

# The jumping plant-lice (Hemiptera: Psylloidea) of the Maltese Islands

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**ABSTRACT.** Twenty-one species of jumping plant-lice accommodated in five different families are here recorded from the Maltese Islands in an annotated checklist. The Aphalaridae is represented by four species (*Agonoscena targionii* (Lichtenstein), *Blastopsylla occidentalis* Taylor, *Colposcena aliena* (Löw) and *Glycaspis brimblecombei* Moore), of which two (*B. occidentalis* and *G. brimblecombei*) are alien species originating from Australia. The Homotomidae is represented by *Homotoma ficus* (Linnaeus) and *Macrohomotoma gladiata* Kuwayama, the latter being an alien species originating from the Far East. The Liviidae is represented by *Euphyllura olivina* (Costa), *Diaphorina lycii* Loginova and *Psyllopsis fraxinicola* (Foerster). The Psyllidae is represented by *Acizzia uncatoides* (Ferris & Klyver), *Cacopsylla myrthi* (Puton) and *C. pyri* (Linnaeus), of which *Acizzia uncatoides* is an alien species originating from Australia. Finally, the most species-rich family is the Triozidae, represented by nine species (*Bactericera albiventris* (Foerster), *B. crithmi* (Löw), *B. trigonica* Hodkinson, *Heterotrioza chenopodii* (Reuter), *Lauritrioza alacris* (Flor), *Trioza centranthi* (Vallot), *T. galii* Foerster, *T. kiefferi* Giard and *T. urticae* (Linnaeus)). For each of the above species, collection data, distribution, host-plant data and other relevant information is provided. *Lycium intricatum* Boiss. is a new host-plant record for *Diaphorina lycii*, and *Rhamnus lycioides* subsp. *oleoides* (L.) Jahand. & Maire is a new host-plant record for *Cacopsylla myrthi*. A host-plant shift is documented for *Bactericera crithmi*, which alternates between *Ferula melitensis* Brullo *et al.* in winter and *Crithmum maritimum* L. in spring.

**KEY WORDS.** Malta, Mediterranean, psyllids, host-plant shift, checklist.

## INTRODUCTION

Jumping plant-lice, or psyllids (Hemiptera: Psylloidea), are a group of specialised phytophagous insects ranging in length from about 1 to 5 mm and belong to the Hemipteran suborder Sternorrhyncha, together with aphids, scale insects and whiteflies. At present, there are eight recognised families and some 4,000 described species of psyllids (BURCKHARDT & OUVREARD, 2012), with the highest species diversity present in the tropics and southern temperate regions.

The host range of psyllids is restricted almost exclusively to perennial dicotyledonous plants except for the small psyllid subfamily Liviinae, species of which live on *Juncus* and *Carex*. Psyllids usually have a high host-plant specificity. This narrow host range is not only a common attribute at species level, but commonly can be found at generic and sometimes even at family level.

Psyllids are usually phloem-feeders. A number of species are known to induce galls in their host-plants and many such galls have been described in the literature. Other psyllids are known to be

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vectors of bacterial and phytoplasma diseases of plants and can be of economic importance, causing damage to agricultural crops; citrus greening disease, pear decline and fireblight of pears are some examples of plant diseases transmitted by psyllids (BURCKHARDT, 1994).

The first psyllid records from Malta were made by BORG (1922), who mentioned *Psylla mali* Schmid. [= *Cacopsylla mali* (Schmidberger, 1836)] 'as being occasionally met with in Maltese orchards'. He also recorded *Euphyllura oleae* [= *Euphyllura olivina* (Costa, 1839)], which he referred to as the olive-flea, causing damage to tender foliage and young shoots of olive trees. Both species were again reported by SALIBA (1963). It is worth mentioning that neither BORG (1922) nor SALIBA (1963) had any reference collections of these insects and most of what they recorded was based on field observations. In fact, since the original citation of *Cacopsylla mali* from Malta by BORG (1922), the species has never been collected from the Maltese archipelago despite repeated field work on its host-plants so the species is excluded from the Maltese psyllid fauna. CARUANA GATTO (1926) made reference to three psyllids: *Trioza alacris* Flor [= *Lauritrioza alacris* (Flor, 1861)], reported as common in all gardens and fields visited on its typical host-plant, *Laurus nobilis* L. on which it produces characteristic leaf-galls; *Trioza galii* Foerster, 1848, recorded as occurring intermittently in valleys on *Sherardia arvensis* L., on which it caused deformation and decolourisation of young leaves; and *Trioza centranthi* (Vallot, 1829), reported as not common but occasionally found at Wied Incita, Wied il-Qliegħa and in some other localities, producing galls on *Fedia graciliflora* Fisch. & C.A. Mey. During 1994 and 1997, the present author did his masters dissertation on the jumping plant-lice of Malta at the University of Malta and provided information on 18 species. This work (MIFSUD, 1997a, 1997b) remained largely unpublished. Based on this unpublished work, BURCKHARDT (2013) listed these 18 species as occurring in Malta in the *Fauna Europaea* database; but because the original collection data of these species were lacking from the published literature, such records were often excluded from other catalogues or online databases such as Psyl'list (OUVRARD, 2020), and rightly so. Since the above-mentioned work, the only three publications where psyllid material from Malta was cited were (i) THAO *et al.* (2000), who examined material of *Cacopsylla myrthi* (Puton, 1876) from Malta collected on *Rhamnus alaternus* L. for primary endosymbionts; (ii) HABER & MIFSUD (2007), who recorded *Euphyllura olivina* (Costa) as occurring on all three main islands of the Maltese archipelago; and (iii) MIFSUD *et al.* (2012), who recorded *Homotoma ficus* (Linnaeus, 1758) on *Ficus carica* L. from Buskett and Paolo (Malta).

The aim of the present work is to provide original collection data and other relevant information on the 18-psyllid species reported by MIFSUD (1997a) and three additional species that have been introduced accidentally and have established in Malta in recent years.

## MATERIALS AND METHODS

Psyllid material was collected by beating or sweeping vegetation. Whenever possible both adults and nymphs were collected and preserved in 75% alcohol. Since most psyllids are host-plant specific, field work was mainly targeted on plants on which psyllid records are already known from the Mediterranean region. Material was collected by the present author and is conserved in his private collection, either mounted on microscope slides or in alcohol. Species identification was based on adult psyllids slide mounted in Canada balsam, using a Zeiss Axioskope and identification keys from various works. The psyllid classification used here follows BURCKHARDT & OUVRARD (2012); taxa are listed alphabetically by family, subfamily, genus and species, both in the annotated checklist below and in Appendix I, which provides a checklist of the 21 psyllids so far recorded from the Maltese Islands. For each species, material examined from the Maltese Islands is included, with

information on global distribution and host-plant data, which were mainly retrieved from OUVARD (2020); for more precise data, including relevant literature, this website should be consulted. Taxonomic treatments of plant names are based on the classification of EURO+MED (2006-2020) database.

### ANNOTATED CHECKLIST

#### Family Aphalaridae Löw, 1879 Subfamily Aphalarinae Löw, 1879

##### *Colposcena aliena* (Löw, 1881)

**Material examined.** MALTA: Salina, 9.i.1994, 3♀♀, 11.iii.1995, 1♂; M'Xlokk, Balluta, 27.ii.1994, 1♀, 14.v.1994, 1♂, 31.v.1994, 1♀, 10.vii.1996, 17♂♂ & 16♀♀; Ramla tat-Torri, 11.iii.1995, 1♂ & 1♀. All the material was collected on *Tamarix* spp.

**Notes.** The genus *Colposcena* Enderlein, 1929 currently accommodates 35 described species, all associated with *Tamarix* spp. (Tamaricaceae) (HOLLIS, 1974). *Colposcena aliena* is widely distributed from the western Palaearctic as far eastwards as Mongolia. This is a relatively common species in the Maltese Islands, usually found in coastal localities where *Tamarix* trees are present.

#### Subfamily Rhinocolinae Vondráček, 1957

##### *Agonoscena targionii* (Lichtenstein, 1874)

**Material examined.** MALTA: Buskett, 20.ii.1994, 3♂♂ & 14♀♀, 6.iv.1996, 1♂ & 4♀♀; Wied Babu, 14.iv.1994, 7♂♂ & 14♀♀, 17.iv.1994, 6♂♂ & 14♀♀; Wardija, 24.v.1994, 20♂♂ & 21♀♀; Xemxija, 10.ii.1995, 5♂♂ & 5♀♀; Mtahleb, 6.iv.1996, 9♂♂ & 7♀♀; Wied Anglu, 9.iv.1996, 6♂♂ & 5♀♀; Wied il-Ghasel, 2.vi.1996, 15♂♂ & 20♀♀; Fawwara, 30.xii.1996, 9♂♂ & 1♀. All the material was collected on *Pistacia lentiscus* L.

**Notes.** The genus *Agonoscena* Enderlein, 1914 currently accommodates 15 described species which are restricted to Mediterranean biotopes of the Palaearctic, Afrotropical and Oriental Regions (BURCKHARDT & LAUTERER, 1989; MALENOVSKÝ *et al.*, 2012). *Agonoscena targionii* is widely distributed within the Mediterranean basin area of the Palaearctic ecozone, extending northwards to Great Britain and eastwards to Tadjhikistan. The principal host-plant of *Agonoscena targionii* is *Pistacia lentiscus* (Anacardiaceae) (BURCKHARDT & LAUTERER, 1989), however, it is also recorded on other *Pistacia* including *P. atlantica* Desf., *P. khinjuk* Stocks, *P. terebinthus* L. and *P. vera* L. (SPODEK *et al.*, 2017). This psyllid is one of the commonest species found throughout the Maltese archipelago.

#### Subfamily Spondylaspidinae Schwarz, 1898

##### *Blastopsylla occidentalis* Taylor, 1985

**Material examined.** MALTA: Zejtun, 7.i.2013, 9♂♂ & 12♀♀; Floriana, 8.ii.2016, 5♂♂ & 14♀♀; Santa Lucia, 11.vi.2016, 6♂♂ & 7♀♀. All the material was collected from very young shoots of *Eucalyptus* spp.

**Notes.** The genus *Blastopsylla* Taylor, 1985 currently accommodates eight described species all native to Australia. *Blastopsylla occidentalis*, commonly referred to as the eucalyptus psyllid, has been accidentally introduced and has established in many countries outside its native range. When it was described (TAYLOR, 1985), it was already present in the United States of America and New Zealand. Later it was recorded from South America and Mexico (BURCKHARDT *et al.*, 1999; HALBERT *et al.*, 2001), Africa (HOLLIS, 2004; DZOKOU *et al.*, 2009) and the western Palaearctic Region (China, Italy, Israel, Egypt, Spain and Turkey), with the first interceptions from this latter region being made in Italy (LAUDONIA, 2006). Like all *Blastopsylla* spp., this psyllid is exclusively associated with *Eucalyptus* spp. (Myrtaceae). The nymphs produce many small wax-covered globules containing honeydew and copious white flocculence which promote the growth of sooty mould. The species was first collected from Malta in 2013 but it is possible that it had been present there for some years before. It is relatively common and widespread in Malta.

#### *Glycaspis brimblecombei* Moore, 1964

**Material examined.** MALTA: Msida, 5.iv.2014, 18♂♂ & 24♀♀, on *Eucalyptus* sp.

**Notes.** The genus *Glycaspis* Taylor, 1960 currently accommodates 137 described species native to Australia, all of which are associated with *Eucalyptus* spp. (Myrtaceae) (OUVRARD, 2020). In the late 1990s *Glycaspis brimblecombei* was found in the United States of America (BRENNAN *et al.*, 1999), followed by Mexico and South America. More recently it was also introduced accidentally to South and East Africa and is now widespread in the western Palaearctic Region, with the first reports originating from the Iberian Peninsula in 2009 (VALENTE & HODKINSON, 2009). Commonly referred to as the red gum lerp psyllid, *G. brimblecombei* is a serious pest of *Eucalyptus* plantations, with heavy infestations leading to defoliation, branch dieback and occasionally tree death. The nymphs are characteristically concealed by shield-like conical white limpet-like coverings known as lerp, which they construct to protect themselves from natural enemies. So far in Malta, this species has been observed in only one locality, where it is relatively common.

#### Family Homotomidae Heslop-Harrison, 1958

##### *Homotoma ficus* (Linnaeus, 1758)

**Material examined.** MALTA: Buskett, 5.vi.1994, 1♀, 30.vi.1996, 2♂♂ & 9♀♀, 14.vi.1996, 24♂♂ & 30♀♀. All the material was collected on *Ficus carica* L.

**Notes.** The genus *Homotoma* Guérin-Méneville, 1844 is currently represented by 34 described species and is most diverse in the Oriental Region (HOLLIS & BROOMFIELD, 1989). *Homotoma ficus* is widely distributed in the western Palaearctic Region and has been introduced accidentally to Great Britain (HODKINSON & WHITE, 1979) and the United States of America (HODKINSON, 1988). The species is monophagous on *Ficus carica* L. (HODKINSON & WHITE, 1979). It was recorded from Malta by MIFSUD *et al.* (2012) and is a relatively common species in the Maltese Islands.

##### *Macrohomotoma gladiata* Kuwayama, 1908

**Material examined.** MALTA: Valletta, 2.x.2014, 24♂♂ & 30♀♀; Msida, 23.x.2015, 40♂♂ & 55♀♀; Birgu, 24.x.2015, 64♂♂ & 78♀♀. All the material was collected on *Ficus microcarpa* L. f.

**Notes.** Fifteen described species are currently accommodated in the genus *Macrohomotoma* Kuwayama, 1908. *Macrohomotoma gladiata* is native to Japan, Taiwan and Hong Kong but since 2010 it became an alien invasive species in a number of European and Mediterranean territories (Algeria, Balearic Islands, Italy, Montenegro and Spain) (PEDATA *et al.*, 2012; MIFSUD & PORCELLI, 2012; GUENAOU & OUVARD, 2016) and, from 2016, also in the United States of America (RUNG, 2016). The species occurs on *Ficus* spp. (Moraceae) with most records found on *F. microcarpa* L. f. and *F. retusa* L. (HOLLIS & BROOMFIELD, 1989; PEDATA *et al.*, 2012). The species was first collected in Malta in 2014 and in less than one year it was observed wherever cultivated *Ficus microcarpa* trees occur. Its presence is easily detected due to the large amount of flocculent wax secretions, which both adults and nymphs produce on the undersides of the leaves.

**Family Liviidae Löw, 1979**  
**Subfamily Euphyllurinae Crawford, 1914**

***Euphyllura olivina* (Costa, 1839)**

**Material examined.** MALTA: Buskett, 5.i.1994, 3♂♂ & 3♀♀, , 20.ii.1994, 1♀, 6.iv.1996, 2♀♀; Marsa, Ghammieri, 7.i.1994, 2♂♂ & 8♀♀; M'Xlokk, Balluta, 27.ii.1994, 1♂, Msida, 29.iii.1994, 20 nymphs; Wardija 24.v.1994, 2♂♂ & 5♀♀; Mistra, 10.ii.1995, 1♀; Fiddien, 19.iii.1996, 8♂♂ & 2♀♀; Selmun, 30.iii.1996, 1♂; Girgenti, 8.x.1996, 6♂♂ & 2♀♀. All the material was collected on *Olea europaea* L.

**Notes.** The genus *Euphyllura* Foerster, 1848 currently accommodates 12 described species, of which four are often considered to be economically important pests on olive (ASADI *et al.*, 2011). *Euphyllura olivina* is a typical central-western Mediterranean species. Records from the Middle East are in need of being re-evaluated. The species has been accidentally introduced to the United States of America (California) (MALUMPHY, 2011). Most records of *Euphyllura olivina* come from *Olea europaea* L. but it is also reported to occur on other Oleaceae including *Olea europaea sylvestris* (Mill.) Hegi and *Phillyrea latifolia* L. and on one species of Elaeagnaceae (*Elaeagnus angustifolia* L.) (PERCY *et al.*, 2012). The psyllid is very common and widespread in the Maltese archipelago and is found wherever olive trees are cultivated. It was previously reported by BORG (1922), SALIBA (1963) and HABER & MIFSUD (2007).

***Diaphorina lycii* Loginova, 1978**

**Material examined.** MALTA: Buskett, 5.i.1994, 1♀, on *Olea europaea* L.; Wardija, 11.xi.1997, 33♂♂ & 46♀♀ and numerous nymphs on *Lycium intricatum* Boiss.

**Notes.** The genus *Diaphorina* Löw, 1880 is mainly distributed in the drier parts of the Old World. Currently, the genus is represented by almost 80 described species but many undescribed species are present in museum collections (BURCKHARDT *et al.*, 2015). *Diaphorina lycii* is widely distributed in the Mediterranean basin, extending eastwards into central Asia up to Mongolia. The psyllid is strictly oligophagous on *Lycium* spp. (Solanaceae) (BURCKHARDT, 1984). In the Maltese Islands, *D. lycii* is rare and has a restricted distribution, reflecting the scarcity of its host plant, *Lycium intricatum* which represents a new host-plant record for this psyllid.

***Psyllopsis fraxinicola* (Foerster, 1848)**

**Material examined.** MALTA: Buskett, 5.vi.1994, 1♀, 3.vii.1994, 7♂♂ & 3♀♀, 6.iv.1996, 3♂♂ & 2♀♀, 15.iv.1996, 4♂♂ & 9♀♀, 30.vi.1996, 6♂♂ & 8♀♀. All the material was collected on *Fraxinus angustifolia* Vahl.

**Notes.** The genus *Psyllopsis* Löw, 1879 currently accommodates 10 described species, all associated with *Fraxinus* spp. (Oleaceae). *Psyllopsis fraxinicola* is widely distributed in the western Palaearctic Region, with its easternmost record from Kazakhstan. The species has been accidentally introduced to Australia, New Zealand, North and South America (HODKINSON, 1988; HOLLIS, 2004; PERCY *et al.*, 2012). Given the rarity of *Fraxinus angustifolia* in Malta, this psyllid is similarly rare and has a very restricted distribution there.

**Family Psyllidae Latreille, 1807**

**Subfamily Acizzinae White & Hodkinson, 1985**

***Acizzia uncatoides* (Ferris & Klyver, 1932)**

**Material examined.** MALTA: M'Xlokk, Balluta, 27.ii.1994, 8♂♂ & 11♀♀, 26.iii.1994, 13♂♂ & 13♀♀, 14.v.1994, 13♂♂ & 25♀♀; Migra Ferha, 31.iii.1994, 8♂♂ & 6♀♀; Ghadira, 14.iv.1994, 2♂♂. All the material was collected on *Acacia cyclops* Don f.

**Notes.** The genus *Acizzia* Heslop-Harrison, 1961 currently accommodates almost 80 described species. Three alien species are reported from the West Palaearctic Region, two of which were introduced from Australia (*A. acaciaebaileyanae* (Froggatt, 1901) and *A. uncatoides*) and one from East Asia (*A. jamatonica* (Kuwayama, 1908)) (HODKINSON & HOLLIS, 1987). *Acizzia uncatoides* is native to Australia but has spread to other territories on cultivated *Acacia*, including New Zealand, and North and South America. In the western Palaearctic, the species was first reported from France (ARZONE & VIDANO, 1985) and was subsequently found in Algeria, Great Britain, Greece, Israel, Italy, Lebanon, Montenegro, Portugal and Spain. *Acizzia uncatoides* is mostly recorded on *Acacia* spp. but is also known to occur on other Fabaceae including *Albizia* spp. (MUNRO, 1965). It is a dimorphic species, with the winter form differing from the summer form by the darker colouration of both body and wings, in addition to the longer antennae and forewings (RAPISARDA, 1990). The species can be noxious to cultivated *Acacia* trees. In the Maltese Islands this species is rather common.

**Subfamily Psyllinae Latreille, 1807**

***Cacopsylla myrthi* (Puton, 1876)**

**Material examined.** MALTA: Buskett, 5.i.1994, 18♂♂ & 31♀♀, 20.ii.1994, 50♂♂ & 62♀♀ & numerous nymphs, 24.iii.1994, 56♂♂ & 47♀♀ & numerous nymphs, 5.vi.1994, 7♂♂ & 12♀♀, 6.iv.1996, 10♂♂ & 17♀♀; Mtahleb, 6.iv.1996, 1♀; Wied Babu, 14.iv.1994, 9♀♀; Mistra, 24.iv.1994, 3♂♂ & 4♀♀; Wardija, 24.v.1994, 5♂♂ & 3♀♀; Bahrija, 17.v.1995, 12♂♂ & 8♀♀; Wied il-Ghasel, 2.iv.1996, 2♀♀; Wied Has-Saptan, 26.iv.1995, 22♂♂ & 35♀♀; Wied Anglu, 9.iv.1996, 2♂♂ & 1♀. All the material was collected on *Rhamnus alaternus* L. and *R. lycioides* subsp. *oleoides* (L.) Jahand. & Maire.

**Notes.** The genus *Cacopsylla* Ossiannilsson, 1970 currently accommodates more than 470 described species. *Cacopsylla myrthi* is a typical Mediterranean species and is recorded from *Rhamnus* spp. (Rhamnaceae) (BURCKHARDT, 1989). The above record from *Rhamnus lycioides* subsp. *oleoides* represents a new host-plant record for this psyllid. It is one of the most common jumping plant-lice in Malta, found in valley and maquis habitats wherever its host-plants occur, and was previously recorded from Malta by THAO *et al.* (2000).

### *Cacopsylla pyri* (Linnaeus, 1758)

**Material examined.** MALTA: Rabat, Chadwick Lakes, 8.vi.1994, 2♂♂ & 1♀, 13.vi.1994, 6♂♂ & 12♀♀. All the material was collected on *Pyrus communis* L.

**Notes.** Around 40 *Cacopsylla* species have been recorded from pear in the Palaearctic Region. Of these, two species (*C. pyricola* (Foerster) and *C. bidens* (Šulc)) were accidentally introduced into the New World (CHO *et al.*, 2017). *Cacopsylla pyri* is present throughout Europe, the Middle East and far eastern Asia. The species is strictly oligophagous on *Pyrus* spp. (Rosaceae) on which it can be a serious pest. ‘*Candidatus* Phytoplasma pyri’ is transmitted by *Cacopsylla pyri*, and is the casual agent of pear decline diseases. The psyllid is seasonally dimorphic, with summer and winter forms easily distinguished on the basis of size, colour and forewing pattern. *Cacopsylla pyri* is frequently found in the Maltese archipelago wherever pear is cultivated.

### Family Triozidae Löw, 1879

#### *Bactericera albiventris* (Foerster, 1848)

**Material examined.** MALTA: Gnien il-Kbir, limits of Rabat, near Buskett, 3.vii.1994, 1♀, on *Salix alba* L.

**Notes.** The genus *Bactericera* Puton, 1876 currently accommodates 160 described species, having a worldwide distribution (BURCKHARDT & LAUTERER, 1997; OUVARD, 2020). *Bactericera albiventris* is widely distributed in the western Palaearctic (except North Africa), and its range extends eastwards into the Middle East (Afghanistan, Caucasus, Iran, Lebanon, Tadjikistan, Turkey, Turkmenistan and Uzbekistan) and the Far East (Mongolia, Russian Far East and Siberia). Host-plants of *B. albiventris* include *Salix* spp. (Salicaceae), with most records being recorded on *S. alba* L., *S. fragilis* L. and *S. triandra* L. (BURCKHARDT & LAUTERER, 1997; OSSIANNILSSON, 1992). In Malta, *Salix alba* is a very rare tree, having a very restricted distribution (LANFRANCO, 1989), which explains why this psyllid is rare and locally endangered.

#### *Bactericera crithmi* (Löw, 1880)

**Material examined.** MALTA: Migra Ferha, 16.i.1994, 1♂ & 4♀♀, on *Ferula melitensis* Brullo, C. Brullo, Cambria, Giusso, Salmeri & Bacch., 31.iii.1994, 3♂♂ & 3♀♀, on *Crithmum maritimum* L., 29.i.1995, 11♂♂, 17♀♀ & 23 nymphs on *F. melitensis*; Selmun, 5.ii.1995, 5♂♂, 8♀♀ & 5 nymphs on *F. melitensis*; Bahrija, 19.iii.1995, 2♀♀, on *C. maritimum*. GOZO, Mgarr, 3.iv.1994, 2♂♂ & 1 nymph, on *F. melitensis*; Dwejra, 9.v.1996, 8♂♂, 2♀♀ & 30 nymphs on *C. maritimum*.

**Notes.** *Bactericera crithmi* is distributed from central Asia to Caucasus, ex-Yugoslavia, France, Spain, Great Britain, Ireland and Italy. Since its original description, *B. crithmi* was always cited

as occurring on *Crithmum maritimum* L. (Apiaceae) but HODKINSON (2009) (based on the above material) recorded it from *Ferula* sp. (Apiaceae), an umbellifer endemic to Malta recently described as *F. melitensis*. Based on observations carried out in Malta, it was found that at least one winter generation (December to March) took place on *Ferula melitensis*, when this plant is actively growing and its usual host-plant, *C. maritimum*, is dormant; and at least one other generation took place on *C. maritimum* between March and May, when this plant is actively growing and *F. melitensis* is dying down. As evidenced by HODKINSON (2009), such host-plant shifts are well known to occur in aphids; the only two multivoltine psyllids recorded with this behaviour are *B. crithmi* and *B. cockerelli* (Šulc, 1909), which shifts between *Lycium* and *Solanum* (COOPER *et al.*, 2019). It is worth mentioning that, despite no apparent morphological differences were observed between adult *B. crithmi* which developed on *F. melitensis* and those that developed on *C. maritimum*, morphological differences in the fifth instar nymphs were found. These differences relate to numbers of head sectasetae (HSS), forewing sectasetae (FSS) and abdominal sectasetae (ASS) as follows (based on 20 fifth instar nymphs from each host-plant): on *Crithmum maritimum*, HSS (45–54), FSS (22–37), ASS (110–136) and on *Ferula melitensis*, HSS (68–83), FSS (36–60), ASS (146–174).

### *Bactericera trigonica* Hodkinson, 1981

**Material examined.** MALTA: Bahrija, 24.vii.1997, 27♂♂ & 30♀♀. GOZO: Ghasri, 25.vi.1995, 4♂♂ & 9♀♀. All the material was collected on cultivated carrots (*Daucus carota* subsp. *sativus* (Hoffm.) Schübl. & G. Martens).

**Notes.** *Bactericera trigonica* is a typical Mediterranean species. It is oligophagous on Apiaceae, recorded mostly on *Daucus carota* s.l. but also on *Apium*, *Ferula* and *Foeniculum* (TERESANI *et al.*, 2015; SPODEK *et al.*, 2017). It is not a common species in the Maltese Islands.

### *Heterotrioza chenopodii* (Reuter, 1876)

**Material examined.** MALTA: M'Xlokk, Balluta, 26.ii.1994, 2♂♂ & 2♀♀, on *Atriplex halimus* L., 26.iii.1994, 1♂, on *Chenopodium murale* (L.) S. Fuentes & *al.*, 14.v.1994, 5♂♂ & 4♀♀; Birzebbugia, 27.iii.1994, 1♀, on *Chenopodium* sp.; Mtaħleb, 17.iv.1994, 21♂♂ & 19♀♀, on *Chenopodium* sp.; Armier, 13.vi.1994, 2♂♂ & 4♀♀, on *Chenopodium* sp.; Rabat, 13.vi.1994, 5♂♂ & 5♀♀, on *C. murale*; Marsa, Għammieri, 7.xii.1994, 2♂♂ & 3♀♀, on *C. murale*; Floriana, 14.xii.1994, 3♂♂ & 3♀♀, on *C. murale*; Fiddien, 19.iii.1996, 3♀♀, on *Chenopodium* sp.; St. Thomas Bay, 20.iv.1996, 1♂ & 7♀♀, on *Atriplex* sp. GOZO: Mgarr, 3.iv.1994, 1♀, on *Chenopodium* sp.; Wied il-Lunzjata, 2.vi.1995, 4♂♂ & 3♀♀, on *Atriplex* sp.; Ghasri, 25.vi.1995, 3 & 8♀♀, on *Atriplex* sp.

**Notes.** The genus *Heterotrioza* Dobreaanu & Manolache, 1960 currently accommodates 13 described species. *Heterotrioza chenopodii* is distributed throughout the Palaearctic Region and was recently introduced accidentally to North America (Canada) (WHEELER & HOEBEKE, 2013), USA and South America (Chile) (PERCY *et al.*, 2020). It is oligophagous on Amaranthaceae, and has been recorded on the following genera: *Amaranthus*, *Atriplex*, *Beta*, *Chenopodium*, *Halimione* and *Spinacia* (BURCKHARDT, 1989; OSSIANILSSON, 1992; HODKINSON & WHITE, 1979). *Heterotrioza chenopodii* is seasonally dimorphic, with the autumn form having shorter wings and the summer form having forewings of a normal length. It often induces leaf deformations on the host-plants mentioned above. In the Maltese Islands this is one of the commonest psyllid species, found everywhere.



*Lauritrioza alacris* (Flor, 1861)

**Material examined.** MALTA: Buskett, 2.i.1994, 6♂♂ & 3♀♀; 5.vi.1994, 53♂♂ & 54♀♀, 30.vi.1996, 17♂♂ & 10♀♀; Marsa, Ghammieri, 4.i.1994, 1♀. All the material was collected on *Laurus nobilis* L.

**Notes.** The genus *Lauritrioza* Conci & Tamanini, 1986 was erected to accommodate a single species, *L. alacris*, which is probably of Mediterranean origin but has been introduced throughout the western Palaearctic Region on cultivated bay laurel. It is also present in the western part of the Middle East (Caucasus, Israel, Lebanon, Syria and Turkey). *Lauritrioza alacris* was also introduced accidentally to North and South America (MIFSUD *et al.*, 2010). The species is restricted to Lauraceae, with most records on *Laurus nobilis*, but it is also recorded on other species of *Laurus* and *Persea indica* (L.) Spreng. (BURCKHARDT, 1989; HODKINSON & WHITE, 1979). The psyllid induces characteristic galls by rolling leaf margins down to the lower surface. In the Maltese Islands it is a very common species, found wherever bay laurel is cultivated; it was recorded from Malta previously by CARUANA GATTO (1926).

*Trioza centranthi* (Vallot, 1829)

**Material examined.** MALTA: Wied Ghommor, 22.iii.1997, 1♂ & 1♀, on galls of *Fedia graciliflora* Fisch. & C.A. Mey.

**Notes.** The genus *Trioza* Foerster, 1848 is a very diverse, ill-defined genus with some 440 described species worldwide (OUVRARD, 2020). *Trioza centranthi* is a widely distributed species in the Mediterranean basin extending eastwards into the Middle East (Caucasus, Israel, Transcaucasus and Turkey). The species is oligophagous on Caprifoliaceae including *Centranthus* spp., *Valerianella* spp. and *Fedia graciliflora* (BURCKHARDT, 1989; OSSIANNILSSON, 1992; RIPKA, 2008). This species causes showy deformations on both leaves and flowers of its host-plants. In the Maltese Islands this psyllid is rather uncommon, and previously reported by CARUANA GATTO (1926).

*Trioza galii* Foerster, 1848

**Material examined.** MALTA: Buskett, 24.iii.1994, 2♂♂ & 4♀♀; St. Thomas Bay, Munxar, 4.xii.1994, 1♂; Bahrija, 19.iii.1995, 1♀; Wied Qirda, 28.i.1996, 4♂♂ & 3♀♀; Zejtun, 4.iv.1996, 1♀; Wied Has-Sabtana, 5.iv.1996, 1♀; Mtahleb, 6.iv.1996, 1♀; Wied Anglu, 9.iv.1996, 1♀. GOZO: Xlendi valley, 16.iii.1994, 3♀♀; Dwejra, 10.v.1996, 1♂. All the material was collected on *Galium* spp.

**Notes.** *Trioza galii* is distributed throughout the Palaearctic Region but apparently absent in North Africa. It is oligophagous on Rubiaceae and was reported on the following genera: *Asperula*, *Cruciata*, *Galium*, *Rubia* and *Sherardia* (BURCKHARDT, 1989; BURCKHARDT & LAUTERER, 2006; NEWBOULD, 2012; OSSIANNILSSON, 1992). *Trioza galii* often induces leaf deformations on the mentioned host-plants. In the Maltese Islands this is a common psyllid, previously recorded by CARUANA GATTO (1926).

### *Trioza kiefferi* Giard, 1902

**Material examined.** MALTA: Mistra Valley, 24.iv.1994, 2♀♀; Wied Has-Sabtan, 5.iv.1996, 12♂♂ & 8♀♀; Mtaheb, 6.iv.1996, 1♂ & 3♀♀; Wied Anglu, 9.iv.1996, 2♂♂; Fawwara, 30.xii.1996, 1♀; Wied Qirda, 1.i.1997, 2♂♂ & 2♀♀ and numerous nymphs. All the material was collected on *Rhamnus lycioides* subsp. *oleoides* (L.) Jahand. & Maire.

**Notes.** This species has a rather restricted distribution in the western Mediterranean, being recorded from southern Italy, France, Portugal, Yugoslavia and Algeria. *Trioza kiefferi* is oligophagous on *Rhamnus* spp. (Rhamnaceae) (BURCKHARDT, 1989). In Sicily, this species was reported as inducing characteristic tube-like galls (each about 3 mm long and 1 mm in diameter) on the leaf surfaces of *Rhamnus* spp. (RAPISARDA, 1989), but such galls have never been observed in Malta, even though it is a relatively common species wherever its host-plant is found.

### *Trioza urticae* (Linnaeus, 1758)

**Material examined.** MALTA: Marsa, Ghammieri, 15.iii.1995, 1♀, 8.v.1996, 1♂ & 2♀♀; Wied Has-Sabtan, 5.iv.1996, 1♂ & 1♀; Buskett, 6.iv.1996, 1♀; Mtaheb, 6.iv.1996, 7♂♂ & 8♀♀. All the material was collected on *Urtica* spp.

**Notes.** *Trioza urticae* is widely distributed throughout the Palaearctic Region. It is oligophagous on *Urtica* spp. (Urticaceae). In central and northern Europe, the species overwinters on conifers or under the bark of various trees (CONCI *et al.*, 1996). It often induces leaf deformations on *Urtica*. In the Maltese Islands it is a relatively common species.

## DISCUSSION

Prior to this work, published original collection data of psyllids occurring in Malta was only available for six species out of the 21 reported here. Of these, four are accidentally introduced and established alien species, of which three originated from Australia (*Acizzia uncatoides*, *Blastopsylla occidentalis* and *Glycaspis brimblecombei*) and one (*Macrohormotoma gladiata*), originated from the Far East. The remaining 17 species should be considered as native to the Maltese Islands, usually having widespread distribution ranges in the Mediterranean or within the West Palaearctic Region, and often having a range extending eastwards to the Middle East or even to the Far East. Three species should be considered as rare and with a restricted distribution on the Maltese Islands, mainly due to the rarity of their host-plants: this is particularly true of *Diaphorina lycii*, since *Lycium intricatum* is locally rare; *Bactericera albiventris*, since *Salix* is locally close to extinction, and *Psyllopsis fraxinicola*, since *Fraxinus* is also very rare in the islands. Of particular interest is the host-plant shift identified for *Bactericera crithmi*, between *Crithmum maritimum*, its typical host-plant, and *Ferula melitensis*. In terms of feeding regimes, only *Homotoma ficus* can be considered as monophagous on *Ficus carica* (Moraceae), whereas most of the other psyllids in Malta can be considered as oligophagous. In fact, many of these psyllids are associated with a single plant genus (including: *Colposcena aliena* on *Tamarix* spp. (Tamaricaceae); *Agonoscena targionii* on *Pistacia* spp. (Anacardiaceae); *Blastopsylla occidentalis* and *Glycaspis brimblecombei* on *Eucalyptus* spp. (Myrtaceae); *Macrohormotoma gladiata* on *Ficus* spp. (Moraceae); *Diaphorina lycii* on *Lycium* spp. (Solanaceae); *Psyllopsis fraxinicola* on *Fraxinus* spp. (Oleaceae); *Cacopsylla myrthi* on *Rhamnus* spp. (Rhamnaceae); *Cacopsylla pyri* on *Pyrus* spp. (Rosaceae); *Bactericera albiventris* on *Salix* spp. (Salicaceae); *Trioza kiefferi* on *Rhamnus* spp. (Rhamnaceae); and *T. urticae* on *Urtica* spp. (Urticaceae)), or occur on related genera within a single plant family (including:

*Acizzia uncatoides* on *Acacia* spp. and *Albizia* spp. (Fabaceae); *Bactericera crithmi* on *Crithmum* and *Ferula* (Apiaceae); *B. trigonica* on Apiaceae; *Heterotrioza chenopodii* on Amaranthaceae; *Lauritrioza alacris* on *Laurus* and *Persea* (Lauraceae); *Trioza galii* on Rubiaceae; and *T. centranthi* on Caprifoliaceae). Only *Euphyllura olivina* is known to occur on hosts in more than one plant family, Oleaceae (*Olea* and *Phillyrea*) and Elaeagnaceae (*Elaeagnus*).

All the psyllids found in Malta are also present on the nearby island of Sicily. Sicily, with about 70 species of jumping plant-lice recorded, is however more than 50 times larger than Malta, with much more diverse habitat types (and hence a much more diverse flora), and with less anthropogenic influence. The lack of certain typical Mediterranean psyllids from Malta can be explained as a result of the absence or rarity of their host plant/s. Thus, at least 10 species of psyllids associated with Genistinae occur in Sicily, whereas the almost complete lack of such plants from Malta accounts for the absence of such psyllids.

Psyllids that occur in countries in close proximity to Malta and for which the host-plants are also present in Malta are many. Thus, in the future, it is expected that some of these other species will be found, especially if targeted field work is carried out. Plants on which further investigation should be carried out for the possible presence of other unrecorded psyllid species in Malta include: *Tamarix*, *Suaeda*, *Populus*, *Erica multiflora* L., *Pistacia lentiscus*, *Cistus*, *Crataegus*, *Rhamnus*, *Cercis siliquastrum* L. and *Atriplex*.

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**Appendix I.** Checklist of the jumping plant-lice of Malta

## Family Aphalaridae

## Subfamily Aphalarinae

*Colposcena aliena* (Löw, 1881)

## Subfamily Rhinocolinae

*Agonoscena targionii* (Lichtenstein, 1874)

## Subfamily Spondyliaepidinae

*Blastopsylla occidentalis* Taylor, 1985*Glycaspis brimblecombei* Moore, 1964

## Family Homotomidae

## Subfamily Homotominae

*Homotoma ficus* (Linnaeus, 1758)*Macrohomotoma gladiata* Kuwayama, 1908

## Family Liviidae

## Subfamily Euphyllurinae

*Euphyllura olivina* (Costa, 1839)*Diaphorina lycii* Loginova, 1978*Psyllopsis fraxinicola* (Foerster, 1848)

## Family Psyllidae

## Subfamily Acizziinae

*Acizzia uncatoides* (Ferris & Klyver, 1932)

## Subfamily Psyllinae

*Cacopsylla myrthi* (Puton, 1876)*Cacopsylla pyri* (Linnaeus, 1758)

## Family Triozidae

*Bactericera albiventris* (Foerster, 1848)*Bactericera crithmi* (Löw, 1880)*Bactericera trigonica* Hodkinson, 1981*Heterotrioza chenopodii* (Reuter, 1876)*Lauritrioza alacris* (Flor, 1861)*Trioza centranthi* (Vallot, 1829)*Trioza galii* Foerster, 1848*Trioza kiefferi* Giard, 1902*Trioza urticae* (Linnaeus, 1758)