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Early stages and life history of *Nephoterix angustella* (HÜBNER, 1796) (Lepidoptera: Pyralidae) in Poland

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Abstract: Early stages and bionomics of *Nephoterix angustella* were studied and described based on materials collected in Poland. The presence of two broods was confirmed, with the summer generation of moths and autumn generation of larvae being more abundant. The extremely early or very late occurrences were considered accidental. Rapid range expansion has been observed in recent decades, which may be related to climate warming.

Key words: Lepidoptera, Pyralidae, *Nephoterix angustella*, preimaginal stages, biology, *Euonymus*.

INTRODUCTION

Nephoterix angustella (HBN.) is the only representative of this genus in Europe. Its distribution range covers southern and central Europe including southern part of Great Britain (GOATER 1986), with a tendency to expand its distribution range towards the north. In Poland, it is currently distributed throughout the country, with the exception of higher elevations in the mountains. The vast majority of data was collected in the 21st century. As an adult seen rather infrequently and in single individuals. Locally common as a larva in berries of spindle. Extremely early appearance of moths in February and March and very late in October suggested the possibility of hibernation in the adult stage. To clarify this case, we decided to investigate the biology of this species in detail.

MATERIAL AND METHODS

Moths were collected on various occasions by attracting them to UV emitting lights sources, such as mercury vapor bulbs, fluorescent lights and LED stripes. Early stages were obtained either by rearing from eggs laid by females in laboratory conditions or by searching for larvae feeding on fruits of *Euonymus europaeus* L. The larvae were collected from July

to September within the period 2012-2022. Rearing was carried out in plastic boxes with the bottom covered with a thin layer of soil. The progress of larval development was monitored daily or every other day. The data was stored in a database and photographic documentation was also made. The hatched moths were set in accordance with the methods recommended for small moths (Buszko & Rynarzewski 2018) and finally deposited in the authors' collections.

PREIMAGINAL STAGES

Egg (Fig. 1): oval in outline, dome-shaped with a flat base. Its color is plain yellow or orange at first, later marked by irregular red spots. Chorion covered with a slight rough network pattern.

Larva: young larva (Fig. 2) yellowish with a pale brown head and without pattern on the body. Only on lateral sites of prothorax are single blackish dots. Full grown larva (Fig. 3, 4) with an orange-brown head and dark brown mouthparts. Body color is dependent on the development of *Euonymus* L. berries. Summer larva feeding on unripe berries is pale green with two rows of dark red spots arranged in broad stripes that merge in the last two abdominal segments. Anal plate yellowish-brown. Dorsal vessel indistinctly marked. Prothorax laterally with a large black spot, smaller spots are present on mesothorax and sometimes on metathorax. Stigmata yellow. Suprastigmal pinacula dark marked, other pinacula are the body color with single yellowish setae. Thoracic legs yellowish brown or yellowish gray. Abdominal legs of the body color. Autumn larva feeding on ripe berries is yellowish gray with the similar color pattern on the body as in the summer larva.

Pupa (Fig. 5): rather slim, shiny, dark yellow with brown head and the posterior part of the abdomen. Cremaster flat with several apically hooked setae.

BIOLOGY

In Poland the main host plant of *N. angustella* (HBN.) is European spindle (*Euonymus europaeus* L.). In NE Poland (Wigry National Park) larvae were found also on *Euonymus verrucosus* SCOP. So far, the search for larvae on ornamental spindle species has been in vain. However, in laboratory conditions, when the larvae received the fruits of *Euonymus fortunei* (TURCZ.) HAND.-MAZZ., they began to feed on them and successfully completed their development. In the first generation, eggs are laid on flower buds or young fruits, in the second generation on ripening fruits. Usually the eggs are placed in the indentations between the fruit lobes. The young larva enters the fruit and feeds internally on seeds. Its presence is indicated by the small hole and protruding frass, which is spun in small clusters. Usually, the amount of food in a single berry is not enough for full development, and the larva frequently moves to of adjacent fruits and connects them with silk threads (Figs. 7-8). The full-grown larva abandons the fruit and looks for a suitable place to pupate. It usually descends to the ground, where in the leaf litter it makes a dense whitish cocoon covered with detritus particles. Sometimes it may find proper site for pupation in the bark crevices.

The most preferred habitats are sunny wood margins, clearings, and in urbanized areas hedgerows and bushy places. Moths (Fig. 6) are rather rarely seen. Since the presence of larvae is easy to detect, their abundance has been found to vary from year to year, sometimes attaining high numbers.

Phenology of adults was compiled on the basis of 127 daily records based on the authors' own data supplemented with entries from the website Lepidoptera Mundi (JONKO 2002-2022)

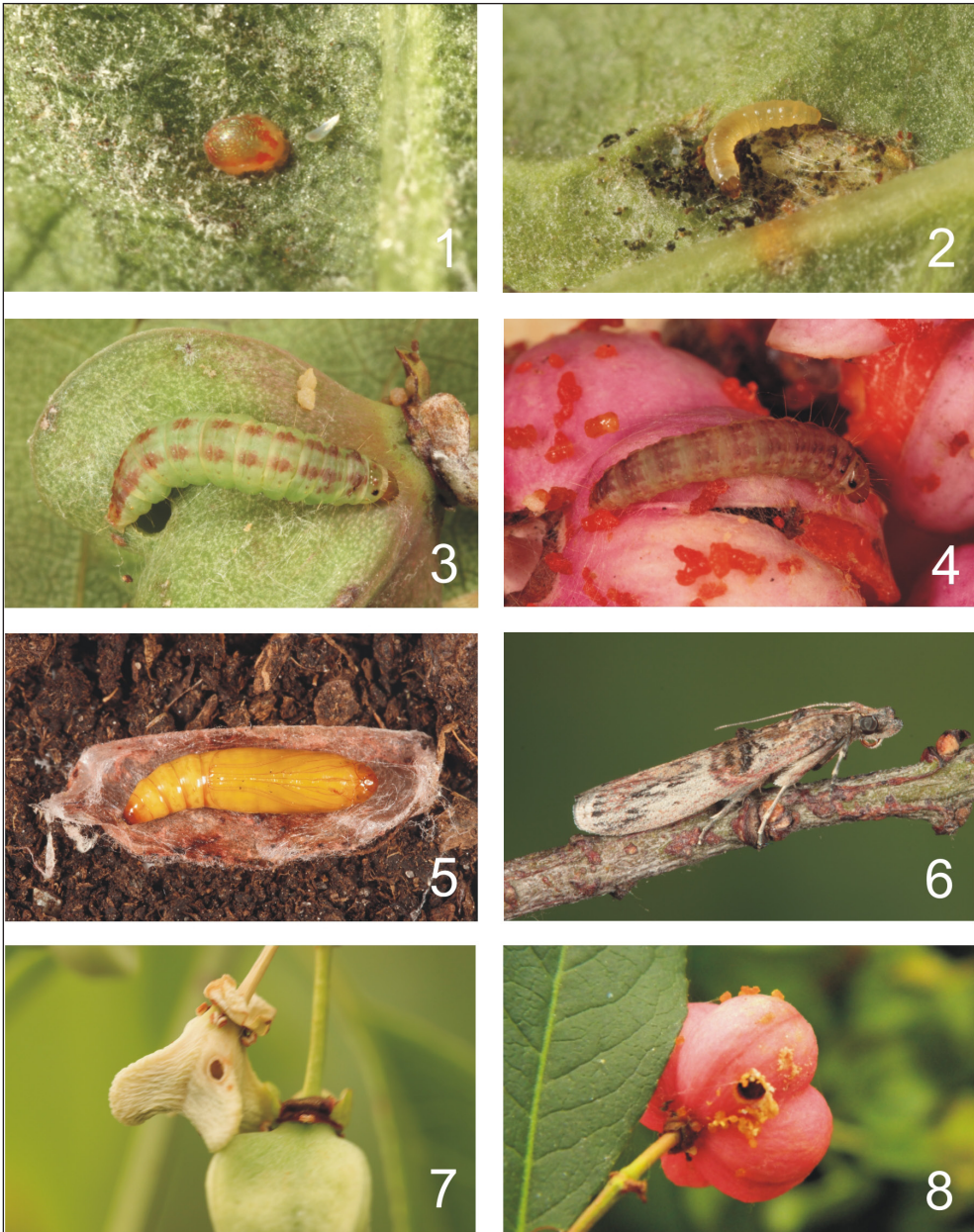
(Fig. 9). The presence of two generations was confirmed. The first generation occurs from end of May to early July, and the second is more extended and occurs from end July to late September with a few occurrences in between. Single records from February, March and October should be treated as an incidental occurrence, probably related to moths hibernating in favorable conditions, e.g. indoors.

The number of observed larvae is much higher in the second generation, which can be associated with better quality of food sources, especially ripening seeds. It should be pointed out that in early summer the berries are still green, smaller and the seeds are poorly developed. The seasonal number of larvae corresponds to the number of moths in the next generation. Based on breeding in the natural environment and in laboratory conditions, it was found that usually the hibernating stage is the full-grown larva. When the larvae pupated in the autumn, the moths usually hatched later that year. Incidentally, some pupae remained alive until spring and adults hatched during the normal phenological period. However, no hibernation of adults has been observed in our breeding experiments.

DISCUSSION

A review of the faunistic literature indicates a rapid expansion of the geographical range of *N. angustella* (HBN.). This phenomenon was noticed in central and northern Poland in the last two decades. The first information about occurrence of *N. angustella* (HBN.) in Poland comes from the 19th century from Lower Silesia, namely from Głogów and Wrocław (WOCKE 1874). He mentioned the presence of only one generation – moths in spring and larvae in autumn. Although in the old monograph of Polish Lepidoptera, the species is listed from several localities, but all of them are currently located in Ukraine (SCHILLE 1930). After a long break the next moths were collected in 1954 and 1955 in Ligota Tworowska in Upper Silesia (DROZDA 1962). Faunistic research carried out in the second half of the 20th century resulted in the appearance of several large faunistic works. The main studies concern the valley of the Lower Nida (KOSTROWICKI 1953), the Pieniny Mountains (BLESZYŃSKI *et al.* 1965) and the vicinity of Kraków (RAZOWSKI & PALIK 1969). However, *N. angustella* (HBN.) is not listed there. Only in the collection of the Institute of Systematics and Evolution of Animals PAS in Krakow there are several specimens from the city of Poznań reared in 1960 and 1970. It is very likely that their occurrence is the result of accidental introduction. At the turn of the century, the species appeared suddenly in many places in southern Poland. In the checklist published at the time, its presence is already mentioned in six voivodships (PAŁKA 2000). The next checklist shows the occurrence in almost all of Poland except for the two northernmost voivodships (PAŁKA 2017). Currently, the species has undoubtedly colonized all suitable habitats throughout Poland.

Range expansion was also seen in Balticum. In the book on northern European pyralids this species is mentioned only from northern Germany and Denmark (PALM 1986). Recent papers provide information on the species from Lithuania (IVINSKIS & RIMŠAITE 2016), Estonia (JURIVETE & ÖUNAP 2020) and Sweden and Finland (KARSHOLT & NIEUKERKEN 2013). The rapid expansion of the geographic range of *N. angustella* (HBN.) towards the north may indicate the influence of climate warming, and ultimately the only limit to the spread of this species may be the range of its host plant.



Figs. 1–8. *Nephopterix angustella* (Hbn.): 1 – egg, 2 – young larva, 3, 4 – full-grown larvae, 5 – pupa, 6 – imago 7 – feeding traces in summer, 8 – feeding traces in autumn (photos 1–7 – J. Buszko, 8 – P. Rączka).

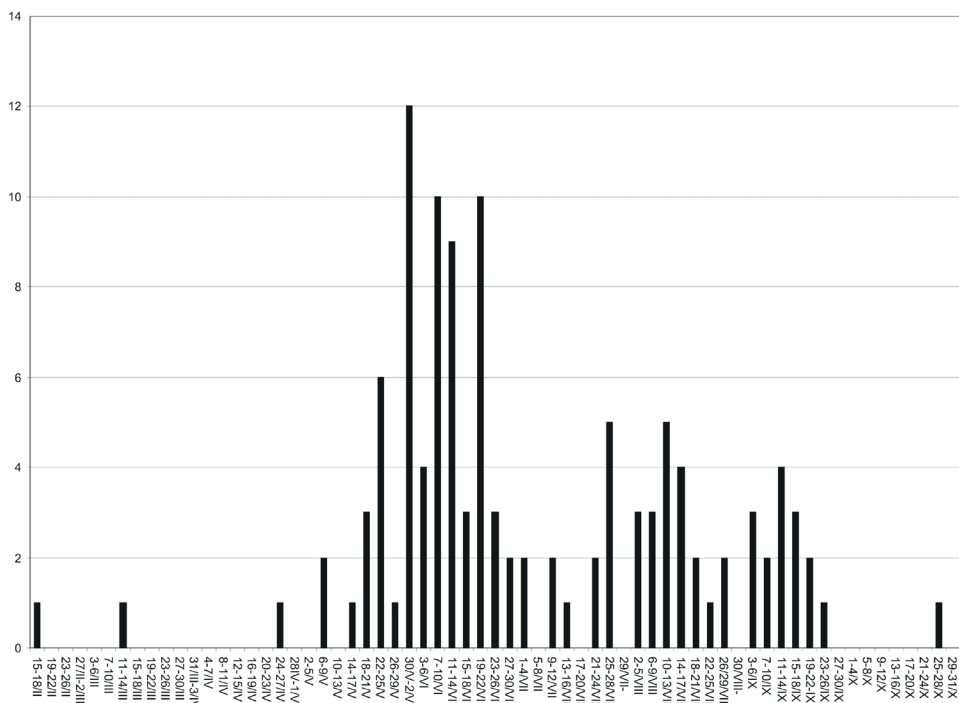


Fig. 9. Annual records based on frequency of moth catching.

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