

JAROSŁAW BUSZKO 

**Early stages and biology of *Pyralis cardinalis* KAILA,  
HUEMER, MUTANEN, TYLLINEN et WIKSTRÖM, 2020  
(Lepidoptera: Pyralidae), with comments on its  
distribution in Poland**

<http://doi.org/10.5281/zenodo.6410548>

Department of Ecology and Biogeography, Nicolaus Copernicus University, Lwowska str. 1, 87-100 Toruń,  
Poland, e-mail: buszko@umk.pl, ORCID 0000-0001-8816-0591

**Abstract:** The preimaginal stages of *Pyralis cardinalis* KAILA et al. are described; they were reared from eggs obtained from a female. The larvae were fed with decaying leaves. The species hibernates in the last larval instar. As a rule, there is one generation per season. Its preferred habitats are various kinds of woodland, especially boggy pine forest. The species has been expanding its range westwards since the 1990s. Since 2010, the species has become common in Poland and has rapidly colonized almost the whole country except for south-western and north-western areas.

**Key words:** Lepidoptera, Pyralidae, *Pyralis cardinalis*, early stages, life history, range expansion.

## INTRODUCTION

*Pyralis cardinalis* KAILA, HUEMER, MUTANEN, TYLLINEN et WIKSTRÖM, 2020 has recently been distinguished from *Pyralis regalis* (DEN. et SCHIFF.) (WIKSTRÖM *et al.* 2020). Its distribution extends from central Europe to Japan. In Europe it occurs predominantly in the northern regions, reaching as far south as northern Slovakia (Z. TOKÁR, pers. com.). Its occurrence in Poland has been confirmed (LARYSZ 2020). All verified records previously concerning *P. regalis* (DEN. et SCHIFF.) in fact refer to *P. cardinalis* KAILA et al. So far, *P. regalis* (DEN. et SCHIFF.) has not been found in Poland, but its occurrence is perfectly possible in the warmest parts of south-eastern Poland. The early stages and biology of *P. cardinalis* KAILA et al. have not been described as yet. However, these have been described for *Pyralis regalis* (DEN. et SCHIFF.) (FELIX & SCHWARZ 1971) based on the breeding of material collected near the Black Sea in Bulgaria. They are compared here with *P. cardinalis* KAILA et al. In 2020, rearing ex ovo was carried out in order to acquire knowledge of its early stages and life strategies. In addition, all the available data on its distribution in Poland are analysed.

## METHODS

Breeding began with one female collected at light. This moth was placed in a plastic box lined with a loose layer of dry leaves and bark scales. On hatching, the larvae started to feed on the dry leaves; later they were given decaying leaves of *Malus domestica*. Breeding in the laboratory was continued until late autumn. The larvae and their growth were monitored once a week. In November, most larvae were transferred to the natural environment, but a small number were retained indoors. In April, the outdoor larvae were brought back into the laboratory. They continued feeding for a short time, after which they constructed cocoons and pupated. The freshly hatched moths were set in the usual way for micro-moths. The distribution and phenology records were obtained chiefly from the Lepidoptera Mundi database (JONKO 2002-2022), the author's own files and data kindly provided by several colleagues.

## PREIMAGINAL STAGES

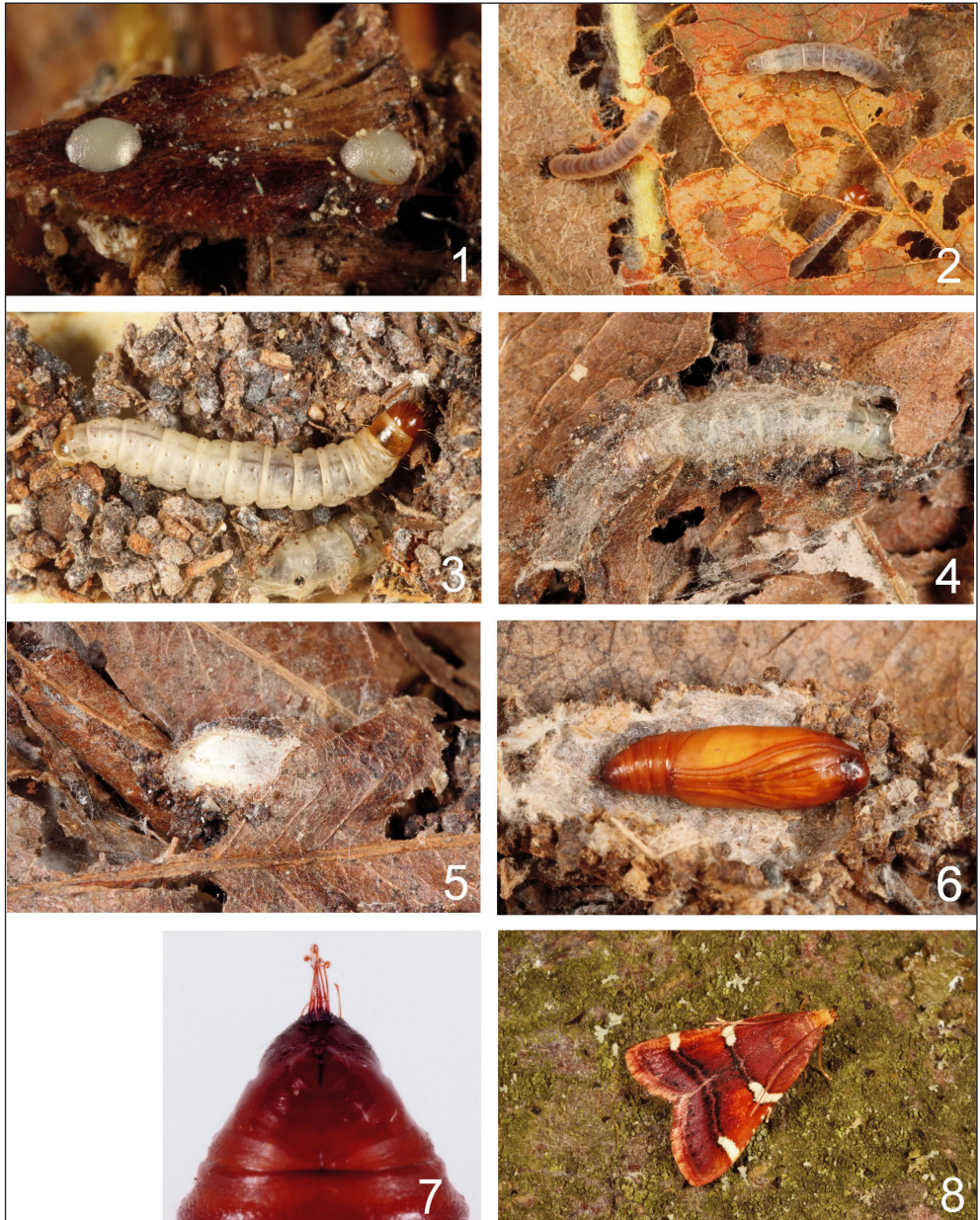
Egg (Fig. 1): wide, oval in outline, hemispherical with flat base. Colour: initially white, turning yellowish after a few days. Surface wrinkled, forming a densely pitted pattern on surface of chorion.

Fully grown larva (Fig. 3): whitish to pale grey with dark dorsal vessel showing through integument. Head red brown, mouthparts darker. Prothoracic plate yellowish-brown, sometimes with large dark brown spot in middle and paler proximal margin. Mesothoracic plate more yellowish with darker fore and hind margins. Metathorax of similar colour to abdominal segments. Abdominal segments I-VIII with paler hind margins. Abdominal segment IX with small darker plate close to hind margin. Abdominal segment X with large triangular brown plate. Pinacula rather large with dark brown centre and single, pale brown and whitish setae. Stigmata small except for those on prothorax and abdominal segment VIII, which are much larger. Thoracic legs pale brown. Abdominal legs same colour as body. Younger instars grey with paler rear end of abdomen.

Pupa (Fig. 6): rather stout, reddish-brown and glossy; cremaster with a bunch of hooked setae on top (Fig. 7).

## BIOLOGY

The female was collected in Rogoźno (XU34) on 6 August 2020. Within a few days she had laid about 50 eggs – these (Fig. 1) were stuck on fragments of plant debris, such as dry leaves, conifer needles or flakes of bark. The young larvae hatched at the end of August. At first, they spun and then lived in a small web, eating out holes in leaves, ultimately skeletonizing them (Fig. 2). The later instar larvae (Fig. 3) constructed silk tunnels in which they remained hidden most of the time (Fig. 4). They were active at night, leaving the tunnel in search of food. They reached the final instar in early October and stopped feeding in preparation for the winter diapause. Most of the larvae were kept outdoors, but a few were retained in a heated room. The larvae of both groups completed diapause around the same time in late April. They then resumed feeding for a short time, after which they began to build dense white cocoons among dry leaves (Fig. 5). The cocoons were covered with fragments of plant debris and frass. The breeding yielded 17 adult specimens, which hatched between 16 May and 3 June. The moths were no different in size or colouration from those collected in nature.



Figs. 1–8. *Pyralis cardinalis* KAILA et al.: 1 – eggs, 2 – young larvae, 3 – fully-grown larva, 4 –larva in a silken tube, 5 – cocoon, 6 – pupa, 7 – cremaster, 8 – imago (photos J. Buszko).

The flight period of the moths was determined on the basis of 243 records obtained from the Lepidoptera Mundi lepidopterological database (JONKO 2012-2022) and my own records from the Wigry National Park. There is usually only one generation a year, from mid-June to late July. However, records from early August indicate the possibility of a partial second generation (Fig. 9).

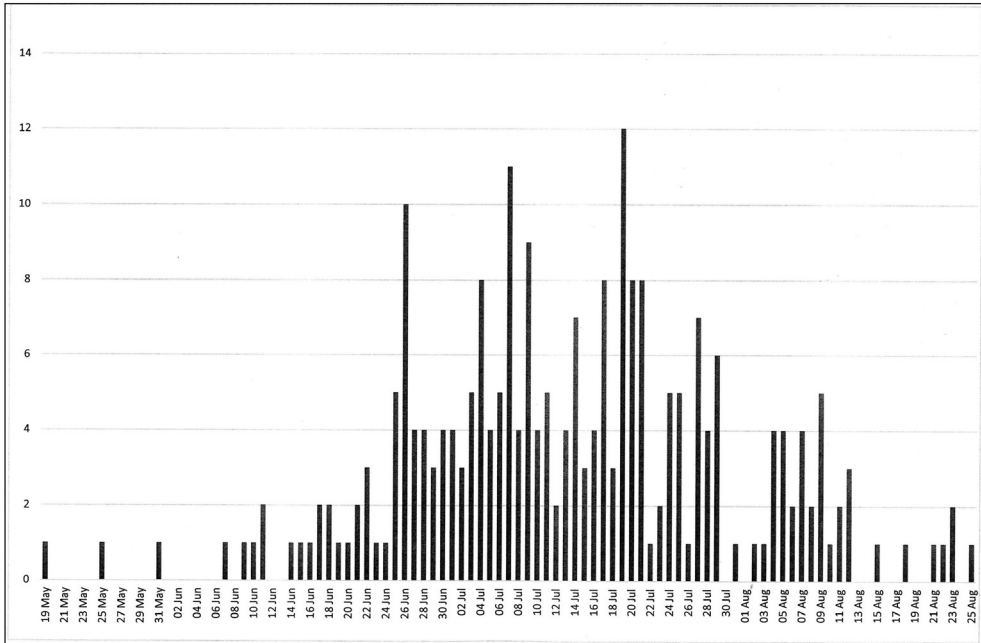


Fig. 9. *Pyralis cardinalis* KAILA et al. – cumulative phenological records within a season.

The species is found in a variety of habitats. It normally inhabits forests, less frequently open and disturbed habitats. Its abundance is low. Quantitative research conducted in five types of forest habitats in the Wigry National Park showed that the preferred habitat was boggy pine forest (46 specimens), with subcontinental mixed forest (17 specimens), alder forest (5 specimens) and oak-hornbeam forest (5 specimens) being less preferred. It was not found in boggy spruce forest. Unlike the related *P. farinalis* (L.), *P. cardinalis* KAILA et al. is not a synanthropic species.

## DISTRIBUTION IN POLAND

The first record from Poland comes from Ulów in SE Poland on July 17, 1912 (NIESIOŁOWSKI & PRÜFFER 1924). The second record in the same area was obtained from Lubycza Królewska on July 16, 1924 (SCHILLE 1930). The next records from Lubasz near Szczucin – 1930s (NIESIOŁOWSKI & WOJTUSIAK 1950), Baligród (5 VIII 1960, S. Toll leg, unpublished data), Kraków – 1960s (RAZOWSKI & PALIK 1969) and the Świętokrzyskie Mountains – 1979 (ŚLIWIŃSKI *et al.* 1991), can be considered examples of accidental or local appearance. An upsurge in expansion came to notice after 1990. These more recent records were from the Borecka Forest – 1992-1994 (my own data), the Białowieża Primeval Forest – 1994 and 1996 (JAROSZEWICZ 1998), and the Lublin Polesie region – 1996 and every year thereafter (M. HOŁOWIŃSKI pers. com.). ŚLIWIŃSKI (1998) mentioned it as a newcomer to central Poland but did not provide any detailed locality data. At the turn of the century, the species did not occur in many provinces in western Poland (BUSZKO & NOWACKI 2000). In the 21<sup>st</sup> century, however, papers were published with later records from northern Poland (SENN 2018) and central Poland (SOBCZAK *et al.* 2012, 2017, 2019). The species' expansion accelerated after 2010 and many new records were obtained. Apart from the literature data, about 300 records from databases and other sources have been used to analyse this expansion. These records



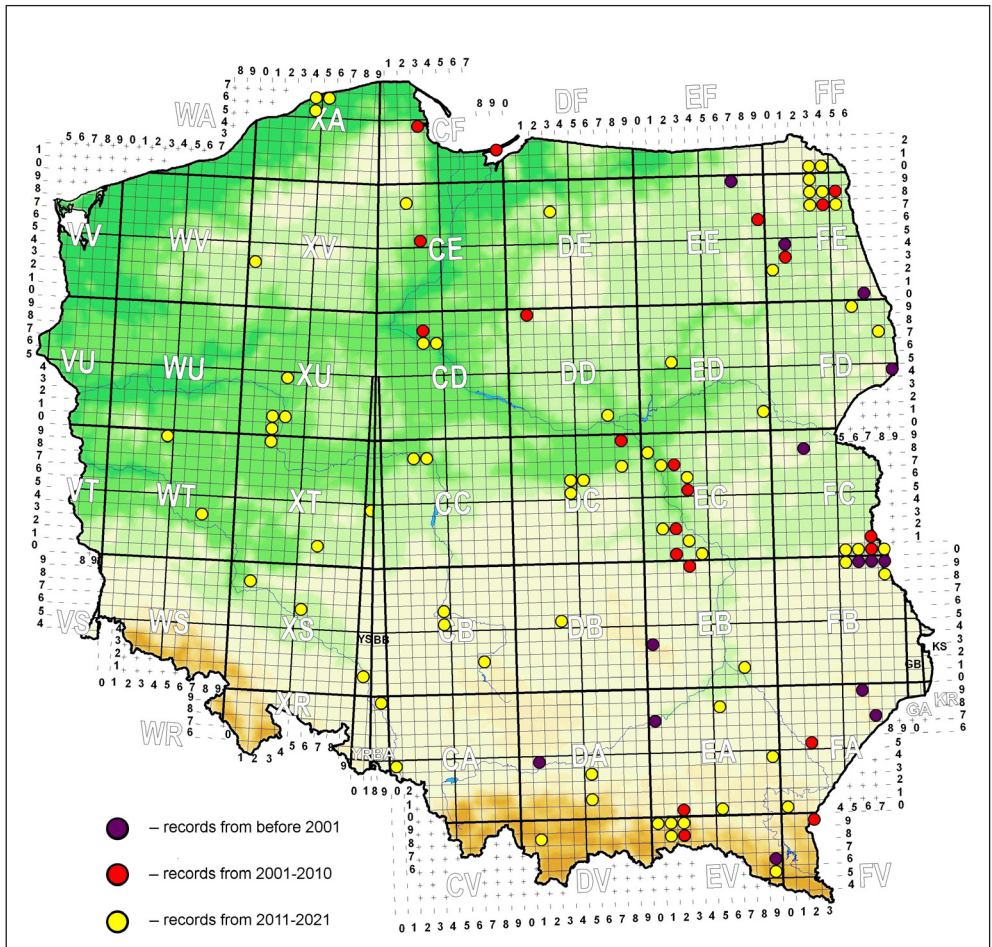


Fig. 10. Distribution of localities of *Pyralis cardinalis* KAILA et al. in Poland.

– from 104 UTM 10-kilometre squares (Fig. 10) – have been divided into three periods: before 2001, 2001–2010 and 2011–2021. The species is currently present in all the Polish provinces except for areas in the north-west and south-west of the country.

## DISCUSSION

Comparison of the features of the eggs and the larvae of *Pyralis cardinalis* KAILA et al. with those of *P. regalis* (DEN. et SCHIFF.) (FELIX & SCHWARZ 1971) and *P. farinalis* (L.) from my own materials does not reveal any significant differences. The morphological differences in the pupae were not studied in detail. According to FELIX & SCHWARZ (1971), the eggs of *P. regalis* (DEN. et SCHIFF.) are laid singly and not attached to any substrate. This may have been the result of keeping the female in a container without any additional surfaces (leaves etc) inside. Those larvae were bred on withered leaves from various trees, whereas those of *P. cardinalis* KAILA et al. evidently preferred dead leaves from the litter. *P. farinalis* (L.) larvae feed on a variety of plant material, which has enabled their synanthropization and led to their very wide geographical distribution. The kind of food the larvae eat shows that in nature, they

live in the leaf litter. It is this that governs their choice of natural environment and to a large extent determines their range. The causes of the range expansion of *P. cardinalis* KAILA et al. are not known – they do not appear to be related to changes in either the environment or the climate. It is to be expected that this species will soon have colonized the whole of Poland and will have encroached into the eastern regions of Germany.

## ACKNOWLEDGEMENTS

I am very obliged to my colleagues who provided me with their unpublished records, literature sources or surveyed museum collections. My thanks go to Artur Berezowski, Krzysztof Frąckiel, Grzegorz Jędro, Marek Hołowiński, Bogdan Jaroszewicz, Adam Malkiewicz, Mariusz Mleczak, Filip Paluch, Łukasz Przybyłowicz, Maciej Sosnowski and Zdeno Tokár (Slovakia). I also would like to express my gratitude to Peter Senn for his linguistic correction of the text.

## REFERENCES

- BUSZKO J., NOWACKI J. [Eds.] 2000. The Lepidoptera of Poland, a Distributional Checklist. *Polish Entomological Monographs* 1: 178 pp.
- FELIX V., SCHWARZ R. 1971. Preimaginalstadien des Zünslers *Pyralis regalis* (DEN. & SCHIFF.) (Lepidoptera, Pyralidae). *Acta Entomologica Bohemoslovaca* 68: 270–275.
- JAROSZEWICZ B. 1998. Zbiory Muzeum Przyrodniczo-Leśnego Białowieskiego Parku Narodowego w Białowieży. Część I: Motyle – Insecta: Lepidoptera. *Parki Narodowe i Rezerваты Przyrody* 17(3): 29–62.
- JONKO C. 2002-2022. Lepidoptera Mundi, <https://lepidoptera.eu> [access 10.02.2022].
- LARYSZ A. 2020. *Pyralis cardinalis* KAILA, HUEMER, MUTANEN, TYLLINEN & WIKSTRÖM, 2020 (Lepidoptera: Pyralidae) w zbiorach Muzeum Górnośląskiego w Bytomiu (USMB). *Acta entomologia silesiana* 28(028): 1–5 [online]. <http://doi.org/10.5281/zenodo.4320376>.
- NIESIOŁOWSKI W., PRÜFFER J. 1924(1923). Materiały do fauny Polski. *Polskie Pismo Entomologiczne* 2(4): 159–171.
- NIESIOŁOWSKI W., WOJTUSIAK J.R. 1950(1949). Przyczynek do znajomości motyli okolic Lubasza pod Szczucinem. *Polskie Pismo Entomologiczne* 19(3–4): 256–276.
- RAZOWSKI J., PALIK E. 1969. Fauna motyli okolic Krakowa. *Acta Zoologica Cracoviensia* 14(11): 217–310.
- SCHILLE F. 1930. Fauna Motyli Polski II. *Prace Monograficzne Komisji Fizjograficznej PAU* 7, Kraków: 358 pp.
- SENN P. 2018. The Lepidoptera of Gdynia. *Rocznik Muzeum Górnośląskiego w Bytomiu, Przyroda* 24(002): 1–58 [online]. <http://doi.org/10.5281/zenodo.1924345>.
- SOBCZAK S., KURZAC T., MALKIEWICZ A., KUBASIK W. 2019. Stan poznania motyli (Lepidoptera) Załęczańskiego Parku Krajobrazowego. *Parki Narodowe i Rezerваты Przyrody* 38(2): 3–38.
- SOBCZAK S., MALKIEWICZ A., KUBASIK W., KURZAC T. 2017. Stan poznania motyli (Lepidoptera) Przedborskiego Parku Krajobrazowego. *Parki Narodowe i Rezerваты Przyrody* 36(4): 51–84.
- SOBCZAK S., MOCARSKI Z., KURZAC T., MALKIEWICZ A., ZAJDA W. 2012. Motyle nocne (Lepidoptera: Heterocera) Bolimowskiego Parku Krajobrazowego. *Parki Narodowe i Rezerваты Przyrody* 31(4): 21–49.
- ŚLIWIŃSKI Z. 1998. Motyle Wyżyny Łódzkiej (Tortricidae, Choreutidae, Stathmopodidae, Batrachedridae, Blastodacnidae, Cosmopterygidae, Blastobasidae, Ethmiidae, Oecophoridae, Pyralidae, Alucitidae, Pterophoridae). *Biuletyn Entomologiczny* 6(1): 8–16.
- ŚLIWIŃSKI Z., WIĄCZKOWSKI S., MARCINIAK B. 1991. Motyle (Lepidoptera) Świętokrzyskiego Parku Narodowego. *Fragmenta Faunistica* 35: 123–145.
- WIKSTRÖM B., HUEMER P., MUTANEN M., TYLLINEN J., KAILA L. 2020. *Pyralis cardinalis*, a charismatic new species related to *P. regalis* [DENIS & SCHIFFERMÜLLER], 1775, first recognized in Finland (Lepidoptera, Pyralidae). *Nota Lepidopterologica* 43: 337–364. <https://doi.org/10.3897/nl.43.54916>.

Accepted: 23 March 2022; published: 4 April 2022

Licensed under a Creative Commons Attribution License <http://creativecommons.org/licenses/by/4.0/>