing methods and only gives limited information on a selection of locally occurring fish including two species of sharks and two of rays, although in a classified list of local species included in this work, 46 Chondrichthyes are given.

Jennings (1979) published a popular guide to Mediterranean fishes that appears to be heavily based on Maltese material, although no specific Maltese records are mentioned. Other popular guides with a Maltese connection that include sections on fish are those of Middleton (1997), Wood & Wood (1999) and Wood (2002). Another three works with a Maltese connection are those of Louis Zammit (undated and ?1991) who published a booklet on hazardous fish in which stingrays and sharks obviously featured (Zammit, undated) and a set of pen drawings of Maltese fish in booklet form (Zammit, ? 1991), and Attard & Muscat (1999) on the more common sharks of the Maltese Islands and the Mediterranean. However, despite the title, many of the species described in this publication are actually either uncommon, rare or exceptional around Malta or indeed throughout the wider Mediterranean Sea; e.g. the Sandtiger *Carcharias taurus*. None of these publications are really useful for faunistic purposes, since they only include a selection of species and limited local data.

Knowledge of local cartilagenous fish was improved through the work of Ian K. Fergusson and his colleagues. In the mid 1990s, Fergusson carried out fieldwork in Malta both at sea and at the local fish markets where he interviewed fishers, shark enthusiasts, divers and Government fisheries officers. As a result of this and using original landings data provided by the Central Fishmarket in Valletta, Fergusson & Marks (1996) submitted an unpublished report on the commercial landings of sharks and other elasmobranchs in Malta to the IUCN-SSC Shark Specialist Group. They included a checklist of 61 species of Maltese elasmobranchs [the same list with updated nomenclature is given as an appendix on Fergusson's website; Fergusson, 1998]. Not all the species on Fergusson's lists are based on verified specimens, but Fergusson & Marks (1996) are well aware of the problems of identification of species by fishers and enthusiasts and discuss these issues. Other work resulting from Fergusson's fieldwork and subsequent studies includes notes on the shark fauna of the Sicilian Channel (Fergusson, 1994), a proposal to the Malta Government's environment protection agency to conserve the Great White Shark *Carcharodon carcharias* in Maltese waters (Fergusson *et al.* , 1999), a first record of *Carcharhinus obscurus* from Maltese waters (Fergusson & Compagno, 2000), a report on predation by *Carcharodon carcharias* on chelonians based partly on a Maltese record (Fergusson *et al.* , 2000), and a wider revision of the occurrence and biology of *Carcharodon carcharias* in the Central Mediterranean Sea (Fergusson, 2002).

Material and methods

The majority of the species listed in the taxonomic section of the present work were identified by the authors from specimens that were collected or photographed personally, or from preserved material kept in private collections in Malta. Commercial species were obtained from the local fish markets in Valletta and Marsaxlokk, both on Malta; there is no fish market on Gozo. Major fish shops were also visited regularly as these are sometimes supplied directly by fishers or through small-scale fishing carried out by the owners. Specimens in excess of 1.5m (standard length) were usually examined and identified *in situ* but were not collected or purchased because of their size and the expense involved; additionally, such large specimens are often sectioned at sea and sold in parts to facilitate transport. The most common species found at the fish markets include those with the highest market value, as well as those that are commonly caught incidentally or as by-catch with the fishing methods adopted by local fishers. Identification of the larger sharks that are only occasionally captured is based on photographic records, obtained from local fishers.

Non-commercial species were not usually available at fish shops or at the fish markets. The majority of information about such species was obtained from private collectors, enthusiasts, reporters and fishers, usually in the form of photographs but sometimes as actual specimens. The majority of the species listed in this work are therefore supported by actual specimens or photographs of specimens. Species reported in the literature that could not be authenticated in the present study are considered as unconfirmed. The exception are those with obvious diagnostic features that were described in detail by their collectors; such species have provisionaly been accepted but with the caveat that they need to be confirmed by actual specimens. For the purposes of this study, the (often regular) sighting reports of large sharks, typically purported as specimens of *Carcharodon carcharias,* cited in newsmedia accounts since 1995 but not substantiated by any physical proof (e.g. photo-video) were discounted.

An attempt was made to examine the material on which Lanfranco's catalogues are based (Lanfranco, 1993 and previous editions). However, only few specimens from his original collection still survive, some of which are housed at the National Museum of Natural History at Mdina and others at the Malta Centre for Fisheries Sciences at Fort St Lucian, Marsaxlokk. The illustrations accompanying this work were made by one of us (TS) based on specimens or from photographs, unless otherwise stated.

In the species list that follows, the common English names are taken from Fischer et al., 1987. Reference to Maltese waters means the 25 nautical mile (40.2 km) exclusive fisheries zone declared by Malta in 1978.

SPECIES LIST

SELACHIMORPHA

HEXANCHIDAE

***Heptranchias perlo* (Bonnaterre, 1788) - Fig. 1G**
[Seven-gilled shark]

Heptanchus cinereus (Rafin.): GULIA, 1861; *Heptanchus cinereus* Muller: GULIA, 1872; *Heptanchus cinereus* (Lin.): DESPOTT, 1919; *Heptranchias perlo*: BARBARA, 1961; *Heptranchias perlo* (Bonn.): LANFRANCO, 1993; *Heptranchias perlo* (Bonnaterre): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Heptranchias perlo* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Heptranchias perlo* (Bonnaterre): SAMMUT, 2001.

Gulia (1872) reported that this species is 'rare' while Despott (1919), Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) consider it as not common. We have regularly encountered this species offered for sale at both the Valletta and Marsaxlokk fish markets and therefore it could be considered as occurring frequently in local waters. However, local status is difficult to assess because a number of specimens marketed in Malta may originate from other parts of the Sicilian Channel, particularly the banks and seamounts to the northwest. These sharks are regularly sold for human consumption in southern Sicilian fisheries (e.g. Mazara del Vallo).

***Hexanchus griseus* (Bonnaterre, 1788) - Fig. 1H**
[Six-gilled shark]

Squalus griseus Linnaeus: TRAPANI, 1838; *Hexanchus griseus* (Rafin.): GULIA, 1861; *Hexanchus griseus* (Raf.): GULIA, 1872; *Hexanchus griseus* (Lin.): DESPOTT, 1919; *Hexanchus griseus*: BARBARA, 1961; *Hexanchus griseus* Bonn.: LANFRANCO, 1993; *Hexanchus griseus* (Bonnaterre): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Hexanchus griseus* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Hexanchus griseus* (Bonnaterre): SAMMUT, 2001.

This species was considered as 'rare' by Trapani (1838) and Gulia (1872), however, in Despott's experience, it is sometimes rare but occasionally quite common (Despott, 1919) while Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) agreed and reported it as 'occasional'. This species has been identified from photographs of specimens caught in local waters but no statements can be made on its frequency of occurrence. *Hexanchus griseus* is not uncommonly caught in artisanal fisheries operating along the southern and southwestern Maltese coasts. A considerable number of specimens have been marketed in recent years (post-1990) at the Central Fishmarket in Valletta, including adult examples of 3-4 metres total length (I. K. Fergusson, unpublished data and photographic records). Misidentification of *H. griseus* is evident in some local fisheries, confusing it with the Smalltooth Sandtiger *Odontaspis ferox*. Although no reliable measure of the abundance of *H. griseus* exists from fishery records, it is caught annually, especially during the winter months, both on demersal droplines and set bottom longlines, and sporadically near the surface nocturnally on drifting surface longlines for *Thunnus thynnus*, possibly while scavenging target species.

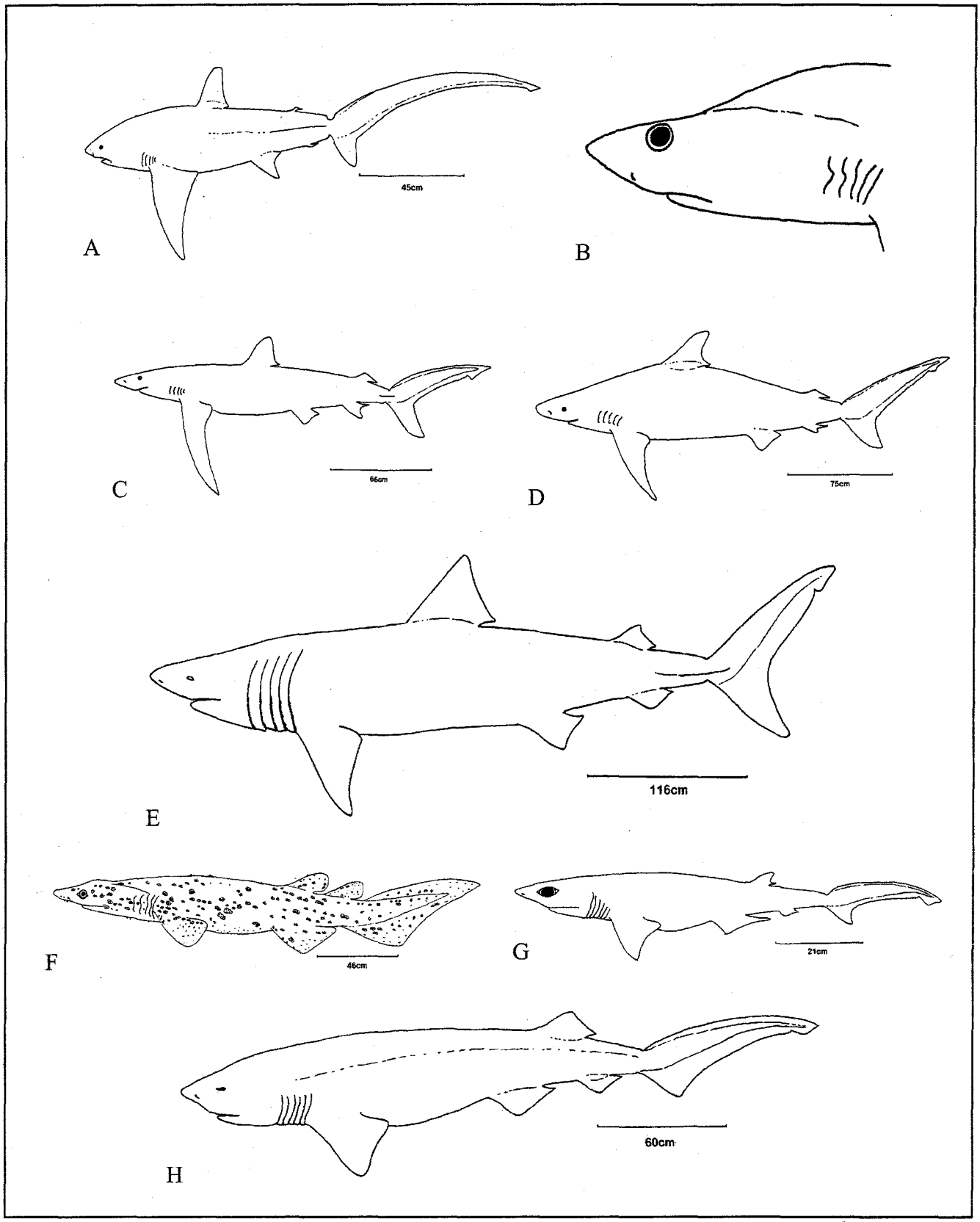

Fig. 1 Habit drawings of Maltese sharks. Diagrams are not shown to scale. Scale bar length is indicated on the drawings. **A** *Alopias vulpinus*; **B** Detail of head of *A. superciliosus*; **C** *Carcharinus obscurus*; **D** *Prionace glauca*; **E** *Cetorhinus maximus*; **F** *Echinorhinus brucus*; **G** *Heptranchias perlo*; **H** *Hexanchus griseus*.

ECHINORHINIDAE

***Echinorhinus brucus* (Bonnaterre, 1788) - Fig. 1 F**
[Bramble shark]

Echinorhinus spinosus (Blainville): GULIA, 1861; *Echinorrhinus spinosus* Bp.: GULIA, 1872; *Echinorhinus spinosus* (Lin.): DESPOTT, 1919; *Echinorhinus spinosus*: BARBARA, 1961; *Echinorhinus brucus* (Benn.), LANFRANCO, 1993; *Echinorhinus brucus* (Bonnaterre): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Echinorhinus brucus* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Echinorhinus brucus* (Bonnaterre): SAMMUT, 2001.

Gulia (1872) reported that this species is 'rare' while it was not seen by Despott (1919) although he included it in his list as 'rare' based on reports by fishers. Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) all reported it as 'not frequent'. No material related to this species has been obtained by the present authors, but fishers interviewed by Fergusson & Marks (1996) were quite familiar with it. Because of its conspicuous spiny scales it is quite unmistakeable, so although formally unconfirmed in the present study, it almost certainly occurs, although apparently very sporadically.

SQUALIDAE

***Squalus acanthias* Linnaeus, 1758 - Fig. 4C (detail)**
[Spur dogfish]

Squalus acanthias Linnaeus: TRAPANI, 1838; *Spinax acanthias* (Cloquet): GULIA, 1861; *Spinax acanthias* Clo.: GULIA 1872; *Squalus acanthias* (Lin.): DESPOTT, 1919; *Squalus acanthias*: BARBARA, 1961; *Squalus acanthias* (Linn.): LANFRANCO, 1993; *Squalus acanthias* (Smith & Radcliffe): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Squalus acanthias* (Linnaeus): Farrugia Randon & Sammut, 1999; *Squalus acanthias*, Sammut, 2001.

Gulia (1872) stated that this species is 'common' and Despott (1919) implied the same. Lanfranco (1993) reported that it is 'frequent' as also seems to be the opinion of Farrugia Randon & Sammut (1999) and Sammut (2001). This species has been confirmed in the present study, however in the collection of data on landings it may be confused with its cogener, the Longnose Spurdog *Squalus blainvillei* and possibly other squalids.

***Squalus blainvillei* (Risso, 1826) - Fig. 4D**
[Longnose spurdog]

Acanthias blainvillei Risso: GULIA, 1872; *Squalus blainvillei* (Risso): DESPOTT, 1919; *?Squalus fernandinus*: BARBARA, 1961; *Squalus blainvillei* (Riss.): LANFRANCO, 1993; *Squalus blainvillei* (Risso): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Squalus blainvillei* (Risso): FARRUGIA RANDON & SAMMUT, 1999; *Squalus blainvillei*: FARRUGIA RANDON, 2001; *Squalus blainvillei* (Risso): SAMMUT, 2001.

Squalus fernandinus Molina 1782 is a synonym of *Squalus acanthias* Linnaeus, 1758 (Eschmeyer, 1998), however, Lanfranco (1993) noted Barbara's record under the present species name, presumably since Barbara (1961) also recorded *Squalus acanthias* under its valid name.gulia (1872) stated that this species is 'very common' and Despott (1919) reported that it is more or less frequent, while Lanfranco (1993) wrote that it is 'frequent' as did Farrugia Randon & Sammut (1999) and Sammut (2001). As for the previous species, while occurrence can be confirmed, it may be confused with the Spur dogfish *Squalus acanthias* and possibly other species in the collection of data on landings.

CENTROPHORIDAE

***Centrophorus granulosus* (Bloch and Schneider, 1801) - Fig. 3C**
[Gulper shark]

Centrophorus granulosus (Bl.): DESPOTT, 1919; *Centrophorus granulosus*: BARBARA, 1961; *Centrophorus granulosus* (Schn.): LANFRANCO, 1993; *Centrophorus granulosus* (Bloch and Schneider): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Centrophorus granulosus* (Schneider): FARRUGIA RANDON & SAMMUT, 1999; *Centrophorus granulosus*: FARRUGIA RANDON, 2001; *Centrophorus granulosus* (Schneider): SAMMUT, 2001.

Despott (1919), Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) all suggested that the Gulper shark occurs frequently. This species has been confirmed by the present study but information on its status is not available since landing records for this species probably include other squalids.

***Centrophorus uyato* (Rafinesque, 1809) - Fig. 3D**
[Little gulper shark]

Spinax uyatus (Bonaparte): GULIA, 1868; *Acanthias uyatus* M.: GULIA, 1872; *Centrophorus uyato* (Raf.): LANFRANCO, 1993; *Centrophorus uyato* (Rafinesque): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Centrophorus uyato* (Rafinesque): FARRUGIA RANDON & SAMMUT, 1999; *Centrophorus uyato* (Rafinesque): SAMMUT, 2001.

Gulia (1872) described this species as 'rare' and, along with Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) reported its occurrence as 'occasional'.

As for the Gulper shark (see previous species), this species can be confirmed but information on its status is not available since landing records probably include other squalids. This species was observed in some numbers at the Central Fishmarket during May 1995 by Fergusson & Marks (1996), with specimens being skinned and filleted for human consumption. It is also on sale regularly in fishmarkets of southern Sicily (Mazara del Vallo; I. K. Fergusson, personal observations; M. Vacchi, personal communication 2003). Specimens sold in Malta may, therefore, include specimens caught further northwest in the Sicilian Channel.

It has been recently suggested (Javier Guallart, personal communication 2003) that the Little Gulper Shark *Centrophorus uyato* does not actually occur in the Mediterranean, and that all previous records to this species should be attributed to *C. granulosus*.

DALATIIDAE

***Dalatias licha* (Bonnaterre, 1788) - Fig. 3E**
[Kitefin shark]

Dalatius licha: BARBARA, 1961; *Dalatias licha* (Bonn.): LANFRANCO, 1993; *Dalatias licha* (Bonnaterre): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Dalatias licha* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Dalatias licha* (Bonnaterre): SAMMUT, 2001.

Lanfranco (1993) recorded this species as 'frequent' while Farrugia Randon & Sammut (1999) and Sammut (2001) reported that it is 'common'. This species is confirmed by the present study.

***Etmopterus spinax* (Linnaeus, 1758) - Fig. 3F**
[Velvet belly shark]

Squalus spinax: FORSSKÅL, 1775; *Etmopterus spinax* (Lin.): DESPOTT, 1919; *Etmopterus spinax*: BARBARA, 1961; *Etmopterus spinax* (Linn.): LANFRANCO, 1993; *Etmopterus spinax* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Etmopterus spinax* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Etmopterus spinax* (Linnaeus): SAMMUT, 2001.

Despott (1919) suggested that this species is rather rare while Lanfranco (1993) stated that it is usually rare but may occasionally be frequent, a statement repeated by Farrugia Randon & Sammut (1999) and Sammut (2001). This species is confirmed by the present study.

OXYNOTIDAE

***Oxynotus centrina* (Linnaeus, 1758) - Fig. 2F**
[Angular rough shark]

Centrina salviani (Risso): GULIA, 1861; *Centrina salviani* Risso: GULIA, 1872; *Centrina salviani* (Risso): DESPOTT, 1919; *Oxynotus centrina*: BARBARA, 1961; *Oxynotus centrina* Linn.: LANFRANCO, 1993; *Oxynotus centrina* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Oxynotus centrina* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Oxynotus centrina* (Linnaeus): SAMMUT, 2001.

According to Gulia (1872), the Angular Roughshark is rare in local waters but Despott (1919) disagreed and stated that its rarity is only apparent since it is landed very infrequently; Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) agreed that it is frequent.

This species can be confirmed on the basis of specimens held in collections and from interviews with fishers. It can also be confirmed that this unmistakeable species is more common than its occasional landings would suggest.

SQUATINIDAE

***Squatina aculeata* (Duméril, 1829)**
[Saw-backed angel shark]
Squatina aculeata (Dumeril): FERGUSSON & MARKS, 1996; FERGUSSON, 1998.

This species has only been listed by Fergusson & Marks (1996) and Fergusson (1998) without any detailed information. No specimens have been encountered during this study and therefore its occurrence cannot be confirmed.

***Squatina oculata* (Bonaparte, 1840)**
[Smoothback angel shark]

Squalina ocellata (Bonap.): GULIA, 1861; *Squatina oculata* Bp.: GULIA, 1872; *Squatina oculata* Bon.: LANFRANCO, 1993; *Squatina oculata* (Bonaparte): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Squatina oculata* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Squatina oculata* (Bonnaterre): SAMMUT, 2001.

The referrence to '*Squalina ocellata*' by Gulia (1861) was most likely a *lapsus*, since the genus does not exist and neither does any species named '*ocellata*' belonging to the Squatinidae (Eschmeyer, 1998); this view is reinforced by the corrected nomenclature in his 1872 paper (Gulia, 1872). Gulia (1872) stated that this species is 'rare' while Lanfranco (1993) reported it as 'not frequent'. Farrugia Randon & Sammut (1999) and Sammut (2001) only refer to it in passing and reported it as "rare". No specimens attributable to this species have been seen during the present study and although it may occur, it cannot be presently confirmed.

***Squatina squatina* (Linnaeus, 1758) - Fig. 4E**
[Angel shark]

Squalus squatina: FORSSKÅL, 1775; *Squatina angelus* (Dumereil): GULIA, 1861; *Squatina angelus* Dum.: GULIA, 1872; *Squatina squatina* (Lin.): DESPOTT, 1919; *Squatina squatina*: BARBARA, 1961; *Squatina squatina* (Linn.): LANFRANCO, 1993; *Squatina squatina* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Squatina squatina* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Squatina squatina* (Linnaeus): SAMMUT, 2001.

This species was regarded as 'very common' by Gulia (1872) and Despott (1919), and as 'frequent' by Lanfranco (1919). Farrugia Randon & Sammut (1999) and Sammut (2001) stated that it was previously common. The occurrence of this species is confirmed in this paper; however, it is easily confused with other angelsharks.

ODONTASPIDIDAE (= Carchariidae)

***Carcharias taurus* Rafinesque, 1810 - Fig. 2D**
[Sandtiger shark]

Odontaspis taurus Mull.: GULIA, 1872; *Odontaspis taurus* (Raf.): DESPOTT, 1919; *Carcharies taurus*: BARBARA, 1961; *Eugomphodus taurus* (Raf.): LANFRANCO, 1993; *Carcharias taurus* (Rafinesque): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Eugomphodus taurus* (Rafinesque): FARRUGIA RANDON & SAMMUT, 1999; *Eugomphodus taurus* (Rafinesque): SAMMUT, 2001.

All authors who have recorded this species agree that it is rare in Maltese waters. We cannot at present confirm its occurrence in Maltese waters; all specimens of Sandtiger sharks examined by us were *Odontaspis ferox* and we are not aware of any confirmed recent Maltese records of *Carcharias taurus*. There is therefore considerable doubt as to whether any records of the Sandtiger shark from Maltese waters exist, other than the historical records listed above. Therefore for the time being *Carcharias taurus* must be regarded as unconfirmed, even if it may have occurred in the past. A recent review concluded that *C. taurus* is either exceptionally rare in the Mediterranean or essentially regionally extinct in some parts (Fergusson *et al.* , 2002). A few specimens have been confirmed post-1970 from the Sicilian Channel and off Croatia (Fergusson *et al.* 2002; Alen Soldo, Institute of Oceanography & Fisheries, Split, personal communication 2003).

***Odontaspis ferox* (Risso, 1810) - Fig. 2E**
[Small-tooth sandtiger]

Odontaspis ferox (Agassiz): GULIA, 1861; *Odontaspis ferox* Ag.: GULIA, 1872; *Odontaspis ferox* (Agass.): DESPOTT, 1919; *Carcharias ferox*: BARBARA, 1961; *Odontaspis ferox* (Riss): LANFRANCO, 1993; *Odontaspis ferox* (Risso): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Odontaspis ferox* (Risso): FARRIGUA RANDON & SAMMUT, 1999; *Odontaspis ferox* (Risso): SAMMUT, 2001.

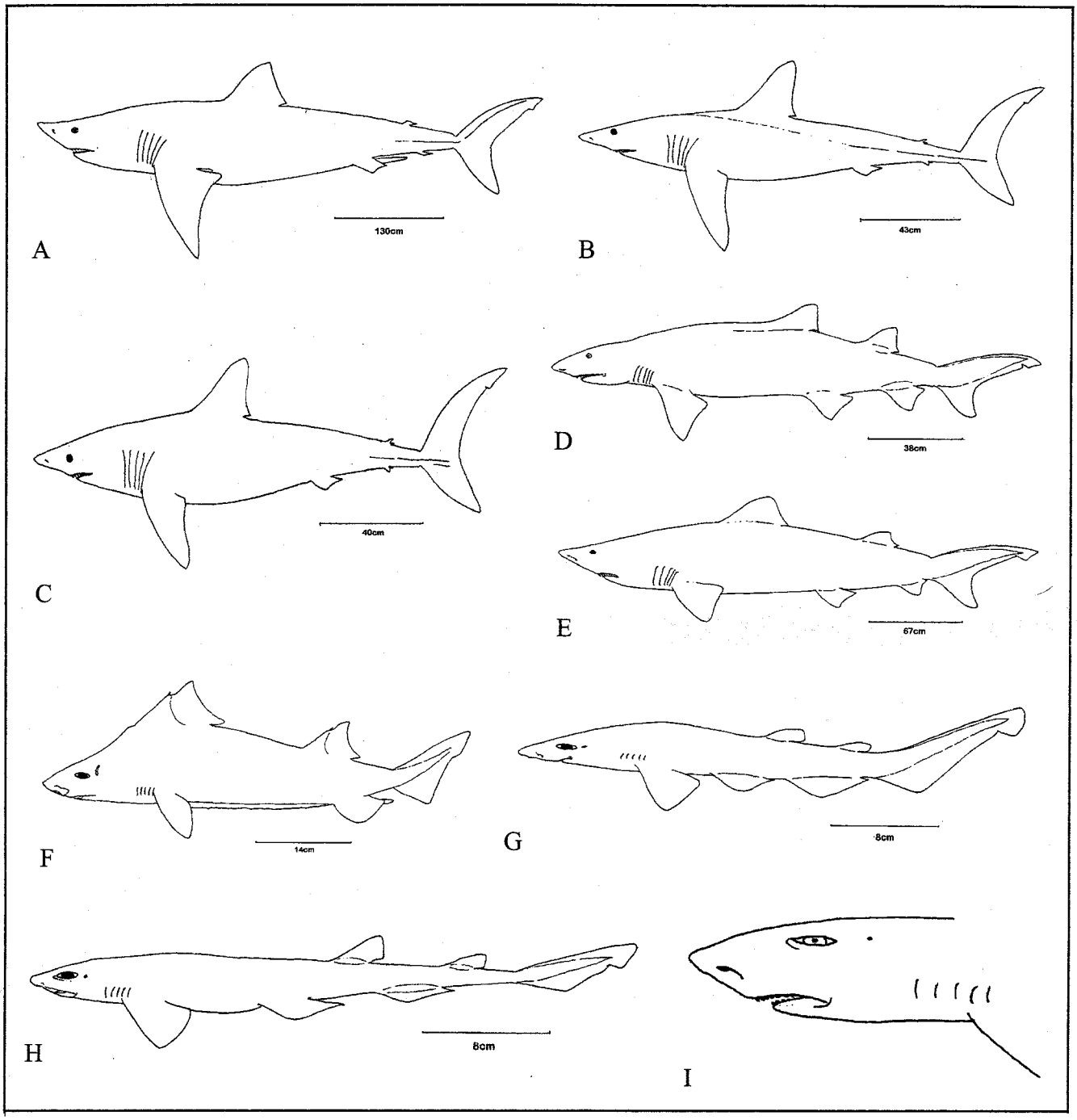

Fig. 2 Habit drawings of Maltese sharks. Diagrams are not shown to scale. Scale bar length is indicated on the drawings. **A** *Carcharodon carcharias*; **B** *Isurus oxyrinchus*; **C** *Lamna nasus*; **D** *Carcharias taurus*; **E** *Odontaspis ferox*; **F** *Oxynotus centrina*; **G** *Galeus melastomus*; **H** *Scyliorhinus canicula*; **I** Detail of head of *Scyliorhinus stellaris*.

Gulia (1872), Despott (1919) and Lanfranco (1993) all described this species as 'rare' while Sammut (2001) stated that it is 'not common'. This present study confirms its occurrence and its rarity. Our data suggests that specimens may be taken annually in small numbers (perhaps 1-2 every year), particularly by bottom gillnets set in depths >50 m around Gozo. Adult female specimens to *ca* 360cm TL have been caught in 1998 and 1999 from Xlendi Bay and Marsalforn, Gozo (confirmed by photographs and dentition); there are further currently unverified records for 2002 and 2003 (Fergusson *et al.*, in press). Research elsewhere suggests that adult female individuals will make repeated visits to selected sites on an annual basis, especially in the summer, possibly for reproduction. Such localities are often coastal reefs and islets contiguous to deep water (Fergusson *et al.*, in press). This site fidelity makes *O. ferox* especially vulnerable, including around the Maltese islands, since it results in loose aggregations of sharks occurring within easy range of many fisheries and such activities as diving and spearfishing.

CETORHINIDAE

***Cetorhinus maximus* (Gunnerus, 1765) - Fig. 1E**
[Basking shark]

? *Squalus lamia*: FORSSKÅL, 1775; ? *Squalus lamia* Linnaeus: TRAPANI, 1838; ? *Squalus maximus* Linnaeus: TRAPANI, 1838; *Centorhinus maximus* (Gunner): DESPOTT, 1919; *Cetorhinus maximus* Gunner: DESPOTT, 1930; *Cetorhinus maximus* (Gunn.): LANFRANCO, 1993; *Cetorhinus maximus* (Gunnerus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Cetorhinus maximus* (Gunnerus): FARRUGIA RANDON & SAMMUT, 1999; *Cetorhinus maximus* (Gunnerus): SAMMUT, 2001.

The name *Squalus lamia* as used by Forsskål (1775) has been regarded as an invalid name coined by this author but without description, hence not attributable to any species (see Eschmeyer, 1998). However, Forsskål gives the Maltese name for *Squalus lamia* as "*il Gabdol*", which is one local name for the Basking Shark *Cetorhinus maximus* to this day, although now spelled '*gabdoll'* (see Lanfranco, 1993). It is here suggested, therefore, that Forsskål (1775) was actually referring to the Basking Shark even if he did not describe it, making it the earliest record of this fish in the Maltese Islands. It should be noted that '*gabdoll'* is also the Maltese name for the Sperm Whale *Physeter macrocephalus*; however, it is not likely that Forsskål (1775) is referring to a cetacean since although he does include two cetaceans in his list of 'fish' ("*Delphinus orca*" and "*Delphinus delphis*") he places these together at the head of his list while he places "*Squalus lamia*" with the sharks (all in the genus *Squalus*), after he lists the rays (all in the genus *Raja*). Alternatively, it is quite possible that Forsskal's reference to *Squalus lamia* may refer to *Carcharodon carcharias*, given that '*lamia'* has been widely used as a vernacular Mediterranean name for this species since ancient Greek times and similar nomenclature was used by later authors, apparently for the White Shark, notably *Carcharias lamia* by Rafinesque (1810) and the *Squalus (Carcharhinus) lamia* by Blainville (1816, 1825).

The records by Trapani (1838) present an interesting problem. This author recorded *Squalus lamia* Linnaeus, however Linnaeus never named such a species (see Eschmeyer, 1998), nor has any similar name ever been ascribed to the basking shark (see taxonomic notes in Compagno, 1984, 2001). Trapani gives the Maltese name for this species as '*Gaddoll'*, suggesting that he was actually referring to *Squalus lamia* Forsskål, which, as already stated above refers to the Basking Shark. Trapani (1838) also recorded *Squalus maximus* Linnaeus, however, again, Linnaeus never named such a species (see Eschmeyer, 1998). Trapani gives the Maltese name for this '*Squalus maximus* Linnaeus' as '*pixxi tunnu*', yet when Despott showed local fishers a specimen of the Basking Shark caught in 1928 (see below), none of them associated it with this name (Despott, 1930).

The vernacular term of 'tuna shark' (*piscitonno*) in neighbouring Sicilian waters has always been ascribed to *Carcharodon carcharias,* where it has a long historical association with traditional trap fisheries for Bluefin Tuna *Thunnus thynnus.* Thus again, the original juxtaposition of Trapani's *pixxi tunnu* with *Squalus maximus* may be erroneous and actually confused the White Shark (i. e. the Sicilian '*piscitonno'*) with the basking shark, perhaps explaining the unfamiliarity described by Despott of local fishers with the latter. Equally, it is noted that some authors still give '*gabdoll'* as a regular vernacular Maltese term for the White Shark (e.g. Lanfranco, 1993) and this may have been the case when Forsskål originally compiled his account.

Therefore the '*Squalus maximus* Linnaeus' reported by Trapani (1838) probably does not refer to the Basking Shark, although there is a possibilty that his reference to '*Squalus lamia* Linnaeus' might refer to this species despite the likelihood that it refers to the Great White *Carcharodon carcharias*. Despott (1919) also included the Basking Shark in his 1919 list on the basis of Trapani's record of "*pixxi tunnu*' [= '*Squalus maximus* Linnaeus'], however he only confirmed its presence years later when a specimen was caught off the northeast coast of Malta in 1928 (Despott, 1930). No other literature records of landed specimens have been traced.

Lanfranco (1993) reported that this species is 'rare' while Farrugia Randon & Sammut (1999) and Sammut (2001) make

general remarks but do not comment on the local status of this species. None of the fishers or fish vendors interviewed by Fergusson & Marks (1996) had seen this species. No material for this species is available but it has been accepted in this paper on the basis of the photograph of the Maltese specimen published by Despott (1930). It is also possible that due to its rarity and its unfamiliarity to local fishers, occasional sightings of this fish have occurred but were not recorded or were recorded under erroneous names (perhaps as Great White *Carcharodon carcharias*), since it was not recognised. The present study confirms that this species is very rare in Maltese waters.

LAMNIDAE

***Carcharodon carcharias* (Linnaeus, 1758) - Fig. 2A**
[Great white shark]

Squalus charcarias Linnaeus: TRAPANI, 1838; *Carcharodon lamia* Bonaparte: GULIA, 1861; *Carcharodon lamia* Bp.: GULIA, 1872; *Carcharodon carcharias* (Lin.): DESPOTT, 1919; *Carcharodon carcharias*: BARBARA, 1961; *Carcharodon carcharias* (Linn.): LANFRANCO, 1993; *Carcharodon carcharias* (Linnaeus), FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Carcharodon carcharias* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Carcharodon carcharias* (Linnaeus): SAMMUT, 2001.

Trapani (1838) stated that this species is 'perennial' while according to Gulia (1872) it is frequent in summer but rarely taken by fishers; this same statement is repeated by Despott (1919). Lanfranco (1993) reports that it is 'rare' while Farrugia Randon & Sammut (1999) and Sammut (2001) made no statement on its status although they recorded a number of captures. The occurrence and status of the Great White in Maltese waters has been thoroughly documented and assessed by Fergusson (1998) who considered the species 'uncommon' to 'rare'. A number of sometimes compelling but wholly unverified sightings, reportedly of this species, have been cited from around the Maltese islands in the past decade. Whilst some of these may be genuine, it is certainly unquestionable that the level of local newsmedia hyperbole associated with the Great White Shark typically outweighs its actual occurrence around Malta. The last confirmed specimen for which photographic proof is available is an adult female, reputedly 713cm TL but possibly nearer 550cm, caught in April 1987 near Filfla (see Fergusson 1996, 2002 for details). Earlier verified records during the second half of the 20th century are large (>300 cm TL) specimens caught in 1964, 1973 and *ca* 1984, with a further indication of occurrence in 1956 (fatal attack on a bather, St. Thomas Bay). Anecdotal references by longstanding Maltese fishers suggest that *C. carcharias* was sporadically taken as bycatch in coastal tuna traps set in northern Maltese coastal waters. This suggestion mirrors confirmed capture data from elsewhere in the central Mediterranean for White Sharks incidentally caught in *'tonnara'* (Sicily) or *'madrague'* (Tunisia) trap nets, where specimens have declined markedly since the second half of the 20th century (Fergusson, 2002) and are now exceptional events. While sightings of large sharks seen around Malta in recent years may be attributed to the White Shark, they may also be attributable to the (equally rare) Basking Shark *Cetorhinus maximus* (see above under this species), or to adult Shortfin Makos *Isurus oxyrinchus*, or even large carcharhinids including *Carcharhinus obscurus*.

***Isurus oxyrinchus* (Rafinesque, 1810) - Fig. 2B**
[Short-fin mako]

Oxyrrhina spallanzani Bp.: GULIA, 1872; *Lamna oxyrinchus* (Raf.): DESPOTT, 1919; *Isurus oxyrinchus*: BARBARA, 1961; *Isurus oxyrinchus* Raf.: LANFRANCO, 1993; *Isurus oxyrinchus* Rafinesque: FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Isurus oxyrinchus* (Rafinesque): FARRUGIA RANDON & SAMMUT, 1999; *Isurus oxyrinchus* (Rafinesque): SAMMUT, 2001.

Gulia (1872) reported that this species is 'rare'; interestingly he reported the Maltese name as *'pixxi tunnu'* but says that it is better known as *'pixxi tondu'*; this opens the possibility that the *'pixxi tunnu'* = *Squalus maximus* of Trapani (1838) referred to the present species (see under *Cetorhinus maximus*). Despott (1919) stated that it is of occasional occurrence while Lanfranco (1993) described its occurrence as 'frequent'. Farrugia Randon & Sammut (1999) and Sammut (2001) implied that this species is common. The present study confirms that this species occurs and is probably quite frequent, however, an assessment of its presence in Maltese waters based on sightings, catches and landings needs to be treated with caution since this species is often confused with and misidentified as *Lamna nasus*, and vice versa (Fergusson & Marks, 1996).

***Lamna nasus* (Bonnaterre, 1788) - Fig. 2C**
[Porbeagle shark]

Lamna cornubica (Bonaparte): GULIA, 1861; *Lamna cornubica* Cuv: GULIA, 1872; *Lamna cornubica* (Lin.): DESPOTT, 1919; *Lamna nasus*: BARBARA, 1961; *Lamna nasus* (Bonn.): LANFRANCO, 1993; *Lamna nasus* (Bonnaterre): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Lamna nasus* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Lamna nasus* (Bonnaterre): SAMMUT, 2001.

Gulia (1872) and Lanfranco (1993) stated that this is a 'rare' species, whilst Despott (1919) reported it as 'occasional'. Farrugia Randon & Sammut (1999) and Sammut (2001) consided this species to be rather rare. No specimens have been seen during the course of this study and therefore its occurrence cannot be confirmed. Although the historic records listed above suggest that it does or used to occur, there is no adequate contemporary data to confirm the presence of this species in Maltese waters, albeit possible given its wide Mediterranean range. Existing landings data made available by the Central Fishmarket, specifically list this species coupled to the colloquial name '*pixxiplamtu*'. However, it is believed that this is erroneous and that the vast majority of Maltese landings attributed to *L. nasus,* if not all of them, actually refer to *Isurus oxyrinchus* (Fergusson & Marks, 1996).

ALOPIIDAE

***Alopias superciliosus* (Lowe, 1839) - Fig. 1B (detail)**
[Bigeye thresher shark]

Alopias superciliosus (Lowe): FERGUSSON & MARKS, 1996; FERGUSSON, 1998.

Records of this species from Maltese waters are not based on observed specimens but on detailed descriptions by fishers as reported in Fergusson *et al.* (in preparation). It is hardly likely that a thresher shark is misindentified as anything else given the conspicuous characteristic tail, and the Maltese fishers interviewed clearly distinguished between two species of thresher, which they called '*pixxivolpi*' (*Alopias vulpinus*, see below) and '*pixxivolpi falz*'. For the latter they cited the key character that distinguishes *Alopias superciliosus* from *Alopias vulpinus*, that is, the prominent large eyes. There being no other species of threshers known from the Mediterranean, or anything which is similar, *Alopias superciliosus* is confirmed to occur in Maltese waters.

According to the fishers interviewed, this species is occasionally and incidentally taken in tuna long-lines laid from 10-90km offshore, but it is habitually discarded at sea as it is deemed not to be of economic value (Fergusson *et al.* , in preparation). The relative abundance of this species is difficult to estimate since specimens are discarded at sea and there is a dearth of landings data throughout the central Mediterranean; however, it is apparently regularly caught in Ionian Sea areas to the east and south-east of Malta (IKF, unpublished data).

***Alopias vulpinus* (Bonnaterre, 1788) - Fig. 1A**
[Thresher shark]

Alopecias vulpes (Müller): GULIA, 1861; *Alopias vulpes* Bp.: GULIA, 1872; *Alopias vulpes* (Gmel.): DESPOTT, 1919; *Alopias vulpinus*: BARBARA, 1961; *Alopias vulpinus* (Bonn.): LANFRANCO, 1993; *Alopias vulpinus* (Bonnaterre): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Alopias vulpinus* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Alopias vulpinus* (Bonnaterre): SAMMUT, 2001.

The literature contains differing views on the abundance of this species in local waters. Gulia (1872) stated that this species is 'rare'. Despott (1919) wrote that it was reported to him that this species is occasionally caught, however, in his own experience it was unknown to fishers and fishmongers, while he himself had only seen one specimen that was caught in tunny nets set at St Paul's Bay. Lanfranco (1993) stated that it is 'sometimes frequent' while Sammut (2001) described it as 'occasionally frequent' in the seas around Malta. It is not likely that such a conspicuous shark is mistaken for anything else, apart from its cogener *Alopias superciliosus* (see above). Fishers interviewed by one of us (IKF) stated that it was sometimes incidentally captured in tuna long-lines but no specific landings data are available to assess its contemporary local abundance.

SCYLIORHINIDAE

***Galeus melastomus* (Rafinesque, 1809) - Fig. 2G**
[Blackmouth catshark]

Scyllium melanostomum (Bonaparte): GULIA, 1861; *Scyllium melanostomum* Bp.: GULIA, 1872; *Pristiurus melanostomus* (Raf.): DESPOTT, 1919; *Galeus melastomus*: BARBARA, 1961; *Galeus melanostomus* Raf.: LANFRANCO, 1993; *Galeus melastomus* Rafinesque: FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Galeus melanostomus* (Rafinesque): FARRUGIA RANDON & SAMMUT, 1999; *Galeus melanostomus* (Rafinesque): SAMMUT, 2001.

Gulia (1872) describes this species as "*avventizio*" meaning 'adventitious', implying that it is not native to Maltese waters. Despott (1919) stated that it is not rare but very infrequently landed. According to Lanfranco (1993), the occurrence of Black-mouth Catshark is frequent and Farrugia Randon & Sammut (1999) and Sammut (2001) stated that it is caught quite often.

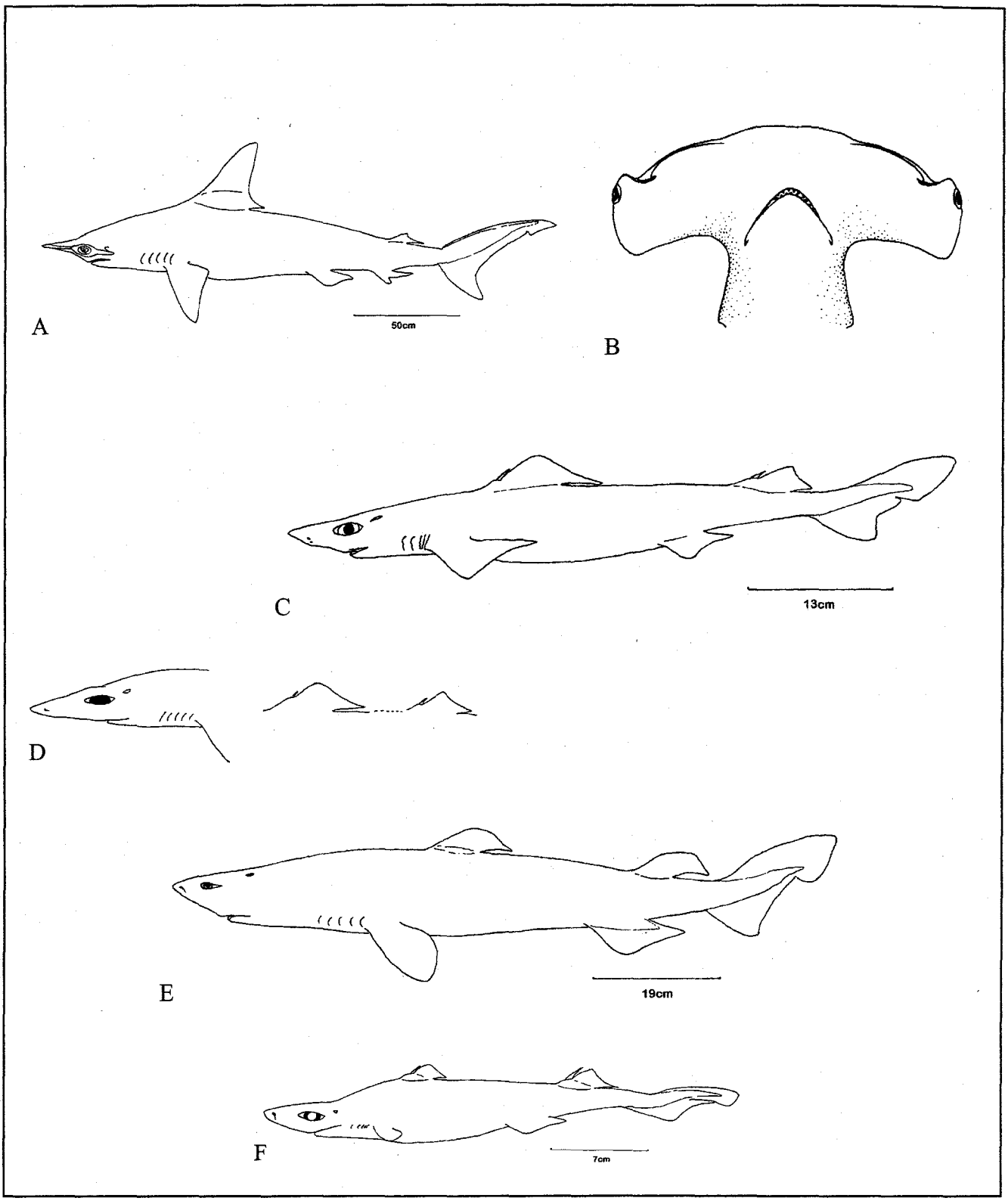

Fig. 3 Habit drawings of Maltese sharks. Diagrams are not shown to scale. Scale bar length is indicated on the drawings. **A** *Sphyrna zygaena*; **B** Detail of head *of S. zygaena*; **C** *Centrophorus granulosus*; **D** Detail of head and dorsal fins of *Centrophorus uyato*; **E** *Dalatias licha*; **F** *Etmopterus spinax*.

No specimens of this species have been seen during this study, and it therefore remains unconfirmed.

***Scyliorhinus canicula* (Linnaeus, 1758) - Fig. 2H**
[Small-spotted catshark]

Squalus catulus: FORSSKÅL, 1775; *Squalus catulus* Linnaeus: TRAPANI, 1838; *Scyllium canicula* (Cuv.): GULIA, 1861; *Scyllium canicula* Cuv.: GULIA, 1872; *Scylliorhinus canicula* (Lin.): DESPOTT, 1919; *Scyliorhinus caniculus*: BARBARA, 1961; *Scyliorhinus canicula* (Linn): LANFRANCO, 1993; *Scyliorhinus canicula* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Scyliorhinus canicula* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Scyliorhinus canicula* (Linnaeus): SAMMUT, 2001.

Gulia (1872) described this species as 'very common', Despott (1919) as 'common' and Lanfranco (1993) as 'frequent'; somewhat surprisingly, Farrugia Randon & Sammut (1999) and Sammut (2001) make no statement on its status. This species has been regularly encountered during this present study at both Valletta and Marsaxlokk fish markets where it is offered for sale in relatively large numbers.

***Scyliorhinus stellaris* (Linnaeus, 1758) - Fig. 2I (detail)**
[Nursehound]

Squalus stellaris Linnaeus: TRAPANI, 1838; *Scyllium stellare* (Bonaparte): GULIA, 1861; *Scyllium stellare* Bp.: GULIA, 1872; *Scylliorhinus stellaris* (Lin.): DESPOTT, 1919; *Scyliorhinus stellaris*: BARBARA, 1961; *Scyliorhinus stellaris* Linn.: LANFRANCO, 1993; *Scyliorhinus stellaris* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Scyliorhinus stellaris* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Scyliorhinus stellaris* (Linnaeus): SAMMUT, 2001.

Gulia (1872) considered this species as 'very common' and Despott (1919) stated that it is 'more or less common'. Lanfranco (1993) reported that it is 'frequent' while Farrugia Randon & Sammut (1999) and Sammut (2001) stated that it is 'common'. This species has been encountered regularly during the course of this present study, although always in small numbers, at both the Valletta and Marsaxlokk fish markets.

TRIAKIDAE

***Galeorhinus galeus* (Linnaeus, 1758) - Fig. 4A**
[Tope shark]

Squalus galeus Linnaeus: TRAPANI, 1838; *Galeus canis* (Rond.): GULIA, 1861; *Galeus canis* Bp.: GULIA, 1872; *Galeorhinus galeus* (Lin.): DESPOTT, 1919; *Galeorhinus galeus*: BARBARA, 1961; *Galeorhinus galeus* (Linn.): LANFRANCO, 1993; *Galeorhinus galeus* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Galeorhinus galeus* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Galeorhinus galeus* (Linnaeus): SAMMUT, 2001.

This species is recorded as 'common' by Gulia (1872), 'very frequent' by Despott (1919), and as 'frequent' by Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001). This species has not been seen during this study and therefore for the time being it must be regarded as unconfirmed, even if it may have occurred in the past.

***Mustelus asterias* Cloquet, 1821 - Fig. 4B**
[Starry smoothhound]

Mustelus canis (Mitch.): DESPOTT, 1919; *Mustelus asterias*: BARBARA, 1961; *Mustelus asterias* Coq.: LANFRANCO, 1993; *Mustelus asterias* Cloquet: FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Mustelus asterias* (Cloquet): FARRUGIA RANDON & SAMMUT, 1999; *Mustelus asterias* (Cloquet): SAMMUT, 2001.

Despott (1919) and Lanfranco (1993) reported that this species is 'common' while Fergusson & Marks (1996) reported that it is frequently offered for sale at the fish markets. This species can be confirmed to occur but it should be noted that mustelids tend to be confused with each other in the collection of landing data so statements on the frequency of occurrence of individual species need to be treated with caution.

***Mustelus mustelus* (Linnaeus, 1758) - Fig. 4B**
[Smoothhound]

Mustelus mustelus (Lin.): DESPOTT, 1919; *Mustelus mustelus*: BARBARA, 1961; *Mustelus mustelus* (Linn.): LANFRANCO, 1993; *Mustelus mustelus* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Mustelus mustelus* (Linnaeus): Farrugia Randon & Sammut, 1999; *Mustelus mustelus* (Linnaeus): Sammut, 2001.

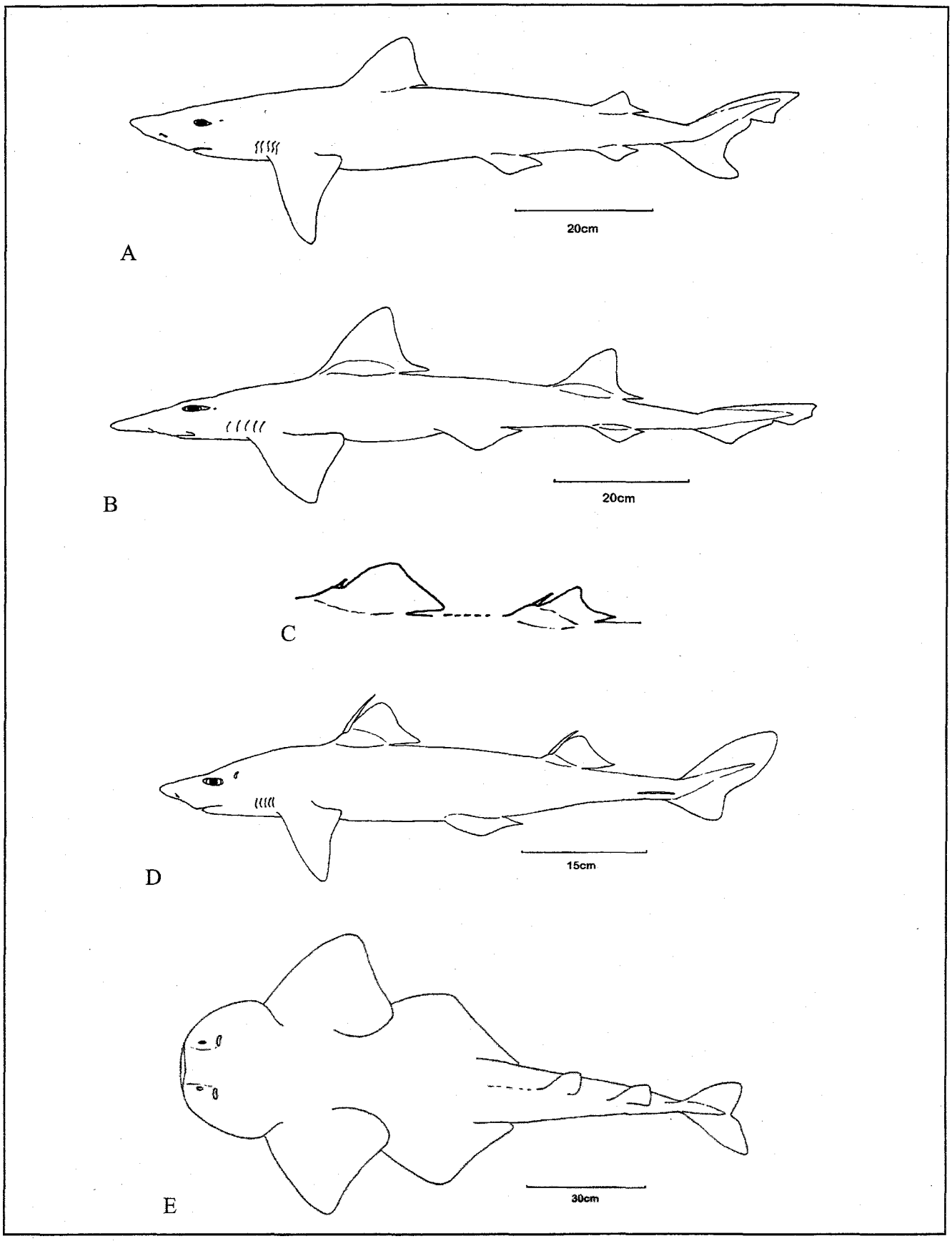

Fig. 4 Habit drawings of Maltese sharks. Diagrams are not shown to scale. Scale bar length is indicated on the drawing and maximum length (TL) is given in brackets. **A** *Galeorhinus galeus* (200 cm); **B** *Mustelus* sp. (200 cm); **C** Detail of dorsal fins of *Squalus acanthias*; **D** *Squalus blainvillei* (110 cm); **E** *Squatina squatina* (183 cm).

Despott (1919) reported that this species is offered for sale in good numbers and Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) reported that it occurs frequently. Fergusson & Marks (1996) stated that this is one of three species that dominate market sales (the others are *Squalus blainvillei* and *Centrophorus granulosus*), where it is sold filleted for human consumption. This species is confirmed by the present study but as in the case of its cogener, *Mustelus asterias,* landings data should be interpreted with caution.

***Mustelus punctulatus* Risso, 1826 - Fig. 4B**
[Blackspotted smoothhound]

Mustelus punctulatus (Risso): FERGUSSON & MARKS, 1996; FERGUSSON, 1998.

This species was only listed by Fergusson & Marks (1996) and Fergusson (1998) with a statement by the former that some numbers are caught with other mustelids. This species can be confirmed on the basis of a photograph of a specimen taken during fieldwork carried out by Fergusson & Marks in the mid 1990s.

CARCHARHINIDAE

***Carcharhinus brachyurus* (Günther, 1870)**

Carcharhinus brachyurus (Günther): FERGUSSON & MARKS, 1996; FERGUSSON, 1998.

This species was only listed by Fergusson & Marks (1996) and Fergusson (1998) without any comments. Although no specimens have been seen at the Valletta and Marsaxlokk fishmarkets during the present study, some loose preserved dentition from a locally sourced example (collection of local enthusiast Mr. John Abela) was examined in 1994 by one of us (IKF). It is noted that *C. brachyurus* is already reliably recorded from neighbouring Sicilian Channel waters (Cigala-Fulgosi, 1984) and, based on other limited records, is known to range widely in the Mediterranean (Marino Vacchi & Ian Fergusson, unpublished species account for the IUCN Shark Specialist Group, prepared in 2003). Thus, the specimen from which the dentition in Abela's collection was taken may have been caught in Maltese coastal waters or alternatively, elsewhere in the Sicilian Channel. This species could therefore be considered as locally unconfirmed but likely to occur.

***Carcharhinus brevipinna* (Müller & Henle, 1839)**
[Spinner shark]

Carcharhinus brevipinnis (Mull & Henl): LANFRANCO, 1993; *Carcharhinus brevipinna* (Müller & Henle): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Carcharhinus brevipinnis* (Muller & Henle): FARRUGIA RANDON & SAMMUT, 1999; *Carcharhinus brevipinnis* (Muller & Henle), SAMMUT, 2001.

Lanfranco (1993) reported this species as 'may be met with' but acknowledged that it is difficult to distinguish from some of its cogeners, while both Farrugia Randon & Sammut (1999) and Sammut (2001) described it as occurring locally but rare. Fergusson & Marks (1966) stated that this species may be sporadically caught, however, with the exception of *Prionace glauca*, all other carcharhinids are grouped together under the name '*kelb griz*' by local fishers and fisheries officers (Fergusson & Compagno, 2000) so it is difficult to make any statements on its occurrence on the basis of fisheries records. Moreover, it should be noted that such 'whaler' sharks may have been caught outside Maltese waters, especially in areas to the south where their presence is confirmed, e.g. near the Pelagian Islands, Tunisia and Libya.

No specimens that can be attributed to this species have been seen during this study, and while it can be considered to likely to occur sporadically, it must remain unconfirmed for the present.

***Carcharhinus limbatus* (Müller & Henle (ex Valenciennes), 1839)**
[Blacktip spinner shark]

Carcharhinus limbatus (Val.): LANFRANCO, 1993; *Carcharhinus limbatus* (Valenciennes): FARRUGIA RANDON & SAMMUT, 1999; *Carcharhinus limbatus* (Valenciennes): SAMMUT, 2001.

This species is only mentioned by Lanfranco (1993) who commented that it is occasionally sighted but is confused with its cogeners, and by Farrugia Randon & Sammut (1999) and Sammut (2001) who stated that it is a rare species that has been recorded in the area.

This species was never encountered during the present study and therefore its presence is unconfirmed. Equally, no specimens have been recorded in southern Sicilian ports fishing in the neighbouring waters of the Sicilian Channel (Marino Vacchi, personal communication 2003) and it is thus an unlikely visitor to Malta.

Carcharhinus melanopterus (Quoy & Gaimard, 1824)
[Blacktip reef shark]

Carcharhinus melanopterus (Q. & G.): LANFRANCO, 1993; *Carcharhinus melanopterus* (Quen. & Gunn.): FARRUGIA RANDON & SAMMUT, 1999; *Carcharhinus melanopterus* (Quen. & Gunn.): SAMMUT, 2001.

This species is only mentioned by Lanfranco (1993) who commented that it is occasionally sighted but is confused with its cogeners, and by Farrugia Randon & Sammut (1999) and Sammut (2001) who stated that it is a rare species that has been recorded in the area. This species was never encountered during the present study and therefore its presence is unconfirmed. Confusion with other sympatric black-tipped carcharhinids, such as *C. brevipinna*, is likely in the Mediterranean.

***Carcharhinus obscurus* (Lesueur, 1818) - Fig. 1C**
[Dusky shark]

Carcharhinus obscurus (Lesueur): Fergusson & Marks, 1996; Fergusson, 1998; *Carcharhinus obscurus* (Lesueur): Fergusson & Compagno, 2000

The only Maltese record of this species is based on a mature male specimen collected some 4km ESE of Filfla (Fergusson & Compagno, 2000). It is known in small numbers from other parts of the central Mediterranean, including Tunisia (Capapé *et al.* , 1979), Sicily (Fergusson & Compagno, 2000) and Libya (IKF unpublished photographic records). Thus, occasional reports from Malta, both inshore and offshore, are quite likely to be true.

***Carcharhinus plumbeus* (Nardo, 1827)**
[Sandbar shark]

Carcharhinus plumbeus: BARBARA, 1961; *Carcharhinus plumbeus* (Nardo): LANFRANCO, 1993; *Carcharhinus plumbeus* (Nardo): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Carcharhinus plumbeus* (Nardo): FARRUGIA RANDON & SAMMUT, 1999; *Carcharhinus plumbeus* (Nardo): SAMMUT, 2001.

As already observed by Lanfranco (1993), some members of the genus *Carcharhinus* may be difficult to distinguish from each other. Literature records of 'requiem' sharks, and thus statements as to their occurrence and abundance, should be treated with caution especially if not based on detailed examination of actual specimens. Lanfranco (1993) described this species as 'often frequent' while Farrugia Randon & Sammut (1999) and Sammut (2001) made a general statement that this is a common open-sea pelagic species but do not comment on local occurrence. On the basis of discussions with fishers and fisheries officers, Fergusson & Marks (1966) stated that this species is the most frequently caught carcharhinid after *Prionace glauca* but acknowledged that records of any *Carcharhinus* may actually refer to a number of species that are grouped together under the name '*kelb griz*' in local fisheries statistics. However, captures of all carcharhinids, excepting *P. glauca,* are rare in Malta and the comparative frequency of their captures is unknown. No specimens have been seen during the present study that can definitely be attributed to this species and although it is likely to occasionally occur, its presence must be considered as unconfirmed at present.

***Prionace glauca* (Linnaeus, 1758) - Fig. 1D**
[Blue shark]

Galeus glaucus (Rond.): GULIA, 1861; *Squalus glaucus* L.: GULIA, 1872; *Prionace glauca* (Lin.): DESPOTT, 1919; *Prionace glauca*: BARBARA, 1961; *Prionace glauca* (Linn.): LANFRANCO, 1993; *Prionace glauca* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Prionace glauca;* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Prionace glauca*, SAMMUT, 2001.

Gulia (1872) described this species as 'common', Despott (1919) as 'more or less common', Lanfranco (1993) as 'frequent' and Farrugia Randon & Sammut (1999) and Sammut (2001) as 'rather frequent'. The presence of this species is confirmed but it is less frequent now than in the past and on the basis of landings data examined from 1982 to 1992, its populations may be declining further (Fergusson & Marks, 1996).

SPHYRNIDAE

***Sphyrna tudes* (Valenciennes, 1822)**
[Lesser hammerhead]

?Platysgnolus tuburo Gulia: GULIA, 1872; *Sphyrna tudes* (Cuv.): DESPOTT, 1919; *Sphyrna tudes* (Val.): LANFRANCO,

1993; *Sphyrna tudes* (Valenciennes): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Sphyrna tudes*: FARRUGIA RANDON & SAMMUT, 1999; *Sphyrna tudes*: SAMMUT, 2001

It is very difficult to ascertain what species Gulia (1872) was referring to, as he seems to have coined the name himself; neither the genus nor the species are given in Eschmeyer (1998). As synonyms of his 'new' species Gulia gave "*Sphyrna tiburo* Raf. " and "*Zygaena tudes* Risso". If by *Sphyrna tiburo* Gulia was referring to *Squalus tiburo* Linnaeus (not Rafinesque), then this is not a synonym of *Zygaena tudes* Valenciennes (not Risso) but a distinct species (now *Sphyrna tiburo*, an extra-Mediterranean species). Despott (1919) quoted Gulia's record under "*Sphyrna tudes* (Cuv.)" and this has been followed by subsequent authors (Lanfranco 1993; Farrugia Randon & Sammut, 1999; Sammut, 2001). If Gulia's record does actually refer to *Sphyrna tudes*, then he considered this species as 'very rare' (Gulia, 1872). Despott (1919) accepted the record on Gulia's authority and stated that he never found the species. Lanfranco (1993) described it as very rare, while Farrugia Randon & Sammut (1999) and Sammut (2001) only mentioned it in passing as a rarer species than *Sphyrna zygaena*. Fergusson & Marks (1996) pointed out that fishers probably confuse different species under the general name 'hammerhead' and apart from *Sphyrna zygaena* and *Sphyrna tudes*, which they accepted as occurring in Maltese waters, they also mentioned (based on previous Mediterranean faunal accounts) the possibility that *Sphyrna mokarran* and *Sphyrna lewini* may occur. Since *Sphyrna tudes,* or any other species of hammerhead apart from *Sphyrna zygaena,* was not authenticated in this present study, then at present all records of species other than *Sphyrna zygaena* must be regarded as unconfirmed and the validity of *S. tudes* as a Mediterranean species remains in doubt.

***Sphyrna zygaena* (Linnaeus, 1758) - Fig. 3A,B**
[Smooth hammerhead]

Squalus zygaena: FORSSKÅL, 1775; *Squalus zygaena* Linnaeus: TRAPANI, 1838; *Zygaena malleus* (Cuvier): GULIA, 1868; *Zygaena malleus* Cuv.: GULIA, 1872; *Sphyrna zygaena* (Lin.): DESPOTT, 1919; *Sphyrna zygaena*: BARBARA, 1961; *Sphyrna zygaena* (Linn.): LANFRANCO, 1993; *Sphyrna zygaena* Linnaeus: FERGUSSON & MARKS, 1996; *Sphyrna zygaena* (Linnaeus): FERGUSSON, 1998; *Sphyrna zygaena* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Sphyrna zygaena* (Linnaeus): SAMMUT, 2001.

Trapani (1838) recorded this species as perennial, while both Gulia (1872) and Despott (1919) stated that it is 'common'. On the other hand, Lanfranco (1993) reported it as 'occasional', while Farrugia Randon & Sammut (1999) and Sammut (2001) made no statement on its status. From their discussions with Maltese fishers and fisheries officers, Fergusson & Marks (1996) concluded that hammerhead sharks (principally *Sphyrna zygaena* but possibly other species as well) have gradually declined in local waters. This species is confirmed on the basis of collection specimens, but it should be noted that from the historical records listed above, it does seem that this once common species has now become very infrequent.

RAJIMORPHA

PRISTIDAE

***Pristis pristis* (Linnaeus, 1758)**
[Sawfish]

Squalus pristis: FORSSKÅL, 1775; *Squalus pristis* Linnaeus: TRAPANI, 1838; *Pristis antiquorum* (Lath.): GULIA, 1861; *Pristis antiquorum* Lath.: GULIA, 1872; *Pristis antiquorum* (Lath.): DESPOTT, 1919; *Pristis pristis* (Linn.): LANFRANCO, 1993; *Pristis pristis* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Pristis pristis* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Pristis pristis* (Linnaeus): SAMMUT, 2001.

Gulia (1872) described this species as 'rare' while Despott (1919) reported that he had never encountered it although fishers reported it to him. Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) all reported that it is very rare and sporadic in the Mediterranean, without giving any indication of the local status. The present authors have seen saws of this species kept as curios, however these are of unknown provenance and until actual specimens are captured in Maltese waters this species must be regarded as unconfirmed.

***Pristis pectinata* Latham, 1794**

[Saw-mouthed shark]

Pristis pectinatus (Latham): FARRUGIA RANDON & SAMMUT, 1999; *Pristis pectinatus* (Latham): SAMMUT, 2001.

This species was only mentioned by Farrugia Randon & Sammut (1999) and Sammut (2001) who stated that it is another rare species that may be encountered but give no indication that it actually occurs in Maltese waters. This species cannot be confirmed by this study.

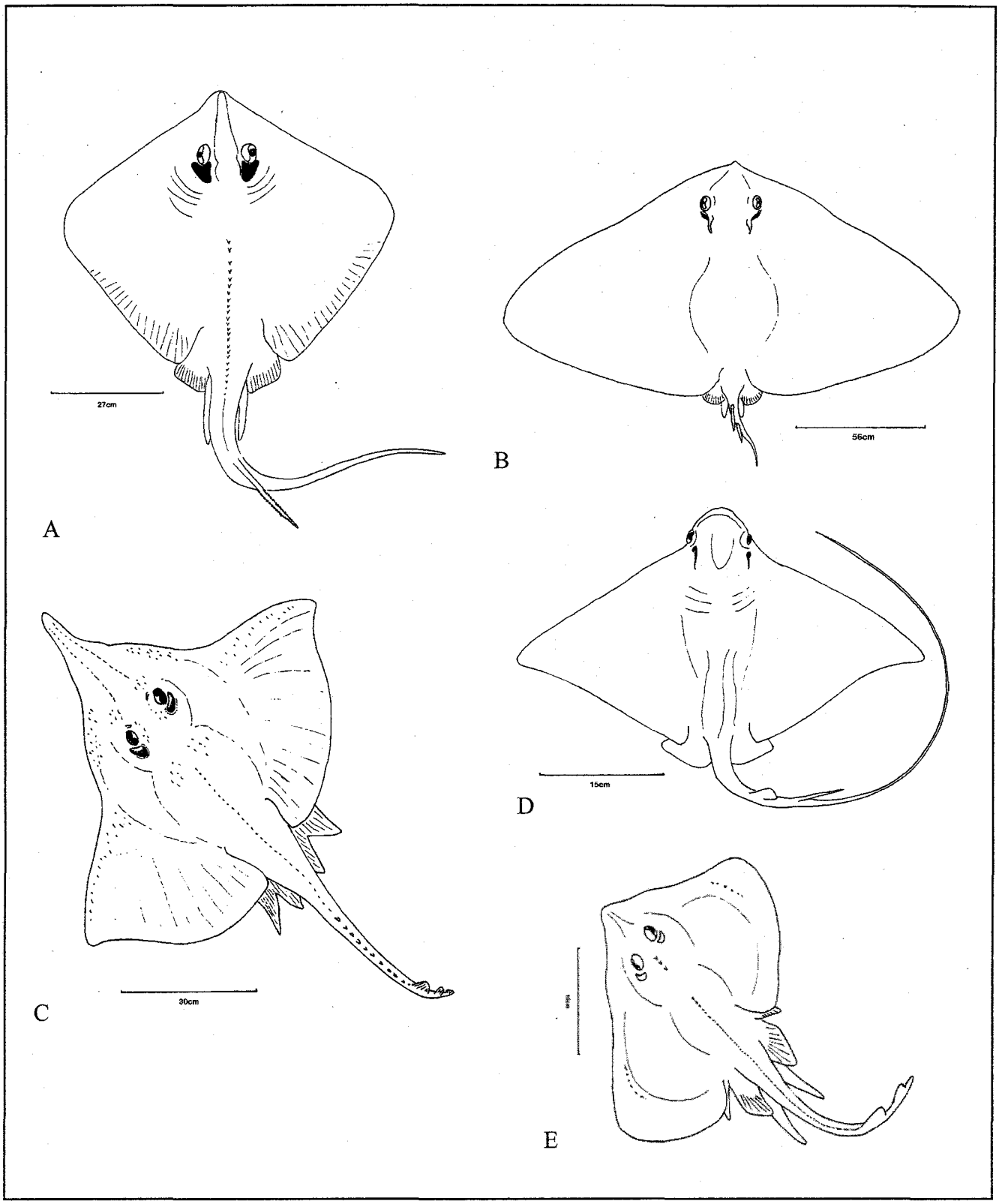

Fig. 5 Habit drawings of Maltese rays. Diagrams are not shown to scale. Scale bar length is indicated on the drawings. **A** *Dasyatis pastinaca*; **B** *Gymnura altavela*; **C** *Dipturus oxyrinchus*; **D** *Myliobatis aquila*; **E** *Raja asterias*.

Rhinobatidae

***Rhinobatos cemiculus* Geoffroy Saint-Hilaire, 1817**
[Blackchin guitarfish]

Rhinobatus halavi (Rupp.): DESPOTT, 1919; *Rhinobatos cemiculus E.Geof*: LANFRANCO, 1993; *Rhinobatos cemiculus E. Geoffroy* Saint-Hilaire: FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Rhinobatus cemiculus* (Geoffroy): FARRUGIA RANDON & SAMMUT, 1999; *Rhinobatus cemiculus* (Geoffroy): SAMMUT, 2001.

Despott (1919) reported that he only ever saw one specimen and described this species as very rare and a straggler, while Lanfranco (1993) reported it as 'not frequent'. Farrugia Randon & Sammut (1999) and Sammut (2001) considered it as 'rare'. The common Maltese name for Guitarfishes (genus *Rhinobatos*) is '*rebekkin*'. In discussions held with local fishers reports of occasional catches were given; this species is not likely to be confused with any other species. However, no specimens have been authenticated in the present study and since it is not possible to determine whether the fishers interviewed were referring to *R. cemiculus* or *R. rhinobatos*, the present species must remain unconfirmed.

***Rhinobatos rhinobatos* (Linnaeus, 1758)**
[Common guitarfish]

Rhinobatus columnae Bp.: GULIA, 1972; *Rhinobatus panduratus* (Raf.): DESPOTT, 1919; *Rhinobatos rhinobatus*: BARBARA, 1961; *Rhinobatos rhinobatos* (Linn.): LANFRANCO, 1993; *Rhinobatos rhinobatos* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Rhinobatus rhinobatus* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Rhinobatus rhinobatus* (Linnaeus): SAMMUT, 2001.

Gulia (1872) considered this species as 'common' but in contrast, Despott (1919) reported that it is extremely rare and that he only saw two specimens. Lanfranco (1993) also considered it as 'rare' as did Farrugia Randon & Sammut (1999) and Sammut (2001). The same comments as for *R. cemiculus* apply (see above) for this species and although it may occur, for the present it cannot be confirmed.

TORPEDINIDAE

***Torpedo (Tetronarce) nobiliana* Bonaparte, 1835**
[Electric ray]

Torpedo nobiliana (Bp.): DESPOTT, 1919; *Torpedo nobiliana*: BARBARA, 1961; *Torpedo (Tetronarce) nobiliana* Bon.: BARBARA, 1961; *Torpedo (Tetronarce) nobiliana* Bonaparte: FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Torpedo nobiliana* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Torpedo nobiliana* (Bonnaterre): SAMMUT, 2001.

Despott (1919) recorded this species on the basis of a single specimen that he examined; however, Lanfranco (1993) stated that it is usually rare but occasionally frequent, which statement is repeated by Farrugia Randon & Sammut (1999) and Sammut (2001).

No specimens that could be attributed to this species were seen during the present study and although it probably occurs, its presence must remain unconfirmed for the time being.

***Torpedo (Torpedo) marmorata* Risso, 1810 - Fig. 6D**
[Marbled electric ray]

Torpedo galvani (Risso): GULIA, 1861; *Torpedo galvanii* Bp.: GULIA, 1872; *Torpedo marmorata* (Risso): DESPOTT, 1919; *Torpedo marmorata*: BARBARA, 1961; *Torpedo (Torpedo) marmorata* Riss.: LANFRANCO, 1993; *Torpedo (Torpedo) marmorata* Risso: FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Torpedo marmorata* (Risso): FARRUGIA RANDON & SAMMUT, 1999; *Torpedo marmorata* (Risso): SAMMUT, 2001.

Gulia (1872) described this species as 'very common', Despott (1919) as 'common', and Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) as 'frequent'. This species has been encountered regularly during the present study at both the Valletta and the Marsaxlokk fish markets.

***Torpedo (Torpedo) torpedo* (Linnaeus, 1758)**
[Common torpedo]

Raja torpedo: FORSSKÅL, 1775; *Raja torpedo* Linnaeus: TRAPANI, 1838; *Torpedo narce* (Bon.): GULIA, 1861; *Torpedo*

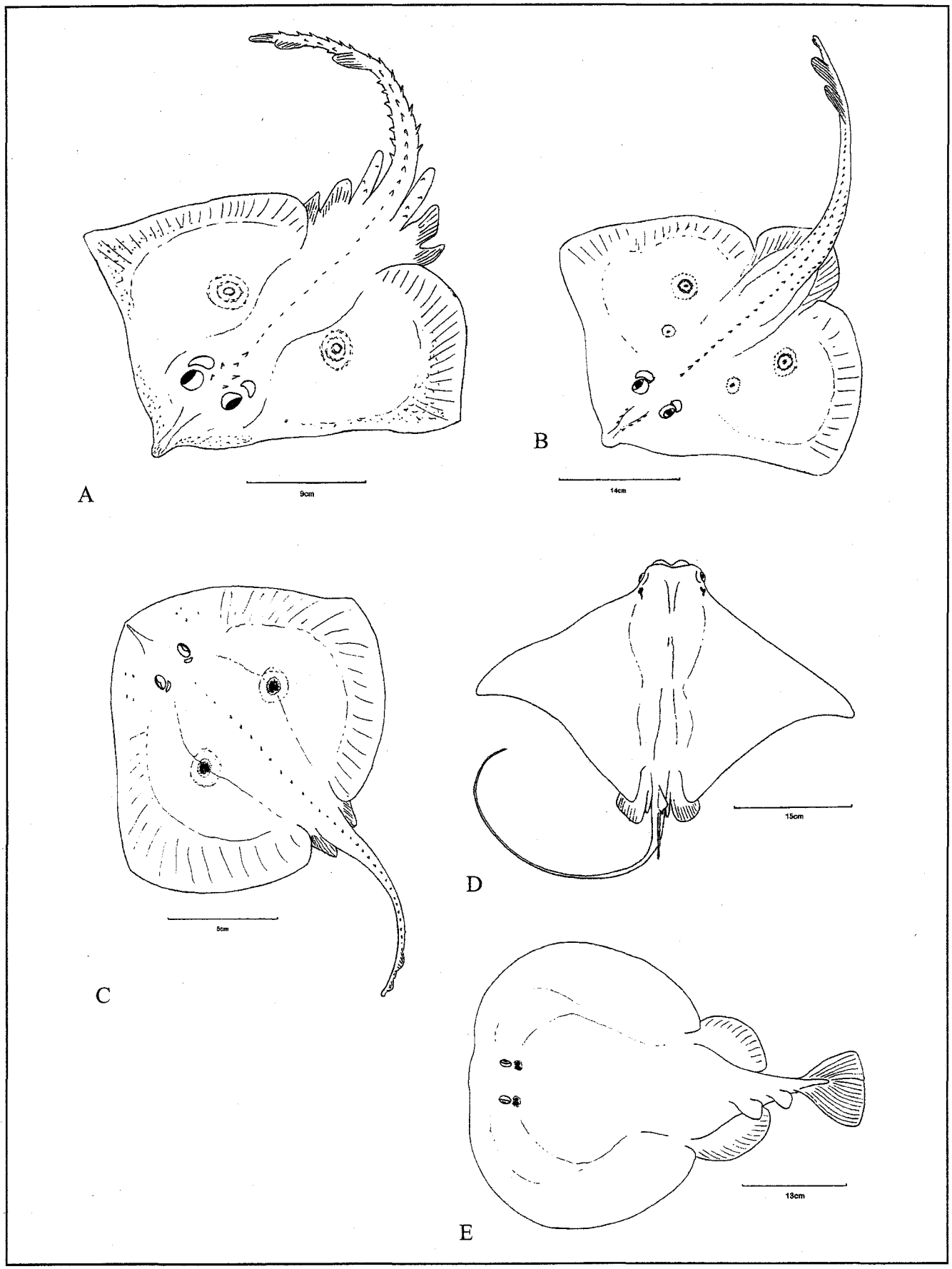

Fig. 6 Habit drawings of Maltese rays. Diagrams are not shown to scale. Scale bar length is indicated on the drawings. **A** *Raja miraletus*; **B** *Raja montagui*; **C** *Raja radula*; **D** *Torpedo marmorata*.

narce Cuv.: GULIA, 1872; *Torpedo ocellata* (Raf.): DESPOTT, 1919; *Torpedo torpedo*: BARBARA, 1961; *Torpedo (Torpedo) torpedo* (Linn.): LANFRANCO, 1993; *Torpedo (Torpedo) torpedo* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Torpedo torpedo* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Torpedo torpedo* (Linnaeus): SAMMUT, 2001.

Gulia (1872) reported this species as 'very common', Despott (1919) as 'common', and Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) as often common. This species can be confirmed on the basis of an accurate description of a specimen that 'electrocuted' a marine biologist whilst diving (Mark Dimech, personal communication 2003).

RAJIDAE

***Dipturus batis* (Linnaeus, 1758)**
[Skate]

Raja batis: FORSSKÅL, 1775; *Raja batis* Linnaeus: TRAPANI, 1838; *Raja batis* (Bonaparte): GULIA, 1861; *Raja batis* (Lin.): DESPOTT, 1919; *Raja batis*: BARBARA, 1961; *Raja* (*Dipturus*) *batis* Linn.: LANFRANCO, 1993; *Raja* (*Dipturus*) *batis* Linnaeus: FERGUSSON & MARKS, 1996; *Dipturus batis* (Linnaeus): FERGUSSON, 1998; *Raja batis* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Raja batis* (Linnaeus): SAMMUT, 2001.

Gulia included this species in his 1861 list (Gulia, 1861) but curiously did not include it in his paper on Maltese elasmobranchs (Gulia 1872) although he did include "*Raja maculata* Montag" with the synonyms, "*R. asterias* Mull", "*R. punctata* Risso" and "*R. batis* Risso". *Raia maculata* Montagu 1818 is an invalid name that has been replaced by *Raja montagui* Fowler 1910; *Raja asterias* Delaroche 1809 (not Risso) is a valid species and not a synonym of *Raja batis*; *Raia punctata* Risso, 1810 is a synonym of *Raja asterias* (see Eschmeyer, 1998). It is difficult to be certain to which species Gulia (1872) was referring to by his "*Raja maculata*". Despott (1919) included this species in his list based on Gulia's (1861) record, however he stated that he never personally saw a specimen. On the other hand, Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) give it as 'not common'. This species is being regarded as unconfirmed for the present.

***Dipturus oxyrinchus* (Linnaeus, 1758) - Fig. 5C**
[Longnose skate]

Raja oxyrinchus Linnaeus: TRAPANI, 1838; *Laeviraja oxyrhynchus* (Bonaparte): GULIA, 1861; *Laeviraja oxyrhynchus* Bp: GULIA, 1872; *Raja oxyrinchus* (Lin.): DESPOTT, 1919; *Raja oxyrhynchus*: BARBARA, 1961; *Raja* (*Dipturus*) *oxyrinchus* Linn.: LANFRANCO, 1993; *Raja* (*Dipturus*) *oxyrinchus* Linnaeus: FERGUSSON & MARKS, 1996; *Dipturus oxyrinchus* (Linnaeus): FERGUSSON, 1998; *Raja oxyrinchus* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Raja oxyrinchus* (Linnaeus): SAMMUT, 2001.

Gulia (1872) stated that this species is 'very common', Despott (1919) that it is 'common' and Lanfranco (1993) that it is 'frequent'. Farrugia Randon & Sammut (1999) and Sammut (2001) described the abundance status of *Raja oxyrinchus* in the Maltese Islands as more frequently encountered than *Raja batis*, which they stated is not common. There is clearly no agreement amongst authors on the occurrence of this species. This is not surprising if these statements were based on landing data, since the different species of *Raja* are easily confused. This species is confirmed by this present study and it is commonly found at both the Valletta and the Marsaxlokk fish markets.

***Leucoraja fullonica* (Linnaeus, 1758)**
[Shagreen ray]

Raja fullonica: BARBARA, 1961; *Raja* (*Leucoraja*) *fullonica* Linn.: LANFRANCO, 1993; *Raja* (*Leucoraja*) *fullonica* Linnaeus: FERGUSSON & MARKS, 1996; *Leucoraja fullonica* (Linnaeus): FERGUSSON, 1998; *Raja fullonica* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Raja fullonica* (Linnaeus): SAMMUT, 2001.

Lanfranco (1993) described this species as 'apparently rare' implying that he may have never personally confirmed it. Farrugia Randon & Sammut (1999) and Sammut (2001) stated that it is 'rare'. This species cannot be presently confirmed.

***Leucoraja melitensis* (Clark, 1926)**
[Maltese brown ray]

Raia melitensis n. sp.: CLARK, 1926; *Raja melitensis* Clarke: DESPOTT, 1934; *Raja* (*Leucoraja*) *melitensis* Clark: LANFRANCO, 1993; *Raja* (*Leucoraja*) *melitensis* Clark: FERGUSSON & MARKS, 1996; *Leucoraja melitensis* (Clark):

FERGUSSON, 1998; *Raja melitensis* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Raja melitensis* (Linnaeus): SAMMUT, 2001.

This species was described by Clark (1926) based on specimens collected from Malta, hence the name, however it is not exclusive to Maltese waters being known also from the coasts of Algeria (where it is rare) and Tunisia. Despott did not include this species in his comprehensive 1919 list (Despott, 1919) but mentions it in his list of the Maltese names of fishes (Despott, 1934), without any other information. Lanfranco (1993) described this species as 'frequent' but adds that it may easily be confused with *Raja miraletus*. Farrugia Randon & Sammut (1999) and Sammut (2001) provided some notes on its depth range and habits but mentioned nothing about its frequency.

As the types come from Malta, this species is accepted as occurring locally, however, no specimens that could be attributed to this species have been seen during this study and it is probably quite rare around Malta, which is at the northern border of its distribution.

***Leucoraja naevus* (Müller & Henle, 1841)**
[Cuckoo ray]

Raja (Leucoraja) naevus Müller & Henle: FERGUSSON & MARKS, 1996; *Leucoraja naevus* (Müller & Henle): FERGUSSON, 1998; *Raja naevus* (Muller & Henle): FARRUGIA RANDON & SAMMUT, 1999; SAMMUT, 2001.

None of the authors who included this species in their lists provide any information on its status, although Farrugia Randon & Sammut (1999) and Sammut (2001) mentioned that it is a rare member of its family, without however indicating if it is rare in local waters or in the Mediterranean as a whole.

This species cannot presently be confirmed.

***Raja (Raja) asterias* Delaroche, 1809 - Fig. 5E**
[Starry ray]

Dasybatis asterias Bp.: GULIA, 1872; *Raja punctata* (Risso): DESPOTT, 1919; *Raja asterias*: BARBARA, 1961; *Raja (Raja) asterias* Del.: LANFRANCO, 1993; *Raja (Raja) asterias* Delaroche: FERGUSSON & MARKS, 1996; *Raja asterias* Delaroche: FERGUSSON, 1998; *Raja asterias* (Delaroche): FARRUGIA RANDON & SAMMUT, 1999; *Raja asterias* (Delaroche): SAMMUT, 2001.

Gulia (1872) reported this species as 'rare' and Despott (1919) stated that he only personally saw two specimens although it was reported to him that it was frequent. Lanfranco (1993) described it as 'common' and Farrugia Randon & Sammut (1999) and Sammut (2001) reported that it is quite commonly found. This species is confirmed and it is frequently landed and sold at the Valletta and the Marsaxlokk fish markets.

***Raja (Raja) clavata* Linnaeus, 1758**
[Thornback ray]

Raja clavata Linnaeus: TRAPANI, 1838; *Raja clavata* (Bon.): GULIA, 1861; *Dasybatis clavata* Blain: GULIA, 1872; *Raja clavata* (Lin.): DESPOTT, 1919; *Raja clavata*: BARBARA, 1961; *Raja (Raja) clavata* Linn.: LANFRANCO, 1993; *Raja (Raja) clavata* Linnaeus: FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Raja clavata* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Raja clavata* (Linnaeus): SAMMUT, 2001.

Gulia (1872) stated that this species is 'rather common' and Despott (1919) agreed, while Lanfranco described it as 'frequent' and Farrugia Randon & Sammut (1999) and Sammut (2001) implied that it is more or less frequent. This species is confirmed by the present study but it is only occasionally caught.

***Raja (Raja) miraletus* Linnaeus, 1758 - Fig. 6A**
[Brown ray]

Raja miraletus Linnaeus: TRAPANI, 1838; *Raja miraletus* (Bon.): GULIA, 1861; *Raja miraletus* Lin.: GULIA, 1872; *Raja miraletus* (Lin.): DESPOTT, 1919; *Raja miraletus*: BARBARA, 1961; *Raja (Raja) miraletus* Linn.: LANFRANCO, 1993; *Raja (Raja) miraletus* Linnaeus: FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Raja miraletus* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Raja miraletus* (Linnaeus): SAMMUT, 2001.

Gulia (1872) reported this species as 'common', Despott (1919) as 'rather common', Lanfranco (1993) as 'frequent', and Farrugia Randon & Sammut (1999) and Sammut (2001) as 'common'. We confirm this species, which is quite frequent at

the Valletta and the Marsaxlokk fish markets.

***Raja (Raja) montagui* Fowler, 1910 - Fig. 6B**
[Spotted ray]

Raja maculata Montag: GULIA 1872; *Raja* (*Raja*) *montagui* Fow.: LANFRANCO 1993; *Raja montagui* (Fowler): FARRUGIA RANDON & SAMMUT, 1999; *Raja montagui* (Fowler): SAMMUT, 2001.

Gulia (1872) uncharacteristically provided no information on abundance for this species while Despott did not list it. Lanfranco (1993) stated that this species is of doubtful occurrence and that records may refer to *Raja radula*. Fergusson & Marks (1996) and Fergusson (1998) did not list it, while Farrugia Randon & Sammut (1999) and Sammut (2001) stated that it is a rare member of its family, without however indicating if it is rare in local waters or in the Mediterranean as a whole.

This species is confirmed by this present study, which, contrary to what the available literature suggests, appears to be frequent at the Valletta and the Marsaxlokk fish markets.

***Raja (Raja) radula* Delaroche, 1809 - Fig. 6C**
[Rough ray]

Raja radula (Delar.): DESPOTT, 1919; *Raja radula*: BARBARA, 1961; *Raja radula* Del.: LANFRANCO, 1993; *Raja (Raja) radula* Delaroche: FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Raja radula* (Delarosche): FARRUGIA RANDON & SAMMUT, 1999; *Raja radula* (Delarosche): Sammut, 2001.

Despott (1919) stated that he only saw two specimens of this species, while Lanfranco (1993) reported it as 'frequent' as did Farrugia Randon & Sammut (1999) and Sammut (2001).

This species is confirmed by this present study, and is frequent at the Valletta and the Marsaxlokk fish markets.

***Raja macrorynchus* Rafinesque, 1810**

Raja macrorhynchus (Rafin.): DESPOTT, 1919.

Despott (1919) is the only author to have mentioned this species, which, according to Quéro *et al.* (1990), is a valid one. Lanfranco (1993) referred to Despott's record as a synonym of *Dipturus batis*, however, in his 1919 list (Despott, 1919) and also in his later checklist of common names (Despott, 1934), Despott gives both *Dipturus batis* (as *Raja batis*) and *Raja macrorynchus* (as *Raja macrorhynchus*) and it is clear that he is referring to different species. Moreover, this "*Raja macrorhynchus*" does not appear to be rare since Despott (1919) stated that it is occasionally frequent and sometimes scarce. Unless new information comes to light, it is not possible to assess Despott's record.

***Raja musmarinus* Forsskål, 1775**

Raja musmarinus (piscis novus): FORSSKÅL, 1775.

This species from Malta named by Forsskål (1775) as new, is invalid since no description or figure were given.

***Rostroraja alba* (Lacepède, 1803)**
[White skate]

Raja alba: BARBARA, 1961; *Raja* (*Rostroraja*) *alba* Lac.: LANFRANCO, 1993; *Raja* (*Rostroraja*) *alba* (Lacepède): FERGUSSON & MARKS, 1996; *Rostroraja alba* (Lacepède): FERGUSSON, 1998; *Raja alba* (Lacepède): FARRUGIA RANDON & SAMMUT, 1999; *Raja alba* (Lacepède): SAMMUT, 2001.

The first reference to this species in the literature on Maltese elasmobranchs is Barbara's nomenclatural list (Barbara, 1961). Lanfranco included it in the latest edition of his guide to Maltese fish as a new record (Lanfranco, 1993) apparently on the basis of Barbara's 'record' and on its inclusion in an undated and privately circulated wordlist of Maltese fish compiled by Victor Jaccarini of the University of Malta and used by Joseph Aquilina in the preparation of his Maltese dictionary (see Aquilina, 1987 p. xxvii; see also Lanfranco, 1993 p. ix). Fergusson & Marks (1996) and Fergusson (1998) just listed this species while Farrugia Randon & Sammut (1999) and Sammut (2001) stated that it is a rare member of the family without any indication as to whether they are referring to the situation in Malta or in the Mediterranean as a whole. There are therefore no clear records of this species from the Maltese Islands and thus it cannot be confirmed.

DASYATIDAE

***Dasyatis centroura* (Mitchill, 1815)**
[Roughtailed stingray]

Dasyatis brucco (Bp.) and *Dasyatis thalassia* (Mull.): DESPOTT, 1919; *Dasyatis centroura* (Mitch.): LANFRANCO, 1993; *Dasyatis centroura* (Mitchill): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Dasyatis centroura* (Mitchill): FARRUGIA RANDON & SAMMUT, 1999; *Dasyatis centroura* (Mitchill): SAMMUT, 2001.

Despott (1919) recorded both *Dasyatis brucco*, based on a single specimen, and *Dasyatis thalassia* of which he saw "*at least three examples*". Both names are synonyms of *Dasyatis centroura* (Eschmeyer, 1998). Like Lanfranco (1993), Farrugia Randon & Sammut (1999) and Sammut (2001) described it as 'rare'.

Based on the historical records, this species may occur, however no attributable specimens have been examined in the present study and therefore it is presently being considered unconfirmed.

***Dasyatis pastinaca* (Linnaeus, 1758) - Fig. 5A**
[Common stingray]

Raja pastinaca: FORSSKÅL, 1775; *Raja pastinaca* Linnaeus: TRAPANI, 1838; *Trygon pastinaca* (Adanson): GULIA, 1861; *Trygon pastinaca* Adans: GULIA, 1872; *Dasyatis pastinaca* (Lin.): DESPOTT, 1919; *Dasyatis pastinaca*: BARBARA, 1961; *Dasyatis pastinaca* (Linn.): LANFRANCO, 1993; *Dasyatis pastinaca* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Dasyatis pastinaca* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Dasyatis pastinaca*: FARRUGIA RANDON, 2001; *Dasyatis pastinaca* (Linnaeus): SAMMUT, 2001.

This species was reported as 'very common' by Gulia (1872) and Despott (1919), as 'common' by Lanfranco (1993) and as 'quite common' by Farrugia Randon & Sammut (1999) and Sammut (2001). This species, which is more or less common, is confirmed by the present study .

***Dasyatis violacea* (Bonaparte, 1832)**
[Violet stingray]

Trygon violacea Bp.: GULIA, 1872; *Dasyatis violacea* (Bp.): DESPOTT, 1919; *Dasyatis violacea*: BARBARA, 1961; *Dasyatis violacea* (Bon.): LANFRANCO, 1993; *Dasyatis violacea* (Bonaparte): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Dasyatis violacea* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Dasyatis violacea* (Bonnaterre): SAMMUT, 2001.

Gulia (1872) stated that he saw a few juveniles of this species and Despott (1919) just repeated Gulia's statement suggesting that he (Despott) never encountered the species. Lanfranco (1993) described it as 'mostly rare'. Farrugia Randon & Sammut (1999) stated that it is 'somewhat rare' however Sammut (2001) qualified this statement by writing "*somewhat rare in the Mediterranean Sea*", making its occurrence around the Maltese Islands and its local abundance unclear.

No attributable specimens of this species have been seen during the present study and thus its presence remains unconfirmed for Maltese waters.

GYMNURIDAE

***Gymnura altavela* (Linnaeus, 1758) - Fig. 5B**
[Spiny butterfly ray]

Raja altavela: FORSSKÅL, 1775; *Gymnura altavela*: BARBARA, 1961; *Gymnura altavela* Linn.: LANFRANCO, 1993; *Gymnura altavela* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Gymnura altavela* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Gymnura altavela* (Linnaeus): SAMMUT, 2001.

It is interesting that this species was reported by Forsskål (1775) but not by Gulia (1861; 1872) or Despott (1919). Lanfranco (1919) simply stated that Barbara listed it and that it is "*sometimes reported*" while Farrugia Randon & Sammut (1999) and Sammut (2001) just mentioned that this is a very rare species. There is therefore a lack of specific records from the Maltese Islands. However, this species can be confirmed on the basis of a single specimen seen at the Valletta fish market (captured in the summer of 1997).

MYLIOBATIDAE

***Myliobatis aquila* (Linnaeus, 1758) - Fig. 5D**
[Common eagle ray]

Raja aquila: FORSSKÅL, 1775; *Raja aquila* Linnaeus: TRAPANI, 1838; *Myliobatis aquila* (Dumereil): GULIA, 1861; *Myliobatis aquila* Bp.: GULIA, 1872; *Myliobatis aquila* (Lin.): DESPOTT, 1919; *Myliobatis aquila*: BARBARA, 1961; *Myliobatis aquila* (Linn.): LANFRANCO, 1993; *Myliobatis aquila* (Linnaeus): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Myliobatis aquila* (Linnaeus): FARRUGIA RANDON & SAMMUT, 1999; *Myliobatis aquila* (Linnaeus): SAMMUT, 2001.

Gulia (1872) reported that this species is 'rare' while Despott (1919) described it as 'rather frequent' and Lanfranco (1993) as 'frequent'. This species is confirmed by the present study.

***Pteromylaeus bovinus* (Geoffroy Saint-Hilaire, 1817)**
[Bull ray]

Myliobatis bovina (Geoff.): DESPOTT, 1919; *Myliobatis bovina*: BARBARA, 1961; *Pteromylaeus bovinus* (Geoff. S. H.): LANFRANCO, 1993; *Pteromylaeus bovinus* (E.Geoffroy Saint-Hiliare): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Pteromylaeus bovinus* (Geoffroy): FARRUGIA RANDON & SAMMUT, 1999; *Pteromylaeus bovinus* (Geoffroy): SAMMUT, 2001.

The reports by Despott (1919) and Lanfranco (1993) are in agreement in that this species is frequent but often confused with *Myliobatis aquila*. Farrugia Randon & Sammut (1999) and Sammut (2001) stated that this species is very similar to the Common Eagle Ray *Myliobatis aquila* but it is less frequent. No specimens attributable to this species have been seen during this study and, although the historical records suggest that it may occur, it must be regarded as unconfirmed for the present.

RHINOPTERIDAE

***Rhinoptera marginata* (Geoffroy Saint-Hiaire, 1817)**
[Lusitanian cownose ray]

Rhinoptera marginata (Geof. S. H.): LANFRANCO, 1993; *Rhinoptera marginata* (E.Geoffroy Saint-Hiaire): FERGUSSON & MARKS, 1996; FERGUSSON, 1998.

Lanfranco (1993) stated that this species is "*occasionally reported*" but that it is usually mistaken for one of the myliobatids. This species can be confirmed on the basis of two specimens seen at the Marsaxlokk fish market (14th July 1999).

MOBULIDAE

***Mobula mobular* (Bonnaterre, 1788)**
[Devil ray]

Cephaloptera giorna Risso: GULIA GIOV., 1909b; *Cephaloptera edentula* (Brunn.): DESPOTT, 1919; *Mobula mobular*: BARBARA, 1961; *Mobula mobular* (Bonn.): LANFRANCO, 1993; *Mobula mobular* (Bonnaterre): FERGUSSON & MARKS, 1996; FERGUSSON, 1998; *Mobular mobular* (Bonnaterre): FARRUGIA RANDON & SAMMUT, 1999; *Mobular mobular* (Bonnaterre): SAMMUT, 2001.

Despott (1919) stated that he only saw two specimens (one in 1910 and one in 1916) up to the time of his writing. Lanfranco (1993) described this species as 'very rare'. Farrugia Randon & Sammut (1999) and Sammut (2001) stated that this species is 'rare' but are not clear if they are referring to Maltese waters or to the Mediterranean in general. Although no specimens of this species have been encountered during this study, its presence is accepted on the basis of past documented records, which are most likely to be correct due to its very characteristic features.

DISCUSSION

In the published scientific literature reviewed in the present study that deals specifically with the Maltese ichthyological fauna (that is, excluding privately circulated material, works that do no use scientific names and purely popular works; these works are reviewed in the 'Introduction'), 37 species of sharks and 26 species of rays have been recorded.

These numbers exclude the species named but not described by Forsskål (1775), the "*Raja macrorhynchus* (Rafin.)" of Despott (1919), whose identity is uncertain, and the species listed by Farrugia Randon & Sammut (1999) and Sammut (2001), but not by any other authors, without any indication that they originate from Maltese waters. Of these 63 reported species, 38 (24 sharks and 14 rays) have been confirmed by this study as definitely occurring, while another two species (both sharks) have not been verified by us but almost certainly occur. Nine species (4 sharks and 5 rays) have been rejected by this study as not occurring (at least on presently available evidence), while another 14 species (7 sharks and 7 rays) may occur but presently are unconfirmed. These results are summarised in Table 1.

It is hardly surprising that most of the rejected and unconfirmed species belong to groups that are notoriously difficult to differentiate, unless examined closely, including the angel sharks (*Squatina* spp.), smoothounds (*Mustelus* spp.), requiem or whaler sharks of the genus *Carcharhinus,* and rays of the family Rajidae. It is expected that further research will transfer some of the unconfirmed species to the confirmed list.

Although different sources give different estimates, around 45 species of sharks occur in the Mediterranean, of which some 43 occur in the western basin, 40 in the central Mediterranean area, and 34 in the eastern basin (Fischer *et al.*, 1987). Using these figures, the confirmed shark species of the Maltese Islands (including the two species that very likely occur) constitute about 57.8% of the total Mediterranean species and 65% of the Central Mediterranean species. Although a high number of Central Mediterranean sharks also occur in Maltese waters, a substantial number of other species are 'missing'. Comparison of the list of confirmed species with that of the Central Mediterranean species shows that the 'missing' species are mainly deep-water demersal species with little or no current commercial value, which even if taken as by-catch, will not be landed. Useful future field research should therefore focus on *in situ* observations made on trawlers operating in deep water.

The corresponding figures for rays are 34 Mediterranean species of which 33 occur in the western basin, 30 in the Central Mediterranean, and 28 in the eastern basin (Fischer *et al.*, 1987). The Maltese ray fauna thus comprises about 41.2% of the total Mediterranean species and 46.7% of the Central Mediterranean species. The ratio of recorded species to the total for the Central Mediterranean is lower for rays than it is for sharks. This is hardly surprising given the greater difficulty in distinguishing between closely related species of rays, their predominantly benthic habits and hence low catchability except by trawling or by bottom longlines.

Statements on trends in abundance are very difficult to make since (i) many species are confused and are often reported under collective names (for example, 'grey sharks', referring to carcharhinids, and 'rays', referring to rajids and possibly members of other families; Fergusson & Marks (1996) give other examples); and (ii) past landing data were collected on the basis of what is marketed at the Valletta Central Fish Market and did not take into account the different fishery characteristics (e.g. fishing effort, fishing gear, fishing grounds and other variables) that change from year to year. This situation is now changing and since 2000, the Malta Centre for Fisheries Sciences has been collecting quantitative data on abundance, while it also holds catch and effort estimates for artisanal gear (Matthew Camilleri, personal communication 2003). Table 1 attempts to give some indication of abundance using a four-point scale of 'common', 'frequent', 'occasional' and 'rare'; 'occasional' refers to those species that may be frequent to common in some years, but rare or absent in others. This table is based on those species included in the published local ichthyological literature, on landing data and on the authors' experience. While subject to major errors, this preliminary analysis provides some interesting insights.

Out of the 25 sharks whose presence around the Maltese Islands has been confirmed by the present study, only four species are considered common (two 'dogfish' or catsharks, and two smoothounds), another seven species are considered frequent, three are occasional, and six are rare; the status of the others is not known. Comparing the historic records with present day abundance estimates, it appears that one species, the Sharpnose Seven-gill shark *Heptranchias perlo*, that was previously considered rare, now appears to be more frequent, but that Blue shark *Prionace glauca*, and Smooth Hammerhead *Sphyrna zygaena*, are now much less common than they apparently were in the past. Of course there is always the possibility that certain fishing techniques are no longer used locally and therefore these species are less frequently caught, however, this decline seems to be Mediterranean-wide (Report of the IUCN SSC Shark Specialist Group Mediterranean Region Red List Workshop held in San Marino in September 2003, in preparation).

For the confirmed rays (14 species), only the Long-nosed Skate *Dipturus oxyrinchus* and the Common Stingray *Dasyatis pastinaca* are considered common, six species are frequent, two species are occasional, and three species are rare; the status of the others is not known.

Within the Mediterranean, a number of species are threatened and Table 1 gives those that are listed in the most recently available version of the IUCN's Red Data List (IUCN, 2002). However, apart from those listed, a number of others are also suspected to be threatened. The IUCN Centre for Mediterranean Cooperation and the IUCN Shark Specialist Group recently convened a 'Red List Workshop' to assess the conservation status of chondrichthyan fishes in the Mediterranean

Sea and to identify vulnerable and threatened species (a key objective of the FAO-International Plan of Action for the Conservation and Management of Sharks – IPOA Sharks). The final Red List assessments are still under review, however, preliminary results indicate that approximately 46% of the species occurring in the Mediterranean are threatened (IUCN Categories: 'Critically Endangered', 'Endangered' or 'Vulnerable'), 9% are 'Near Threatened', 15% are 'Least Concern' and 30% are 'Data Deficient' (Rachel Cavanagh, IUCN Shark Specialist Group, personal communication 2003). It is important to keep in mind that 'Data Deficient' does not mean that these taxa are not of conservation concern but only that there is a lack of scientific and fisheries research that could provide data on these poorly known fishes.

Highly threatened species include the Common (or Grey) Skate *Dipturus batis*. This once common species, highly vulnerable to trawl fisheries, has now virtually disappeared from the Mediterranean Sea. The two species of sandtiger sharks *(Carcharias taurus* and *Odontaspis ferox*) occurring in the Mediterranean Sea are also now extremely rare. These sharks congregate at specific sites and are especially vulnerable to coastal fisheries and the effects of habitat degradation (Report of the IUCN SSC Shark Specialist Group Mediterranean Region Red List Workshop held in San Marino in September 2003, in preparation). Other species of serious concern include the sawfishes (*Pristis* spp.) and the angel sharks (*Squatina* spp.) (Report of the IUCN SSC Shark Specialist Group Mediterranean Region Red List Workshop held in San Marino in September 2003, in preparation).

Species of direct relevance to Malta include: the Smalltooth Sandtiger *Odontaspis ferox*, which may be regionally declining and whose status requires monitoring; the Blue shark *Prionace glauca*, landings of which have markedly declined since 1984 (data published by the National Statistics Office, Valletta, Malta), and the Shortfin Mako *Isurus oxyrinchus,* both of which may be near threatened and require monitoring; the Smooth Hammerhead *Sphyrna zygaena* which has become very rare locally and which may also be threatened; the Bramble Shark *Echinorhinus brucus*, which very likely occurs, and which is highly vulnerable to habitat degradation and is on the decline within the Mediterranean (Report of the IUCN SSC Shark Specialist Group Mediterranean Region Red List Workshop held in San Marino in September 2003, in preparation); and all species of *Squatina*, which are threatened by habitat degradation (Report of the IUCN SSC Shark Specialist Group Mediterranean Region Red List Workshop held in San Marino in September 2003, in preparation).

In spite of this, only three species are protected by international treaties: the Great White Shark *Carcharodon carcharias*, the Basking Shark *Cetorhinus maximus* and the Devil Ray *Mobula mobular* (Table 1). These three species are also protected by local legislation enacted in terms of the Environment Protection Act (Legal Notice 49 of 1992 as amended by Legal Notice 161 of 1999); in the case of the White Shark, this protection is subject to the caveat that public security and civil protection authorities may take "*any necessary steps*" to ensure safety of bathers and other persons engaged in marine activities. Recently enacted regulations – the Flora, Fauna and Natural Habitat Protection Regulations, 2003 (Legal Notice 257 of 2003) – list these same three elasmobranchs under Schedule V, "*Protected fauna*" with the same caveat in the case of the Great White. Additionally, they list *Alopias vulpinus*, *Carcharias taurus*, *Carcharhinus brevipinna*, *Carcharhinus limbatus*, *Carcharhinus plumbeus*, *Galeorhinus galeus*, *Hexanchus griseus*, *Isurus oxyrinchus*, *Lamna nasus*, *Prionace glauca*, *Squatina squatina*, *Pristis pristis*, *Rostroraja alba* (as *Raja alba*), and *Leucoraja melitensis* (as *Raja melitensis*) in Schedule VI, which essentially gives species that need to be monitored in order to assess if measures should be taken to maintain the populations of these species in a favourable conservation status. At the time of writing, this legislation is in force but public comment has been invited.

ACKNOWLEDGEMENTS

We express our thanks to the various persons who provided us with specimens and information, particularly the fishers at the Marsaxlokk fish market and the personnel at the Valletta fish market who allowed us to examine and photograph their catches and who patiently responded to our questions, the staff at the Malta Centre for Fisheries Sciences and particularly Matthew Camilleri for providing information about annual landings and other statistics and for allowing us to examine specimens in their collections, Ms Carmen Mifsud of the Malta Environment and Planning Authority for help in establishing contacts, and Guido Lanfranco for sharing with us his vast knowledge of the Maltese fish fauna. Charles Busuttil, John Abela, Alfredo Cutajar and Alex Buttigieg are thanked by Ian Fergusson for their provision of useful information and photographic records. We are much obliged to the anonymous referee of this paper for a very thorough review that greatly improved the work. This work was supported by a research grant from the University of Malta to PJS, for which we are grateful.

Table 1. Classified list of the species of sharks and rays recorded in the published scientific literature from the Maltese Islands with validation of their occurrence (Oc.), an estimate of their abundance (Ab.) in Maltese waters and their conservation and legal status.

	Oc.	Ab.	IUCN Red List Category (year of assessment)	International treaties	Maltese legislation
Hexanchidae					
Heptranchias perlo (Bonnaterre, 1788)	+	F			
Hexanchus griseus (Bonnaterre, 1788)	+	O	LR/nt (2000)		FFNHPR (VI)
Echinorhinidae					
Echinorhinus brucus (Bonnaterre, 1788)	(+)?				
Squalidae					
Squalus acanthias Linnaeus, 1758	+	?			
Squalus blainvillei (Risso, 1827)	+	?			
Centrophoridae					
Centrophorus granulosus (Bloch & Schneider,	+	?	VU (2000)		
Centrophorus uyato (Rafinesque, 1810)	+	?			
Dalatiidae					
Dalatias licha (Bonnaterre, 1788)	+	F	DD (2000)		
Etmopterus spinax (Linnaeus, 1758)	+	O			
Oxynotidae					
Oxynotus centrina (Linnaeus, 1758)	+	F			
Squatinidae					
Squatina aculeata Cuvier (ex Dumeril), 1829	-				
Squatina oculata Bonaparte, 1840	(-)?				
Squatina squatina (Linnaeus, 1758)	+	F?	VU (2000)		FFNHPR (VI)
Odontaspididae (= Carchariidae)					
Carcharias taurus Rafinesque, 1810	-		VU (2000)		FFNHPR (VI)
Odontaspis ferox (Risso, 1810)	+	R			
Cetorhinidae					
Cetorhinus maximus (Gunnerus, 1765)	+	R	VU (2000)	SPABIM (II), BERN (II)	FFPR (II) FFNHPR (V)
Lamnidae					
Carcharodon carcharias (Linnaeus, 1758)	+	R	VU (2000)	SPABIM (II), BERN (II)	FFPR (II) FFNHPR (V)
Isurus oxyrinchus Rafinesque, 1810	+	F	LR/nt (2000)		FFNHPR (VI)
Lamna nasus (Bonnaterre, 1788)	(+)?		LR/nt (2000)		FFNHPR (VI)
Alopiidae					
Alopias superciliosus (Lowe, 1841)	+	O			
Alopias vulpinus (Bonnaterre, 1788)	+	F	DD (2001)		FFNHPR (VI)
Scyliorhinidae					
Galeus melastomus Rafinesque, 1810	(-)?				
Scyliorhinus canicula (Linnaeus, 1758)	+	C			
Scyliorhinus canicula (Linnaeus, 1758)	+	C			
Scyliorhinus stellaris (Linnaeus, 1758)	+	C			

Scyliorhinus canicula (Linnaeus, 1758)	+	C			
Scyliorhinus stellaris (Linnaeus, 1758)	+	C			
Triakidae					
Galeorhinus galeus (Linnaeus, 1758)	(-)?		**VU (2000)**		**FFNHPR (VI)**
Mustelus asterias Cloquet, 1821	+	C			
Mustelus mustelus (Linnaeus, 1758)	+	C			
Mustelus punctulatus Risso, 1827	+	?			
Carcharhinidae					
Carcharhinus brachyurus (Günther, 1870)	(-)?				
Carcharhinus brevipinna (Muller & Henle, 1839)	(-)?		**LR/nt (2000)**		**FFNHPR (VI)**
Carcharhinus limbatus [Muller & Henle (ex Valenciennes), 1839)]	-		**LR/nt (2000)**		**FFNHPR (VI)**
Carcharhinus melanopterus (Quoy & Gaimard, 1824)	-		**LR/nt (2000)**		
Carcharhinus obscurus (LeSueur, 1818)	+	R	**LR/nt (2000)**		
Carcharhinus plumbeus (Nardo, 1827)	(-)?		**LR/nt (2000)**		**FFNHPR (VI)**
Prionace glauca (Linnaeus, 1758)	+	F?			**FFNHPR (VI)**
Sphyrnidae					
Sphyrna tudes (Valenciennes, 1822)	-				
Sphyrna zygaena (Linnaeus, 1758)	+	R	**LR/nt (2000)**		
Pristidae					
Pristis pectinata Latham, 1794	-				
Pristis pristis (Linnaeus, 1758)	(-)?		**CR (2000)**		**FFNHPR (VI)**
Rhinobatidae					
Rhinobatos cemiculus Geoffroy Saint-Hilaire, 1817	(-)?				
Rhinobatos rhinobatos (Linnaeus, 1758)	(-)?				
Torpedinidae					
Torpedo (Tetronarce) nobiliana Bonaparte, 1835	(-)?				
Torpedo (Torpedo) marmorata Risso, 1810	+	F			
Torpedo (Torpedo) torpedo (Linnaeus, 1758)	+	?			
Rajidae					
Dipturus batis (Linnaeus, 1758)	(-)?				
Dipturus oxyrinchus (Linnaeus, 1758)	+	C			
Leucoraja fullonica (Linnaeus, 1758)	-				
Leucoraja melitensis (Clark, 1926)	+	R			**FFNHPR (VI)**
Leucoraja naevus (M‖ller & Henle, 1841)	-				
Raja asterias Delaroche, 1809	+	F			
Raja clavata Linnaeus, 1758	+	O	**LR/nt (2000)**		
Raja miraletus Linnaeus, 1758	+	F			
Raja montagui Fowler, 1910	+	F			
Raja radula Delaroche, 1809	+	F			
Rostroraja alba (Lacephde, 1803)	-				**FFNHPR (VI)**

Dasyatidae					
Dasyatis centroura (Mitchill, 1815)	(-)?				
Dasyatis pastinaca (Linnaeus, 1758)	+	C			
Dasyatis pastinaca (Linnaeus, 1758)	+	C			
Dasyatis violacea (Bonaparte, 1832)	-				
Gymnuridae					
Gymnura altavela (Linnaeus, 1758)	+	R			
Myliobatidae					
Myliobatis aquila (Linnaeus, 1758)	+	F			
Pteromylaeus bovinus (Geoffroy Saint-Hilaire, 1817)	(-)?				
Rhinopteridae					
Rhinoptera marginata (Geoffroy Saint-Hilaire, 1817)	+	O			
Mobulidae					
Mobula mobular (Bonnaterre, 1788)	+	R	**VU (2000)**	**SPABIM (II)**	**FFPR (II)/ FFNHPR (V)**

Key:

Occurrence:

+ Confirmed to occur;
(+)? Not confirmed but almost certainly occur;
- Do not occur;
(-)? Not confirmed but may occur

Abundance:

C Common;
F Frequent;
O Occasional;
R Rare;
? Status unknown.

IUCN Red List:

CR Critically endangered;
VU Vulnerable;
LR/nt Lower risk/near threatened;
DD Data deficient.
[Note: Apart from *Alopias vulpinus*, all other species were evaluated on ver 2.3 (1994) criteria]

International treaties:

SPABIM (II): Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (Barcelona) - Annex II List of endangered or threatened species.
BERN (II): Convention on the Conservation of European Wildlife and Natural Habitats (Bern) - Appendix II Strictly Protected Fauna Species

Maltese legislation:

FFPR (II): Flora and Fauna Protection Regulations, 1992 as amended by the Flora and Fauna Protection (Amendment) Regulations, 1999 - Schedule II (Protected fauna).
FFNHPR (V)/(VI): Flora, Fauna and Natural Habitat Protection Regulations, 2003 – Schedules V (Protected fauna) and Schdule VI (Animal and plant species of national importance and of importance to agreement states whose taking in the wild and exploitation may be subject to management measures).

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The Central Mediterranean Naturalist	4(1): 105 - 108	Malta: December 2003

SHORT COMMUNICATIONS

Carcharoles megalodon (Agassiz) (Lamnidae: Neoselachae): A historical note.

Carmel Galea Bonavia[1]

The Natural History Museum (London) owes its origins to Sir Hans Sloane (1660-1753), a cultured English doctor and an avid collector. At his death he bequeathed his collections to the nation. These formed the nucleus of what would eventually become the Natural History Museum (London), the British Museum and the British Library (Anderson 1997; see also online at http//: www.nhm.ac.uk).

When examining the Maltese specimens of teeth of *Carcharocles megalodon* (Agassiz) held in that Museum, I came across several (e.g. 995, 997, 1073, 1279) labelled as belonging to the "Sloane Collection". These particular specimens formed part of the original collections of Sir Hans Sloane and are thus amongst the "oldest" Maltese fossils held in that Museum.

This is not unexpected. Maltese fossil shark teeth, known as "Saint Paul's tongues" were renowned all over Europe for their supposed efficacy as antidotes to poisons (see Zammit Maempel 1989 and references therein). It is certain that Sir Hans Sloane knew about them and had some interest in them, as there is an Italian manuscript, also forming part of the Sloane Collection, in the British Library, arguing for the miraculous nature of Maltese fossils (Zammit-Maempel 1989). It is equally certain that Sir Hans Sloane would have wanted to obtain some examples of these wondrous "tongues" for his collection-which he obviously did.

"Saint Paul's tongues" refers not only to the teeth of *Carcharocles megalodon* (Agassiz) but also to the teeth of other fossil sharks. Furthermore other fossils are associated with Saint Paul, such as "serpent's eyes" (the petrified eyes of the poisonous snakes cursed by Saint Paul) not to mention bits and pieces of his anatomy such as his nipples and his "stick" (see Zammit-Maempel 1989). It would be interesting to find out if there are other fossils associated with Saint Paul in the "Sloane" collection and, particularly from a historical aspect, elucidate how these teeth and other fossils, if any, came to be part of the Sloane Collection.

Acknowledgements: I wish to thank the Trustees of the Natural History Museum (London) for giving me permission to examine the fossils held in their care and particularly to Ms. A. Longbottom of the Department of Palaeontology for her great help.

(Accepted: 14th September 2003)

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The presence of the black rat *Rattus rattus* on Fungus Rock (Maltese Islands)

John J. Borg[2] **& Joe Sultana**[3]

The presence of *Rattus* sp. on Fungus Rock was first noted on 26th May 1988, when one of the authors (JS) visited the islet and collected droppings of rats. These droppings were also examined by Prof. P. J. Schembri (Biology Department, University of Malta) who confirmed that they probably belonged to rats and consisted mainly of woody vegetable fibres with some insect exoskeletal remains, mainly of beetles. During this visit it was also noted that rodents had eaten plants of the famed "Maltese Fungus" *Cynomorium coccineum.*

[1] "Russet" Zebbug Road, Attard, Malta. cgb@maltanet.net
[2] National Museum of Natural History, Vilhena Palace, Mdina, Malta. john.j.borg@gov.mt
[3] Dar ta' Gajdoru / 3, Gajdoru Street, Xaghra, Gozo XRA 104, Malta. joesultana@maltanet.net

The present authors have visited Fungus Rock five times since 2000 primarily to monitor the Cory's Shearwater, *Calonectris diomedea,* population breeding on this islet. Part of this monitoring includes the investigation of rats' predation on the species. Many droppings corresponding to those of the Black Rat *Rattus rattus,* as described by Macdonald and Barrett (1993), were noted in many different parts of the islet. On one occasion a freshly dead racing pigeon bearing a yellow ring (06-3158 Malta 2002) was found partly eaten by rats. A rat was taken from the islet on 17th May 2003 and was later identified as being a Black Rat *Rattus rattus*. Identification of the specimen was also confirmed by Dr. F. LoValvo of the Museo di Scienze Naturali di Terrasini (PA).

The measurements of this specimen in mm are as follows:
Head/body: 175; Tail: 220; Hind foot: 32.8
Cranial – Condylobasal length: 42.6; Nasal Length: 15.9; Superior dental file 6.5; Lower mandible 24.2.

These measurements fall within the range of those given for *Rattus rattus* by Toschi (1965), Hufnagl (1972), Van Den Brink (1977), Niethammer & Krapp (1978), and Macdonald & Barrett (1993). See also Fig. 1.

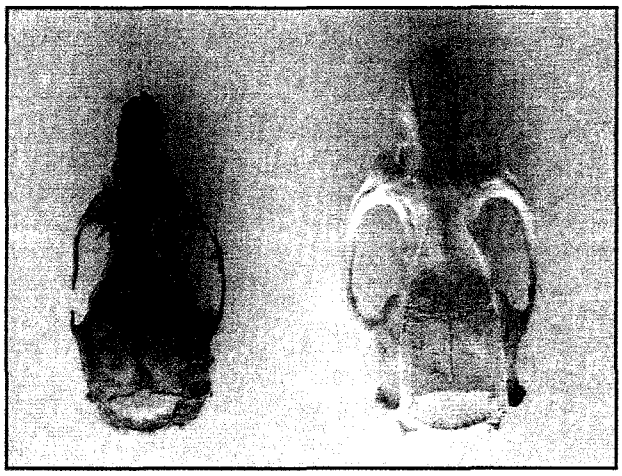

Fig. 1. Skull of *Rattus rattus* (left) taken from Fungus Rock and one (right) of *Rattus norvegicus* for comparison. Both skulls are deposited at the National Museum of Natural History, Mdina, Malta. *(Photo: Joe Sultana)*

The species could have reached the islet either by swimming (the shortest distance is at Ir-Ras at the north point of Dwejra Bay, a distance of *ca.* 17 m.), or more likely that it has been present since the 17th century, when cables set for the use of the 'basket ferry' joined Fungus Rock to Gozo. Rats are well known to be able to walk on tight ropes. In harbours mooring cones (rat excluders) are sometimes set on the mooring ropes to keep rats away from reaching ships.

In a recent publication Baldacchino & Schembri (2002) state that the Brown Rat *Rattus norvegicus* occurs on Fungus Rock, without giving any conclusive evidence. No mention of the presence of the Black Rat *Rattus rattus* on the islet is made. Unfortunately no systematic rat trapping programme has been undertaken on the islet or, as far as we are aware, anywhere else in the Maltese Islands, and the range and status of the two *Rattus* species are still very poorly documented.

Acknowledgements: We thank Prof. P.J. Schembri for confirming that the pellets found in May 1988 probably belonged to rats, Dr. F. LoValvo for confirming that the specimen was *Rattus rattus*, Dr Christian Stettmer and Bernard Jacquat for providing some of the literature referred to, the Environment Protection Directorate of MEPA for giving us permission to visit the islet, and Bernard Bonnici for helping us to climb on Fungus Rock.

(Accepted: 2nd November 2003)

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Tripterygion delaisi (Pisces, Perciformes, Tripterygiidae), a new species for the Maltese Islands (Central Mediterranean)

Mark-Anthony Falzon[4]

The family Triperygiidae (Eng. Threefin blennies) is represented by three species in the Mediterranean. Two of these have been recorded for the Maltese Islands. *Tripterygion tripteronotus* Risso 1810 (Malt: Budakkra rasha sewda) is common and widespread and was recorded by Gulia (1861), Despott (1919), Lanfranco (1993), and Falzon (1999). *Tripterygion melanurus melanurus* Guichenot 1845 (Malt: Bżaru sekond) was recorded for the first time by Falzon (*op. cit.*) and has since been found to be common and fairly widespread. This brief paper reports on a third species that has been found.

Tripterygion delaisi Cadenat and Blache 1971 (= *T. xanthosoma* Zander and Heymer 1971) is distributed in the Mediterranean and along the Atlantic coast from southern England to Senegal, Madeira, and the Canaries (Whitehead *et al.* 1986). The reproductive period lasts from May to July in the northern Mediterranean (*ibid.*) and April to July in the Mediterranean in general (Riedl 1991, Miller & Loates 1997). The following is the first record for the Maltese Islands.

One individual fish was observed by the author at a depth of *ca.* 2m at Mgarr ix-Xini, Gozo, on 3 May 2003 (p.m.). The habitat is a shady steep rock face characterised by algal growths and frequent crevices. The fish was noted to be very approachable and was observed closely over a span of about 5 minutes, in excellent light. Notes were taken on the spot.

Characteristics: Typical Tripterygiidae 'Gurnard-like' shape and dorsal fin in three sections, the first two with spiny and the last with soft rays. In this case the first rays of the second dorsal were greatly prolonged – a characteristic of territorial males (Whitehead *et al.* 1986). The coloration was also typical of territoriality. The body was of an intense lemon-yellow colour, contrasting greatly and very conspicuously with the black head and pelvic fins. Five very faint broad vertical bars could be made out. The edges to the dorsal fins (particularly the prolonged second) were blue. The dark spot on the caudal peduncle with an extension onto the base of the caudal finrays, which is typical of the species, was not clearly discernible; the absence of this character is a feature of territorial males (Riedl *op. cit.*). Size was about 70 mm.

The only species with which *T. delaisi* could be confused is *T. triperonotus*. However, males are quite unmistakeable during the reproductive season, since the colour of *T. tripteronutus* is a conspicuous red with a black head, while that of *T. delaisi* is yellow with a black head. The species is not known to have any colour variants (although *T. delaisi* was previously thought to be a yellow variant of *T. triperonotus*).

Two subspecies are recognised. The nominate is found in the Atlantic while *T. delaisi xanthosoma* is distributed in the Mediterranean. Although the behavioural and ecological data required definitively to tell these subspecies apart are not available at this stage, it is presumed that the individual observed belonged to *T. delaisi xanthosoma.*

I have since been informed that two other individuals were observed by divers on 27 April 2003 (a.m.) at Dahlet ix-Xilep, at a depth of 8 – 18m. Both displayed the coloration of territorial males (O. Cardona, pers. comm.).

It is proposed that the species be given the Maltese name 'Bżaru isfar'.

(Accepted: 9th September 2003)

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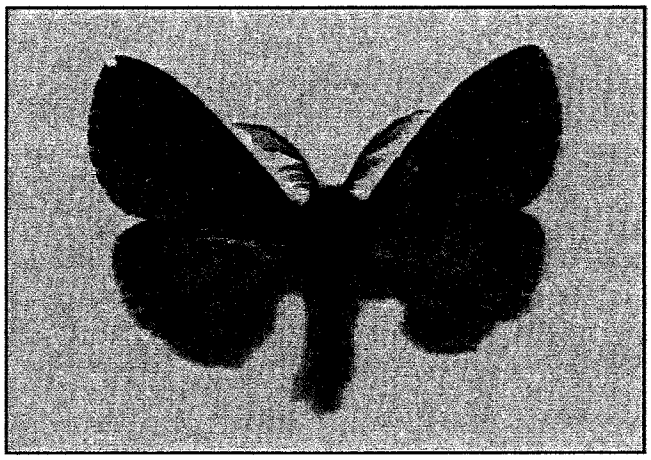
[4] "Posidonia", America Str., Naxxar Nxr 05, Malta.

First record of *Lymantria atlantica* (Rambur, 1837) (Lepidoptera:Lymantriidae) from the Maltese Islands

Paul Sammut[5]

The family Lymantriidae is represented in Europe by no less than 29 species (Karsholt & Razowski, 1996). In Malta three species had been previously recorded. *Orgyia trigotephras* Boisduval, 1828 is by far the commonest species. In this species, the female is apterous while the male is often seen during the day and is easily mistaken for a butterfly. *Euproctis chrysorrhoea* (Linnaeus, 1758) has been recorded on two occasions, once from Gnejna Bay on June 27, 1983 from 3 specimens by the author, and secondly by Anthony Seguna from a single specimen collected from Bingemma on June 3, 1993 (Sammut, 2000). The third species is *Casama innotata* (Walker, 1855) recorded from a single specimen collected by Anthony Seguna from Benghisa on October 23, 1987. The record of this last species from the Maltese Islands is the only record to date for all of Europe (Sammut, 2000).

A male specimen of the fourth species of Lymantridae, *Lymantria atantica* (Rambur, 1837), was taken at light from Wied Babu, Zurrieq by Denis Magro on August 30, 2002. The specimen is in the collection of Mr. Denis Magro.



This African species has been recorded for Europe from France, Spain, Corsica, Sardegna and Sicily (Karsholt & Razowski, 1996). It also occurs in North Africa (Seitz, 1913).

Little is known about the biology of this species. The eggs are laid in bark crevices. The larvae feed during the night on foliage of *Schinus*, causing great damage, and hide during the day. Adults are on the wing in June and are attracted to light. The species is reported to be migratory (Soures, 1948). Locally, the larval food plant has not been identified.

I propose the Maltese name "L-Imferfex ta' l-Atlantiku" for this species.

Acknowledgements: I thank Mr. Denis Magro for making the specimen available for study and Dr. Martin Honey of the Natural History Museum, London, for his help with identification of the species.

(Accepted: 17th October 2003)

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[5] 'Fawkner', Dingli Road, Rabat, RBT 07. farfett@onvol.net

THE CENTRAL MEDITERRANEAN NATURALIST

2003 - 2004

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