

## New records of Coleophoridae (Lepidoptera) from the Maltese Islands

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**ABSTRACT.** Six species of Coleophoridae, *Coleophora acrisella*, *C. arenicola*, *C. bilineella*, *C. festivella*, *C. fretella*, and *C. helianthemella* are recorded for the first time from the Maltese Islands. The record of *C. arenicola* is also the first one for Europe. The female of *C. fretella* is described and its biology outlined. Notes on the local biology of *C. semicinerea* are also given. A check-list of the Maltese Coleophoridae is provided along with new data for *C. jefreniensis*.

**KEY WORDS.** Mediterranean, new records, checklist, Malta.

### INTRODUCTION

The Coleophoridae is a large family with 1,342 described species (BALDIZZONE *et al.* 2006). The majority of these species are accommodated in the genus *Coleophora* Hübner, 1822. In a study carried out by BAUER *et al.* (2012) it was concluded that the five formerly recognised coleophorid genera, *Augasma* Herrich-Schäffer, 1853, *Coleophora* Hübner, 1822, *Goniodoma* Zeller, 1849, *Metriotes* Herrich-Schäffer, 1853 and *Ischnophanes* Meyrick, 1891 should be reduced to three, namely *Augasma*, *Coleophora* and *Ischnophanes* and the remaining genera, *Goniodoma* and *Metriotes* were synonymized with *Coleophora* (BAUER *et al.* 2012). In Europe, the Coleophoridae are currently represented by 568 species accommodated in three genera, of which 563 species belong to the genus *Coleophora*, 4 species in *Ischnophanes* and a single species in *Augasma* (BALDIZZONE & VAN DER WOLF, 2013). Coleophoridae have a worldwide distribution, with the larger diversity occurring in the West Palearctic region and central Asia (BALDIZZONE *et al.* 2006).

Adult Coleophoridae have a smooth-scaled head, antennae simple, about three quarters length of forewing, in some species basal segments thickened with scales and scape rough haired or tufted. In the genus *Coleophora*, when at rest the antennae are often held porrect close together. Labial palpus also held porrect with the third segment often angled upwards. 2<sup>nd</sup> segment often tufted at the apex. Wings are lanceolate with varying venation and hind wings often with long cilia two or three times width of wing. Abdomen with patches of short chitinous spines dorsally on tergites 1 to 7 exposed in *Coleophora* but concealed with scales in other genera. The larvae all construct a portable case at some stage in their life except a couple of exceptions. Pupation takes place inside the case in *Coleophora* with the exception of a couple of species which pupate in a silken cocoon in the soil, inside bark or inside a stem. On emergence the exuvia remains inside the site chosen for pupation (EMMET, 1996). Most species are nocturnal and attracted to light whilst others are active by day.

Ten species of Coleophoridae were to-date recorded from the Maltese Islands (SAMMUT, 2008). The present study brings the total number to 16 species. The biology of Coleophoridae on the Maltese Islands have been poorly studied prior to the present work with most records published on the basis of material obtained by UV light traps.

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## MATERIAL AND METHODS

The bulk of the material examined in the present work has been reared from larvae collected from the respective food plants from Malta and Gozo. Other methods of collecting are specified within the 'material examined' section of the respective species in the annotated species list. Dates included in the material examined indicate emergence or collection of adult and collection time of larvae. The material is deposited in the private collections of the author (CMZ) and of Dr Giorgio Baldizzone, Italy (CGB). In the species list, species marked with an (\*) represent new records for the Maltese Islands.

Colour photographs of adults and larval cases have been taken with a Cannon EOS 600D digital SLR camera mounted with a 100mm macro lens. Photographs of genitalia slides have been taken with an Opticam B5 digital camera mounted on a Bresser compound microscope.

## ANNOTATED SPECIES LIST

### \**Coleophora acrisella* Milliere, 1872

**Material examined:** Malta, Il-Mistra, 11.ix.2005, 2 ♂♂, same locality but 13.ix.2005, 1 ♂; Il-Qammieh, 13.viii.2006, 1 ♀, same locality but 20.viii.2006, 1 ♂; L-Imtahleb, 9.ix.2009, 1 ♂ & 1 ♀, same locality but 1.x.2009, 1 ♂; Ghajn Żnuber, 9.ix.2012, 1 ♀, same locality but 13.ix.2012, 1 ♀, same locality but 15.ix.2012, 2 ♂♂ & 1 ♀, same locality but 19.ix.2012, 1 ♀. All ex larva. All leg. M. Zerafa (CMZ). Larval cases: Malta, Il-Mistra, 10.ii.2005, n=10; Il-Qammieh, 1.i.2006, n=14; L-Imtahleb, 22.ii.2009, n=10; Ghajn Żnuber, 19.ii.2012, n=13. All on *Anthyllis hermanniae* L. All leg. M. Zerafa (CMZ).

**Short description:** Adult (Fig. 1). Wing span 9.4–11 mm (n=5); Head white with a light brown central fascia extending from the base tapering at the frons. Antennae white ringed light brown. Scape light brown, with white spreading scales underneath. Labial palpus; 3<sup>rd</sup> segment almost same length of 2<sup>nd</sup> segment and slightly bent upwards. 2<sup>nd</sup> segment white inside, outside brown, with lower half, white. 3<sup>rd</sup> segment brown, inside sometimes mottled with white scales. Haustellum covered with white scales. Thorax white with a central light brown fascia continuing from base of head tapering at the abdomen. Tegula white with a light brown fascia along the dorsal edge. Forewing dark brown with a white fascia on costa, starting from base of wing widening just before the apex and then terminating suddenly at the apex. A thin white line at base of wing fold and another thin white line from base to middle of wing on dorsum; basal half below wing fold brown; cilia brown. Hind wings and cilia light brown. Fore legs and mid legs brown outside, light brown inside; a white fascia dorsally on the coxa, tibia and tarsi and ventrally on the femur. Hind legs are similar but tibia has long light brown hairs on the inside with the white fascia wider to the side, white long hairs ventrally and the brown reduced to a thin line. Abdomen greyish brown to light brown, ventrally heavily mottled white.

Larval case (Fig. 12). 4.5–5 mm long and 2.3–2.5 mm wide when fully grown (dorsally) (n=5); The case is constructed from 6 or 7 pieces of hollowed out leaves. Each section is roughly rhombic and they are attached to each other along the longest edges creating an arching case slightly helicoidal at first. The earlier sections are the most strongly arched. The case becomes dark brown with the sericeous covering of the leaf giving it a silky look. Section fringes become light brown. The oral opening is small and circular, at 10° to the long axis when viewed laterally. The anal opening is bivalved, flat. Cases are arched slightly either to the right or left hand side (47% to the right & 53%

to the left when viewed ventrally) with the anal opening finally turning towards the front of the case but perpendicular to the oral opening. The oral opening is slightly offset from the centre to the opposite side of the anal opening when viewed ventrally.

**Distribution:** It is found in Austria, Croatia, Czech Republic, France, Greece, Hungary, Italy, Macedonia, Portugal and Spain (BALDIZZONE & VAN DER WOLF, 2013).

**Biology:** On the continent this species has been recorded feeding on *Dorycnium hirsutum* (L) Ser., *D. pentaphyllum* Scop. and *D. pentaphyllum germanicum* Gams (ELLIS, 2007). In his original description Millière said that this species fed on *Aster (Erigeron) acris* L. (MILLIÈRE, 1872) but this is most probably a mistake. *Dorycnium* does not grow in Malta and all the larvae were collected from *Anthyllis hermanniae* L. Egg laying has not been observed locally. Larvae enlarge their cases by mining a blotch close to the leaf margin according to the required size then slit open the margin and insert the oral opening between the upper and lower epidermis. The larva then cuts open the case from the oral opening sideways to the same width of the new section. The edges are then spun together. The new section is then excised from the leaf and the front part reduced to form the oral opening. The whole case is reinforced by silk from the inside. The larva feeds by penetrating the leaf generally from the underside but also from the upper side especially younger larvae, then creating a blotch mine. The frass is ejected from the anal opening and is often trapped inside the curved space of the ventral side of the case. Larval cases have been collected in the winter months and continue feeding till April. The larvae then find a sheltered strong branch on the shrub and attach the case firmly to it. Diapause during summer. Adults emerge from mid-August till early October. MILLIÈRE (1872) reported that this species undegoes two generations per year. ELLIS (2007) indicates three generations with reference to SUIRE (1961) and HERING (1967). Only one generation per year is recorded from Malta.

**Notes:** The species was determined by genitalia mounts (slide no. GP012–14, leg. M. Zerafa) and confirmed by Dr G. Baldizzone and a species of parasitic wasp feeding on *C. acrisella* is being studied.

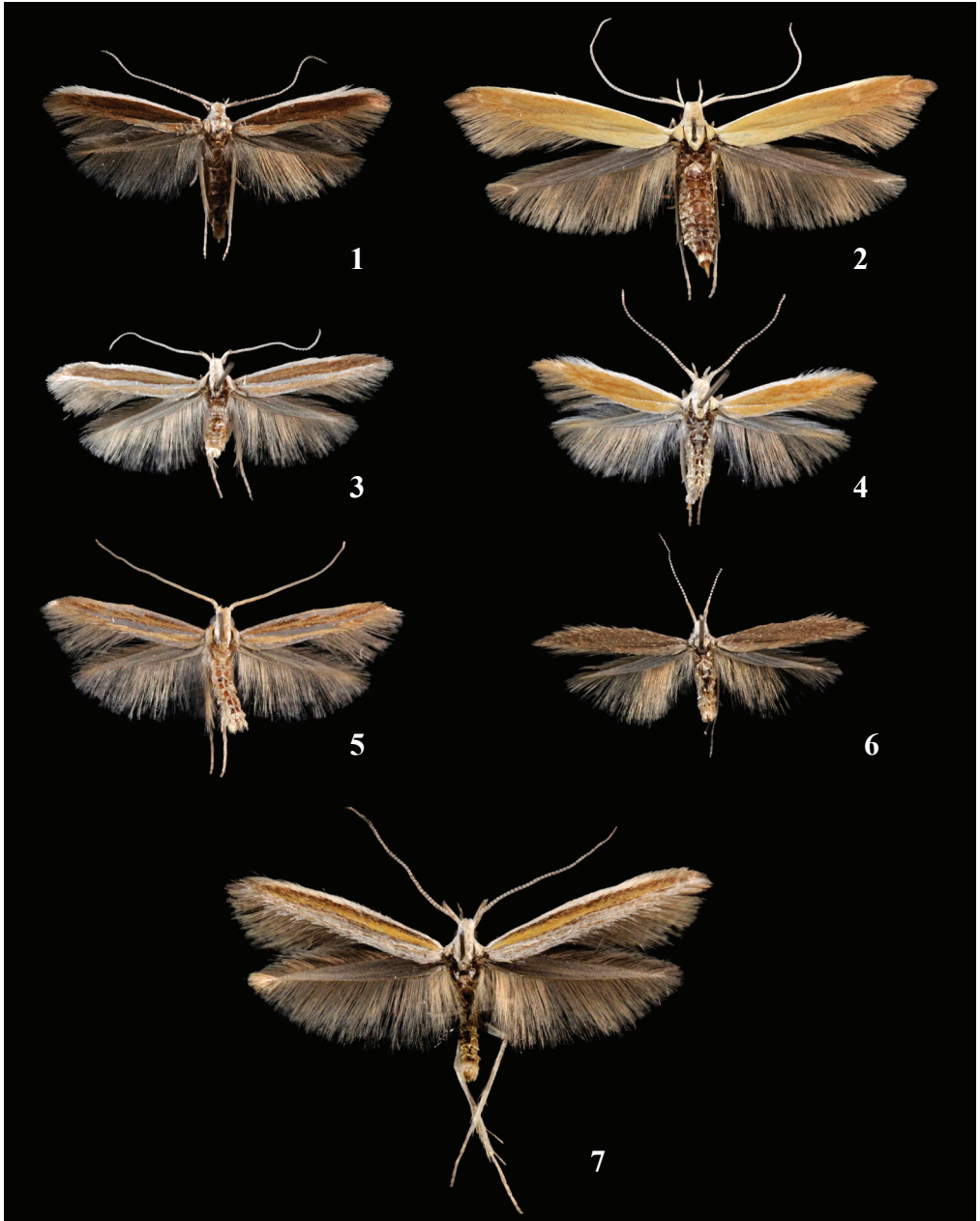
#### *\*Coleophora arenicola* Toll, 1952

**Material examined:** Malta, Had Dingli, 26.iii.2012, 1 ♀ (CMZ), same location but 31.iii.2012, 2 ♀♀ (CGB, CMZ) all ex pupa; Had Dingli, 31.iii.2014, 2 ♂♂ (CGB, CMZ), by beating. All leg. M. Zerafa. Larval cases: Malta, Had Dingli, 1.v.2008, n=11, on *Hedysarum coronarium* L., same location but 19.iii.2012, n=5, attached to rock face (CGB, CMZ). All leg. M. Zerafa.

**Short description:** Adult (Fig. 2). Wing span 16.5–17.2 mm (n=5). Head buff to pale buff, crown cream. Antennae cream slightly ringed buff with buff coloured scape on underside. Labial palpus ochre on the outside, inside cream buff in male, cream in female. 3<sup>rd</sup> segment almost ½ length of 2<sup>nd</sup> segment. Haustellum whitish cream. Thorax cream in male, buff in female. Forewing pale buff to buff, ochre on costal half towards apex. Costa cream up to apex, in female from base up to ¾ of wing. Cilia ochre. Hind wings grey. Cilia ochre. Abdomen pale buff. Legs pale buff with brown line on outside of femur and tibia. Tarsi brown, pale buff in female.

Larval case (Fig. 13). 8.7–9.3 mm long and 2.3–2.4 mm in diameter when fully grown (n=10). The case is cylindrical in shape constructed from silk. Oral opening is circular, at app 50° to the long axis. Anal opening trivalved. The case has two dorsal keels starting just behind the oral opening dorsally and forking out to each edge of the top flap of the anal trivalve and a small ventral keel

starts where the lateral flaps meet ventrally, down towards the oral opening. The colour is dark brown, paler towards the oral opening. Dorsal keels light brown.



**Figures 1–7:** Coleophoridae. **1:** *Coleophora acrisella*; **2:** *Coleophora arenicola*; **3:** *Coleophora bilineella*; **4:** *Coleophora festivella*; **5:** *Coleophora helianthemella*; **6:** *Coleophora jefreniensis*; **7:** *Coleophora semicinera*.

**Distribution:** Algeria (BALDIZZONE, 2003). The present record is the first for Europe.

**Biology:** In Algeria it has been recorded from *Hedysarum multijugum* L (BALDIZZONE, 2003; FALKOVITSH, 2006). In Malta larval cases were first collected from Had Dingli in May 2008 on seed pods of *Hedysarum coronarium* L. The early larval stages have not been observed locally. The larva constructs the case from silk. It feeds by attaching the case on the side of the pod, penetrates it and eats the unripe seed. Feeding lasts till end of May. The larva then finds a sheltered location on the sides of rocks and attaches the case securely. Diapause within larval case. Adults emerge in March.

**Notes:** The species was determined by Dr G. Baldizzone by genitalia mounts (slide nos. GP025–14, ♂, GP027–14, ♀, leg. M. Zerafa).



Figures 8–9: *Coleophora fretella*. 8: male; 9: female.

**\**Coleophora bilineella* Herrich-Schaffer, 1854**

**Material examined:** Malta, L-Imtahleb, 31.vii.2009, 1 ♂, same location but 9.viii.2009, 1 ♀, same location but 11.viii.2009, 1 ♀, same location but 13.viii.2009, 1 ♂, same location but 14.viii.2009, 1 ♀, same location but 15.viii.2009, 1 ♂, same location but 27.viii.2009, 2 ♂♂, same location but 28.viii.2009, 1 ♂, same location but 13.ix.2009, 1 ♀, same location but 24.ix.2009, 1 ♀, all ex larva. All leg. M. Zerafa (CMZ). Larval cases: Malta, L-Imtahleb, iii.2009, n=26, on *Cystus creticus* L.

**Short description:** Adult (Fig. 3). Wing span 8.8–11.5 mm (n=10). Head variable, white with a light brown central fascia to completely light brown. Antennae also variable from white to light brown. Scape brown sometimes mottled with white on top. Labial palpus small, straight. 3<sup>rd</sup> segment ½ length of 2<sup>nd</sup> segment. 2<sup>nd</sup> segment brown outside, white or light brown inside. 3<sup>rd</sup> segment same as 2<sup>nd</sup> segment but sometimes all brown. Haustellum white or light brown. Thorax variable same as head. Tegula white or light brown with a brown fascia on dorsal edge. Forewing upper half above wing fold, brown, lower half ochre. A shiny white fascia on costa starting from base and terminates just before apex. Another shiny white fascia along wing fold from base up to lower half of apex. On some specimens both fascia are shiny light brown instead. Cilia ochre. Hind wings shiny light

brown and cilia ochre. Abdomen shiny light brown on top and brown underside. Fore legs and mid legs brown outside, light brown inside. Some specimens with a white fascia on outside of tibia and 1<sup>st</sup> tarsi. Hind legs brown outside, light brown inside with long hairs on tibia.

Larval case (Figs. 14, 15). 5.5–7.5 mm long and 1.5–1.8 mm wide when fully grown (dorsally) (n=11). Constructed from 2 to 4 pieces of mined leaves and reinforced with silk from the inside. The adult case is more or less straight, laterally compressed with a dorsal and ventral keel. The oral opening is circular with a small lip and at about 45° to the long axis. The anal opening is bivalved. The first and second sections from the oral opening are straight with a diagonal joint. The third and fourth are generally attached at 90° to each other and to the second section at an angle of 45° when viewed laterally. Sections 3 and 4 sometimes absent. When present they are not used and the anal opening is redone in the second section from oral opening. Colour ochre brown.

**Distribution:** In Europe this species is recorded from Austria, Corsica, Crete, Cyprus, France, Greece, Hungary, Italy, Portugal, Romania, Sardinia and Spain. It is also known from North Africa and in the Near East, from Asian Turkey to the Caucasus, Iran down to the Arabian peninsula up to Israel and the Sinai peninsula (BALDIZZONE & VAN DER WOLF, 2013).

**Biology:** On the continent *C. bilineella* feeds on *Cistus monspeliensis* L., *C. salvifolus* L., *Fumana* sp., *Helianthemum canum* Baumg., *H. hirtum* Mill. (ELLIS, 2007). In Malta larvae have been collected only from *Cistus creticus* L. The first case is excised from a blotch mine generally at the edge. The larva then feeds on leaves by attaching the case on the underside and creates blotch mines. Young larvae have been noticed in December and keep feeding till early May when they also feed on the flower buds and unripe seeds. Locally, this species produces one generation per year.

**Notes:** The species was determined by genitalia mounts (slide no. GP016–14, leg. M. Zerafa) and confirmed by Dr G. Baldizzone. A species of parasitic wasp feeding on *C. bilineella* is being studied.

#### *\*Coleophora festivella* Toll, 1952

**Material examined:** Malta, Had Dingli, 19.iii.2009, 1 ♀, beating; Had Dingli 14.iii.2009, 1 ♀, same location but 8.iv.2009, 1 ♂, same location but 9.iv.2009, 1 ♂, same location but 11.iv.2009, 1 ♀, same location but 24.iv.2009, 1 ♀, same location but 27.iv.2009, 1 ♀, same location but 18.v.2009, 1 ♂, same location but 21.v.2009, 2 ♀♀, same location but 12.vi.2009, 1 ♀, same location but 24.vi.2009, 1 ♂, same location but 7.vii.2009, 1 ♂, same location but 21.vii.2009, 1 ♂, same location but 22.vii.2009, 1 ♂, same location but 23.vii.2009, 1 ♂, same location but 12.viii.2009, 1 ♂, same location but 12.x.2009, 1 ♀, same location but 18.xii.2009, 1 ♂, same location but 29.xii.2009, 1 ♂, all ex larva; Pembroke, 24.iv.2009, 1 ♀, same location but 8.v.2009, 1 ♂, all ex larva; L-Imtahleb, 12.x.2009, 1 ♀, ex larva. Gozo, Ix-Xlendi, 26.iv.2009, 1 ♂, ex larva. All leg. M. Zerafa (CMZ). Larval cases: Malta, Had Dingli, 10.ii.2009, n=6, same location but 19.iii.2009, n=46; Pembroke, 14.iii.2009, n=4; L-Imtahleb, 9.v.2009, n=5; Ghar Lapsi, 2.iv.2010, n=2. Gozo, Ix-Xlendi, 17.iii.2009, n=8. All on *Lotus cytisoides* L. All leg. M. Zerafa (CMZ).

**Short description:** Adult (Fig. 4). Wing span 7.7–11.5 mm (n=7). Head light brown in male and cream to light ochre in female, both with a white ring around the eye. Antennae brown ringed white. Scape brown in male, cream in female. Labial palpus; 3<sup>rd</sup> segment almost same length of 2<sup>nd</sup> segment and slightly bent upwards. 2<sup>nd</sup> segment white inside and outside, mottled brown in male and ochre in female dorsally. 3<sup>rd</sup> segment white, mottled brown in male and ochre in female. Haustellum white. Thorax light brown in male, light ochre in female, both with two white fasciae from base of head

towards abdomen. Tegula white with a fascia along the dorsal edge, light brown in male and light ochre in female. Forewing light ochre at base becoming ochre towards the apex; a white fascia on costa from base of wing to apex, more or less of same thickness. A thin white line in wing fold and another short white line from base to middle of wing on dorsum; base of dorsum with some light ochre scales; cilia ochre. Hind wings light brown with ochre cilia. Fore legs and mid legs brown to light brown; a white fascia dorsally on the tibia and tarsi and ventrally on the femur and tibia. Hind legs are white; tibia has long cream to light ochre hairs on the inside with a light brown thin fascia ventrally. Abdomen brown to light brown dorsally, light brown ventrally. Specimens which have brown forewings have been noticed locally (n=2). They are overall more brownish than described above.

Larval case (Figs. 18a–c). 5.7–6.9 mm long and 1.6–1.9 mm wide when fully grown (dorsally) (n=9); the case is constructed from 5 or 7 pieces of leaves and dorsally compressed. The final shape of the lobe case resembles a dry terminal shoot of the host plant. The initial sections from the oral opening are often made from complete leaves. The anal sections are made from excised parts of leaves and forming a half crescent when viewed dorsally; internally reinforced by white silk. The crescent can be either to the left or right when viewed dorsally. The oral opening is circular and at  $<10^\circ$  to the long axis. The last instar larval case has a lip to the opening made of a single piece of leaf. The anal opening is bivalved. The colour is cream-white.

**Distribution:** Spain and North Africa (BALDIZZONE & VAN DER WOLF, 2013).

**Biology:** In Malta larval cases have been collected only on *Lotus cytisoides* L. The pale green larva has a black head and black prothoracic plates. Those of the mesothorax reduced to two black spots. Thoracic legs black. The first case is excised from a blotch mine then successively enlarged by inserting the oral opening inside a mined leaf always from the upper side. The two are joined together forming a compressed cylindrical space; the leaf is often excised half way leaving the edges and tip (which will be facing towards the anal opening) and most often the last two sections are a complete mined leaf with the oral opening close to the petiole. These sections are added alternately, dorsally and ventrally. The case is attached in a sheltered location on the food plant or some other woody shrub before pupation. There are at least two overlapping generations in Malta. From cases that were collected in March adults emerged in April, May, June, July and December.

**Notes:** The species was determined by genitalia mounts (slide no. GP010–14, leg. M. Zerafa) and confirmed by Dr G. Baldizzone. A species of wing less parasitic wasp feeding on *C. festivella* is being studied.

#### *\*Coleophora fretella* Zeller, 1847

**Material examined:** Malta, Il-Qammieh, 30.iii.2005, 1 ♂, at light, same location but 14.iv.2005, 1 ♂, at light; Il-Manikata, 18.iii.2005, 2 ♂♂, beating; Birguma, 6.iii.2006, 1 ♀, ex larva, same location but 10.iii.2007, 1 ♀, ex larva; Bormla, 15.iii.2006, 1 ♀, ex larva; Mosta Valley, 9.iii.2009, 1 ♀, same location but 13.iii.2009, 1 ♂, same location but 14.iii.2009, 1 ♂ & 2 ♀♀, same location but 17.iii.2009, 1 ♂ & 2 ♀♀, same location but 28.iii.2009, 1 ♀, all ex larva; Had Dingli, 10.ii.2009, 4 ♂♂, beating, same location but 27.ii.2010, 1 ♀, ex larva, same location but 18.ii.2011, 1 ♂, ex larva. All ex larva on *Ranunculus bullatus* L. All leg. M. Zerafa (CGB, CMZ). Gozo, Dahlet Qorrot, 12.iii.2012, 1 ♀, ex larva on *R. bullatus*, leg. M. Zerafa (CMZ). Larval cases: Malta, Birguma, 12.xii.2005, n=1, same location but 7.i.2007, n=3; Il-Qammieh, 1.i.2006, n=5; Bormla, 8.ii.2006, n=1; Mosta Valley, 1.i.2009, n=30, same

location but 18.i.2009, n=10; Had Dingli, 1.i.2010, n=1, same location but 10.ii.2011, n=2; Naxxar Gap, 26.xi.2014, n=15; Ghajn Tuffieha, n=10. Gozo, Dahlet Qorrot, 10.ii.2012, n=1. All on *R. bullatus*, leg. M. Zerafa (CGB, CMZ). Larva: Malta, Naxxar Gap, 10.i.2015, n=2. leg. M. Zerafa (CMZ).

**Short description:** Male (Fig. 8). Wing span 9.5–10.5 mm (n=4). Head ochre. Antennae brown slightly ringed cream. Labial palpus ochre on the outside, cream inside. 3<sup>rd</sup> segment  $\frac{1}{2}$  length of 2<sup>nd</sup> segment with tuft on 2<sup>nd</sup> segment  $\frac{3}{4}$  length of 3<sup>rd</sup> segment. Haustellum cream. Thorax ochre. Forewing ochre. Costa cream from base to apex. A pale ochre wedge from base tapering to middle of wing. A pale ochre line in cell towards apex. Costal cilia cream. Apical cilia ochre and dorsal cilia brown grey. Hind wings and cilia brown grey. Abdomen brown grey with pale ochre tuft on last segment. Legs ochre outside, cream inside.

Female (Fig. 9). Wing span 9.9–12 mm (n=8). Head ochre. Antennae ochre slightly ringed cream. Labial palpus same as in male. Haustellum cream. Thorax ochre with two cream lines from behind eyes to middle of metathorax. Tegula ochre, edged cream dorsally. Forewing narrow, ochre. A cream fascia on costa from base of wing to apex. A pale ochre wedge sometimes almost cream, starting from the base tapering to middle of wing. A pale ochre line in cell towards apex. Costal cilia reduced, cream. Apical cilia short, ochre and dorsal cilia short, cream to brown grey towards middle of wing. Hind wings reduced and narrow almost  $\frac{3}{5}$  of forewing, shiny pale brown. Cilia almost absent with only a tuft at base of wing on dorsum and a tuft at the apex, pale brown almost cream. Abdomen brown grey to brown, pale ventrally. Legs ochre outside, cream inside.

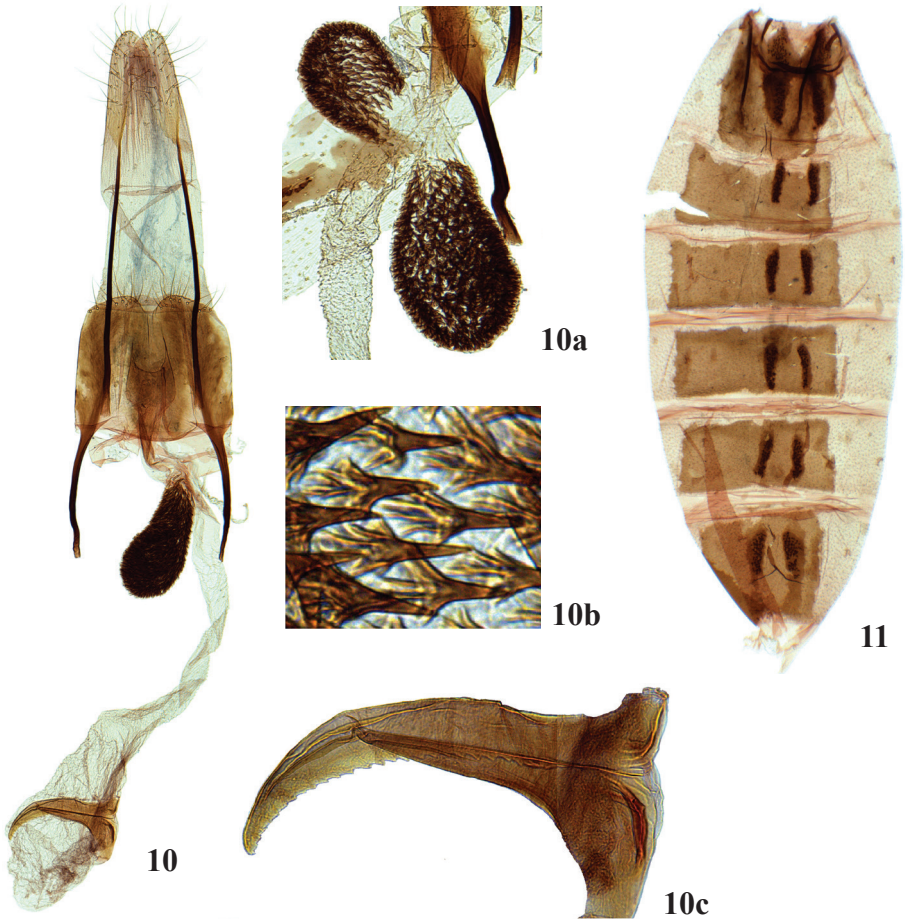
Female genitalia (Fig. 10). Papillae anales elongated and 3.3 times longer than wide; covered in bristles of different lengths. Posterior apophyses twice as long as anterior apophyses. Sterigma sclerotized, slightly trapezoidal almost rectangular; as long as anterior apophyses and 1.2 times wide; apically depressed in centre and having several bristles. Ostium strongly U shaped. Colliculum short and sclerotized. Spinulate section of ductus bursae inflated into a pear shaped appendage just after colliculum, sometimes separated into two; as long as sterigma. Ductus bursae twice as long as sterigma, then widening into an elongated corpus bursae which has a large signum. Fine serrations on ventral edge of signum.

Abdominal sections (Fig. 11). Posterior lateral bars absent. Transverse bar with distal margin more or less straight and convex ends, medially thin, proximal margin convex and thickened especially in female. Tergial patches about 4 times longer than wide with about 40–60 sharp conical spines (in female).

Ova barrel shaped with fine grooved sculpture approximately 0.6 mm long and 0.4 mm in diameter. Colour yellow when freshly laid.

Larva (Fig. 20). 5–7 mm long and 1.1–1.3 mm in diameter (n=2). Head black. Prothoracic plate black with dark brown margin and narrow median sulcus, mesothoracic plate narrower also black with dark brown margin, and metathoracic plate reduced to two dark brown spots. A lateral black plate above each thoracic leg. Thoracic legs dark brown almost black. Anal plate dark brown almost black. Thoracic segments pale cream in colour, abdominal segments starting pale yellow and becoming yellow towards the last segments. Abdominal legs reduced, crotchets present formed as two parallel rows with 18–21 hooks, but on 6<sup>th</sup> segment reduced to one row with 2–3 hooks on each side. Anal legs well developed with linear crotchets having 16–25 hooks each. Short setae along thoracic segments and last abdominal segment.





**Figure 10:** *Coleophora fretella* female genitalia. **a:** Spinulate part of ductus bursae separated into two; **b:** enlarged spines; **c:** enlarged signum. **Figure 11:** Female abdomen.

Larval case (Fig. 16). 7.6–10 mm long and 1.2–1.5 mm wide when fully grown (dorsally) (n=9); constructed from silk. It is cylindrical slightly compressed laterally with a ventral keel. Oral opening circular with curved neck and lip. Opening at 35° to the long axis. Dorsally ochre coloured and ventrally dark brown almost black with enlargement lines visible. Anal opening trivalved, with the horizontal flap dorsally and the other two meet ventrally forming part of the ventral keel.

Exuvia (Fig. 21) within larval case. Aedeagus obte. Abdominal sections 3 to 6 very thinly sclerotized and partially fold inside each other upon emergence.

**Distribution:** In Europe it is found in Austria, Greece, Italy, Sicily and Spain. In North Africa in Tunisia and in the Near East in Turkey (Baldizzone, G., *pers. comm.*).

**Biology:** The egg is laid on leaves of *Ranunculus bullatus* L. in March. The early larval stages are unknown. Diapause during hot summer months not observed in Malta. The larva constructs the case from silk. It is enlarged from the ventral keel all along the case especially towards the anal opening. The silk is white at first then turns dark brown almost black. From observation of cases collected in November/December it is evident that early stages at least when the larva resumes feeding are bivalved and probably more laterally compressed. The larva attaches the case on the underside of a leaf and penetrates the skin feeding in a blotch mine sometimes 6–8 mm in diameter often forming 5 to 6 blotches in one leaf. Full grown larvae also feed on the underside of the leaf leaving only the upper epidermis and sometimes sclerotizing thinner parts of the leaf. Pupation takes place inside the case after attaching it to a strong substrate like a twig or rocks. Adults emerge in March. Females are not capable of flight but can jump up to 30 cm when disturbed. Active in the afternoon and at night. All females were obtained from larvae.

**Notes:** The species was determined by Dr G. Baldizzone from genitalia mounts (slide nos. GP018–14, ♂, GP020–14, ♀, GP031–14, ♂, GP035–14, ♀, leg. M. Zerafa). Two species of parasitic wasp feeding on *C. fretella* are being studied. The species *fretella* was originally described by ZELLER (1847) on the basis of a single male that he collected on the 16<sup>th</sup> of April, 1844 in Messina, Sicily. Other males have since been collected and redescribed. However, the biology and the description of the female of this species were unknown.

#### *\*Coleophora helianthemella* Milliere, 1870

**Material examined:** Malta, Ghajn Znuber, 10.viii.2008, 1 ♀, same location but 20.viii.2008, 1 ♂, same location but 23.viii.2008, 1 ♀, same location but 27.viii.2008, 1 ♂ & 1 ♀, same location but 28.viii.2008, 1 ♀, same location but 30.viii.2008, 1 ♂, same location but 6.ix.2008, 1 ♂, same location but 8.ix.2008, 1 ♂, same location but 10.ix.2008, 1 ♂ & 2 ♀♀; L-Imtahleb, 11.viii.2008, 1 ♂, same location but 15.viii.2008, 1 ♀, same location but 16.viii.2008, 1 ♂, same location but 21.ix.2009, 1 ♀. All ex larva. All leg. M. Zerafa (CMZ). Larval cases: Malta, Ghajn Tuffieha, 10.ii.2008, n=1; L-Imtahleb, 19.iii.2008, n=4, same location but 5.iv.2009, n=1; Ghajn Znuber, 10-21.vi.2008, n=35. All on *Fumana thymifolia* (L.) Spach ex Webb. and *F. arabica* (L.) Spach. All leg. M. Zerafa (CMZ).

**Short description:** Adult (Fig. 5). Wing span 9–16 mm (n=7). Head pale brown to ochre with whitish scales above the eyes. Antennae pale ochre; basal sections brown underneath and covered with brown ochre scales in female. Scape pale ochre above, brown ochre beneath. Labial palpus short and straight; 3<sup>rd</sup> segment  $\frac{2}{3}$  length of 2<sup>nd</sup> segment, brown with pale brown to whitish scales ventrally, paler in female. Haustellum pale ochre. Thorax ochre with two silver fascia laterally one on each side. Tegula ochre with a silver fascia medially. Forewing ochre with three iridescent silver fasciae. One along costa, starting from the base and terminating at  $\frac{2}{3}$  of wing length; another starting at base, continuing along wing fold and widening, then turning slightly and terminating at apex as a wedge; the other starting at the base and terminating half way along the dorsum. The fascia along the costa is ringed with an incomplete thin line of dark brown scales, less visible in females. Cilia ochre. Hind wings pale ochre in males and pale grey in females, both with ochre cilia. All legs brown outside and pale brown inside. Tibia of hind legs with long pale brown scales on inside and longer scales dorsally. Abdomen pale brown to pale ochre.

Larval case (Fig. 17). 9.8–12.6 mm long and 1.9–2.5 mm wide when fully grown (dorsally) (n=14). Case is cylindrical, laterally slightly compressed, constructed from mined excised leaves reinforced with silk from the inside. The leaves are placed laterally opposite to each other and sometimes

forming a ventral and dorsal keel. Oral opening circular with a lip and at 30°–35° to the long axis. Anal opening bivalved. Adult cases are dark ochre in colour with yellowish silk visible especially towards the anal area.

**Distribution:** Cyprus, France, Greece, Italy, North Aegean islands, Portugal, Sardinia and Spain (BALDIZZONE & VAN DER WOLF, 2013). It is also known from Crete, Sicily, Turkey, Libya and Algeria (Baldizzone, G., *pers. comm.*).

**Biology:** The species has been recorded feeding on *Cistus* sp., *Fumana* sp. *Helianthemum* sp. and *Tuberaria* sp. in Europe (ELLIS, 2007). Locally larvae have been collected from *Fumana thymifolia* (L.) Spach ex Webb and *F. arabica* (L.) Spach. In captivity larvae also fed on *Cistus creticus* L. but have not been found on *Cistus* in the wild. Very early stages have not been observed. The first case is made from a single completely mined leaf. A larva at this stage has been collected in February. The case is enlarged by adding subsequent leaves as follows: the leaf is completely mined, then one edge of the leaf is opened and the oral opening of the case inserted keeping it always linear to the leaf edge, then attaching the upper and lower epidermis of the leaf to the case. This process is repeated from 6 to 8 times and always expanding the case giving it a more cylindrical shape. The individual leaves are difficult sometimes to distinguish on the full grown larval case due to this expansion process. The larva also feeds on the unripe fruit by cutting a hole on the side and emptying the contents. The larva then finds a sheltered place on the food plant or adjacent shrub where it attaches the case firmly and pupates. Adults emerge in August to September in one generation.

**Notes:** The species was determined by genitalia mounts (slide no. GP014–14, leg. M. Zerafa) and confirmed by Dr G. Baldizzone.

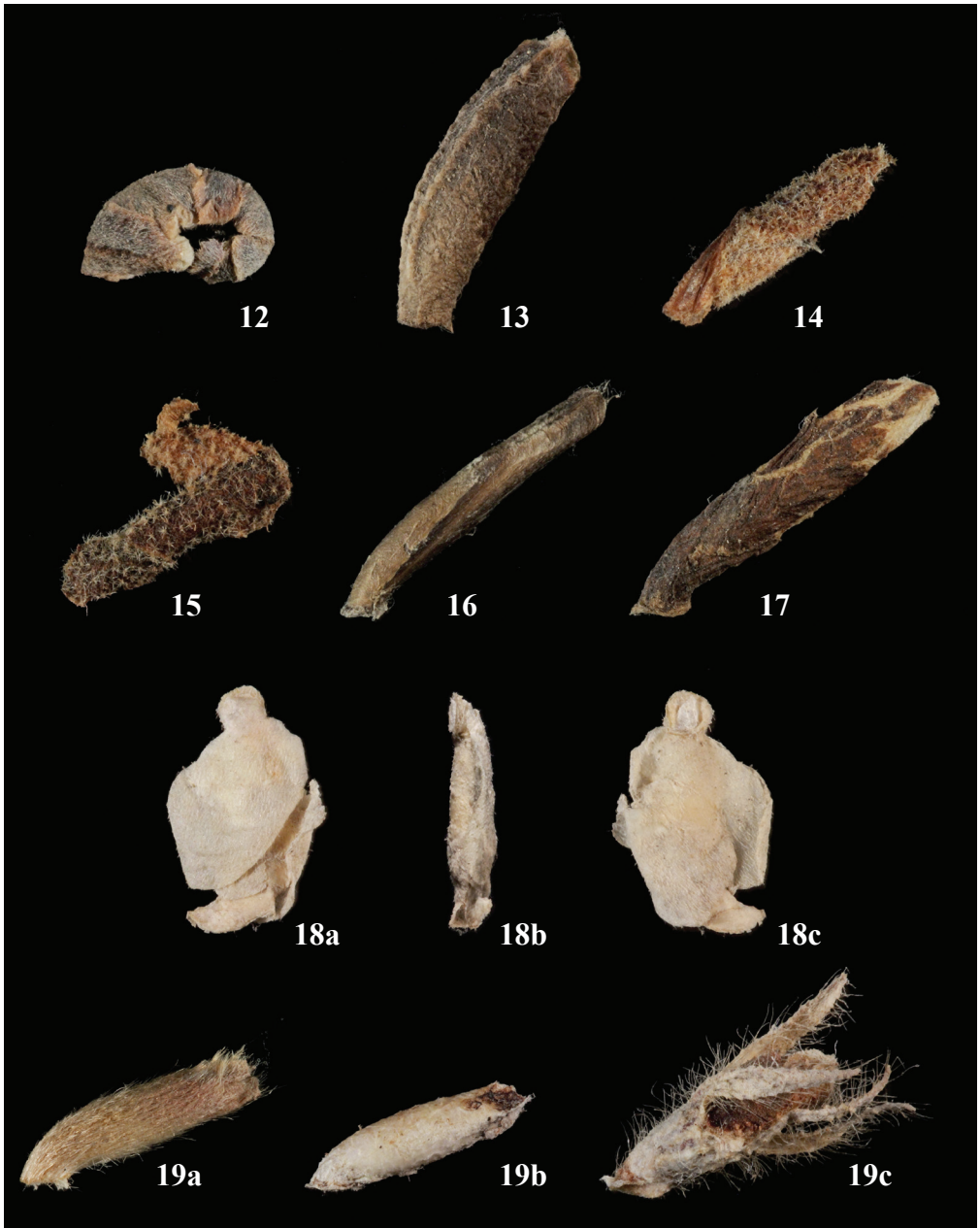
### *Coleophora jefreniensis* Toll, 1954

(Fig. 6)

**Material examined:** Malta, Il-Manikata, 28.iv.2005, 2 ♂♂ & 3 ♀♀, at light. Gozo, Ta' Lambert limits of Ghajnsielem, 29.iii.2013, 1 ♂, beating. leg. M. Zerafa (CMZ).

**Distribution:** Tunisia, Malta (SAMMUT, 2008), Libya (Baldizzone, G. *pers. comm.*), Spain and Greece (van Der Wolf, H.W. *pers. comm.*).

**Discussion:** This species was first recorded for Europe by SAMMUT (2008) from material collected in Malta between the 5<sup>th</sup> and the 11<sup>th</sup> of April 2004 (2 ♂♂ & 1 ♀) by Bjarne Skule of Vesko, Denmark. The above data indicates that the species is most probably indigenous. The biology of the species is not known. The species was determined by genitalia mounts (slide no. GP021–14, leg. M. Zerafa) and confirmed by Dr G. Baldizzone.



**Figures 12–19:** Larval cases of Coleophoridae. **12:** *Coleophora acrisella*; **13:** *Coleophora arenicola*; **14–15:** *Coleophora bilineella*; **16:** *Coleophora fretella*; **17:** *Coleophora helianthemella*; **18a–c:** *Coleophora festivella*. **a:** dorsal view; **b:** lateral view; **c:** ventral view; **19a–c:** *Coleophora semicinerea*. **a:** constructed from calyx of *Anthyllis vulneraria* (typical); **b:** external calyx cover eroded showing silk case; **c:** constructed from calyx of *Lotus edulis*.



**Figures 20–21:** *Coleophora fretella*. **20a–b:** Larva. **a:** dorsal view; **b:** lateral view; **21:** exuvia in lateral view. **Figures 22a–b:** Larva of *Coleophora semicinerea*. **a:** lateral view; **b:** dorsal view.

### *Coleophora semicinerea* Staudinger, 1859

(Fig. 7)

**Material examined:** Malta, Il-Qammieh, 1.i.2005, n=1; Birguma, 12.xii.2005, n=1, same location but 1.i.2006, n=2; Ghajn Żnuber, 1.i.2006, n=2; Landrijiet, 10.vi.2006, n=2, on *Lotus edulis* L.; It-Torri l-Abjad, 25.xii.2006, n=1; Selmun, 14.i.2007, n=2; Had Dingli, 31.iii.2009, n=1, on *Lotus edulis*; Pembroke, 6.v.2012, n=14, on *Anthyllis vulneraria* L.; Ghar Lapsi, 22.ii.2012, n=1, same location but 16.ii.2014, n=3; Iż-Żebbieh, 8.xii.2014, n=3. Gozo, Ghajn Damma, 1.v.2012, n=23, on *Tripodion tetraphyllum* (L.) Fourr. All leg. M. Zerafa (CMZ). Larva: Ghar Lapsi, 16.ii.2014, n=2. leg. M. Zerafa (CMZ).

**Distribution:** This species is reported from Crete, Cyprus, Greece, Italy, Malta, Portugal, Sardinia, Sicily, Spain and Morocco (BALDIZZONE & VAN DER WOLF, 2013), Canary Islands (van der Wolf, H.W. *pers. comm.*). It was recently also found in southern France and Macedonia (Baldizzone, G., *pers. comm.*).

**Biology:** The biology of this species was addressed by Giorgio Baldizzone who found it on *Colutea arborescens* L. but the larval stage was described by NEL (1994) which was collected on *Anthyllis tetraphylla* L.. NEL (1994) described and illustrated the larval case and the larva mentioning only the thoracic plates and illustrating them and gave the number of claws on the abdominal and anal crotchets without mentioning the size and colour of the larva or the size of the case. In Malta, the species was collected from various localities on *Tripodion tetraphyllum* (L.) Fourr. to which *Anthyllis tetraphylla* L. is today considered a synonym, *Anthyllis vulneraria* L. and *Lotus edulis* L. A description of the larva and larval case from locally collected specimens is given hereunder.

Larva (Fig. 22). 5.4 mm long and 1.6 mm in diameter (n=2). (Larvae described here were in diapause). Head ochre to pale ochre. Prothoracic plate pale ochre with four brown spots; two medially close to the distal margin and one on each end. Mesothoracic plate narrower also with four dark brown spots, and metathoracic plate absent (The difference from the illustration given by NEL (1994) is that the dark markings on the Prothoracic plate along the proximal edge are reduced to two spots on the sides and the two small plates with a dark spot on the metathorax are absent). A lateral dark brown spot above each thoracic leg. Thoracic legs pale ochre almost yellow. Anal plate pale

ochre. Body colour bright yellow. Abdominal legs reduced, crotchets present with 10–12 hooks on each side. Anal legs well developed with linear crotchets having 12–13 hooks on each side. Short setae along thoracic segments and last abdominal segment.

Larval case (Figs. 19a–c). 8–9.8 mm long and 2–2.8 mm wide when fully grown (dorsally) (n=10). The case is constructed from part of or the entire calyx of the host plant, reinforced internally with silk; it is always excised with the oral opening formed from the base or towards the base of the calyx. The case is cylindrical. The oral opening is circular with a well formed lip, at 10°–20° to the long axis. The anal opening is trivalved, and the lower meeting point of the flaps is always at the right side when viewed posteriorly. This trivalve is often concealed by the terminal parts of the calyx. The colour depends on the type of food plant and varies from pale ochre, ochre to brown. The silk used is pale cream in colour.

Young larvae mine the ovary and then eat it completely. The case is constructed once and is not enlarged. When constructing a case from the calyx of *Tripodion tetraphyllum* (L.) Fourr. which has a large calyx only a part is excised. This is done as follows: the larva makes two almost parallel cuts laterally starting from the terminal part downwards and gradually are made further apart. The larva then attaches together the two ends with silk and creates a cylindrical shape. This process is continued to about half way of the calyx length where a rough semi-circular cut is made. The case is loosely attached to the remaining calyx whilst the larva continues reinforcing the case internally with silk. Then it forms the oral opening with a small lip made from silk. Several other layers of silk are lined internally and the three flapped valve formed during the following days making a strong case. The serracious appearance provides excellent camouflage when feeding. Full grown larvae can be found from late April till May after which the larva leaves the host plant and finds a well sheltered location in crevices and on the side of rocks where it attaches the case firmly. The larva has a long diapause of 9–10 months locally and due to this the outer cover made from the calyx starts decaying revealing the silken case underneath. Cases can remain attached in the same location for a couple of years after the adult has emerged, where only the silk case remains. Adults are on the wing from late February till early April.

**Notes:** The species was determined by genitalia mounts (slide nos. GP008–14, ♂, GP023–14, ♂, GP029–14, ♀. leg. M. Zerafa) and confirmed by Dr G. Baldizzone. A species of parasitic wasp feeding on *C. semicinerea* is being studied.

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## CHECK LIST OF THE MALTESE COLEOPHORIDAE

## Coleophoridae Bruand 1850

## Coleophora Hübner 1822

- Coleophora acrisella* Millière, 1872  
*Coleophora arenicola* Toll, 1952  
*Coleophora bilineella* Herrich-Schäffer, 1854  
*Coleophora binotapennella* (Duponchel, 1843)  
*Coleophora calycotomella* Stainton, 1869  
*Coleophora conyzae* Zeller, 1868  
*Coleophora crepidinella* Zeller, 1847  
*Coleophora festivella* Toll, 1952  
*Coleophora fretella* Zeller, 1847  
*Coleophora helianthemella* Millière, 1870  
*Coleophora jefreniensis* Toll, 1954  
*Coleophora limoniella* Stainton, 1884  
*Coleophora luteolella* Staudinger, 1880  
*Coleophora pulchripennella* Baldizzone, 2011  
*Coleophora semicinerea* Staudinger, 1859  
*Coleophora versurella* Zeller, 1849

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