Feeding behaviour of *Eccopisa effractella* larvae (Lepidoptera: Pyralidae)

Ruben Meert

Abstract. In the summer of 2017 several larvae of *Eccopisa effractella* Zeller, 1848 were found in old webs of apple ermine, *Yponomeuta malinellus* Zeller, 1838 on apple trees (*Malus domestica*) in an orchard in Lebbeke (East Flanders). Later that year some larvae were obtained from old *Yponomeuta* spp. webs on bird cherry (*Prunus padus*) and even on spindle (*Euonymus europaeus*). After performing some experiments with newly found larvae in 2018, it is clear that *E. effractella* can complete its development entirely within those webs and does not need fresh tissue to feed on. In this article, these new findings about the biology *of E. effractella* are described in detail.

Samenvatting. In de zomer van 2017 werden meerdere rupsen van *Eccopisa effractella* Zeller, 1848 (geelpalpmot) gevonden in verlaten spinselnesten van *Yponomeuta malinellus* Zeller, 1838 (appelstippelmot) op appelbomen (*Malus domestica*) in een boomgaard te Lebbeke (Oost-Vlaanderen). Later dat jaar werd de soort na gerichte zoekacties eveneens geobserveerd in oude spinsels van *Yponomeuta* spp. op vogelkers (*Prunus padus*) en wilde kardinaalsmuts (*Euonymus europaeus*). Na onderzoek in 2018 werd vastgesteld dat de rupsen geen vers plantenmateriaal nodig hebben, maar zich volledig kunnen ontwikkelen in zo'n spinselnest. In dit artikel worden deze nieuwe bevindingen over de levenswijze van *E. effractella* uitgebreid besproken.

Résumé. Durant l'été 2017, quelques chenilles d' *Eccopisa effractella* Zeller, 1848 ont été trouvées dans des vieux nids soyeux d' *Yponomeuta malinellus* Zeller, 1838 présents sur des pommiers (*Malus domestica*) dans un verger à Lebbeke (Flandre Orientale). Quelques temps plus tard, des recherches ciblées ont permis d'en trouver dans les vieux nids d'autres espèces d'*Yponomeuta*, celles vivant aux dépens du cerisier à grappes (*Prunus padus*) et du fusain d'Europe (*Euonymus europaeus*). Des expériences menées en 2018 ont montré que les chenilles bouclent avec succès leur cycle de développement au sein de tels types de nids, les préférant au feuillage vivant. Dans cet article ces nouvelles mœurs d' *E. effractella* sont décrites en détail.

Keywords: *Eccopisa effractella* – *Yponomeuta* – Larva – Feeding behaviour – Pyralidae.

Meert R.: Grote Snijdersstraat 75, B-9280 Lebbeke. ruben_meert@hotmail.com

Introduction

Eccopisa effractella Zeller, 1848 is a Pyralid moth which occurs in most European countries except for most Mediterranean islands, Ireland and the northern part of Scandinavia (Speidel *et al*. 2013).

The species was discovered in The British Isles in the gardens of Buckingham palace in 1995 (Agassiz 1996). In Belgium *E. effractella* is considered as fairly common and is known in all provinces since 2004 (De Prins *et al.* 2018). On waarnemingen.be, the data portal of the NGO Natuurpunt for nature observations by citizen scientists, the distribution map showing all uploaded Belgian records in the period 1980 to 2018 suggests that *E. effractella* is more widely distributed in the northern half of Belgium except for the coastal region.

Nearly all consulted sources (see references at the end) mention different kinds of deciduous trees such as apple (*Malus* sp.), *Prunus* sp. and hazel (*Corylus* sp.) as hostplants for *E. effractella*. A closer look on the consulted literature reveals that those plants were all initially mentioned in the study of Chrétien (1930).

The notes Chrétien made concerning the feeding behaviour were based on an artificial indoor set-up which started with eggs laid by some captured females. In his study, performed in 1917 – 1918, he provided the hatched larvae with leaves of apple (*Malus* sp.) on which they were feeding and where they were hiding under a slight web on or near the midrib on both sides of the leaf. When given, he noticed that leaves of plum (*Prunus domestica*) were also accepted to feed on.

Chrétien assumed that common hazel (*Corylus avellana*) was also a host plant, because he found a similar caterpillar on it in 1908 and in 1916 he beat a few adult moths out of a hedge nearby some hazel trees. Although he was convinced that the caterpillar found in 1908 belonged to *E. effractella* (after having compared the mounted specimen with the bred caterpillars in 1917), actual feeding on hazel (*Corylus avellana*) is not confirmed.

In 2002, Friedmar Graf bred 2 adult moths by coincidence from a 2 to 3 cm wide gall on goat willow (*Salix caprea*) which was collected in Horka bei Kamenz (Sachsen, Germany) in winter (pers. comm. F. Graf). On Lepiforum.de, the German web portal of Lepiforum e. V., is stated that another observation was made from a gall on oak (*Quercus* sp.). Both observations however don't give a conclusive answer about the larval feeding habits of *E. effractella*.

Andreev (2005) describes a completely different feeding behaviour. *E. effractella* was observed in South Bulgaria from 1986 till 2003 and the larvae fed behind bark on wood of different fruit trees: apple (*Malus* sp.), plum (*Prunus domestica*), peach (*Prunus persica*) and quince (*Cydonia oblonga*). In apple and quince feeding was also observed on the seeds within the fruits.

The last few years more and more lepidopterists have started searching for early stages of different species of butterflies and moths. Despite of all the efforts made by dozens of observers, neither caterpillars nor chrysalides of *E. effractella* were found in Belgium.

Relationship with *Yponomeuta malinellus*

On 24 August 2017, the author inspected his apple orchard in Lebbeke (East Flanders). That year, larvae of apple ermine, *Yponomeuta malinellus* Zeller, 1838 were quite abundant in spring (waarnemingen.be 2017) and a lot of abandoned webs remained in the apple trees (*Malus domestica*) (fig. 1). While removing a web, the author noticed a small micromoth caterpillar inside, clearly no *Yponomeuta* larva, which was quickly crawling backwards. (fig. 2).

The same day, several other webs were examined. Nearly 50 % of them contained up to 3 similar larvae. In total 10 larvae were collected at that time, not knowing which species of micromoth they belonged to.

Fig 1. Lebbeke , 27.ix.2017, web of *Ypononeuta malinellus* containing a larva of *Eccopisa effractella*, © Ruben Meert.
Fig. 1. Lebbeke, 27.ix.2017, spinsel van *Ypononeuta malinellus* met een larve van *Eccopisa effractella*, © Ruben Meert.
Fig. 1. Lebbeke, 27.ix.2017, nid d' *Yponomeuta malinellus* avec une chenille d' *Eccopisa effractella*, © Ruben Meert.

Fig. 2. Lebbeke, 27.ix.2017, caterpillar of *Eccopisa effractella* in web of *Ypononeuta malinellus*, © Ruben Meert.
Fig. 2. Lebbeke, 27.ix.2017, rups of *Eccopisa effractella* in spinsel van *Ypononeuta malinellus*, © Ruben Meert.
Fig. 2. Lebbeke, 27.ix.2017, chenille d' *Eccopisa effractella* dans un nid d' *Ypononeuta malinellus*, © Ruben Meert.

After informing him, this remarkable behaviour was confirmed by Cédric De Noyette who also found a larva in an old web in his own apple trees (*Malus* sp.) in Roborst (East Flanders).

The collected larvae and webs were kept in a jar at room temperature. On 27 September 2017 a first adult moth appeared, which could undoubtedly be identified as *E. effractella*. Two more adults were obtained in the following days. A close inspection of the collected webs revealed that by the end of September, all the other cocoons still contained larvae and no pupae. These observations seem to confirm the occurrence of a partial second generation of *E. effractella* in autumn.

End October, the remaining larvae were placed outside. This resulted in the appearance of adult moths by the end of May 2018. Earlier that month, fresh chrysalides were found within the *Y. malinellus* web, each in a white silken cocoon in which some organic material was incorporated.

After Pierre Chrétien obtained some adult moths in the autumn of 1918, he wondered if the remaining larvae would pupate the following spring: "» Eclosion de l'imago d' *effractella* le matin et dans l'après-midi. 15, IX, 18. Quant aux chenilles retardataires, passeront-elles l'hiver pour ne se chrysalider qu'au printemps prochain? « A la Garenne je n'ai pas pris le temps de vérifier ce détail. Mais, il me parait probable." (Chrétien 1930). Finally, 100 years later, his hypothesis can be confirmed.

Relationship with other *Yponomeuta* species

In Deinze (East Flanders), on 28 September 2017 the author inspected some old webs of bird-cherry ermine, *Yponomeuta evonymella* (Linnaeus, 1758) on bird cherry (*Prunus padus*). One web contained a larva of *E. effractella* (fig. 3). On the same location a web of either scarce ermine, *Yponomeuta irrorella* (Hübner, [1796]) or spindle ermine, *Y. cagnagella* (Hübner, [1813]) on spindle (*Euonymus europaeus*) was examined, and there too a larva was found (fig. 4). In Wieze (East Flanders) another larva was found in a web bird cherry (*Prunus padus*) on 6 October 2017.

Fig. 3. Deinze, 28.ix.2017, larva of *Eccopisa effractella* in web of *Yponomeuta* sp. on spindle (*Euonymus europaeus*), © Ruben Meert.
Fig. 3. Deinze, 28.ix.2017, larve van *Eccopsia effractella* in spinsel van *Ypononeuta* sp. op *Euonymus europaeus*, © Ruben Meert.
Fig. 3. Deinze, 28.ix.2017, une chenille d' *Eccopisa effractella* dans un nid d' *Yponomeuta* sp. sur *Euonymus europaeus*, © Ruben Meert.

Fig. 4. Deinze, 28.ix.2017, larva of *Eccopisa effractella* in web of *Yponomeuta evonymella* on bird cherry (*Prunus padus*), picture of pupa taken on 11.v.2018, © Ruben Meert.
Fig. 4. Deinze, 28.ix.2017, rups van *Eccopisa effractella* in spinsel van *Yponomeuta evonymella* op *Prunus padus*, foto van pop genomen op 11.v.2018, © Ruben Meert.
Fig. 4. Deinze, 28.ix.2017, chenille d' Eccopisa effractella dans un nid d' *Yponomeuta evonymella* sur *Prunus padus*, la photo a été prise le 11.v.2018, © Ruben Meert.

The fact that larvae were found in the webs of three different hosts belonging to two different plant families: Rosaceae and Celastraceae, suggests that it is not the plant itself that matters to the larvae, it's the presence of old webs that does.

In the autumn of 2017 several webs of other *Yponomeuta* were investigated, but neither webs of orchard ermine, *Yponomeuta padella* (Linnaeus, 1758) on common hawthorn (*Crataegus monogyna*) nor those belonging to willow ermine, *Yponomeuta rorella* (Hübner, [1796]) on goat willow (*Salix caprea*) and crack willow (*S. fragilis*) contained any caterpillars.

No external indication of presence of *E. effractella* larvae were found in the above-mentioned cases, exept that occupied webs seemed to be bigger and more firmly attached to leaves or branches of the hostplant than webs without *E. effractella* larvae. Possibly the larvae use their own silk to prevent the web from falling on the ground. If that is the case, large webs found in late summer and in autumn might have a bigger chance to contain larvae. 10 of the biggest *Y. malinellus* webs on the authors apple trees (*Malus* sp.) were examined early September 2018, 6 of which having a caterpillar inside (= 60 %). Despite being a very small sample size, it seems to confirm this hypothesis

Observation on bulrush (*Typha latifolia*) in Germany

On 30 December 2017, Hartmuth Strutzberg posted a contribution on Lepiforum concerning 4 unknown caterpillars he found in spun dry male flowers of bulrush (*Typha latifolia*) in Weimar (Thüringen, Germany) on 30 April 2016 (fig. 5), while searching for the larvae of bulrush cosmet, *Limnaecia phragmitella* Stainton, 1851 (Lepiforum.de). On 26 May 2016 he identified the first hatched adult moth as *E. effractella*.

Whether the larvae lived only in the dried flowers or maybe also in parts of a web of *L. phragmitella,* could not be confirmed.

Fig. 5. Ettersberg (Germany), 30.iv.2016, larva of *Eccopisa effractella* on bulrush (*Typha latyfolia*), © Hartmuth Strutzberg.
Fig. 5. Ettersberg (Duitsland), 30.iv.2016, rups van *Eccopisa effractella* op *Typha latyfolia*, © Hartmuth Strutzberg.
Fig. 5. Ettersberg (l'Allemagne), 30.iv.2016, chenille d' *Eccopisa* sur *Typha latyfolia*, © Hartmuth Strutzberg.

Description

The author refers to the study of Chretien that provides good descriptions of all stages of this species (egg, larva, chrysalis and imago). Instead of 'brun canelle foncé' (= 'dark cinnamon') (Chrétien 1930), the author would prefer 'dark brownish pink' to describe the body colour of the larva (fig. 2).

Although Andreev (2005) states that the larvae evolve from whitish (1st instar) to greenish grey (3rd instar), no larvae were found with green pigments.

Experiments

In 2018, *Yponomeuta malinellus* webs were even more abundant than the year before (waarnemingen.be, 2018). 4 webs of *Y. malinellus* on apple (*Malus* sp.), each containing a young larva of *E. effractella* were collected on 21 and 22 July. All larvae measured between 2.5 and 3.5 mm, whereas full grown caterpillars have an average body length of 12 mm (Chrétien 1930).

In a first set-up 2 larvae were placed indoors in a jar and were given nothing but the web in which they were found. To observe if the larvae leave the web to feed on the leaves of the hostplant, a second set-up was made in which the 2 remaining webs were hung between the branches of a small potted apple tree (*Malus* sp.). All of its damaged leaves were removed and the tree was placed outside in a net cage to prevent any other insect eating the leaves.

During the time of development, none of the larvae was observed outside the web to feed. Well-developed adults of the first set-up emerged on 17 August 2018. The larvae from the second set-up developed more slowly, possibly because they belonged to the overwintering generation. Nevertheless, on 15 September 2018, one larva was full-grown without having caused any visible feeding damage on the apple leaves (*Malus* sp.).

Fig. 6. Lebbeke, 24.ix.2018, captured larvae of *Eccopisa effractella* feeding on dried apple leaves (*Malus* sp.), © Ruben Meert.
Fig. 6. Lebbeke, 24.ix.2018, gevangen rupsen van *Eccopisa effractella* eten van gedroogde appelbladeren, © Ruben Meert.
Fig. 6. Lebbeke, 24.ix.2018, chenilles d' *Eccopisa effractella* mangent des feuilles de pommier séchées, © Ruben Meert.

On 17 August 4 more half-grown larvae were collected within a 5 minute search from *Y. malinellus* webs on apple (*Malus* sp.). In a third set-up, those larvae were kept in a jar and were only supplied with some fresh apple leaves (*Malus* sp.) to simulate the experiment Chrétien performed in 1918. After wandering around for about a day, they effectively started skeletonising the leaves, after having made a small web in between. Even after the leaves completely dried out, the larvae kept feeding on them (fig. 6), being full-grown by the end of September 2018. At the same time, no similar feeding patterns were found on the living apple leaves (*Malus* sp.) in the orchard.

Fig. 7. *Eccopisa effractella*, Lebbeke, 21.vii.2018, caterpillar found in a web of *Yponomeuta malinellus* on apple (*Malus* sp.), e.l. 17.viii.2018, © Ruben Meert.
Fig. 7. *Eccopisa effractella*, Lebbeke, 21.vii.2018, rups gevonden in een spinsel van *Yponomeuta malinellus* op *Malus* sp., e.l. 17.viii.2018, © Ruben Meert.
Fig. 7. *Eccopisa effractella*, Lebbeke, 21.vii.2018, chenille trouvée dans un nid d' *Yponomeuta malinellus* sur *Malus* sp., e.l. 17.viii.2018, © Ruben Meert.

Discussion and conclusion

The experiments and observations show that larvae of *E. effractella* succeed in completing their development with nothing more than an *Yponomeuta* web to feed on. In the described set-ups, they didn't come out of the web to feed from living tissue but stayed within. Only when there was no web available, they started feeding upon fresh leaves. It is likely that the larvae do prefer to feed on web in natural conditions too. Perhaps it is no coincidence that the adults of *E. effractella* are well camouflaged while sitting on such an old web (fig. 7).

This particular behaviour has never been described before. On 28 August 2018, a few tiny parasitoid wasps, probably *Gelis aerator* (Panzer, 1804) (pers. comm. Fons Verheyde), were inspecting old *Yponomeuta* webs on apple trees (*Malus* sp.). 2 webs in which they were particularly interested contained an *E. effractella* larva. These observations, in a period that webs are unlikely to contain any original *Yponomeuta* larvae, suggest that at least one predator is familiar with this feeding behaviour.

Fig. 8. Lebbeke, 28.viii.2018, parasitoid wasp on *Yponomeuta* web containing an *Eccopisa effractella* larva, © Ruben Meert.
Fig. 8. Lebbeke, 28.viii.2018, parasitoïde wesp op een *Yponomeuta* spinsel met een *Eccopisa effractella* rups, © Ruben Meert.
Fig. 8. Lebbeke, 28.viii.2018, guêpe parasitoïde sur un nid d' *Yponomeuta* avec une chenille d' *Eccopisa effractella*, © Ruben Meert.

An *Yponomeuta* web consists of 4 main components: frass, larval skins and silk produced by the *Yponomeuta* larvae and dry organic fragments (of leaves, fruits, flower petals, etc.) of the hostplant. The *E. effractella* larvae must feed on at least one of these components. This might be the subject for a future study, but the results of the third set-up show that dried leaves are suitable food.

No larvae of *E. effractella* were found in webs of *Y. padella* on hawthorn (*Crataegus* spp.) and *Y. rorella* on willow (*Salix* spp.). In case of *Y. rorella* the silk was clearly spun less tightly compared to the other *Yponomeuta* species, providing less hiding and feeding possibilities.

Despite the abundance of *E. effractella* larvae in the authors orchard in 2018 and intensive field search, feeding under bark of fruit trees or on the seeds of quinces (*Cydonia oblonga*) and apples (*Malus* sp.), as described by Andreev 2005, was not observed. The presence of larvae or chrysalides of this species in insect galls and in dead flowers of bulrush (*T. latifolia*), as mentioned above, also requires further investigation. In this study only *Yponomeuta* webs were examined, but there are other

Lepidoptera species of which larvae produce webs that remain on the host plant for a while, e.g. oak processionary, *Thaumetopoea processionea* (Linnaeus, 1758), brown-tail, *Euproctis chrysorrhoea* (Linnaeus, 1758) and black-veined white, *Aporia crataegi* (Linnaeus, 1758).

Therefore it would be useful to report observations of *E. effractella* larvae, preferably on the data portal www.waarnemingen.be for observations in Belgium or www.observation.org when it concerns observations elsewhere. It is important to mention the host plant and specific conditions (galls, web , under bark, etc.) in which the larvae were found.

Field search tips

Larvae of *E. effractella* can be searched for from mid-summer until spring. Old *Yponomeuta* webs on at least apple (*Malus* spp.), spindle (*Euonymus* spp.) and bird cherry (*Prunus padus*) can contain larvae of this species. While handling and opening a web, it is advised to keep something underneath the web to prevent larvae from falling on the ground.

Where this species occurs, *Yponomeuta* webs that remain attached to the host plant in winter have a good chance to contain full grown larvae in a whitish cocoon.

One can also collect webs at random in summer or autumn and put them in a jar, covered with a paper tissue or some fine grained gauze. Keep the web slightly moist. If they contain larvae, this should result in emerging moths later that year or next spring.

Acknowledgements

I wish to thank everybody that has contributed to this study: Cédric De Noyette, Frantisec Slamka, David Agassiz, Friedmar Graf, Hartmuth Strutzberg, Peter Buchner, Keith Bland, Rudi Goossens, Zoë Vanstraelen and the editorial staff of Phegea.

I'm very grateful to Karen Segers, Theo Garrevoet and Stéphane Claerebout for correcting an earlier draft of this article and to Annelies Moeyersoon for translating the Bulgarian article of Andreev.

Special thanks to Fons Verheyde for the determination of the parasitoid wasp and Willy De Prins for providing the articles of Andreev, Hanneman and Chrétien.

References

Agassiz D. J. L. 1996. *Eccopisa effractella* Zeller (Lepidoptera: Pyralidae) new to the British Isles. – *Entomologist's Gazette* **47**: 181 – 183.

Andreev R. 2005. *Eccopisa effractella* Z. – A little known fruit tree pest in Bulgaria. – *Acta Entomologica Bulgarica*, volume **11**, N° 1,2: 52–56

Chrétien P. 1930. Chenilles de Phycides de la faune Française. – *L'Amateur de Papillons*, Paris **5**: 97–103.

De Prins W., Steeman C., Sierens T., Garrevoet T., De Prins G., & Verboven A. 2018. Catalogue of the Lepidoptera of Belgium. – http://projects.biodiversity.be/lepidoptera/ [accessed 24.ix.2018]

Hannemann H. J. 1964. *Kleinschmetterlinge oder Microlepidoptera. 2. Die Wickler (s. l.) (Cochylidae und Carposinidae). Die Zünslerartigen (Pyraloidea)*. – Die Tierwelt Deutschlands, **50**: 1–401, 22 pls.

Lepiforum.de 2017. Forum 2: *Eccopisa effractella* – http://www.lepiforum.de/2_forum_2017.pl?page=1;md=read;id=2473 [accessed 31.xii.2017]

Slamka F. 1995. *Die Zünslerfalter (Pyraloidea) Mitteleuropas. Bestimmen – Verbreitung – Fluggebiet – Lebensweise der Raupen*. – 112 pp.

Speidel W., Segerer A. & Nuss M. 2013. Fauna Europaea: Pyralidae – In: Karsholt, O. & Nieukerken, E.J. van 2013 Fauna Europaea: Lepidoptera, Moths. Fauna Europaea version 2017.06, https://fauna-eu.org [accessed 29.xii.2017].

Waarnemingen.be 2017. *Eccopisa effractella* — www.waarnemingen.be [accessed 29.xii.2017].

Waarnemingen.be 2017 and 2018. *Yponomeuta malinellus* — www.waarnemingen.be [accessed 30.xii.2017 and 21.vii.2018].