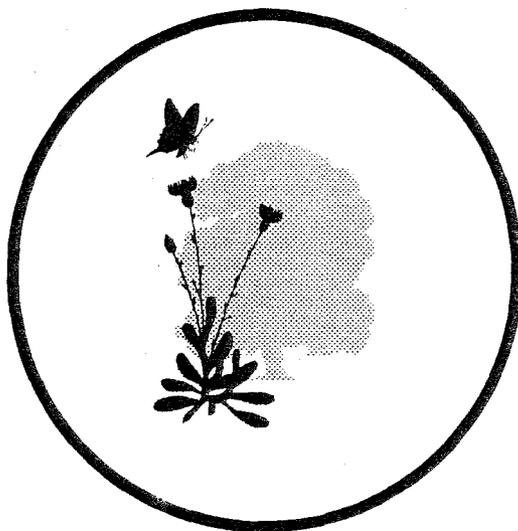

**THE
CENTRAL MEDITERRANEAN
NATURALIST**



Nature Trust (Malta)

VOLUME 3 PART 2

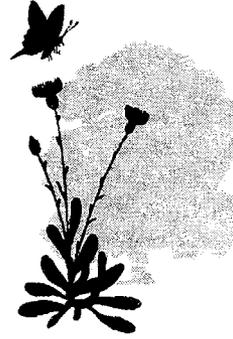
MALTA, DECEMBER 2000

THE CENTRAL MEDITERRANEAN NATURALIST

DECEMBER 2000

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Nature Trust (Malta)

During 1998, three non-Governmental organisations 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 efficient and 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 8 January, 1999. 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. Current activities include tree-planting and frog-conservation projects, the protection of indigenous trees, the fostering of eco-tourism and a nation-wide campaign against illegal dumping.

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

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PTINID BEETLES (COLEOPTERA, PTINIDAE) FROM THE MALTESE ISLANDS**Xavier Bellés¹ and David Mifsud²****ABSTRACT**

The following ten species of ptinid beetles are recorded from the Maltese Islands: *Dignomus brevipilis* (Desbrochers), *Dignomus reichei* (Boieldieu), *Ptinus (Gynopterus) variegatus* Rossi, *Ptinus (Pseudobruchus) spitzyi* Villa, *Ptinus (Heteroptinus) affinis* Desbrochers, *Ptinus (Ptinus) clavipes* Panzer, *Microptinus melitensis* Pic, *Mezium americanum* (Laporte), *Gibbium aequinoctiale* Boieldieu and *Gibbium psylloides* (Czenpinski). Of these, *Ptinus clavipes* was not previously recorded whereas *Gibbium aequinoctiale* was referred to as *G. boieldieui* (Levrat).

INTRODUCTION

The Ptinidae is a family of small insects commonly known as spider beetles, presently composed of some 70 genera and approximately 700 described species. Their distribution is cosmopolitan although they seem to be more abundant in the drier regions of the world (Philips, 2000). From a systematic point of view, ptinid beetles have been considered as a formal family within the Bostrichoidea (Crowson, 1967, 1981; Paulian, 1988) or as a subfamily of Anobiidae (Lawrence & Newton, 1995; Philips, 2000). In any case, ptinid beetles are a well defined group that seems to be monophyletic according to the recent studies by Philips (2000), which suggests that the consideration of them as a formal family may be not only practical but also reasonable from a biosystematic point of view. Morphological characters which distinguish Ptinidae from Anobiidae have been detailed by Crowson (1967), among others. Ptinids include specialized myrmecophiles, dung feeders and wood-boring species. Several species are often associated with stored products where they are considered as minor pests.

The first endemic Maltese ptinid was described by Pic (1903), under the name of *Microptinus melitensis*. This species was later included by Tonna-Barthet (1931) in a list of rare beetles peculiar to the Maltese Islands, and again cited by Cilia (1989) in the Red Data Book. However, the main contribution to the knowledge of Ptinidae from the Maltese Islands is the checklist of Coleoptera published by Cameron &

Caruana Gatto (1907), in which seven valid species of this family were cited.

Recent collections made by one of us (DM) allow an up to-date study of the ptinid beetles inhabiting the Maltese Islands. The results are presented below. Material has been deposited in the collections of the authors and at the Natural History Museum of Basel, Switzerland.

ANNOTATED LIST OF SPECIES***Dignomus brevipilis* (Desbrochers, 1875)**

Data from Malta. Recorded from Buskett and Attard by Cameron & Caruana Gatto (1907).

Material examined. MALTA, St. Thomas Bay (towards Munxar), 3 exs., under stone near coastal area, 20.v.1990 and 23.v.1994, leg. D. Mifsud.

Comments. The inclusion of this species under the genus *Dignomus* has been recently proposed by Bellés (1996). *D. brevipilis* has a West Mediterranean distribution (Pic, 1912; Bellés, 1996).

***Dignomus reichei* (Boieldieu, 1854)**

Data from Malta. Recorded from Gnejna (Cameron & Caruana Gatto, 1907).

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² Naturhistorisches Museum, Augustinergasse 2, CH-4001 Basel. SWITZERLAND.

The inclusion of this species under the genus *Dignomus* has been recently proposed by Bellés (1996). Although no recent records are available, the occurrence of *D. reichei* in Malta is probable, given that it has a distribution comprising Greece, Sicily and North Africa (Pic, 1912; Bellés, 1996).

Ptinus (Gynopterus) variegatus Rossi, 1794

Data from Malta. Recorded from Valletta by Cameron & Caruana Gatto (1907).

Material examined. MALTA, Birzebbuga, 1 ex., 27.iii.1994, leg. D. Mifsud; Marsa (Ghammieri), 7 exs., under bark of *Eucalyptus* trees, 7-28.xii.1993, leg. D. Mifsud; Msida (University gardens), 1 ex., 2.iv.1995, leg. D. Mifsud; Pembroke 2 exs., in private orchard, 27.iii.1990 and 6.v.1990, leg. A. Micallef.

Comments. *Ptinus duvali* Lareynie, 1852, which was also cited from Malta (Coll. Gatto) by Cameron & Caruana Gatto (1907), is a variety of *P. (G.) variegatus* (Pic, 1912) without formal taxonomic value. *Ptinus insularis* Desbrochers, mentioned from Malta in the original description (Desbrochers, 1871), was synonymised with *P. (G.) variegatus* (Pic, 1912). *P. (G.) variegatus* has a Palaearctic distribution (Pic, 1912).

Ptinus (Pseudobruchus) spitzyi Villa, 1838

Data from Malta. Recorded from Gnejna by Cameron & Caruana Gatto (1907).

Comments. Although no recent records are available, the occurrence of *P. (P.) spitzyi* in Malta is probable, given that it has a West Mediterranean distribution, comprising Corsica (Pic, 1912).

Ptinus (Heteroptinus) affinis Desbrochers, 1871 (figure 1)

Data from Malta. Recorded from Valletta by Cameron & Caruana Gatto (1907).

Material examined. MALTA, St. Thomas Bay (towards Munxar), 1 ex., 25.v.1994, leg. D. Mifsud; Hagar Qim, 1 ex., 22.x.1989, leg. D. Mifsud; Marsa (Ghammieri), 43 exs., under bark of *Eucalyptus* trees, 2-28.xii.1993 and 19.ii.2000, leg. D. Mifsud; Msida (University gardens), 1 ex., 13.xii.1994, leg. C. Farrugia; Bahrija, 2 exs., 12.v.1996, leg. D. Mifsud.

GOZO, Ramla, 1 ex., under stone near sand dune vegetation, 16.x.1997, leg. D. Mifsud.

Comments. *P. (H.) affinis* was described from Sicily by Desbrochers (1871) and later reported only from Malta (sic) by Reitter (1884). Pic (1912) mentions both localities, Malta and Sicily.

Ptinus (Ptinus) clavipes Panzer, 1792

Material examined. MALTA, St. Thomas Bay, 1 ex., 29.iii.1991, leg. D. Mifsud; Marsa (Ghammieri), 2 exs., in human habitation, 20.iv.1994 and 13.ii.1995, leg. D. Mifsud; Mdina, 2 exs., in old demolished building under pigeon dung, 17.ii.2000, leg. D. Mifsud.

Comments. The status of this species was revised by Moore (1957). *P. (P.) clavipes* frequently shows synanthropic habits, and its distribution is practically cosmopolitan (Hinton, 1941). There were no previous records of *P. clavipes* from the Maltese Islands.

Microptinus melitensis Pic, 1903 (figure 2)

Material examined. MALTA, Delimara, 1 ex., under stone near large accumulations of rabbit dung, 26.ii.1990, leg. D. Mifsud; Buskett, 1 ex., 17.xi.1995, leg. D. Mifsud; Mtahleb, 1 ex., in leaf litter under *Cistus monspeliensis*, 5.iv.1998, leg. D. Mifsud; Mellieha, 1 ex., in leaf litter under *Tetraclinis articulata*, 30.ix.1997, leg. D. Mifsud. GOZO, San Blas, 1 ex., in leaf litter under *Ceratonia siliqua*, 7.i.1995, leg. D. Mifsud.

Comments. *M. melitensis* is endemic to Malta (Pic, 1903). Cameron & Caruana Gatto (1907) reported *Microptinus reitteri* Pic (1895) from Imtahleb, as identified by Maurice Pic. However, Pic himself later stated that *M. reitteri* is known only from Sicily (Pic, 1912), whereas the *Microptinus* found in Malta is *M. melitensis*.

From these data we have inferred that Pic provisionally identified the material from Malta for Cameron and Caruana Gatto as *M. reitteri*, before discovering that the Maltese *Microptinus* belonged to a new species. Pic then described *M. melitensis* in 1903, but Cameron and Caruana Gatto still used the identification of *M. reitteri* determined by the French specialist before 1903.

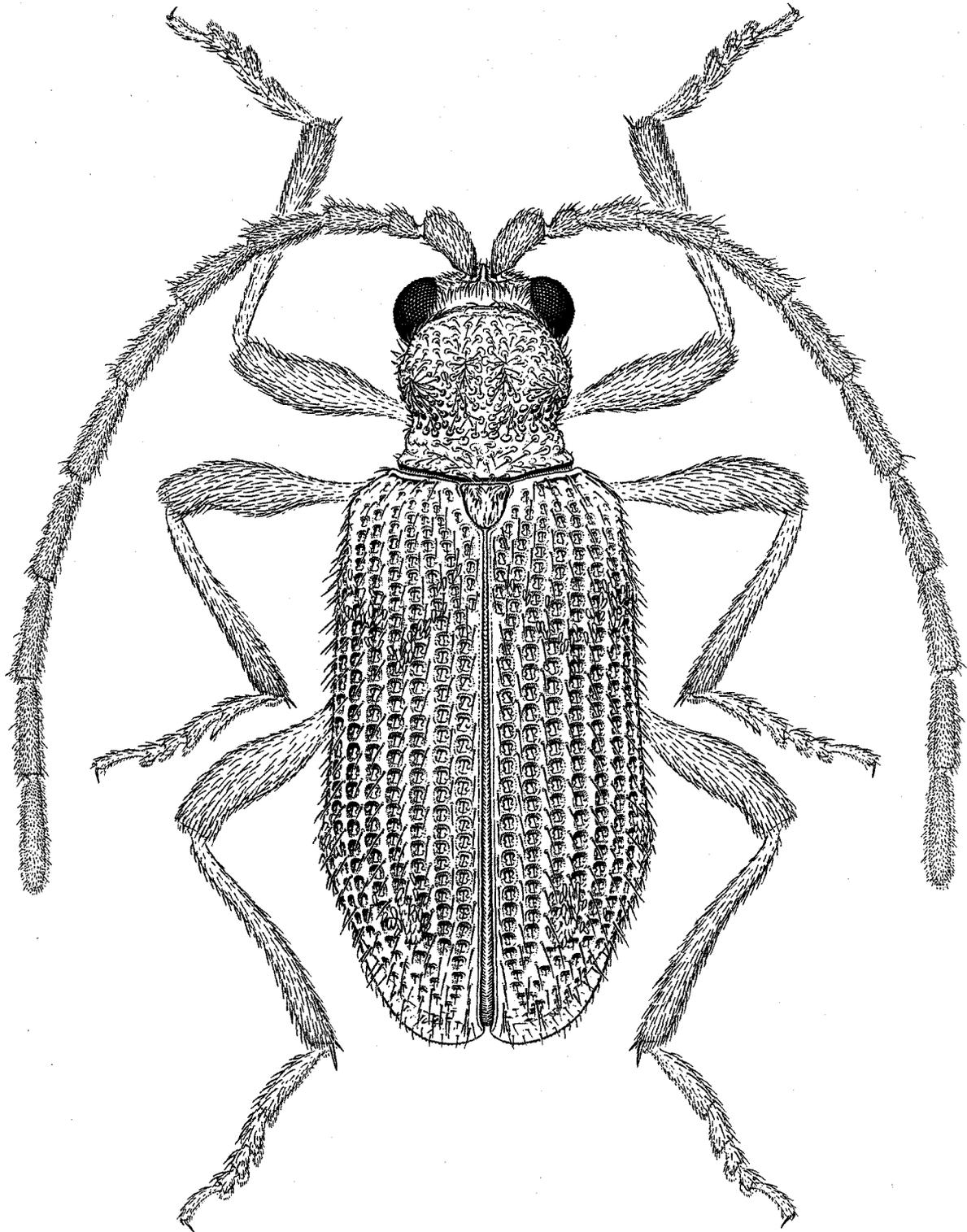


Fig. 1. Habitus of the male of *Ptinus (Heteroptinus) affinis* Desbrochers.

***Mezium americanum* (Laporte, 1840)**

Data from Malta: Recorded from "Malta" by Bellés (1985a)

Comments. It is a frequently synanthropic species with a practically cosmopolitan distribution (Bellés, 1985a)

***Gibbium aequinoctiale* Boieldieu, 1854**

Material examined. MALTA, Zejtun, 15 exs., in human habitation, 12.vii.1997, 20.ix.1997, 3.iii.1998, 6 and 20.iv.1998, 1.v.1998, 22.i.1999 and 18.ii.2000, leg. D. Mifsud; Marsa (Ghammieri), 8 exs., in human habitation, 8.x.1993, 15.vi.1994, 4 and 6.v.1995, 3.v.1996 and 8.vii.1997, leg. D. Mifsud.

Comments. There were no previous records of this species from Malta. However, the mention of *Gibbium boieldieui* Levrat, by Cameron & Caruana Gatto (1907) from Valletta, could be attributed to *Gibbium aequinoctiale*, given the relative similarity between both species. *G. boieldieui* is known from West Asia, including Turkey, although there are some old unconfirmed records from Greece and Malay archipelago (Bellés, 1985a).

The main characters to separate the two species, including the description of the respective male

genitalia, have been reported by Bellés (1985a).

The status of this species was revised by Bellés (1985a) and Bellés & Halstead (1985). Its distribution is practically cosmopolitan, although most of the records are concentrated in tropical or subtropical areas (Bellés, 1985a; Bellés & Halstead, 1985). It shows synanthropic habits (Bellés, 1985b).

***Gibbium psylloides* (Czenpinski, 1778)**

Data from Malta: Recorded from "Malta" by Bellés (1985a).

Comments: It is a typically synanthropic species distributed in the Mediterranean area (Bellés, 1985a; Bellés & Halstead, 1985).

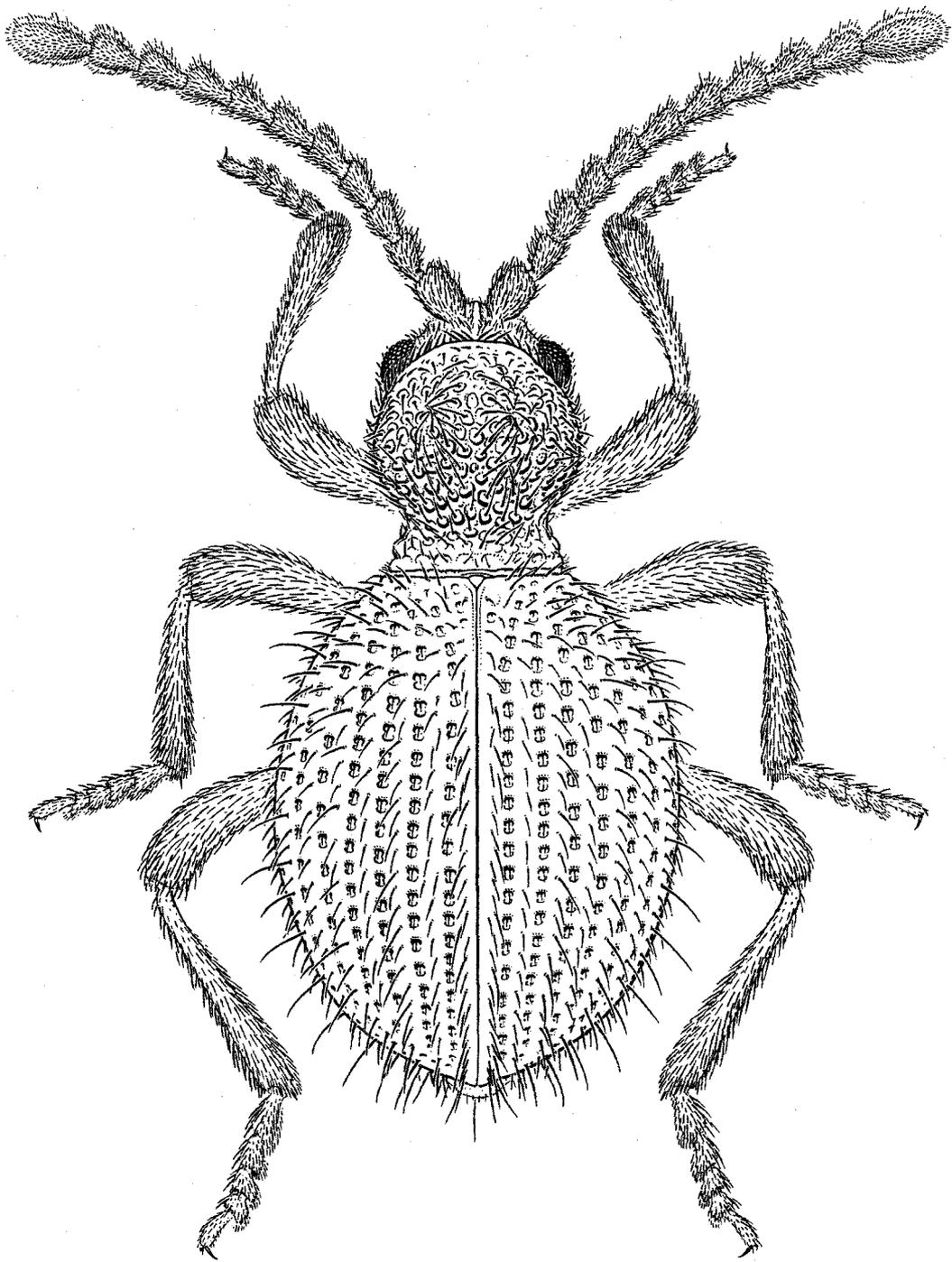
ACKNOWLEDGEMENTS

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1mm

Fig. 2. Habitus of *Microptinus melitensis* Pic.

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THE LANGURIIDAE (COLEOPTERA) OF THE MALTESE ISLANDS

David Mifsud¹

ABSTRACT

Four species of Languriidae are recorded from Malta: *Xenoscelis costipennis* (Fairmaire), *Leucohimatium arundinaceum* (Forskål), *Setariola sericea* (Mulsant & Rey) and *Cryptophilus integer* (Heer). Of these, *S. sericea* was not previously recorded from the Maltese Islands.

INTRODUCTION

The Languriidae is a relatively small family of beetles with 98 genera and 1051 described species (Leschen & Wegrzynowicz, 1998). The taxonomic history of the Languriidae is complicated because many of the currently recognized genera were at one time included in either the Cryptophagidae or the Erotylidae and the phylogeny of these beetles is not yet clear. In this account, the classification follows that proposed by Pakaluk et al. (1994) and Lawrence & Newton (1995), in which five subfamilies are recognised within the Languriidae. These are the Languriinae, Xenoscelinae, Setariolinae, Toraminae and Cryptophilinae.

The Languriinae, commonly known as Lizard Beetles, are the most numerous, with over 750 described species in the tropics. Seventy-five described species are included in the Toraminae which are mainly distributed in Central and South America. The Xenoscelinae and Cryptophilinae contain 191 and 33 described species respectively and have a world wide distribution. The Setariolinae is a monotypic subfamily with a South European representative.

Some members of the Languriidae, such as *Cryptophilus integer* (Heer) and *Leucohimatium arundinaceum* (Forskål), are considered as incidental pests of stored grain. Most Languriinae and some Xenoscelinae are strictly phytophagous, while the remaining taxa are either saprophagous, associated with decaying plant material, or mycophagous, or are pollen feeders.

Only three subfamilies of Languriidae are represented in the Maltese Islands. In the list of Coleoptera occurring in the Maltese Islands, Cameron & Caruna Gatto (1907) included three species. *Cryptophilus integer* (Heer) and *Leucohimatium arundinaceum* (Forskål) (= *elongatum* Erichson, 1846) under 'Cryptophagidae' and *Xenoscelis costipennis* (Fairmaire) under 'Cucujidae'. The Italian fauna of this family is represented by the same four species mentioned in this work. However, in the recent checklist of species of the Italian fauna (Angelini et al., 1995) *Cryptophilus integer* was omitted by mistake (Poggi, R., pers. comm.).

Material has been deposited in the following collections:

BMNH The Natural History Museum, London, UK,
CMM private Collection, Mifsud, Malta,
MCSN Museo Civico di Storia Naturale 'Giacomo Doria', Genova, Italy,
NHMB Naturhistorisches Museum, Basel, Switzerland.

ANNOTATED LIST OF SPECIES

Xenoscelinae Ganglbauer, 1899

Xenoscelis costipennis (Fairmaire, 1852)

Material examined. MALTA, St. Thomas Bay (towards tal-Munxar), 1 ex., 25.v.1994, leg. D. Mifsud (CMM); Bidnija, 2 exs., under decaying vegetation, 23.ii.1997, leg. D. Mifsud (CMM).

¹ Naturhistorisches Museum, Augustinergasse 2, CH-4001 Basel, SWITZERLAND.

Comments. *X. costipennis* was previously recorded from Gnejna (Cameron & Caruana Gatto, 1907). It has a Mediterranean distribution.

***Leucohimatium arundinaceum* (Forskål, 1775)**

Material examined. MALTA, 1 ex., (no additional data) (BMNH - Champion Coll.).

Comments. *L. arundinaceum* is almost cosmopolitan in distribution, and has been reported to feed on nutspores. It is frequently found associated with stored products.

Setariolinae Crowson, 1952

***Setariola sericea* (Mulsant & Rey, 1863)**

(Fig. 1)

Material examined. MALTA, Mtahleb, 15 exs., in leaf litter under *Cistus monspeliensis*, 2.v.1997, leg. D. Mifsud & R. Poggi (CMM, MCSN), 6 exs., same data but 5.iv.1998, leg. D. Mifsud (BMNH, CMM), 2 exs., same data but 13.i.1999 (CMM).

Comments. *Setariola sericea* has a South European distribution (Leschen & Wegrzynowicz, 1998). It has been found in leaf litter under *Cistus* shrubs. In the Maltese Islands, *Cistus* shrubs are rare and with a restricted distribution (Lanfranco, 1989). Thus, the status of this beetle is locally vulnerable. A population of *Cistus monspeliensis* is known also from Gozo (Wied Bingemma/Wied ir-Rihan area)

where, most likely, *S. sericea* also occurs. *S. sericea* was not previously recorded from the Maltese Islands.

Cryptophilinae Casey, 1900

***Cryptophilus integer* (Heer, 1841)**

Material examined. MALTA, 6 exs., (no additional data) (BMNH-Champion Coll.); Zejtun, 1 ex., 21.v.1989, leg. D. Mifsud (CMM); Ghammieri (Marsa), 2 exs., under bark of *Eucalyptus* trees, 16.xii.1993, leg. D. Mifsud (CMM); Siggiewi, 1 ex., 10.v.1998, leg. D. Mifsud (CMM); Buskett, 7 exs., under decaying hay and vegetation, 12.ii.2000, leg. D. Mifsud (CMM, NHMB); Bahrija, 1 ex., 20.vii.1997, leg. D. Mifsud (CMM).

Comments. *Cryptophilus integer* was recorded from Buskett (Cameron & Caruana Gatto, 1907). It is a minor pest of stored products but is also found in leaf litter and mouldy vegetation. It has a world wide distribution with most records concentrated in temperate regions.

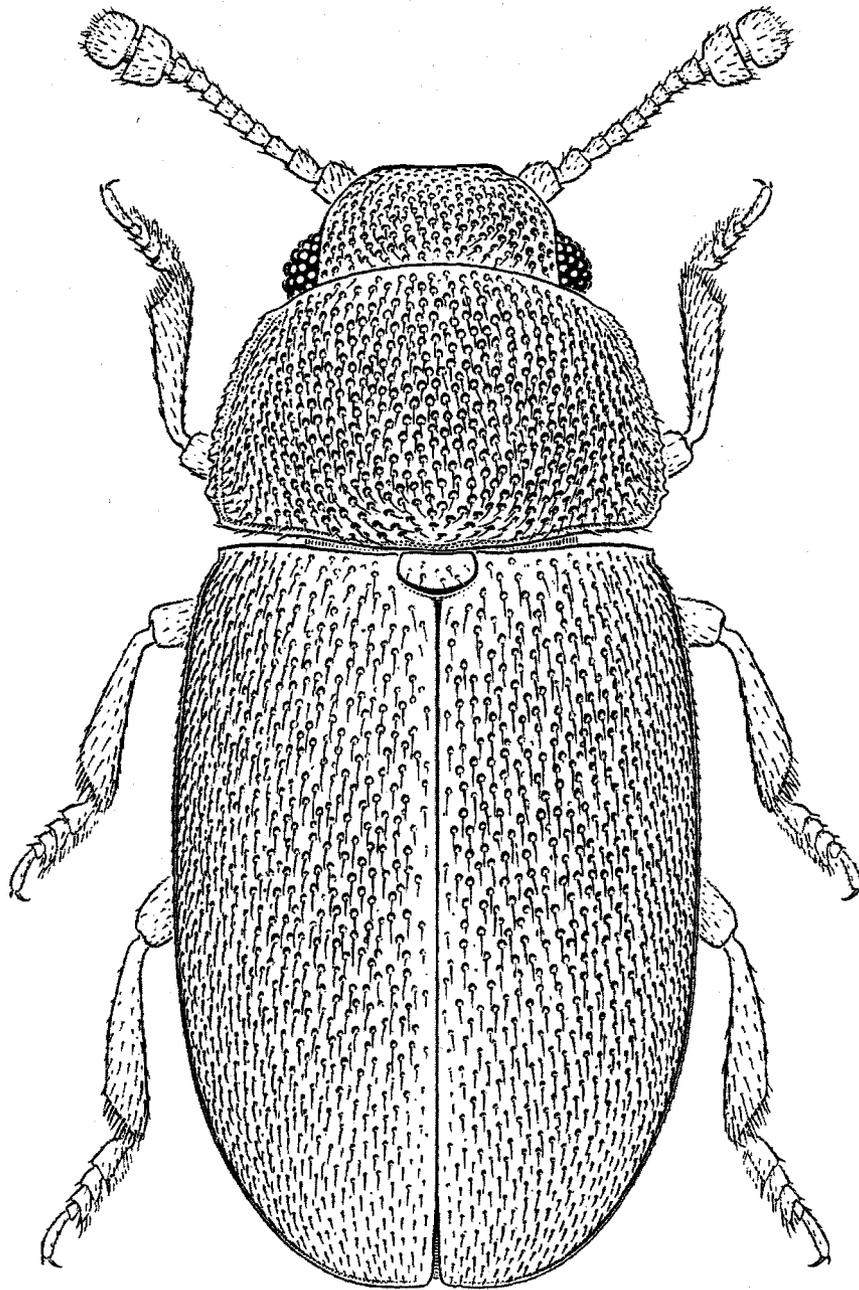
ACKNOWLEDGEMENTS

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1mm

Fig. 1 - Habitus of *Setariola sericea* (Mulsant & Rey, 1863)

Leschen, R. A. B. & Wegrzynowicz, P., (1998). Generic catalogue and taxonomic status of Languriidae (Cucujoidea). *Annales Zoologici*, **48** (3-4): 221-243.

Pakaluk, J., Slipinski, S. A. & Lawrence, J. F., (1994). Current classification and Family-group names in Cucujoidea (Coleoptera). *Genus*, **5** (4): 223-268.

THE PRESENCE OF GEKKONIDAE (REPTILIA: SQUAMATA) ON FUNGUS ROCK AND FILFLA (MALTESE ARCHIPELAGO)

Joe Sultana¹ and John J. Borg²

ABSTRACT

The presence of *Hemidactylus turcicus* (L.) on Fungus Rock is recorded for the first time, while its presence on Filfla is confirmed. Other specimens were observed on Filfla and one was tentatively identified as *Tarentola mauritanica* (L.).

INTRODUCTION

Two species of gecko, the Moorish Gecko, *Tarentola mauritanica* (L.) and the Turkish Gecko, *Hemidactylus turcicus* (L.), are found in the Maltese Islands, and are quite widespread (Despott 1913, 1915, Lanfranco 1955, Mertens 1968, Lanza 1973, Böhme 1981, Savona Ventura 1983a, 1983b, Lanfranco & Schembri 1989, Baldacchino & Schembri 1993, Baldacchino 1996, & pers. obs.). Savona Ventura (1983b) states that *Hemidactylus turcicus* appears to be very widespread in the Maltese Islands, being recorded from all islands and islets except General's Rock (Fungus Rock) at Dwejra, Gozo.

RECORDS FROM FUNGUS ROCK

On the 26th May 2000 we visited Fungus Rock primarily to collect data on the shearwaters (*Calonectris diomedea* and *Puffinus yelkouan*) breeding on the islet, as well as on the endemic race of the Maltese Wall Lizard *Podarcis filfolensis generalensis* and the parasitic plant of historical interest *Cynomorium coccineum*. While on the rock we discovered a small specimen of *Hemidactylus turcicus* hiding under a small boulder. We identified the species as it had claws on its five toes, while the adhesive pads did not extend to the toe-tips. The overall length of the specimen (from the tip of the head to the tip of the tail) was 70mm, while the length from the tip of the head to the cloaca was 34mm. This would appear to be the first record of this species on the islet.

RECORDS FROM FILFLA

Despott (1917) was the first to confirm the presence of Gekkonidae on Filfla. He states that two years earlier, during one of his "excursions" to the islet he "caught a glimpse of a member of the Gecko's family" which he could not "ascribe to any of the two species met with in Malta, but which might be the *Phyllodactylus europeus* which according to Giglioli is to be found here". The latter statement was taken from Gulia (1914) who had declared at the 9th International Zoological Congress in March 1913, that he could not confirm what E. Giglioli had suggested to him, viz. that *Phyllodactylus europaeus* should occur in the Maltese Islands. On a visit to Filfla, Mertens (1968) examined two specimens which he identified as the nominate race of the Moorish Gecko *Tarentola m. mauritanica*. Savona Ventura (1983a) mentions that both *Tarentola mauritanica mauritanica* and *Hemidactylus turcicus turcicus* are found on Filfla but he gave no details or records.

Since 1968 we have been visiting Filfla up to five times a year, mainly to monitor the population of seabirds breeding there. We have seen specimens of Gekkonidae on at least four occasions. One specimen, which was not identified as it could not be examined closely, was noted amongst the boulders beneath the cliffs on the night of 6-7th June 1992. Another, which was seen in a very narrow crevice on the plateau surface during daytime on 23rd May 1995, probably belonged to *T. mauritanica* as we had the

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impression that it had claws on only two of its toes. Following this, two other specimens, which were examined in the hand on 19th May 1997 (during daytime on the plateau surface), and on 5th August 1999 (at night beneath the cliffs) respectively, were definitely identified as *H. turcicus*. Two other gecko specimens, which could not be examined, were also seen in crevices beneath the cliffs on the latter date.

It is interesting to note that all the specimens we have seen on the two islets were always of approximately the same small size as the one measured on Fungus Rock. We could not ascertain whether the specimens we have seen were those of juvenile geckos or of small adults whose size was conditioned by the particular small-islet environment.

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NEW RECORDS FOR THE MALTESE FLORA: *ELEUSINE INDICA* (L.) GAERTNER SUBSP. *AFRICANA* (KENNEDY-O'BYRNE) S. PHILLIPS (POACEAE) AND *CENTRANTHUS MACROSIPHON* BOISSIER (CAPRIFOLIACEAE)

Edwin Lanfranco¹

ABSTRACT

The occurrence in Malta of *Centranthus macrosiphon* Boissier and of *Eleusine indica* (L.) Gaertner subsp. *africana* (Kennedy-O'Byrne) S. Phillips as adventive weeds is reported for the first time.

1. *Eleusine indica* (L.) Gaertner subsp. *africana* (Kennedy-O'Byrne) S. Phillips

Plants originating from the Marsa Sports Club, collected in August 1996 and submitted to me by Mr David Dandria turned out to be *Eleusine indica* (L.) Gaertner subsp. *africana* (Kennedy-O'Byrne) S. Phillips. They were growing as turf weeds.

In the summer of 2000 several other specimens belonging to this taxon were found growing in flower-pots in Sliema.

Eleusine indica subsp. *africana* is variously known as Yard grass, Crowfoot grass, Goosegrass and Crabgrass (Bews, 1929) and is a native of tropical Africa but is a widespread weed especially in tropical and subtropical climates. It is also more or less naturalised in several parts of the Mediterranean area.

The most obvious differences from subsp. *indica*, (which is not recorded in the Maltese islands) are the prominently ciliate ligule, lower glume with 2-3 nerves (as against one nerve) and a generally more robust habit (Cope & Hosni, 1991; Stace, 1995). It is suspected that, at least in the case of the Sliema specimens, the plants were accidentally introduced in the seed bank of the compost of imported ornamental plants.

Although this is the first record for this taxon from the Maltese Islands, Borg (1927) records *Eleusine coracana* (L.) Gaertn as a weed from San Anton Gardens in Attard. However this has not persisted and is long extinct. Borg recorded the plant as *Eleusine*

indica (L.) Gaertn. Var. *coracana* Gaertn. which he later "corrects" to "var. *coracasana* Gaertn." (Borg, 1935). This is known as Finger Millet (Ryves *et al.*, 1996) or African Millet (Bailey, 1949) as well as by numerous native names. It is widely cultivated as a cereal in India and elsewhere.

Specimens studied: Marsa Sports Club, Marsa, Malta, leg. David Dandria, viii.1996; Sliema, weed in flower pots, leg. Edwin Lanfranco, 20.vii.2000.

2. *Centranthus macrosiphon* Boissier

Several specimens of *Centranthus macrosiphon* Boissier were encountered at Ta' Qali on the 16th May 1996 where they were growing as weeds in a flowerbed.

The plants were all rather stunted so that they did not develop the thickened hollow stem characteristic of the species; however they were readily separated from the fairly frequent native *Centranthus calcitrapae* (L.) Dufresne because of their much longer corolla tube (6-8 mm as against 1-2 mm).

Centranthus macrosiphon is endemic to the south of Spain (Murcia and Andalucia) and northern Morocco (Guinea Lopez & Ceballos Jimenez, 1974). It is also naturalised in the vicinity of Naples and possibly in Pianosa (Pignatti, 1982).

Specimen studied: Ta' Qali (l/o Attard, Malta), weed in flowerbed, 16.v.1996, leg. E. Lanfranco. Deposited in the author's private herbarium.

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Note: Most floras place this and related taxa in the family Valerianaceae. However with a better understanding of phylogenetic relationships, thanks to macromolecular techniques, it is now apparent that the Valerianaceae, together with Dipsacaceae and most of the traditional Caprifoliaceae form one monophyletic clade (Judd *et al.*, 1999).

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FIRST RECORDS OF DIXIDAE (DIPTERA, NEMATOCERA) FROM MALTA.**Martin J. Ebejer¹****ABSTRACT**

Three species of Dixidae are recorded for the first time from the Maltese Islands: *Dixa nebulosa* Meigen, *Dixella attica* (Pandaziz) and *Dixella graeca* (Pandaziz).

INTRODUCTION

Few nematoceros Diptera (midges and gnats) have ever been recorded from Malta. These flies are generally associated with aquatic habitats and such habitats are restricted on these relatively arid islands. Freshwater with vegetation is almost non-existent in the hot months from the end of May to early October. The Dixidae is a small family of midges allied to mosquitoes (Culicidae). Only two of the six known genera occur in Europe and North Africa. Within this geographical area 16 species of *Dixa* Meigen, 1818 and 20 species of *Dixella* Dyar & Shannon, 1924 are known (Rozkošný, 1990).

Dixid flies, also known as meniscus midges, are dependant on an aquatic habitat for larval development. Some species also develop in urban gardens, utilising small water bodies especially those that have aquatic plants. The larva occupies the niche created by the meniscus at the edge of the surface film and it carries this with it as it moves on the substrate. It feeds on microorganisms and decaying plant debris filtering out the particles by using mouth brushes in a way similar to that used by the mosquito larva. Three species of Dixidae, based on an examination of over 250 specimens, are here recorded for the first time from Malta and Gozo. These species have been able to survive in a relatively hostile environment.

MATERIAL AND METHODS

The material, with the exception of two specimens, was collected by the author (MJE) and Dr Paul Gatt (PG) of Rabat, Malta. In the winter months, sweeping in suitable habitats was generally rewarded with good numbers of both sexes, although males predominated.

Most specimens are preserved in alcohol. For identification, selected male and female abdomens were removed and cleared in KOH before microscopic examination in glycerine on a slide. Identification was based on Disney, (1975, 1992) and Wagner *et al.*, (1992). All the specimens are either in the author's collection or in the private collection of Dr Gatt according to the person who collected the respective specimens. In the case of the two specimens collected by Mr Schembri, their depository is indicated by the initials of the author or of Dr Gatt.

***Dixa nebulosa* Meigen, 1830**

1 ♂, Buskett, 7.iv.1977, S. Schembri, (MJE).

This species, with its distinctive wing pattern, has been recorded only once. If this locality was the only site where it bred then it may well have become extinct since there have been significant changes to its habitat over the last 15 years. It is found throughout European countries and in North Africa, from Morocco.

***Dixella attica* (Pandaziz, 1933)**

1 ♂, Fiddien, 14.xii.1976, MJE; 1 ♂, Ghajn Rihana, 7.iii.1979, S.P. Schembri, (PG); 2 ♂♂ and 2 ♀♀, Fiddien, 5.iii.1991, MJE; 4 ♂♂ and 1 ♀, Fiddien, 11.v.1991, MJE; 2 ♀♀, Girgenti, 20.xi.1991, MJE; 1 ♂ and 1 ♀, Fiddien, 8.iv.1992, MJE; 1 ♂ and 1 ♀, Fiddien, 15.iv.1992, MJE; 1 ♀, Balzan (garden), 20.iv.1992, MJE; 1 ♀, Rabat, Fiddien, 15.iv.1992, PG; 1 ♀, Gozo, Wied ir-Ramla, 23.iv.1992, MJE; 4 ♂♂ and 1 ♀, Rabat, Fiddien, 10.v.1992, PG; 1 ♂,

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Chadwick Lakes, 29.x.1992, PG; 2 ♀♀, Rabat, Fiddien, 1.xi. 1992, PG; 2 ♂♂ and 3 ♀♀, Fiddien, 8.xi. 1992, MJE; 15 ♂♂ and 3 ♀♀, Rabat, Fiddien, 23.i.1993, PG; 2 ♂♂ and 4 ♀♀, Bahrija, 30.i.1993, PG; 1 ♀ and 2 larvae, Ghajn Rihana, 21.ii.1993, both larvae pupated after 2 days and 2 ♀♀ emerged on 27 February, PG; 7 ♂♂ and 4 ♀♀, Gozo, Wied ir-Ramla, 10.iv.1993, MJE; 1 ♀, Gozo, Wied ir-Ramla, 17.iv.1993, PG; 1 ♂ and 2 ♀♀, Gozo, Wied ir-Ramla, 17.iv.1993, PG; 5 ♂♂ and 5 ♀♀, Wied il-Qlejgha, 2.ii.1994, MJE; 3 ♂ and 1 ♀, Bahrija, 2.ii.1994, PG; 41 ♂♂ and 15 ♀♀, Ghajn Rihana, 5.ii.1994, PG; 6 ♂♂ and 1 ♀, Rabat, Fiddien, 3.iii.1994, PG; 1 ♂ Buskett, 27.iii.1994, PG; 16 ♂♂ and 6 ♀♀, Ghajn Rihana, 1.iv.1994, PG; 5 ♂♂ and 4 ♀♀, Bahrija, 2.iv.1994, PG; 1 ♂, Rabat, at window, 3.iv.1994, PG; 9 ♂♂ and 4 ♀♀ and 3 larvae, Ghajn Rihana, 4.xii.1994, 3 ♂ adults emerged on 8, 11 and 12 December, PG; 3 ♂♂ and 1 ♀, Wied Qannotta, 26.ii.1995, PG; 4 ♂♂ and 1 ♀, Wied Qannotta, 16.xii.1995, MJE; 6 ♂♂ and 2 ♀♀, Wied Qannotta, 18.iii.1996, MJE; 13 ♂♂ and 4 ♀♀, Zebbieh, Wied Ghajn Rihana, 3.iii.1997, MJE.

A common and widespread species occurring throughout the cooler months on Malta and Gozo. It occurs in several western European countries

including Greece. It is also known from Israel, Tunisia and Algeria.

Dixella graeca (Pandaziz, 1937)

1 ♀, Attard (garden), 21.xii.1976, MJE; 1 ♂ and 1 ♀, Fiddien, 5.iii.1991, MJE; 3 ♂♂ and 1 ♀, Girgenti, 20.xi. 1991, MJE; 4 larvae, Rabat, Fiddien, 15.iv.1992, PG; 1 ♂ and 1 ♀, Fiddien, 11.v.1992, MJE; 3 ♂♂, Bahrija, 30.i.1993, PG; 1 ♀, Wied il-Ghasel, 4.ii.1993, PG; 1 ♂, Bahrija, 8.iv.1993, PG; 2 ♂♂, Ghajn Rihana, 4.ii.1994, PG; 1 ♂, Ghajn Rihana, 2.iv.1994, PG; 1 ♂ and 5 ♀♀, Bahrija, 2.iv.1994, PG; 2 ♂♂, Buskett, 27.xi.1994, PG; 1 ♂, Bahrija, 24.xii.1998, MJE.

A small dark species easily recognised by the male genitalia. It is less widespread and less frequent than the foregoing species. Damp, shaded habitats seem to be preferred. Known from Italy and Greece.

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REDISCOVERY OF *LOTUS HALOPHILUS* BOISSIER ET SPRUNER (FABACEAE) FROM THE ISLAND OF COMINO (MALTA, CENTRAL MEDITERRANEAN)**Edwin Lanfranco¹ and Darrin T. Stevens²****ABSTRACT**

Surveys were recently carried out at selected sites in the Maltese Islands in order to rediscover the presumably extinct *Lotus halophilus*. The rediscovery of this species is reported, reconfirming the presence of this taxon in the Maltese Islands after more than 70 years.

INTRODUCTION

Lotus halophilus Boissier et Spruner (= *Lotus pusillus* Viviani non Medicus), the Sand Restharrow, is native to the central and eastern Mediterranean (Greuter *et al.*, 1989) and is generally restricted to coastal areas, particularly to sand dunes. It has been historically reported from various parts of Malta, Gozo and Comino, namely from the *Marfa* peninsula and *Mellieha* in northern Malta (Sommier & Caruana Gatto, 1915; Borg, 1927); *Qbajjar* (Borg, 1927), *San Blas* (Borg, 1927) and *ir-Ramla l-Hamra* (Duthie, 1874; Gulia, 1875; Sommier & Caruana Gatto, 1915; Borg, 1927) from northern Gozo; and from *il-Qala ta' Santa Marija* (Borg, 1927) and other, often unspecified, sites in Comino ("on sandy ground by the sea" - Duthie, 1874; "verso il centro dell'isola" - Sommier & Caruana Gatto, 1915; and "on the rocky hills around it [referring to *il-Qala ta' Santa Marija*] and along the valley" - Borg, 1927).

However, these records have remained unsubstantiated for over 70 years, and the species was considered as either possibly extinct or a misidentification for *Lotus cytisoides* L., which is known from the same localities. For this reason, the species was not included in Lanfranco (1989).

The authors undertook different surveys in most of the areas where this species has been historically recorded, and a few individuals of this species were

rediscovered by one of the authors (DTS) in February 1998 on sandy soil adjacent to the extant sand dunes of *il-Qala ta' Santa Marija* in Comino. The species was however identified with certainty only in April 1998, when the plants were observed in flower and fruit by both authors.

The species was accompanied by *Lotus cytisoides* L., *Pancreatium maritimum* L., *Euphorbia pinea* L. and *Plantago crypsoides* Boissier. Other species in the vicinity included *Cakile maritima* Scopoli [including subsp. *integrifolia* (Hornemann) N. Hylander ex Greuter & Burdet], *Echium arenarium* Gussone, *Inula crithmoides* L., *Polycarpon diphylum* Cavanilles and *Tamarix africana* Poir. Parts of a fruiting individual were collected in April 1998 and are deposited in the private herbarium of one of the authors (EL).

Surveys carried out by the authors in the remaining sand dunes of the Maltese Islands where this species had been reported have yielded negative results. In fact, the extant relict sand dune ecosystems of the *Marfa* peninsula (namely *ir-Ramla ta' l-Armier* and *ir-Ramla tat-Torri*), *Mellieha* (referring to *Ghadira*), *ir-Ramla tal-Mixquqa* and *ir-Ramla l-Hamra* are all heavily degraded (Anderson & Schembri, 1989), and many species confined to these areas are either possibly extinct [e.g. *Ammophila littoralis* (Beauvois) Rothmaler, *Otanthus maritimus* (L.) Hoffmannsegg & Link and *Valerianella microcarpa*

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Loiseleur] or on the verge of extinction [e.g. *Calystegia soldanella* (L.) Roemer & Schultes, *Ononis variegata* L. and *Pseudorlaya pumila* (L.) Grande]. Surveys at *il-Qbajjar* have also yielded negative results, possibly because the coastal area is now heavily exploited for recreational purposes, and has been greatly modified since the records of Borg (1927).

Past records also mention *Lotus halophilus* as a host to the endemic Maltese Sand Broomrape, *Orobanche densiflora* Salzmann forma *melitensis* Beck (Sommier & Caruana Gatto, 1915; Borg, 1927; Haslam *et al.*, 1977). Nevertheless, the authors have not observed this broomrape species in Comino, and have never observed it parasitising *L. halophilus*. However it has always been found parasitising *Lotus cytisoides* (Lanfranco, 1989), and is still frequent at *ir-Ramla tat-Torri* and the nearby *Ahrax garrigue*.

Despite previous records, which gave it as present in most sand dune ecosystems, and report it as "*abbondante verso il centro dell'isola*" [referring to Comino] (Sommier & Caruana Gatto, 1915), it seems that currently *L. halophilus* has a very restricted distribution in the Maltese Islands, and is possibly confined to this very small area of Comino, which covers less than 5m² in extent. The species is hence critically endangered on a national scale since,

in addition to the plant's rarity, the site is a popular beach with considerable visitor pressure; moreover, the site is also in close vicinity to an official camping area.

The area where this species has been rediscovered is legally protected by Government Notice 401 of 1996, as provided by the Development Planning Act (Act I of 1992).

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TINODEMUS MIFSUDI SP. N. (COLEOPTERA, PHALACRIDAE) FROM MALTAZdeněk Švec¹**ABSTRACT**

Tinodemus mifsudi sp. n. from Malta is described. The genus *Tinodemus* Guillebeau, 1894 is recorded from Europe for the first time. Systematic position of the genus *Tinodemus* is briefly indicated. *Stilbus polygramma* Flach, 1888 is transferred to the genus *Tinodemus*.

INTRODUCTION

Since 1894 when Guillebeau erected the genus *Tinodemus* describing and designating the type species *T. grouvellei* Guillebeau, 1894 no data or additional information on the genus was published. Through the kindness of David Mifsud (Basel), I had an opportunity to study a collection of Phalacridae from the Maltese Islands. Among the material, there were three specimens not belonging to any of the hitherto known Old World genera. I identified these as a species belonging to the genus *Tinodemus* Guillebeau, 1894. To date, four described species from South America are included in the genus *Tinodemus*. The African species of the genus are currently under revision.

RESULTS

According to present knowledge, the genus *Tinodemus* should be placed in the subfamily Phalacrinae. The examination of the type species - *Tinodemus grouvellei* Guillebeau, 1894 showed strong affinity to the genus *Stilbus* Seidlitz, 1872 and its allies. At least four genera - *Stilbus*, *Tinodemus*, *Nesiotus* Guillebeau, 1896 and *Podoces* Guillebeau, 1894 seem to be forming a group sharing important characters, mainly the similar meso- and metasternal structures, length ratios of segments of hind tarsi, presence of metasternal lines and shape of the ultimate segment of maxillary palpi.

The relationship between the above mentioned genera will be discussed in the forthcoming work reviewing the African species of the genus *Tinodemus*.

Tinodemus polygramma (Flach, 1888); **comb. n.**

Stilbus polygramma Flach, 1888: 75

Stilbus polygramma, Švec, 1992: 435

Distribution Algeria, Egypt, Italy including Sicily, Spain (Gibraltar), Israel, Syria and Turkey. *T. polygramma rubidus* (Flach, 1889) was described from Japan.

Remarks The examination of the type species of the genus *Tinodemus* showed that *Stilbus polygramma* agreed with all generic characters of *Tinodemus*, mainly, the shape of metasternal lines and aedeagus. Therefore the species is here transferred to the genus *Tinodemus*.

Tinodemus mifsudi sp. n.

TYPE MATERIAL

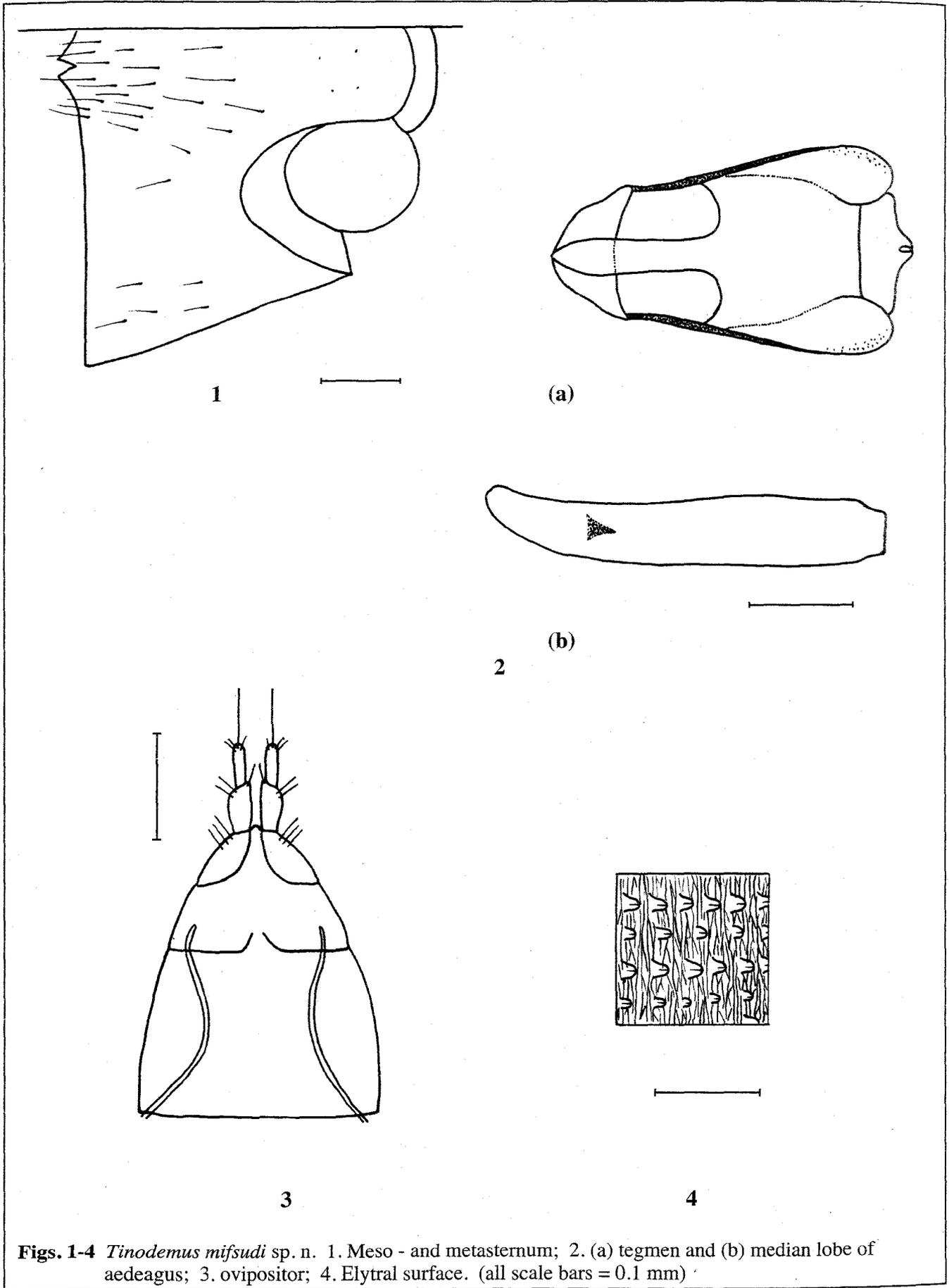
Holotype, ♂, MALTA, Bahrija, 16.vii.1997, leg. D. Mifsud; paratypes, 1 ♀, same data as holotype; 1 ♀, MALTA, Bahrija, 24.vii.1997, leg. D. Mifsud.

The holotype is deposited in the collection of the Naturhistorisches Museum, Basel, the paratypes in Mifsud's and Švec's collections.

DESCRIPTION

Length of body 1.4 - 1.5 mm, in holotype 1.4 mm, head 0.1 mm, pronotum 0.4 mm, elytra 0.9 mm, antenna 0.4 mm, maximal width of head 0.5 mm, pronotum 0.8 mm at base, elytra 0.8 mm just behind base.

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Figs. 1-4 *Tinodemus mifsudi* sp. n. 1. Meso- and metasternum; 2. (a) tegmen and (b) median lobe of aedeagus; 3. ovipositor; 4. Elytral surface. (all scale bars = 0.1 mm)

Body oblong oval, shiny, dorsum dark brown, clypeus red-brown, elytra gradually lighter with red-brown posterior half. Legs, antennae and mouthparts yellow. Venter reddish yellow.

Head. Without microsculpture. Finely and sparsely punctured. Punctures spaced by 6-8 or more times their own diameters.

Length ratios of antennal segments 2-11 in holotype (segment 2 equal to 1.0): 1.0 - 0.6 - 0.4 - 0.4 - 0.4 - 0.4 - 0.4 - 0.9 - 0.8 - 1.6. The same ratios of width: 1.0 - 0.5 - 0.5 - 0.5 - 0.5 - 0.5 - 0.7 - 1.3 - 1.3 - 1.5. The same ratios of width:length of antennal segments 2-11: 0.8 - 0.6 - 1.0 - 1.0 - 1.0 - 1.0 - 1.3 - 1.1 - 1.3 - 0.7. Segments of antennal club very feebly asymmetric..

Pronotum. Without microsculpture. Finely, sparsely and irregularly punctured. Punctures separated by about 6-10 or more times their own diameters. Puncturing denser and more distinct postero-laterally. Base feebly bordered at its middle third. Posterior angles slightly sharp with closely rounded tip in dorsal view; slightly blunt closely rounded in lateral view.

Scutellum. Without puncturation; smooth.

Elytra. Widest just behind shoulders; gradually roundly narrowed posteriorly. Both lateral margins simultaneously invisible in dorsal view. Area between anterior margin of elytra and basal line running from shoulders to scutellum covered by oblique strigosites.

All elytral surface microsculptured, with transverse very long narrow cells. Sutural stria reaching anterior third of elytral length. Interval between suture and sutural stria flatly raised. With distinct regular rows of widely opened E-shaped punctures disappearing toward base becoming simply pointed on anterior quarter of elytral length. E-punctures become shallower and wider resembling transverse wrinkles with short central setae posteriorly and laterally. Wrinkle-shaped lateral and distal punctures connecting in some places with their lateral neighbors. Each interval with row of smaller punctures similar to those in primary rows. Discal E-

shaped punctures of primary rows separated transversely by about 1 times their own diameter from punctures of interval rows and by about 0.75 times their own diameter longitudinally (Fig. 4). Smaller and sparser punctures of interval rows spaced by about 2 times their own diameter longitudinally.

Prosternal process. Sharply edged posteriorly.

Meso- and metasternum. As in Fig. 1.

Legs. Anterior tibiae with two closely standing spurs latero-distally. Segments 2 and 3 of anterior tarsi slightly widened in male. Middle tibiae distinctly curved; hind tibiae straight.

Genitalia. Male genitalia as in Figs 2a, 2b. Ovipositor as in Fig. 3.

Variability. Pronotum brown; elytra gradually lighter with posterior third of their length red-brown in paratypes.

Differential diagnosis. *Tinodemus mifsudi* sp. n. is similar to *T. polygramma* (Flach, 1888) sharing the well developed elytral rows of E-punctures. It differs by punctures of interval rows smaller than those in primary rows while interval punctures are of the same size in *T. polygramma*.

The male genitalia of the two species are also distinctly different.

Derivatio nominis. The species is named after its collector.

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MEDICINAL AND OTHER LEECHES (ANNELIDA, HIRUDINEA) IN THE MALTESE ISLANDS

Charles Savona-Ventura¹, Roy T. Sawyer² and Patrick J. Schembri³

ABSTRACT

The identity and possible provenance of the leeches used medicinally in the Maltese Islands since the sixteenth century and particularly during the nineteenth century is discussed. Two haematophagous species have been identified as possible medicinal imports. Five other non-medicinal species of leeches have been identified as either presently occurring in the Maltese Islands, or as having been possibly introduced in the past.

INTRODUCTION

Leeches have been used medically for centuries. In Europe the use of leeches to drain off blood reached its height of popularity in the 19th century. In the Maltese Islands, the first definite documented record of the use of leeches in medicine dates to the 16th century (Parisi, 1592). After this there is increasing documentation that haematophagous leeches were regularly used for medicinal purposes throughout the subsequent centuries, and especially in the nineteenth. Their use persisted until the early decades of the twentieth century (Savona-Ventura *et al.*, in prep.).

This paper discusses the identity and provenance of the leeches that may have been used for medical purposes in Malta since the sixteenth century. It also reviews the various local and introduced leeches, updating the list given by Schembri (1986).

Records of leeches from the Maltese Islands

No leech species capable of sucking human blood is today native to the Maltese Islands. The presence of wild leeches in the Maltese Islands was first recorded in 1913, however the species concerned were not identified (Gulia, 1913).

To date, the species listed below are known to occur or have probably been imported into the Maltese Islands.

HIRUDINIFORMES

Family: Hirudinidae

Hirudo medicinalis Linnaeus, 1758 - European Medicinal Leech

Previous records: Schembri (1986).

Geographical distribution: Formerly this species' range extended from western and southern Europe to the Ural Mountains and the countries bordering the eastern Mediterranean. Today it has become extinct or endangered throughout most of its original range.

Comments: The Medicinal Leech was probably imported into Malta for medicinal purposes from European sources. A definite instance of the importation of the Medicinal Leech from Sicily occurred in the 1960s when a doctor of Sicilian origin prescribed the application of leeches over the hypochondrium of an elderly man suffering from severe congestive heart failure (Schembri, 1986; G. Zammit Maempel, personal communication 16/11/1998). However, no preserved specimens are today available for study in any of the biological collections in Malta.

Hirudo troctina Johnson, 1816 - Algerian Dragon

Previous records: none.

Geographical distribution: Originally described from Algeria, Tunisia and Morocco.

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Comments: This poorly characterised species was possibly imported into Malta for medicinal use during the 19th century from Tunis and Bone in North Africa (Medical & Health Archives, 1842-47). A further possible reference to the importation of medicinal leeches from an unspecified North African French protectorate is recorded in a Maltese historical novel (Preca, 1900). No preserved specimens are today available for study in any of the biological collections in Malta.

Limnatis nilotica (Savigny, 1820)

Previous records: Schembri (1986).

Geographical distribution: circum-Mediterranean.

Comments: In the past, leeches have reportedly been introduced into Malta accidentally with imported cattle. These leeches were often found in the drinking troughs used by the animals (e.g. Birkirkara, Malta in the 1930s), being deposited in the troughs when the drinking animals snorted. These leeches are presumed to have been *Limnatis nilotica* (Schembri, 1986; G. Zammit Maempel, personal communication 16/11/1998). However, no preserved specimens are today available for study in any biological collection in Malta. In the mid-1930s (1936-37) bovines were imported to Malta mainly from Yugoslavia (62.2% of bovine imports) and Bulgaria (20.8%). Other imports came from Tunis (6.3%), Poland (5.2%) and Turkey (4.0%), with minor contributions from Algeria (0.8%), Rumania (0.6%), Albania (0.1%) and England (0.01%) (Mercieca, 1937-38). *Limnatis nilotica* parasitises frogs but will suck mammalian blood. With poorly developed mouthparts, it is unable to pierce mammalian skin and therefore attaches itself to the soft buccal and nasal mucosa. The biology of this species makes it a very unlikely candidate for use as a medicinal leech.

Family: Haemopidae

Haemopsis sanguisuga (Linnaeus, 1758) - Horse Leech

Previous records: Schembri (1986).

Geographical distribution: Western Palaearctic – common in most of Europe, including Italy and Sicily. Known also from the Atlas Mountains in Morocco. In the Maltese Islands it is known from one locality in Gozo (Wied tal-Lunzjata), where there is perennial running water.

Comments: This species, which superficially resembles *Hirudo medicinalis*, does not suck blood. It is an amphibious macrophagous predatory leech. There is no evidence to indicate that this species is not indigenous. Although fairly common at its site of occurrence, this species is overall rare in the Maltese

Islands and is considered as 'vulnerable' in the *Red Data Book for the Maltese Islands* (Schembri, 1989).

ERPOBDELLIFORME

Family: Erpobdellidae

Barbronia ?assiuti Hussein and El-Shimy, 1982

Previous records: none, but see Schembri (1992).

Geographical distribution: known only from the type locality in Egypt.

Comments: This species (tentatively identified as *B. assiuti*) was accidentally imported into Malta with tropical freshwater fish and on occasion relatively large populations have become established in heated tropical aquaria. It is predatory on benthic invertebrates. There is no evidence that this species has established itself in the wild in the Maltese Islands.

RHYNCHOBDELLIDA

Family: Glossiphoniidae

Batracobdella algira (Moquin-Tandon, 1846) - Frog Leech

Previous records: Schembri (1989, 1992).

Geographical distribution: North Africa, Iberian Peninsula, Balearic Islands, Corsica and southern Europe including the Crimea.

Comments: This species is an ectoparasite of various frogs and urodeles, including the Painted Frog *Discoglossus pictus*, which is the only amphibian in the Maltese Islands. This leech has only been recorded once from Malta, from a garden pond, and it is not known if it is a true native or has been accidentally introduced.

Family: Piscicolidae

Pontobdella ?muricata (Linnaeus, 1758) – Skate Leech

Previous records: Schembri (1995).

Geographical distribution: Mediterranean and East Atlantic.

Comments: This marine species is occasionally found attached to the gills or body of skates *Raja* spp. and other fish.

DISCUSSION

Since no leeches haematophagous on mammals have been described as being found in the wild on the

Maltese Islands, it must be presumed that the use of these animals for medicinal purposes required their importation. There is to date no information as to the source of leeches before the nineteenth century, but historical sources suggest that the major trade links included most of the cities around the Mediterranean littoral, but little contact with North African countries (Mallia-Milanes, 1971; Vassallo, 1997). It is thus likely that the medicinal leeches imported during these centuries were the European Medicinal Leech *Hirudo medicinalis*. Trade-links changed significantly at the turn of the eighteenth century when the Islands fell under British dominion. Maltese mercantile interests abroad started being provided for by Great Britain's wider and better-organised consular system. During the nineteenth century, the leeches used in the Maltese charitable institutions were purchased after a public call for tenders was issued. The contractor, who had to submit a sample of fifty leeches before being awarded the contract, bound himself to supply the quantity required for a whole year (Anon., 1884). Interruptions in the provision of leeches sometimes occurred either because of their inferior quality, or because of the exhaustion of the reserve stock, or because of delay in their importation from Tunis and Bone on account of bad weather (Medical & Health Archives, 1842-47). The owners of merchant ships reportedly imported the medicinal leeches to Malta. In 1900 the Maltese novelist A. Preca records a fictional dialogue between two merchant ship owners in a Maltese harbour setting in *circa* 1885. One owner remarks that he had imported leeches from a French protectorate ("*Kala Franza*"). These he had bought from an Arab who had supposedly collected them himself by the simple expedient of putting his bare leg in the mud near the river's edge (Preca, 1900). The species reportedly imported from Tunis and Bone in the nineteenth century may have been the North African Leech *Hirudo troctina*. Early accounts refer to this species as originating from 'western North Africa', but it has barely been mentioned for about 150 years. The species imported from Sicily in the 1960s was most likely *Hirudo medicinalis*.

The modern Maltese word for leech is *SANGISUG*. The Maltese language is generally considered to be a mixed Romance/Semitic one. '*Sangisug*' is of Romance derivation and means 'bloodsucker' (cf. Italian '*sanguisuga*'; Latin '*sanguisuga*') (Schembri, 1995; Aquilina, 1987). The original Semitic Maltese word for leeches which had apparently fallen into disuse by the nineteenth century has been recorded in several 18th century dictionaries as "*Għalaq*" (plural "*egħilqa*") meaning 'handle', 'leech', or 'something that hangs on to something else'. The derivation is from the Arabic root "gh-l-q" (cf. Arabic "*għalaqa*") which means 'to hang on to something' (Thezan, c.1721; Agius de Soldanis, c.1750; Vassali, 1796).

The presence of a Semitic word for leeches in the Maltese language may reflect the possibility that leeches were imported to Malta even prior to the sixteenth century, when the Arabic influence on the Maltese language was more dominant. It may also suggest that these animals may have been previously indigenous to the Maltese Islands. There is definite palaeontological, archaeological, toponymic and historical evidence for the past presence of freshwater and brackish water wetlands in Malta. With the extensive alteration of habitat that has occurred on the islands over the centuries, the wetland-associated biota has become rare in Malta and some species, including leeches, may even have become extinct (Schembri and Lanfranco, 1993; Haslam and Borg, 1998).

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PRELIMINARY INVESTIGATIONS INTO THE VERTICAL STRUCTURE OF PROPAGULE BANKS OF TEMPORARY FRESHWATER ROCKPOOLS IN THE MALTESE ISLANDS

Sandro Lanfranco¹, James Callus², Stephen Cilia³, Howard J. Zammit⁴

ABSTRACT

The vertical structure of the propagule bank of five angiosperms (*Elatine gussonei*, *Damasonium bourgaei*, *Callitriche truncata*, *Ranunculus saniculaefolius*, *Zannichellia palustris*) and one charophyte (*Chara vulgaris*) was studied in eight ephemeral autumnal rockpools from two localities in the Maltese Islands. Distribution of seeds and oöspores was distinctly non-uniform, with 94% of propagules being located in the top 4cm of sediment. Propagules that were recovered from depths exceeding 4cm are unlikely to have been buried *in situ* but are probably due to percolation from the surface during the dry season when cracks and fissures in desiccated sediment provide such a route. Operation of this process is indicated by over-representation of the smallest propagules in the deepest strata. The presence of large numbers of propagules in the surface layers is adaptive, facilitating reception of germination cues and attainment of the soil surface by young shoots. However this strategy also exposes propagules to predation as well as to high temperatures during the dry season. The data obtained in the present study suggest that quantification of contributions to and losses from the propagule bank should be the focus of subsequent work aimed at constructing a predictive model of the population dynamics of these species.

INTRODUCTION

Temporary freshwater pools of the Maltese Islands are restricted to outcrops of karst terrain. The distribution of pools is limited by the relative scarcity of such terrain while the high insularity of the pool habitat implies that resident organisms restricted to these pools would also be relatively infrequent in occurrence and therefore of significance for conservation. As such, a high proportion of obligate hydrophytes recorded from temporary freshwater rockpools in the Maltese Islands are included in the Red Data Book for the Maltese Islands. Allocation of these hydrophytes to IUCN Red List categories (Species Survival Commission, 1994) would require estimation of the mean time to extinction (T_e) of known populations. The construction of models that may be used to predict T_e of aquatic macrophytes necessitates investigation of all the life-cycle stages of these organisms.

Studies concerning the ecological dynamics of macrophytes in temporary freshwater rockpools of the Maltese Islands [Lanfranco (1990, 1995), Vassallo (1998)] have tended to focus on the vegetative stage of the life-cycle without considering the role of the

propagule bank in these processes. Whilst investigations of this form can certainly generate valuable ecological data, they are inherently limited by that lack of attention paid to the dynamics of the propagule bank. The only studies concerning propagule banks of temporary freshwater pools in the Maltese Islands are those of Zammit (1999), who worked on pools in Malta and Gozo, and Callus & Cilia (2000), who assessed a number of pools in Malta as part of a wider study concerning the ecology of hydrophytes.

All hydrophyte genera recorded from temporary freshwater pools in the Maltese Islands have also been recorded from other ephemeral wetlands along the north-western coast of the Mediterranean and the structure and composition of local propagule banks would therefore be expected to exhibit considerable overlap with propagule banks in other parts of the Mediterranean. Investigations of propagule banks in temporary wetlands of the Mediterranean region include Grillas *et al.* (1992) in the Camargue, Grillas *et al.* (1993) in the Doñana, Bonis and Lepart (1994) in the Camargue and Bonis and others (1995) in the Camargue.

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The present study aims to provide a preliminary characterisation of the vertical structure of the propagule bank of eight temporary freshwater rockpools with a view to generating foundations for testable hypotheses and ecological models in subsequent investigations.

MATERIALS AND METHODS

The sites of study - The material included in the present study was derived from propagule banks of eight pools in two localities. Five pools were situated at San Pawl tat-Tarġa, Malta and three at il-Blat tal-Kapuċċel, Munxar, Gozo. Rock outcrops at both localities comprised karstified lower coralline limestone characterised by several kamenitzas within which rainwater accumulated during the wet season (September/October - March/April). Identification codes given to each pool follow nomenclature in previous studies and are summarised in Table 1. The longest axis of the study pools ranged from 1.17m to 2.10m, maximum water depth from 0.06m to 0.24m and maximum depth of sediment from 0.06m to 0.21m.

since this had to take place shortly after wetting and before the onset of germination.

Seed and oöspore samples were collected by pushing a corer (internal diameter 3cm) through the sediment. The propagule bank of each pool was characterised by collecting a number of replicated samples from randomly-selected points in each pool. The number of replicates varied according to the size of the pool. Details relating to sample size are recorded in Table 2.

Laboratory Methods - Seeds and oöspores were isolated from the soil samples using the method outlined in Grillas *et al.* (1993). Each core section was dried to constant weight at 70°C and subsequently washed for one hour in a 1% solution of H₂O₂ amended with 10g of sodium metaphosphate per litre. The treated sediment was then sifted through two separate sieves of mesh 2mm and 125µm using low-intensity jets of tapwater. The sediment retained by the 125µm mesh was placed on filter paper and dried overnight at 70°C. The dried sediment was subsequently examined under a dissecting microscope and all seeds and oöspores present identified and tallied. Only propagules that are viable contribute to

Table 1: Identification codes of study pools.

Identification code	Locality	Nomenclature
Pool 1	San Pawl tat-Tarġa, Malta	Lanfranco (1990, 1995) Callus & Cilia (2000)
Pool 2	San Pawl tat-Tarġa, Malta	Zammit (1999)
Pool C	San Pawl tat-Tarġa, Malta	Callus & Cilia (2000)
Pool D	San Pawl tat-Tarġa, Malta	Callus & Cilia (2000)
Pool E	San Pawl tat-Tarġa, Malta	Callus & Cilia (2000)
Munxar 6	Munxar, Gozo	Zammit (1999)
Munxar 15	Munxar, Gozo	Zammit (1999)
Munxar "New Pool"	Munxar, Gozo	Zammit (1999)

Choice of species - Characterisation of propagule banks of the study pools was limited to the five angiosperms (*Elatine gussonei*, *Damasonium bourgaei*, *Callitriche truncata*, *Ranunculus saniculaefolius*, *Zannichellia palustris*) and one charophyte (*Chara vulgaris*) for which reliable reference material was available at the time of the study.

Field methods - Coring of sediment from the study pools was carried out in November 1998, immediately following the first wetting (but not flooding) of the pools. No cores were taken during the dry season due to the friable texture of the substratum when desiccated. As such, coring was only practical when the sediment was moist and therefore consolidated. Timing of sediment collection was therefore crucial,

the active reserve, and all seeds and oöspores observed were therefore punctured to test for viability.

Management and analysis of data - Descriptions of propagule banks were based on the numerical abundance of seeds and oöspores. Numerical abundance was standardised in order to permit comparison of abundance between seeds of different species. Standardisation of abundance for propagules of a single species in a single core segment was carried out by dividing the number of propagules recovered from a segment by the total number of propagules in the entire core.

The variance of seed and oöspore abundance within pools and between pools was assessed using One-way

Table 2: Samples taken from study pools.

Pool	Number of replicate cores	Number of core sections (replicate 1)	Number of core sections (replicate 2)	Number of core sections (replicate 3)	Number of core sections (replicate 4)	Number of core sections (replicate 5)
Pool 1	5	11	4	3	7	4
Pool 2	1	4	-	-	-	-
Pool C	4	7	3	2	6	-
Pool D	5	8	6	5	5	2
Pool E	5	5	5	5	4	3
Munxar 6	2	4	6	-	-	-
Munxar 15	1	2	-	-	-	-
Munxar "New Pool"	2	4	2	-	-	-

ANOVA. Comparison of seed and oöspore counts from different strata within a core was carried out using Student's unpaired *t*-test and Welch's approximate *t* while comparison of propagule numbers in the 0-4cm depth range with propagule numbers from strata deeper than 4cm was carried out using a Mann-Whitney Test. Correlation of propagule abundance with depth of burial was carried out using Pearson's product-moment correlation coefficient. All statistical tests were performed using GraphPad InStat version 3.02 for Windows 95 (GraphPad Software, 1998).

RESULTS

Representation of species in propagule banks - The most frequently recorded propagules, in terms of raw numerical abundance, were seeds of *Elatine gussonei* and oöspores belonging to *Chara vulgaris*. Seeds of *Elatine gussonei* were recorded from all pools, all cores and from 92% of core sections. Oöspores attributed to *Chara vulgaris* were present in five pools, 80% of cores and 72% of core sections. Larger seeds (*Damasonium bourgaei*, *Ranunculus saniculaefolius*, *Callitriche truncata* and *Zannichellia palustris*) were noted less frequently. These data are summarised in Table 3.

Within-pool and between-pool variance - The results of One-way ANOVA indicated that the variance of mean seed abundance (for *Elatine gussonei*) and mean oöspore abundance (*Chara vulgaris*) in the top layer of sediment within pools was not significantly different from the variance between pools (*E.gussonei*, $P=0.1511$; *C.vulgaris*, $P=0.0687$). This suggested that seed and oöspore counts from different pools could be combined in order to derive generalisations about the vertical

structure of the propagule bank. Data from the other four species were too scant to fulfil the assumptions of One-way ANOVA and this probability was therefore not calculated.

Vertical structure of the propagule bank (all species) - The top four centimetres of sediment across all pools contained 94% of all macrophyte propagules recorded. These data are summarised in Figures 1 and 2. A One-way ANOVA with Tukey-Kramer Multiple Comparisons post test indicated that the variation in the mean standardised abundance across the top six sediment strata (0-1cm to 5-6cm) was significantly greater than expected by chance ($P=0.0041$). The standardised total abundance of propagules in the top layer of sediment was significantly higher than that in strata below 2cm (Table 4).

Vertical structure of the propagule bank (individual species) - The vertical distribution of seeds (oöspores, in the case of *Chara vulgaris*) of the six macrophytes under consideration is summarised in Figures 3 and 4. Inspection of the data suggests that the general trend for all species is repeated at the level of individual species, with more propagules being recorded from surface horizons. These data were however characterised by large variance and the mean abundance of propagules in the topmost horizon was consequently not significantly larger than that from deeper sediment for any species. These results are summarised in Table 5.

When strata down to the 7-8cm level were considered, negative correlation between sediment depth and number of propagules was noted for all species (Table 6). Nevertheless, only two correlations (*E. gussonei* seeds with depth and *C. vulgaris* oöspores with depth) are statistically significant.

Table 1: Presence of macrophyte propagules in samples from study pools.

Species	Frequency in pools	Frequency in cores	Frequency in core sections
<i>Elatine gussonei</i>	100%	100%	92%
<i>Chara vulgaris</i>	63%	80%	77%
<i>Damasonium bourgaei</i>	75%	72%	39%
<i>Callitriche truncata</i>	50%	40%	20%
<i>Ranunculus saniculaefolius</i>	88%	52%	21%
<i>Zannichellia palustris</i>	50%	20%	12%

Table 4: Comparison of standardised total abundance of propagules in top layer and deeper layers.

Strata compared	q statistic*	P value
0-1cm with 1-2cm	3.582	P > 0.05
0-1cm with 2-3cm	4.347	P < 0.05
0-1cm with 3-4cm	4.562	P < 0.05
0-1cm with 4-5cm	4.522	P < 0.05
0-1cm with 5-6cm	4.301	P < 0.05

* The q statistic is derived from the Tukey-Kramer Multiple Comparisons Test.

Table 5: Comparison of propagule abundance in top layer with deeper layers for each species. Comparisons performed using Student's unpaired t-test and Welch's approximate t.

Species	Strata compared		
	0-1cm with 1-2cm	0-1cm with 2-3cm	0-1cm with 3-4cm
<i>E. gussonei</i>	P=0.9624	P=0.3835	P=0.7015
<i>C. vulgaris</i>	P=0.8492	P=0.2270	P=0.0883
<i>D. bourgaei</i>	P=0.5193	P=0.5184	P=0.5652
<i>C. truncata</i>	P=0.8057	P=0.8952	P=0.4405
<i>R. saniculaefolius</i>	P=0.3940	P=0.4188	P=0.4138
<i>Z. palustris</i>	P=0.2451	P=0.2527	P=0.2853

Table 6: Correlation of mean propagule abundance with depth of burial (all pools)

Species	Correlation coefficient (r)	P value
<i>Elatine gussonei</i>	-0.8994	P=0.0024
<i>Chara vulgaris</i>	-0.8705	P=0.0049
<i>Damasonium bourgaei</i>	-0.6095	P=0.1462
<i>Callitriche truncata</i>	-0.7915	P=0.2085
<i>Ranunculus saniculaefolius</i>	-0.6114	P=0.1972
<i>Zannichellia palustris</i>	-0.7880	P=0.2120

Table 7: Ratio of larger seeds to smaller propagules in all sediment strata from all pools.

Stratum	10-11cm	9-10cm	8-9cm	7-8cm	6-7cm	5-6cm	4-5cm	3-4cm	2-3cm	1-2cm	0-1cm
Ratio	0.00	0.00	0.00	0.00	1.39	0.29	0.59	2.58	1.37	1.14	3.63

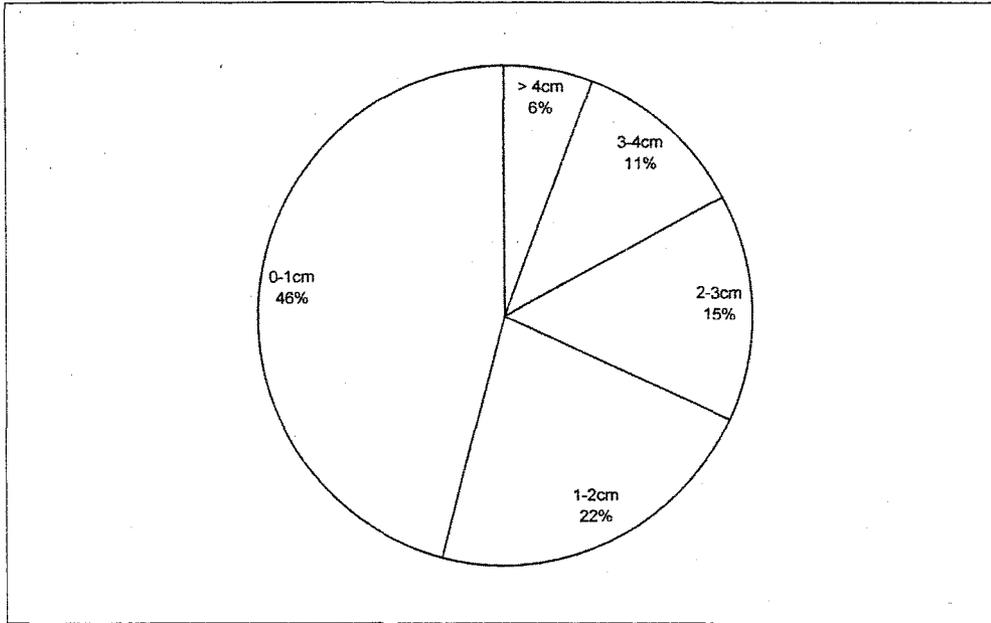


Figure 1: Vertical distribution of seeds and oöspores based on standardised total abundance (all species and all pools).

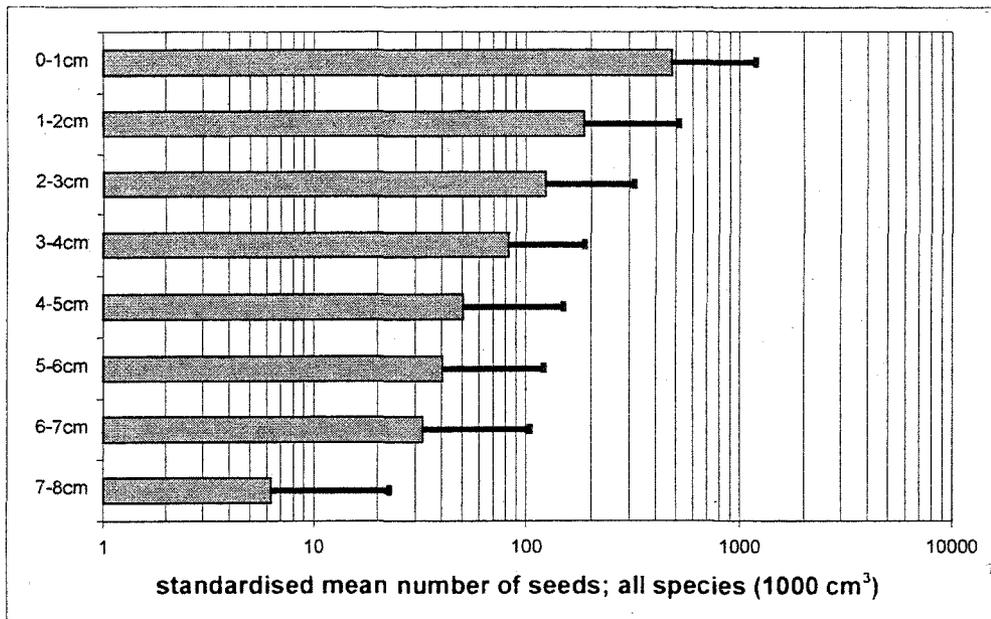


Figure 2: Vertical distribution of seeds and oöspores based on standardised mean abundance (all species and all pools). Error bars represent one standard deviation from the mean.

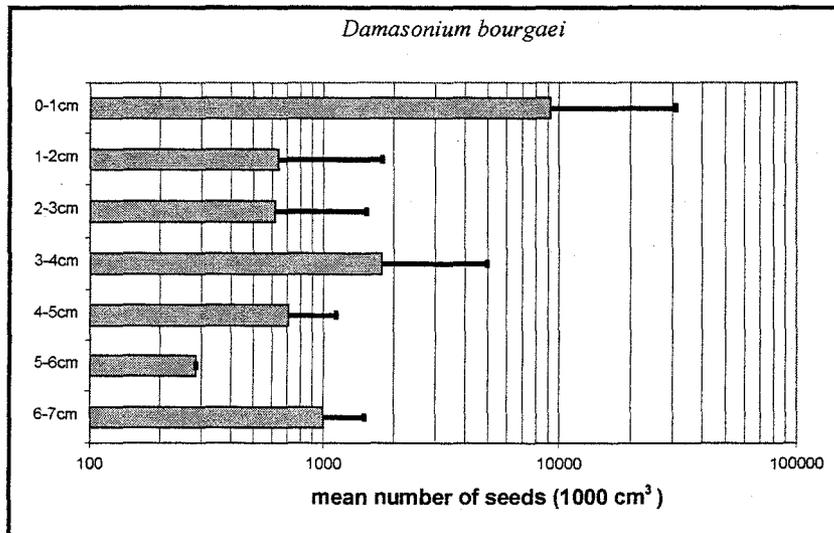
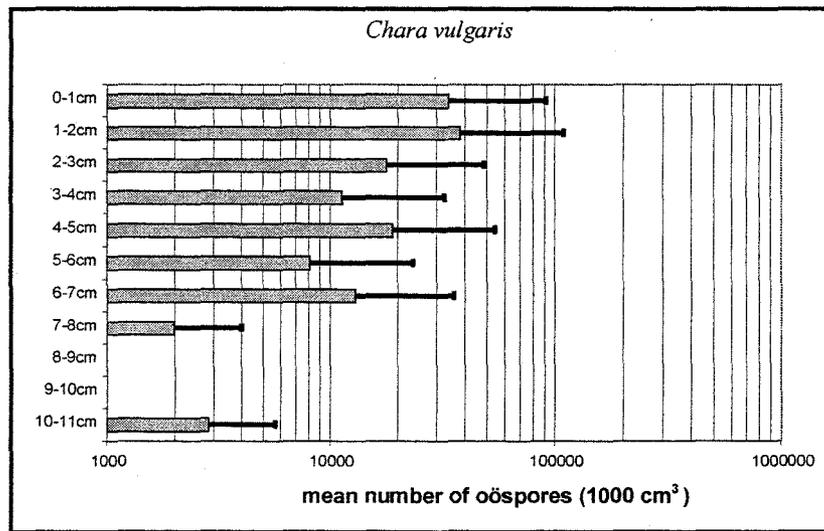
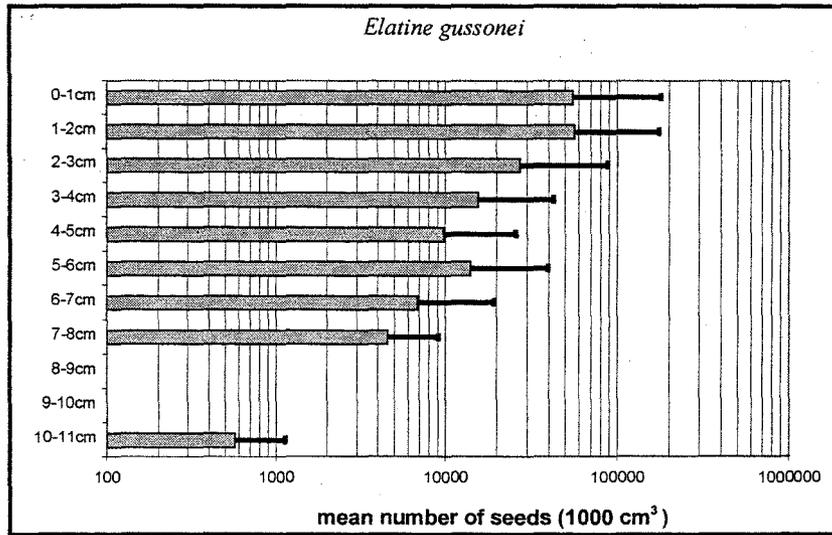


Figure 3. Vertical distribution of propagules attributed to *E. gussonei*, *C. vulgaris* and *D. bourgaei* (all pools). Error bars represent one standard deviation from the mean.

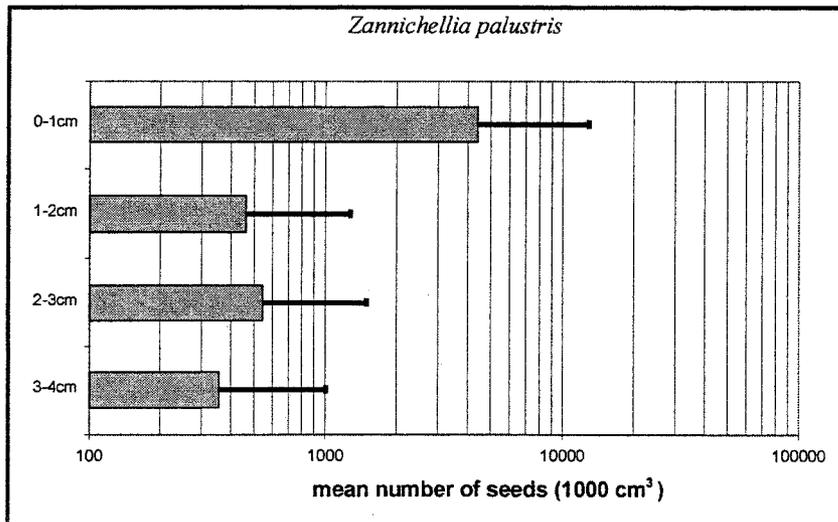
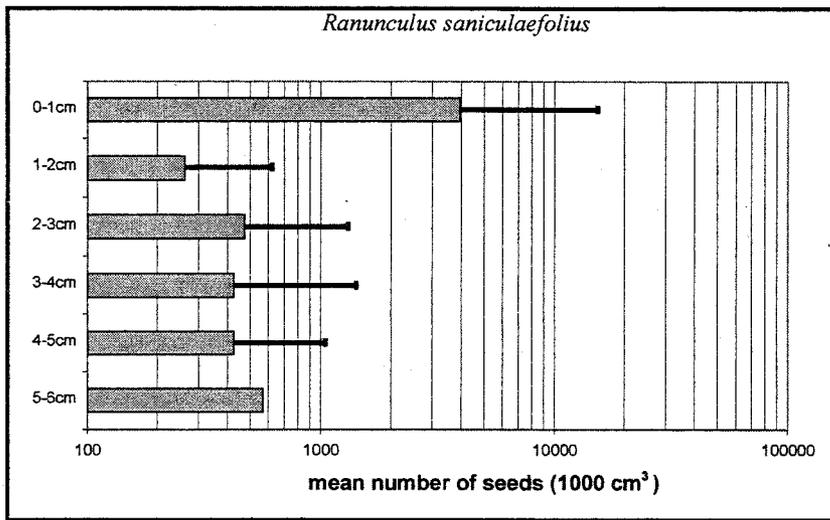
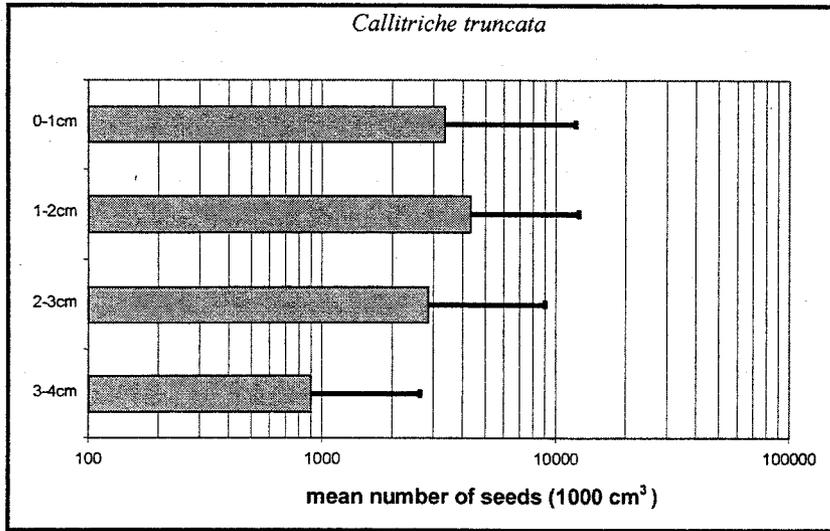


Figure 4: Vertical distribution of propagules attributed to *C. truncata*, *R. saniculaefolius* and *Z. palustris* (all pools). Error bars represent one standard deviation from the mean

Representation of smaller seeds in deeper sediment strata - The ratio of larger seeds (*D. bourgaei*, *R. saniculaefolius*, *C. truncata*, *Z. palustris*) to smaller propagules (*C. vulgaris*, *E. gussonei*) was calculated for all sediment strata by comparing total standardised abundance for the two size classes. These results are summarised in Table 7 and indicate that smaller propagules are over-represented in deeper sediment strata (>4cm) relative to shallower layers (P=0.0242).

Vegetative stages of aquatic macrophytes - The species represented by propagules in the propagule bank were generally also present in a vegetative form during the wet season. In six pools from the eight under study, all the species represented in the seed/oospore bank were also present in vegetative form. In Pool 2, *Chara vulgaris* was not recorded in vegetative form although its oöspores were present in the propagule bank. In Munxar "New Pool", *Damasonium bourgaei* and *Zannichellia palustris* were present in the propagule bank but were not recorded in vegetative form. These results are summarised in Table 8.

The pronounced asymmetric vertical distribution in the pools under study is attributable to the low rates of net sediment accumulation in the pools under observation. Although not directly quantified, these are inferred to be very low, facilitating the accumulation of propagules in the surface horizons.

Low rates of sediment accumulation suggest that seeds and oöspores recovered from deeper strata (below 4-5cm) are therefore unlikely to have been buried *in situ*, but may be the product of downward transport through the sediment. Opportunities for such downward movement would occur during the dry season when cracks and fissures in desiccated sediment provide such a route. This suggests that the over-representation of smaller propagules (seeds of *Elatine gussonei* and oöspores of *Chara vulgaris*) in the deeper strata is a consequence of this process. Various authors (Leck (1989), Bonis and Lepart (1994b)) suggest that disturbance by earthworms, mammals and waterfowl may be responsible for transporting buried seeds to the surface. These processes are unlikely to be significant in the temporary pools included in the present study since

Table 8: Representation of species by seeds (S), oöspores (O) and vegetative forms (V) in the pools under study.

Species	Pool 1		Pool 2		Pool C		Pool D		Pool E		Munxar 6		Munxar 15		Munxar "New Pool"	
	S	V	S	V	S	V	S	V	S	V	S	V	S	V	S	V
<i>E. gussonei</i>	S	V	S	V	S	V	S	V	S	V	S	V	S	V	S	V
<i>C. vulgaris</i>	O	V	O	-	O	V	O	V	O	V	-	-	-	-	-	-
<i>D. bourgaei</i>	S	V	-	-	S	V	S	V	S	V	S	V	-	-	S	-
<i>C. truncata</i>	S	V	S	V	-	-	S	V	S	V	-	-	-	-	-	-
<i>R. saniculaefolius</i>	S	V	-	-	S	V	S	V	S	V	S	V	S	V	S	V
<i>Z. palustris</i>	-	-	S	V	-	-	-	-	-	-	S	V	S	V	S	-

DISCUSSION

Vertical structure of propagule banks - The propagule banks followed in this study were characterised by distinct vertical distribution of seeds and oöspores, with 94% of propagules being located in the top 4cm of sediment. This is comparable to the results obtained by Grillas *et al.* (1993) from Doñana marshland (55% of propagules in top 4cm) and by Bonis and Lepart (1994b) from the Camargue (76% to 97% of propagules in top 4cm). The distribution of propagules in these wetlands should be contrasted with the structure of the propagule bank in other habitats such as swamps, prairie marshes and bogs, where only 20% to 50% of propagules occur in the top 5cm (Leck (1989)). This trend is not merely general but has been observed for all species included in the present study.

earthworms are not present in pools for much of the year, if at all, while waterfowl and large mammals are uncommon or altogether absent.

Storage of large numbers of propagules in a surficial bank is an adaptive strategy for the species concerned since this facilitates reception of germination cues and attainment of the soil surface by young shoots. However, this strategy exposes propagules to attack by predators, to high daytime temperatures throughout the dry season and to possible transport out of the sediment by surface runoff.

No direct assessment of loss of propagules due to predation was made during the present study although removal of seeds by ants had been noted from Pool 1 in March 1988. High sediment temperatures during the dry season may also be a source of stress for propagules. The upper lethal temperatures for seeds

are species-specific and depend upon duration of exposure (Baskin & Baskin, 1998). Upper lethal temperatures for the species under study are not known although it should be noted that temperatures of desiccated pool sediment during the dry season may attain 45°C (Lanfranco, 1990). Surface runoff following heavy rainfall may remove propagules from the sediment surface and deposit them elsewhere. Although this may function as a mode of dispersal, it should be borne in mind that freshwater rockpools are ecological islands surrounded by inhospitable habitat and displacement of propagules would therefore result in erosion of the metapopulation propagule reserve.

Relation of propagule bank to established vegetation - Patterns of established vegetation mostly reflected the species diversity of propagules in the pool sediment. The absence of *Chara vulgaris* from the established vegetation of Pool 2 and of *Damasonium bourgaei* and *Zannichellia palustris* from Munxar "New Pool" cannot be commented on definitively until germination patterns of these species in such habitats are studied.

General comments - The results obtained in the present work are ultimately based on the numerical abundance of propagules. Whilst such a measure is appropriate for comparisons involving the same species, it is not ideal for comparing among species. Different species allocate reproductive effort into producing numerous small seeds or few large ones and comparison based on numerical abundance is

therefore not satisfactory, especially if the propagules involved are characterised by large variance in size. Although standardising numerical abundance across species alleviates this difficulty, it probably does not remove it entirely. This indicates that subsequent studies should focus on biomass of seeds and oöspores rather than numerical abundance in isolation.

The general results of this study indicate that quantification of contributions to and losses from the propagule bank should be the focus of subsequent work aimed at constructing a predictive model of the population dynamics of the species in these pools.

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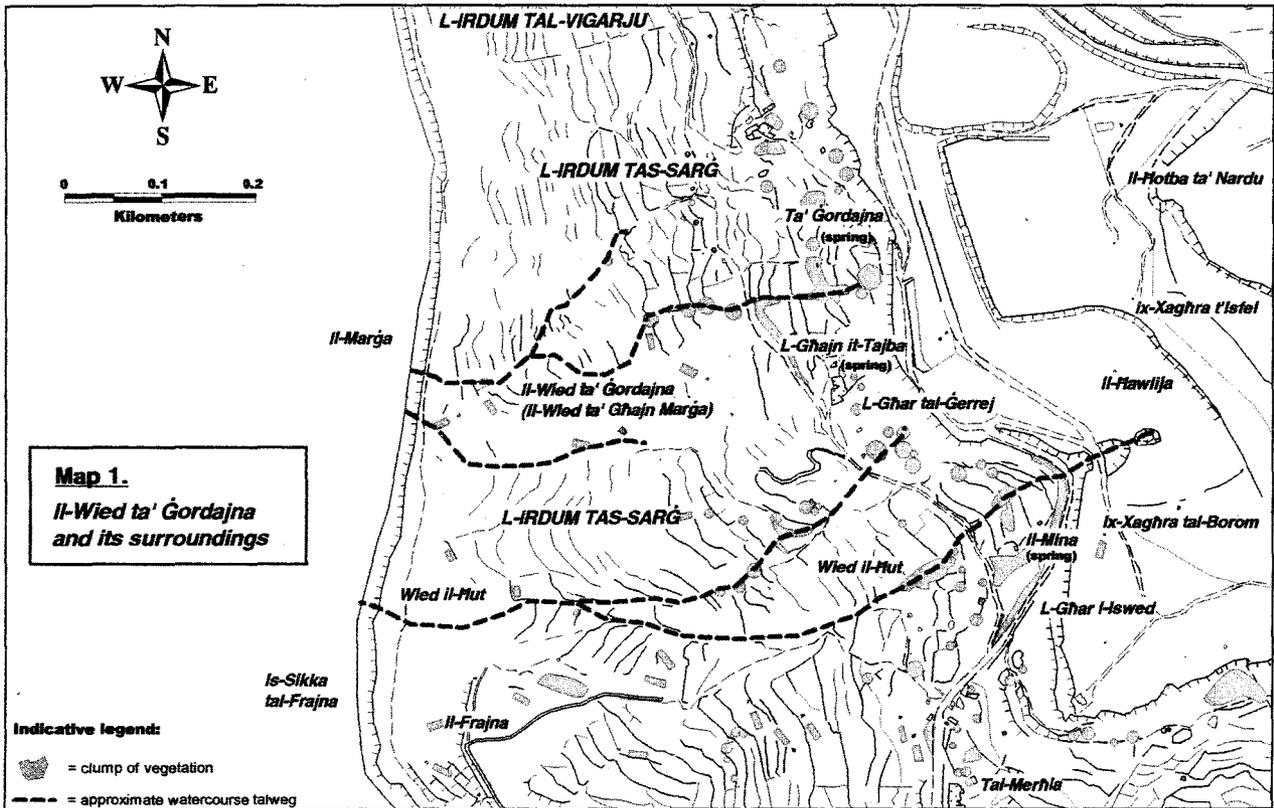


Fig. 1. II-Wied ta' Ġordajna and its surroundings.

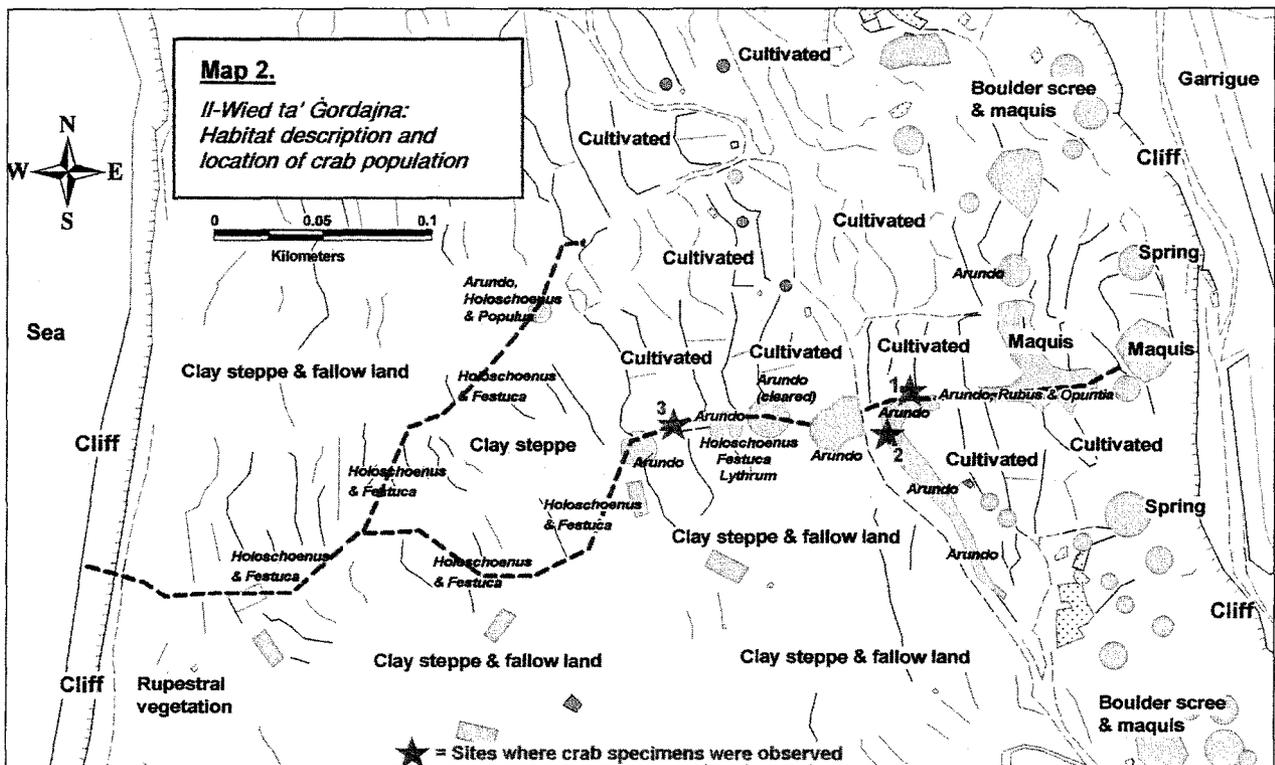


Fig. 2. II-Wied ta' Ġordajna: Habitat description and location of crab population

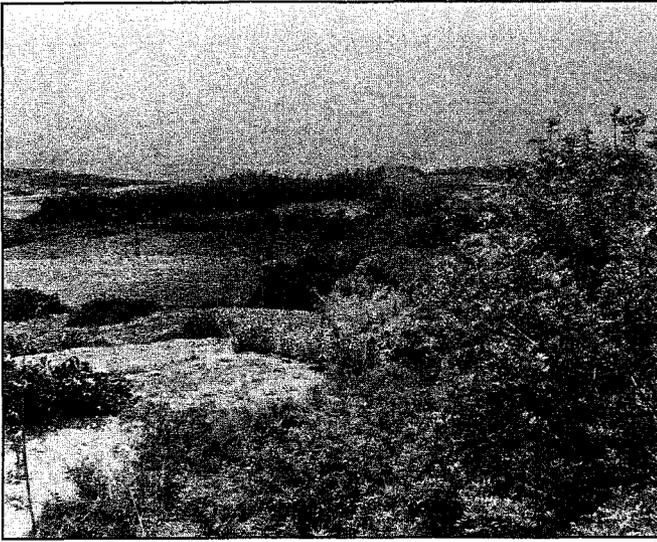


Fig. 3. Il-Wied ta' Ġordajna – Panorama



Fig. 4. Il-Wied ta' Ġordajna – Habitat



Fig. 5. *P. fluviatile lanfrancoi*.

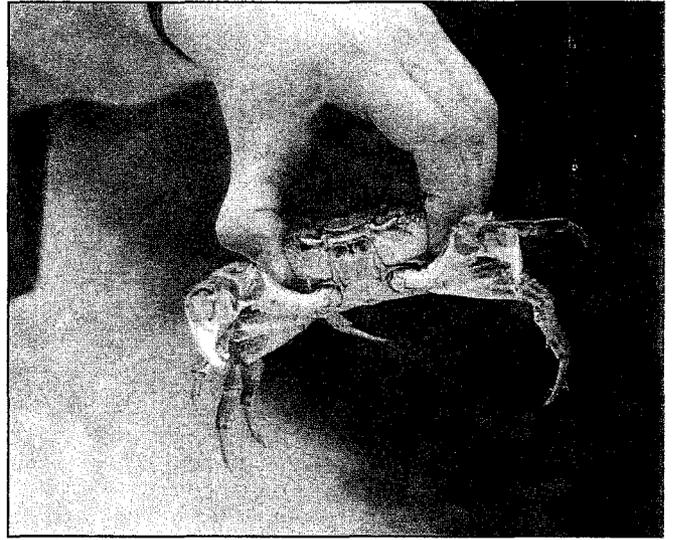


Fig. 6. *P. fluviatile lanfrancoi*. Close-up.



Fig. 7. Burrow



Fig. 8. Torn snail shells.

Polygona monspeliensis, *Lythrum graefferi*, the endangered *Mentha suaveolens*, and *Apium nodiflorum* which is a reliable indicator of relatively unpolluted freshwater (Lanfranco, 2000 pers. comm.).

FIELD OBSERVATIONS AT IL-WIED TA' GORDAJNA

The watercourse at Il-Wied ta' Ġordajna was repeatedly surveyed in the course of the various field visits. Several individual crabs (Figs. 5 & 6), together with other indicators [e.g. burrows (Fig. 7), exoskeleton fragments including carapaces and chelæ, exuviae, excavation piles, and mutilated snail shells (Fig 8)] were recorded from three main sites within the stream, as marked on Fig. 2. Details of field observations, including detailed measurements, are summarised in Tables 1 and 2.

Existing records from "Mtaħleb" - Since the environs of Il-Wied ta' Ġordajna are often loosely considered as part of L-Imtaħleb, an assessment of current documentation about *P. fluviatile* from "Mtaħleb" (*sic*) is of some relevance.

Schembri & Lanfranco (1984) overlook the population at L-Imtaħleb in their description of "Wied ir-Rum, Wied Ġħar Ilma, Wied Markozz and Wied Miġra Ferħa". The occurrence of the freshwater crab at L-Imtaħleb is also overlooked by Schembri (1983), who states that "In Malta it has been reported at Baħrija and Bingemma Valleys, at San Martin and at Ġnejna while in Gozo it is found at Wied tal-Lunzjata". Likewise, Schembri *et al.* (1987) only make reference to crab populations at Wied il-Baħrija, San Martin and Wied il-Lunzjata (Gozo).

Documented records of *P. fluviatile* that refer to "Mtaħleb" are vague and apparently refer to the much larger and better-known permanent stream at Il-Wied ta' l-Imtaħleb (Stevens, 1999 pers. comm.; Lanfranco, 1999 pers. comm.), which lies over 1 km to the west-southwest of Il-Wied ta' Ġordajna and forms part of an entirely distinct catchment that ultimately discharges at Miġra l-Ferħa.

Capolongo & Cilia (1987) record the existence of *P. fluviatile* at "Imtaħleb", confirming an earlier record by Pace (1974), and describe the locality as a valley having a "North West to Northerly (flow ?) direction" similar to "Baħrija, San Martin, Ġnejna" and unlike "Wied Lunzjata which is directed South to South West". This geographic reference does not tally

with any of the valleys in the area (including Il-Wied ta' Ġordajna, Il-Wied tal-Ġħajn it-Tajba, Wied il-Ħut, Wied Markozz, Il-Wied ta' l-Imtaħleb, Il-Wied ta' Miġra l-Ferħa, and the entire Wied ir-Rum catchment system except Wied Ħazrun). Capolongo & Cilia also include a schematic map (unsuitable for precise location of the crab populations) showing "Localities with freshwater crabs in the Maltese Islands". Due to inadvertent interchange of map symbols for L-Imtaħleb and Bingemma, "Imthaleb" (*sic*) is marked as a locality from which the crab is probably extinct; this has since been rectified by Cachia (1997).

In order to determine whether the "Mtaħleb" records could be mistaken references to the Il-Wied ta' Ġordajna population, Il-Wied ta' l-Imtaħleb and its major tributary Wied Markozz were inspected in December 1999, whereupon discrete clusters of partly-flooded burrows were observed in both valleys. Wied Markozz is thus another undocumented station for the species. In both cases, burrows were located under thick reed beds along stream banks; a single small living crab (reddish-pink in colour) was noted at Il-Wied ta' l-Imtaħleb. The presence of crabs at Wied Markozz/Il-Wied ta' l-Imtaħleb is well-known among local farmers interviewed on the same date.

CONCLUSION

The new record of *P. fluviatile* at Il-Wied ta' Ġordajna is particularly interesting in view of its geographical location roughly midway between the Il-Wied ta' l-Imtaħleb and Wied il-Baħrija valley systems, where populations of crabs are already known.

Although interaction between the various populations of *P. fluviatile* appears unlikely, in view of the significant distances and intervening topographical, microclimatic and ecological barriers, this possibility should not be entirely discarded without further investigation, especially in view of the following:

1. Studies carried out by Cachia (1997) at San Martin (near Il-Wardija, l/o San Pawl il-Baħar) record a secondary crab population near a perennial spring (Ġħajn Astas) that is separated by about 250-350 metres of dry habitat and cultivated land from the main population in the watercourse proper. Whereas the separation of Il-Wied ta' Ġordajna from both Wied Markozz/Il-Wied ta' l-Imtaħleb and Wied Rini/Wied il-Baħrija is about three to four times as much, Cachia's observations do not rule out the remote possibility that greater distances may be travelled by the crabs.

TABLE 1. Field visits carried out during this study

FIELD VISIT NO.	DATE	TIME	AREA	PRESENT	NOTES
1	05 DEC 1999	16.30 hrs (at dusk)	Site 1 on Map 2	AC, AZ	Several flooded burrow openings were observed along the west-facing edge of the reed bed. It could not be determined whether burrows were occupied.
2	25 MAR 2000	17.45 – 18.45 hrs	Site 1 on Map 2	AC, SC	
3	03 JUN 2000	12.00 – 17.30 hrs	Sites 1 & 2 on Map 2	AC, SC	Nineteen burrow openings were identified on the stream-bed at Site 1; a fresh excavation pile was prominently visible round one of the openings.
4	07 JUN 2000	10.30 – 14.30 hrs	Sites 2 & 3 on Map 2	AC, SC, JFC	Five burrow openings on the stream-bed at Site 3. Several mutilated snail-shells (mostly <i>Helix aspersa</i>), probably victims of the crabs, were noted at Site 3. A nearby valley between Il-Wied ta' Ġordajna and Wied il-Hut, dry at the time, was also investigated but no signs of habitation by crabs were noted.

Key to abbreviations used in Table 1: AC= Alex Camilleri; AZ= Alexei Zammit; SC= Stephen Cachia; JFC= John F. Cachia.

TABLE 2. Specimen records. (? denotes data that could not be obtained).

Specimen	Field Visit	Location	Maturity	Moult stage	Sex	Heterochely	Injuries	Car. Width (mm)	Car. length (mm)	R. Chela length (mm)	R. Chela width (mm)	R. Chela height (mm)	L. Chela length (mm)	L. Chela width (mm)	L. Chela height (mm)	Fresh weight (g)
1	1	Field margin near watercourse	A	Old	?	N/A	Missing L. chela	?	?	?	?	?	N/A	N/A	N/A	?
2	2	Under stone on stream bed	S	?	♀	N/A	Missing R. chela	24.00	20.45	N/A	N/A	N/A	14.75	5.50	4.05	5.0
3	2	Under stone on stream bed	S	?	♂	R.	Small 2 nd R pereiopod	21.60	18.00	14.10	6.35	4.35	13.55	5.10	3.60	≈ 4.0 – 5.0
4	3	Near burrow on muddy stream bed	A	Old	♂	N/A	Missing L. chela	42.20	36.35	30.40	10.40	14.60	N/A	N/A	N/A	34.0
5	3	Pool (Site 2)	J	?	?	?	?	?	?	?	?	?	?	?	?	?
6	3	Muddy stream bed	?	Old	?	?	?	?	?	?	?	?	?	?	?	?
7	3	Muddy stream bed	J	Old	♂	R.	None	21.80	19.30	14.80	4.90	6.70	14.00	3.90	4.90	4.0
8	3	Muddy stream bed	J	Fresh	?	?	?	Slightly larger than specimen 7		?	?	?	?	?	?	?
9	3	Muddy stream bed	?	?	?	?	?	?	?	?	?	?	?	?	?	?
10	4	Pool (Site 2)	A	Old	♂	R.	None	55.00	48.60	47.50	14.80	21.50	40.85	9.95	14.70	92.0
11	4	Inside burrow (Site 3)	S	Fresh	?	?	?	?	?	?	?	?	?	?	?	?
12	4	Pool (Site 2)	A	Old	♂	R.	Missing 3 rd R. pereiopod	44.80	39.10	33.10	11.00	16.30	29.10	8.40	12.40	54.0

Key to abbreviations used in Table 2: A = adult; S = sub-adult; J = juvenile; R. = right; L = left; N/A = not applicable; Car. = carapace

2. Radio-tracking studies in Toscana (Italy) indicate that *P. fluviatile* is capable of long-distance movements of up to 100 metres across areas that lack surface water (Gherardi *et al.*, 1988; Gherardi & Vannini, 1989).

3. The possibility of other "bridging" populations is not excluded, especially since numerous other springs (including L-Għajn it-Tajba, near Il-Wied ta' Gordajna) have been observed throughout the continuous rim of *irdumijiet* (complexes of cliffs, clay taluses and boulder screes) that surrounds the entire area.

SUPPLEMENTARY NOTE

The entire area at L-Imtaħleb and L-Irdum tas-Sarg, including all the springs and valleys mentioned in this paper, is legally protected ("scheduled") by virtue of Government Notice 400/1996, issued under the

provisions of Section 46 of the Development Planning Act, 1992.

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