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The scale insects (Hemiptera: Coccoidea) of the Maltese Archipelago

DAVID MIFSUD[1,4], GAETANA MAZZEO[2], AGATINO RUSSO[2] & GILLIAN W. WATSON[3]

[1]*Institute of Earth Systems, Division of Rural Sciences and Food Systems, University of Malta, Msida, Malta.*
E-mail: david.a.mifsud@um.edu.mt
[2]*Dipartimento di Gestione dei Sistemi agroalimentari e ambientali, University of Catania, Italy.*
E-mail: gamazzeo@unict.it; agarusso@unict.it
[3]*Plant Pest Diagnostic Center, California Department of Food & Agriculture, Sacramento, California, U.S.A.*
E-mail: gillian.watson@cdfa.ca.gov
[4]*Corresponding author. E-mail: david.a.mifsud@um.edu.mt*

Abstract

Past works on scale insects (Hemiptera: Coccoidea) from the Maltese Archipelago are reviewed. Based on the literature and contemporary collections, a total of 93 species of scale insects belonging to 12 scale insect families are here reported (Aclerdidae 1 species; Asterolecaniidae 4; Coccidae 17; Diaspididae 46; Eriococcidae 5; Kermesidae 1; Margarodidae 1; Micrococcidae 1; Monophlebidae 2; Pseudoccocidae 11; Putoidae 2 and Rhizoecidae 2). Of these, 17 species represent new distribution records. Ten species are excluded from the scale insect fauna of the Maltese Islands. Of the 93 species present, only 29 (31.18%) are probably indigenous and the rest (68.82%) represent established introductions from elsewhere. More than 65% of the indigenous species are typical Mediterranean in distribution, with a few species having a mainly European chorotype. A quarter of the established aliens originate from Eurasia, followed by an East Asian/ Oriental component (20.31%); European (14.06%); Neotropical (14.06%); cryptogenic (14.06%); African (7.81%) and Australasian (4.70%). Movement of live fruit trees and ornamental plants into the Maltese Archipelago from nearby countries is probably the main route for entry of alien scale insects into the country. Some possible future introductions are discussed.

Key words: Mediterranean, new records, Malta, invasive species

Introduction

The Maltese Archipelago is a group of low-lying islands aligned in a NW-SE direction, located in the central Mediterranean basin. It consists of three inhabited islands: Malta, Gozo and Comino, and a number of small uninhabited islets such as Cominotto, Filfla and St. Paul's Islands. The total land area is about 316 km^2, with Malta (245.7 km^2) and Gozo (67.1 km^2) being the largest islands. The climate is typical of the Mediterranean, with mild, wet winters and hot, dry summers. The average annual precipitation is about 500 mm, but rainfall is highly variable from year to year, with only about 190 mm in extremely dry years and exceeding 1000 mm in extremely wet years. Human impact on the natural environment of the Maltese Islands is quite severe and has been ongoing since Neolithic times. Currently, the overall population density is 1,317 per km^2, making the archipelago one of the most densely populated regions in the World. This resident population is augmented by tourists, who have averaged between 1.1–1.4 million annually in the last five years. It is therefore not surprising that human impact on the natural environment is a key feature of the islands' ecology. Despite this, the islands still harbour a diverse array of natural and/or semi-natural habitats, with a total of about 1,100 species of vascular plants, of which around 77% are indigenous and the rest are naturalised aliens (Lanfranco *et al*., 2013). The most common natural vegetation type is the garrigue community of rocky grounds. Other common habitat types include steppic grassland and disturbed ground. Less common and more restricted in distribution are the maquis habitats, found in relatively inaccessible sites such as the sides of steep valleys and at the foot of inland cliffs. The natural woodland habitat of Malta is all but extinct and only remnants of small copses of Holm Oak (*Quercus ilex* L.) remain. One locality (Buskett) can be best described as a semi-natural woodland, as it was originally planted by man but is now self-regenerating and has

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Fruit crops could be impacted by the accidental introduction of *Comstockaspis perniciosa* (Comstock) on stone and pome fruit and *Rubus* spp. (this scale is also known to damage *Ribes*, but this is not grown in Malta); *Pseudococcus calceolariae* Maskell on pome fruit and *Citrus*; *Ceroplastes japonicus* Green on *Citrus* and *Morus* spp.; *Parasaissetia nigra* Nietner on fruit trees including pomegranate and *Citrus* spp.; and *Neopulvinaria innumerabilis* (Rathvon) on grape vines, on which it is a vector of Grapevine Leafroll Virus 1 (GLRV-1) and Grapevine Virus A (GVA).

Ornamental plants could be impacted by introduction of the polyphagous *Pa. nigra*, *Phenacoccus solani* Ferris, *Ph. solenopsis* Tinsley and *Ph. madeirensis* Green, the latter species occurring particularly on *Lantana camara*, *Pelargonium* sp. and *Gerbera* sp.; *Ce. japonicus* on many ornamentals including *Nerium oleander*, which is widely cultivated in the Maltese archipelago; also by *Co. perniciosa* on rosaceous plants like *Crataegus* spp.; *Phoenicococcus marlatti* Cockerell on palms; *Ph. defectus* Ferris on ornamentals, particularly succulents including Crassulaceae and Euphorbiaceae; *Hypogeococcus pungens* Granara de Willink on succulents including cacti; *Acanthococcus coccineus* (Cockerell) on Cactaceae; *Ovaticoccus agavacearum* Pellizzari & Kozár, *O. agavium* (Douglas) and *O. exoticus* Pellizzari & Kozár on *Agave* spp.; and *Trochiscococcus speciosus* (De Lotto) on Liliaceae *sensu lato*—although the potential economic impact of the latter species is not known.

Crops in the Maltese archipelago could be impacted by introduced *Ph. solani*, particularly solanaceous crops in the field and under glass; *Ph. solenopsis* on field crops, particularly Malvaceae even though such crops (e.g. cotton and okra) which were widely cultivated in the past, are no longer grown in Malta; *Ph. madeirensis* in the field and under glass on *Capsicum* sp., legumes and herbs, and some fruit crops; and *Phoen. marlatti* on date palms, although the latter host is grown only as an ornamental and not for fruit production.

Lastly, native plants in the natural environment might be impacted by accidental introductions, e.g. *Co. perniciosa* on rosaceous plants like *Crataegus monogyna*, *Cr. azarolus*, their hybrid *Cr.* x *ruscinonensis*, and *Rubus ulmifolius*; *Ph. defectus* on native euphorbiaceous shrubs such as the endemic *E. melitensis* as well as *E. dendroides* and the rare *E. characias*; and *Ce. japonicus* on *Laurus nobilis* and *Myrtus communis*.

Of the potential invasive species listed in Table 1, *Co. perniciosa* probably presents the greatest threat, potentially impacting fruit crops, ornamental and native plants. If introduced in the absence of its natural enemies this species can be highly destructive, although its impact can largely be minimised in the long term if biological control can be implemented successfully (Rosen & DeBach, 1978).

On the basis of the records assembled here, it is apparent that the movement of live fruit trees and ornamental plants into the Maltese Archipelago, particularly from Sicily, is the main route for entry of alien scale insects into the country. Since Sicily has 169 recorded species of scale insects (Mazzeo *et al*., 2011), it is anticipated that more accidental introductions to the Maltese Archipelago are likely to occur in the future. Future introductions may present significant threats to crops, ornamental plants and the environment there.

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APPENDIX 1. Coccoidea occurring in the Maltese Archipelago that are probably indigenous, with their possible areas of origin, based on Ben-Dov *et al*. (2014).

Family	Species	Distribution
Aclerdidae	*Aclerda berlesii*	Mediterranean
Asterolecaniidae	*Asterodiaspis ilicicola*	Mediterranean
	Pollinia pollini	Mediterranean
Coccidae	*Filippia follicularis*	Mediterranean
Diaspididae	*Adiscodiaspis ericicola*	Mediterranean
	Aonidia lauri	Mediterranean
	Aonidia mediterranea	Mediterranean
	Aspidiotus hedericola	Mediterranean
	Carulaspis juniperi	European extending in Mediterranean
	Carulaspis minima	Mediterranean
	Diaspidiotus viticola	Mediterranean
	Duplachionaspis berlesii	Mediterranean
	Duplachionaspis sicula	Mediterranean
	Gonaspidiotus minimus	Mediterranean
	Leucaspis pini	European extending in Mediterranean
	Leucaspis pusilla	European extending in Mediterranean
	Leucaspis riccae	Central and eastern Mediterranean
	Melanaspis inopinata	Central and eastern Mediterranean
	Targionia vitis	Mediterranean and Central European
Eriococcidae	*Anophococcus formicicola*	Eastern Mediterranean
	Rhizococcus cactearum	Mediterranean
Kermesidae	*Kermes vermilio*	Mediterranean
Micrococcidae	*Micrococcus* sp.	Mediterranean
Monophlebidae	*Gueriniella serratulae*	Mediterranean
Pseudococcidae	*Lacombia dactyloni*	Central and eastern Mediterranean
	Peliococcus cycliger	Mediterranean
	Phenacoccus neohordei	Sub-endemic (southern Italy including Sicily and Malta)
Putoidae	*Puto palinuri*	Mediterranean
	Puto superbus	Mediterranean and Central European