

The Nepticulidae of Malta (Lepidoptera)

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ABSTRACT. Three species of Nepticulidae are recorded for the first time from the Maltese Islands. *Acalypttris minimella*, *Ectoedemia euphorbiella*, and *Parafomoria pseudocistivora* are added to the previously recorded *Stigmella aurella*. A short description of the adults and notes on ecology are given. Information on the egg oviposition and number of mines on leaves collected locally is provided for all species. Adults and mines are illustrated and distributional data is also provided.

KEY WORDS. New records, species list, Mediterranean.

INTRODUCTION

The Nepticulidae, includes some of the smallest moths known to science and although found in most parts of the world, the group was only recently recorded for the first time from Malta (ZERAFA, 2008). The adult moths are characterized by having an expanded scape covered with scales forming eye caps. They also have simple antennae. Ocelli are absent, the proboscis is short, but functional. The frons is ornamented with erect hairscales. Recumbent scales arise from the back of the head forming a collar. The forewings are relatively broad, the terminal cilia giving a rounded appearance. The hindwings are lanceolate with very long fringes. The venation is greatly reduced and varies between genera (VAN NIEUKERKEN, 1986). The scales on the wings are extraordinarily large compared to the size of the moths; generally darker at the tips than at the base. Structural colours are often present with gold, copper, purple, violet or blue reflections and it is often difficult to describe them as they vary according to angle of view. Pale fascias or spots are often present with their colour ranging from metallic gold to dull yellow and metallic silver to dull white. The hindwings are generally unicolorous, in some species the males possess androconial scales on fore- and/or hindwings. When present on the forewings they are generally on the underside. The female genitalia are monotrysian and the ovipositor usually short, but pointed when laying eggs on a hairy surface (e.g. *Parafomoria pseudocistivora*). The male and female genitalia offer good characters in most cases for identification to species level (VAN NIEUKERKEN, 1986; JOHANSSON *et al.* 1990). The egg is largely unknown, because it is covered by secretion, forming a domed egg case (JOHANSSON *et al.* 1990: photographs on page 31). The larva eats its way through directly into the leaf without exposure to the air. The side and position of a leaf selected for oviposition is fairly constant for most species (EMMET, 1976).

Nepticulidae mostly mine leaves, although a few mine bark, buds and fruits. The larva is adapted to its way of feeding. The head is flattened and resembles a sharp horizontal wedge. The larva is apodial, slender and very small, usually less than 5 mm long; prolegs are absent, their function is taken over by paired ambulatory calli. The larvae are unicolorous ranging from bright green to bright yellow and all the shades in between, with often a darker headcapsule (VAN NIEUKERKEN, 1986). Pupation generally takes place outside the mine in a cocoon, but some species pupate inside

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the mine. The pupal skin is delicate and transparent. The pupa often extrudes from the cocoon before emergence of the imago. The cocoon is a domed silken structure which is nearly circular in outline, but with a hint of triangularity with curved sides and bluntly rounded corners. The colour of the cocoons vary a lot between species. They may be white, creamy, yellow, brown, reddish, purple, violet, green, fuscous or black. This coloration can aid in the determination of some species (EMMET, 1976).

The mines created by Nepticulidae are often used in the identification of species due to their usually constant characteristics. The majority mine leaves and unlike other leaf mining families the leaves are very rarely deformed. The two main forms of mine are the gallery and the blotch. The gallery can be strait, angular, sinuous or highly contorted. The blotch can be an elongated oval, circular or irregular, sometimes covering most of the leaf. Some species keep to one form or another but others start as a gallery and develop into a blotch, or a compacted gallery creating a false blotch. The pattern in which the frass is deposited is as important as the shape of the mine for identification purposes. The frass can be deposited in different ways and can be linear, broken linear, dispersed or coiled (arranged in a series of zigzag arcs from side to side). The width can also vary, from filling the whole gallery to narrow lines leaving clear wide margins. Frass in a blotch is generally dispersed. The colour can also be diagnostic and may be black, green or reddish brown. Nepticulidae mines always contain frass. When fully grown, larvae cut a semicircular slit in the epidermis of the leaf through which they leave the mine for pupation (EMMET, 1976; JOHANSSON *et al.*, 1990).

In Europe the Nepticulidae are represented by 264 species accommodated in 8 genera (VAN NIEUKERKEN, 2011). The present study brings the total of species in Malta to 4 and adds 3 genera to the previous recorded one. We have found three further species on *Lotus*, *Crataegus* and *Rhamnus* that are currently under study and for which the identity is not yet certain.

All material mentioned in the present work has been collected from Malta by the first author, and has been reared from larvae unless otherwise stated. The second author has carried out and verified the species identification. Plant material has been examined by means of a dissecting microscope (Optica Lab 2), and mined leaves were preserved using leaf pressing methods. The number of mines of each species on the leaves of the main host plants were counted and the oviposition site on the leaves (under- or upperside, midrib, margin or in between) was noted; the results are presented as percentages of total in Table 1. Colour photographs of set specimens and mines were taken using a digital camera (Opticam USB) mounted on dissecting microscope. The material is deposited in the private collection of the senior author and of the Netherlands Centre for Biodiversity Naturalis (Leiden, The Netherlands).

Table 1. Oviposition sites on leaves, given as percentage and number of mines on locally collected leaves of the main host plants of each species.

Species	Egg Oviposition on leaf (%)					Number of mines per leaf (%)					Total No. of leaves
	Upperside	Underside	Margin	Midrib	Between margin & midrib	1	2	3	4	5 - 10	
<i>S. aurella</i>	66	34	42	17	41	93	7	—	—	—	27
<i>A. minimella</i>	82	18	—	35	65	100	—	—	—	—	17
<i>E. euphorbiella</i>	6	94	52	26	22	70	28	2	—	—	40
<i>P. pseudocistivora</i>	100	0	4	15	81	51	30	15	2	2	81

ANNOTATED SPECIES LIST

Stigmella aurella (Fabricius, 1775)

Note. This species was recorded by the first author (ZERAFA, 2008) where description, ecology and figures of adult and leaf mine were provided and will not be repeated here.

Global distribution. Widespread in Europe and Turkey, but absent from Fennoscandia and Denmark (VAN NIEUKERKEN, 2011).

Acalytris minimella (Rebel, 1924)

Material examined. MALTA: Naxxar Gap, 1/8.v.2009, 1 ♂, 2 ♀♀, ex larva; Mosta, Wied il-Ghasel, 7.xii.2008, 2 mines, 1 ♂, same data but 10.iv.2011; Wied iż-Żurrieq, 25/30.x.2008, 12 mines; same locality but 13.xii.2008, 2 mines; Naxxar Gap, 13.xii.2008, 1 mine; same locality but 23.i.2011, 2 mines, all on *Pistacia lentiscus*.

Short description. Male (Fig. 1a): wing span 5 mm. Head: ochreous yellow; collar pale fuscous; eye caps pale ochre; antenna ochre. Thorax yellowish ochre with some brown scales; abdomen light gray. Forewing yellowish ochre and irrorate with brown scales. Cilia yellowish. Hindwing light grey. At base, an elongated hairpencil of androconial yellow scales present. Female: wing span 4.7 - 5.1 mm, otherwise same as male but lacking androconial scales. Larva is yellow. The cocoon is ochre in colour.

Ecology. The egg is generally laid on the upper side close to a rib on a leaf of *Pistacia lentiscus*. The mine (Fig. 1b,c) starts as a very narrow linear gallery running along the leaf margin; then it turns back either close to the petiole or leaf tip and forms a slightly wavy, gradually widening gallery mine, turning in sharp S turns. It very rarely crosses the mid rib. Frass is black or dark brown and fills the linear part of the mine, in the second part it fills only about two thirds of the width and is coiled. The cocoon is spun amongst leaf litter sometimes covered with soil particles. On the continent *A. minimella* was also recorded on *Pistacia terebinthus* (VAN NIEUKERKEN, LAŠTŮVKA & LAŠTŮVKA, 2004). Probably produces two broods locally.

Global distribution. Balearic Islands, Corsica, Croatia, France, Gibraltar, Italy, Portugal, Sardinia, Sicily, Slovenia, Spain, and North Africa (Morocco, Algeria and Tunisia) (VAN NIEUKERKEN, 2007). The species is new for Malta.

Ectoedemia euphorbiella (Stainton, 1869)

Material examined. MALTA: Naxxar, 15.xii.2006, 2 ♂♂, at light; Naxxar Gap, 28.i.2008, 2 ♀♀, ex larva; same locality but 12-31.x.2009, 3 ♂♂, 2 ♀♀, ex larva; same locality but 4-20.xi.2009, 5 ♂♂, 1 ♀, and 6-29.xii.2009, 3 ♂♂, 2 ♀♀, all ex larva; same locality but 3.i.2010, 1 ♂, 1 ♀, ex larva; Naxxar Gap, 28.xii.2007, 9 mines; same locality but 8.xii.2008, 14 mines, 18.xii.2008, 10 mines, and 13.iii.2009, 10 mines all on *Euphorbia dendroides*; same locality but 11.ii.2008, 4 mines, and 11.iii.2009, 1 mine on *Euphorbia pinea*; Bahrija, Kuncizjoni, 5-10.ii.2008, 3 mines; Pembroke, 14.iii.2009, 1 mine; Dingli, 31.iii.2009, 1 mine; all on *Euphorbia pinea*; Mellieha, Qammieh, 2.i.2008, 5 mines; Ghajn Tuffieha, Ta' Lippija, 6.i.2008, 4 mines on *Euphorbia melitensis* (material of *E. melitensis* lost).

Short description. Male: wing span 5 - 6.4 mm. Head: ochre with dark fuscous at tuft tip; collar pale ochre; eye caps pale ochre; antenna brown fuscous. Thorax ochre with brown scales; abdomen

dark grey. Forewing variable; pale ochre with dark brown scales arranged more or less in three fascia, one at base, middle of the wing and another at the apex. Cilia pale ochre. Hindwing light brown to grey. Darker or lighter specimens common. Female (Fig. 2a): wing span 4.6 - 6.3 mm, otherwise same as male. Larva is pale yellow to greenish. The cocoon is bright green.

Ecology. The egg is generally laid on the underside of a leaf of *Euphorbia* sp. The mine (Fig. 2b) starts as a sinusoidal gallery then it widens into a blotch crossing over the earlier path. Sometimes the entire leaf is mined depending on size of the leaf and number of larvae. Frass is greenish black and arranged in small piles for the first half of the mine then sparsely distributed throughout the blotch. The cocoon is spun amongst leaf litter. In Malta mines have been collected from *Euphorbia dendroides*, *E. pinea* and *E. melitensis*. The last two are new records. In Europe it has been recorded mining several species of *Euphorbia* namely *E. dendroides*, *E. palustris*, *E. fragifera*, *E. characias*, *E. rigida*, *E. myrsinites*, *E. acanthothamnos*, *E. brittingeri*, *E. serrata* and *E. terracina* (VAN NIEUKERKEN, LAŠTŮVKA & LAŠTŮVKA, 2004). *E. euphorbiella* probably produces up to three overlapping broods in Malta. Larvae that spun their cocoon in late February to March 2009 emerged as adults between October and November of the same year. Diapause in cocoon.

Global distribution. France, Greece, Italy, Monaco, Romania, Sicily, Spain (VAN NIEUKERKEN, 2011). The species is new for Malta.

Parafomoria pseudocistivora (van Nieukerken, 1983)

Material examined. MALTA: Imtahleb, 5.xi.2009, 2 ♀♀, ex pupa; same locality but 21-30. ix.2010, 3 ♂♂, 2 ♀♀, and 5-28.x.2010, 9 ♂♂, 21 ♀♀, all ex larva; Selmun, 22/25.x.2010, 2 ♂♂, 3 ♀♀, and 7/10.xi.2010, 2 ♂♂, 1 ♀, all ex larva; Imtahleb, 24.xii.2009, 5 larvae in ethanol; Imtahleb, 22.ii.2009, 22 mined leaves; same locality but 24.xii.2009, 116 mined leaves, all on *Cistus creticus*; Selmun, 25.xii.2009, 16 mined leaves on *Cistus creticus*.

Short description. Male (Fig. 3a): wing span 4 - 5.1 mm. Head: brown fuscous; eye caps ochre with brown fuscous scales; antenna brown fuscous. Thorax brown fuscous; abdomen brownish grey. Forewing brown fuscous with a light brown fascia beyond mid wing, sometimes absent. Cilia light brown. Hindwing light brown. Female: wing span 3.9 - 4.9 mm, otherwise same as male but pale fascia more prominent. Larva yellow. Cocoon ochre in colour.

Ecology. The egg is always laid on the upper side of a leaf of *Cistus*. The mine (Fig. 3b) starts as a linear gallery following the leaf's margin and most often going around the entire leaf thereafter it turns into a sinusoidal mine and moves towards the centre of the leaf. Frass is black and deposited linearly in the centre of the mine. At the later stages of the mine the frass line is often interrupted. Around the first part of the mine, the leaf often turns red and about half of the leaves affected would contain more than one larva. The cocoon is always spun in the soil up to 5 mm depth and it is completely covered with soil particles. In Malta mines have been collected from *Cistus creticus*, elsewhere in Europe on hairy species of *Cistus* (*C. salvifolius*, *C. albidus* and *C. crispus*). This species produces only one brood in Malta. Larvae that spun their cocoon in January to February emerged as adults from September to November of the same year. Diapause in cocoon.

Global distribution. Corsica, Croatia, France, Greece, Italy, Portugal, Sicily, Spain, and the south coast of Turkey. Recorded also from Tunisia in North Africa (VAN NIEUKERKEN, 1983; VAN NIEUKERKEN, 2011; VAN NIEUKERKEN, LAŠTŮVKA & LAŠTŮVKA, 2004; unpublished data). The species is new for Malta.

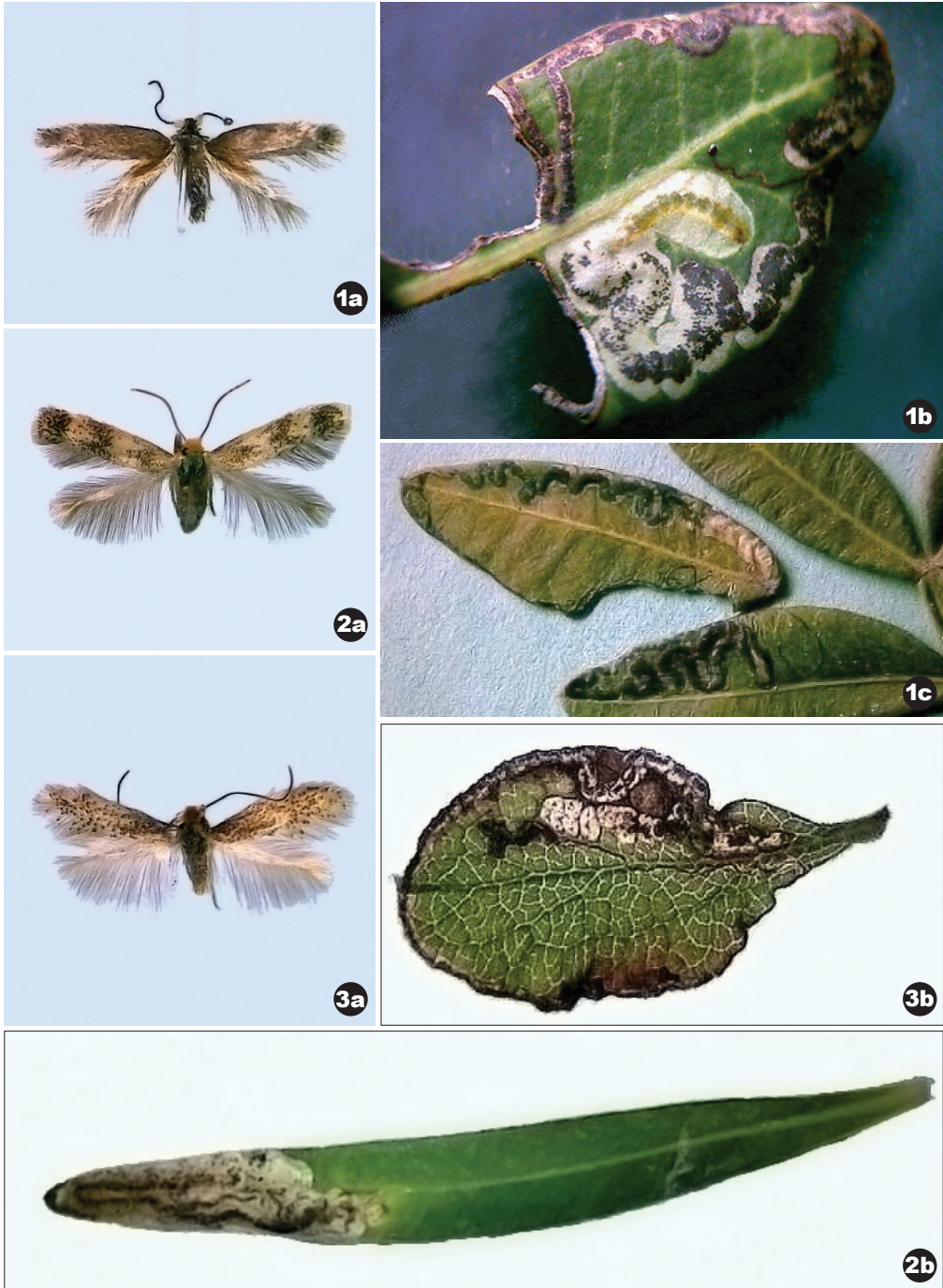


Figure 1: *Acaliptris minimella*. **a**, Adult male; **b-c**, Leaf mines on *Pistacia lentiscus*. **Figure 2:** *Ectodemia euphorbiella*. **a**, Adult female, **b**, Leaf mine on *Euphorbia dendroides*. **Figure 3:** *Parafomoria pseudocistivora*. **a**, Adult male, **b**, Leaf mine on *Cistus creticus*.

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