

# Ladybirds (Coleoptera, Coccinellidae) of midfield thickets

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## Abstract

The aim of the research concerning ladybirds, which are considered to be one of the most effective aphidophags, was to characterize communities of coleopterons of the Coccinellidae family present in different types of midfield thickets. Observations were carried out in 2002 – 2004, from May until October in the village of Tomaszków near Olsztyn. The research resulted in catches of 425 specimens in total, belonging to 15 Coccinellidae species, most of which were predators, the remaining part was polyphagous and herbivorous ladybirds. The presence of some ladybird species was connected with the nature of the researched thickets, especially plants which grew there. Peak activity of ladybirds had a varied course in particular years of the research and to a large extent was conditioned by weather conditions.

## Introduction

Crops are attacked by numerous phytophagous insects including aphids. Natural enemies of the Aphidiidae have a significant influence on the control of their numbers. The most effective aphidophagous insects present in field crops include coleopterons of the Coccinellidae family. Most ladybirds belong to beneficial species due to their predatory nature. The only exception in this group are phytophagous species damaging crops e.g. *Subcoccinella vigintiquatuorpunctata* (Linnaeus, 1758) (ALI, 1979). Larvae as well as adult ladybirds feed on other insects, especially those with soft body construction such as Aphidiidae (IPERTI & PAOLETTI, 1999). Coccinellidae are also considered to be good bio – indicators providing much information on ecosystems in which they live (ANDERSEN, 1999; IPERTI & PAOLETTI, 1999). They are active in the environment throughout the entire growth season, since early spring until late autumn which increases ladybirds' positive role of unspecialized natural enemies of the pests (OLSZAK, 1982).

The aim of the research was to find out about species composition, domination structure, number and seasonal changeability of coleopterons of the Coccinellidae family which live in midfield thickets of various character.

## Research area and methods

The field research was carried out in the experiment area of the Education and Experiment Department of the Warmia and Mazury University in Tomaszków, near Olsztyn, in 2002 – 2004 since May until October.

The research took place on three sites with midfield thickets of various area size, surroundings and herbaceous plant species structure.

Midfield thickets I: area size: 27 m<sup>2</sup>, situated 100 m away from asphalt road and 20 m away from ground road. Mainly herbaceous plants with dominating species grew here, including: *Cirsium arvense* Scop., *Ranunculus repens* L., *Artemisia vulgaris* L., *Rumex obtusifolius* L., *Carduus crispus* L., *Poa pratensis* L. The studied midfield thickets were surrounded by cereal crops, from south – east and north. From the west these midfield thickets adhered to midfield trees which consisted of: 90% pines, 10% birches the age of which was about 45 years old.

Midfield thickets II: area size: 38 m<sup>2</sup>, situated about 50 m away from a ground road, near former farming buildings. It is an area grown over with herbaceous plants in which the following

dominated: *Poa pratensis* L., *Equisetum arvense* L., *Dactylis glomerata* L. and *Urtica dioica* L. From the west to the studied area there was a gathering of cow dung and compost.

On the area adhering the discussed habitat from the south – eastern and north – eastern sides there were triticale crops. From the south – western side there grew young pine – trees of 23 – year – old growth.

Midfield thicket III: area size: 20 m<sup>2</sup>, situated about 300m away from ground road and 80 m from swampy area. The area is grown over with herbaceous plants and grasses (*P. pratensis* L., *E. arvense* L., *Stellaria media* (L.) Vill., *Rumex crispus* L., *U. dioica* L., *A. vulgaris* L., *Chenopodium polyspermum* L., *Bromus hordeaceus* L., *P. pratense* L.). This site from the west adhered to midfield trees, of 0.35 ha size. Species composition of the tree thickets included: pine trees (20%) and birch trees (20%). The age of trees was as follows: pine trees about 50 – years – old, birch – 25 – years – old. On the south – eastern side and north – western side the studied area was surrounded by cereal crops.

Ladybirds were caught using an entomological sweep net. Fifty beats of the net were made at the height of plant tops. Samples were collected in 6 – 8 days intervals, on sunny days between 10 am and 2 pm, and insects were killed using ethyl acetate. The species of the collected coleopterons were identified using the key by BIELAWSKI (1959). Species terminology and systematic division were designed according to CANEPARI (2009).

## Results

During the course of a three – year – long research, in research sites in total 425 specimens of the Coccinellidae family were caught, out of which 15 species were identified (Tab. 1). The number of ladybirds was represented differently in particular research sites and years. The highest species diversity based on Shannon – Weaver coefficient ( $H'$ ) and regularity ( $J'$ ) was observed in thickets II, surrounded by the most diversified settlings (Tab. 1). In 2002 in total 257 coleopterons from the Coccinellidae family from 11 species, were observed which was the highest of all the discussed values.

In total, the most numerous species was *Psyllobora vigintiduopunctata* (71 specimens). In site 1, this species constituted as much as 44.7% of all the ladybirds. In thickets II, *Coccinella septempunctata* (42.1%) was the most numerous species, whereas in thickets III it was *Propylea quatuordecimpunctata* (23.8%). Both the fungivores *P. vigintiduopunctata* and *C. septempunctata* in all the sites belonged to eudominants. To this class of dominance the following species were also included: *Coccinulla quatuordecimpustulata* (thickets I and II), *Hippodamia notata* and *Tytthaspis sedecimpunctata* (thickets II and III). Percentage share of the five remaining species of the Coccinellidae was less than 10% in all the combinations.

In the second year of the research (2003) the total number of caught ladybirds was significantly smaller than in the previous one and amounted to only 78 specimens. In that case most coleopterons were recorded in thickets III and fewest in thickets I (Tab. 1). Also the number of identified species was much smaller, i.e. 6. The most numerous species was *C. quatuordecimpustulata*, which in thickets II constituted 52.2% of the community while in thickets I – 47.4%. In all the three types of thickets *C. septempunctata* was included in eudominants (I – 36.8%, II – 21.7%, III – 30.6%). This class of dominance also included the following: *T. sedecimpunctata* (47.2% in thicket III) and *P. vigintiduopunctata* (10.5% in thickets I and 13% in thickets II). The two remaining species appeared occasionally.

In the following, third year of the research (2004), in total 90 Coccinellidae coleopterons were caught. Most specimens were present in thickets II, and fewest in thickets I (Tab. 1). Ten species of these insects were identified to belong to 10 species. The most numerous species was a herbivorous *Subcoccinella vigintiquatuor punctata*. In thickets III this species constituted 75% of all the ladybirds, and in thickets II – 66%, and in thickets I – 30%. *P. vigintiduopunctata* was present in a smaller number, though in thickets I it constituted half of all the specimens. In site III also *C.*

*quatuordecempustulata* was considered as eudominants (11.1%). The number of the seven remaining species did not exceed 10% of all the combinations of the experiment.

The studied thickets differed with respect to the trophic structure of the Coccinellidae present in it (Fig. 1).

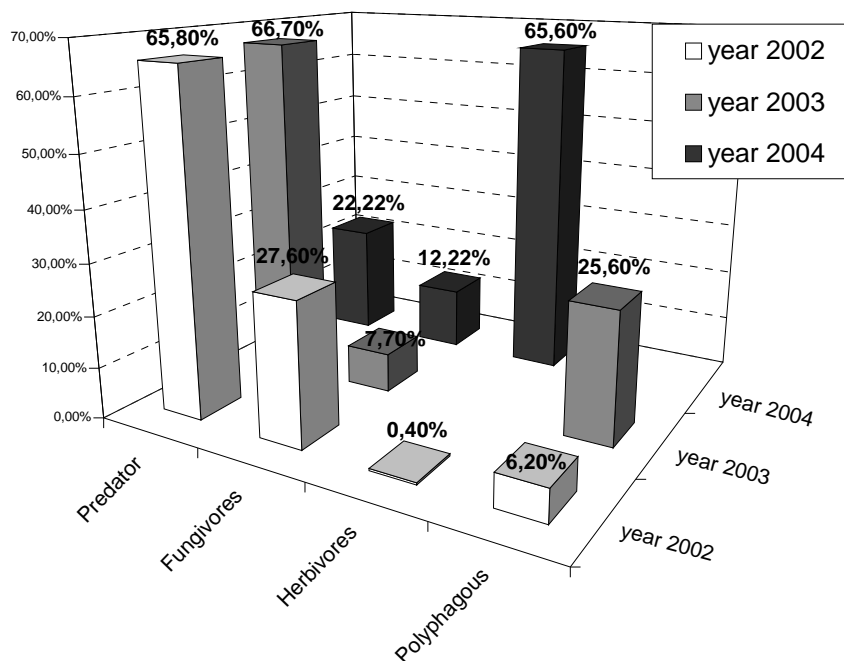


Figure 1. Trophic structure of Coccinellidae in midfield thickets, in 2002 – 2004

Species considered to be unspecialized predators were considered to be most numerous. In total this trophic group constituted 57% of all the identified ladybirds (11 species). The only fungivorous species *P. vigintiduopunctata* was less numerous (21%) followed by herbivorous species (*S. vigintiquatuoropunctata* and *Cynegetis impunctata* – 14%) and polyphagous species *T. sedecimpunctata* (8%). In the first year of the research in all the studied thickets predators were found to be most numerous, i.e. 65.8%, whereas herbivorous species (0.4%) were the least numerous. In 2003 in thickets ladybirds considered to be zoophagous were again the most numerous group. Polyphagous species (25.6%) and the fungivorous *P. vigintiduopunctata* (7.7%) were less numerous. In that year no herbivorous species were recorded. A different situation was recorded in the last year of the catches in which certainly the most numerous group was constituted by phytophagous *P. vigintiquatuoropunctata*, which amounted to 65.6% of all the specimens. Predatory Coccinellidae amounted to 2.2% while the fungivorous species 12.2%.

Seasonal dynamics of ladybird presence in all the research sites was diversified in particular years of the research (Figs. 2, 3 and 4).

In 2002, the first ladybird specimens were caught in thickets III in the second decade of May (Fig. 2). The first ladybirds in thickets I and II were registered at the end of June and the beginning of July. Most ladybirds in all the research sites were caught in July and the beginning of August. In the case of thickets III the maximum number was recorded on 8<sup>th</sup> July (23 specimens), while in thickets I on 29<sup>th</sup> July (22 specimens). The number of ladybirds in thickets II almost during the entire time of the catches was much smaller than in the remaining thickets. Most Coccinellidae in that habitat were recorded on 22<sup>nd</sup> July (6 specimens).

In 2003, first ladybirds appeared in thickets I in the third decade of May, and in thickets III in the second decade of June (Fig. 3). The latest, i.e. in the beginning of August first coleopterons of the Coccinellidae were registered in thickets II. Most ladybirds were recorded on 27<sup>th</sup> August in thicket III (12 specimens).

Table 1. Coccinellidae caught in midfield thickets in 2002 – 2004 (n – numbers, D [%] – dominance coefficient)

Species	2002						2003						2004					
	Thickets 1		Thickets 2		Thickets 3		Thickets 1		Thickets 2		Thickets 3		Thickets 1		Thickets 2		Thickets 3	
	n	D [%]	n	D [%]	n	D [%]	n	D [%]	n	D [%]	n	D [%]	n	D [%]	n	D [%]	n	D [%]
<i>Adalia bipunctata</i> (L)	2	1.75	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<i>Calvia decempunctata</i> (L.)	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	10.00	0	0.00	1	2.78
<i>Coccinella quinquepunctata</i> (L)	0	0.00	1	2.63	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<i>Coccinella septempunctata</i> (L)	13	11.40	16	42.11	21	20.00	7	36.84	5	21.74	11	30.56	0	0.0	2	4.55	0	0.00
<i>Coccinula quatuordecimpustulata</i> (L)	32	28.07	6	15.79	7	6.67	9	47.37	12	52.17	5	13.89	0	0.00	4	9.09	0	0.00
<i>Cynegetis impunctata</i> (L)	1	0.88	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<i>Exochomus quadripustulatus</i> (L.)	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	10.00	0	0.00	1	2.78
<i>Hippodamia notata</i> (Laich)	7	6.14	4	10.53	23	21.90	0	0.00	0	0.00	2	5.56	0	0.00	4	9.09	27	75.00
<i>Hippodamia tredecimpunctata</i> (L)	1	0.88	0	0.00	2	1.90	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	2.78
<i>Hippodamia variegata</i> (Goeze)	0	0.00	1	2.63	1	0.95	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<i>Propylea quatuordecimpunctata</i> (L)	6	5.26	1	2.63	25	23.81	1	5.26	0	0.00	0	0.00	0	0.00	1	2.27	2	5.56
<i>Psyllobora vigintiduopunctata</i> (L)	51	44.74	5	13.16	15	14.29	2	10.53	3	13.04	1	2.78	5	50.0	4	9.09	0	0.00
<i>Subcoccinella vigintiquatuor punctata</i> (L.)	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	3	30.0	29	65.91	4	11.11
<i>Tythaspis sedecimpunctata</i> (L)	1	0.88	4	10.53	11	10.48	0	0.00	3	13.04	17	47.22	0	0.0	0	0.00	0	0.00
Total Individuals	114		38		105		19		23		36		10		44		36	
Total Species	9		8		8		4		4		5		4		6		6	
Shannon H' Log Base 2,718	1.49		1.68		1.81		1.11		1.20		1.25		1.17		1.16		0.92	
Shannon J'	0.68		0.81		0.87		0.80		0.87		0.78		0.84		0.65		0.51	

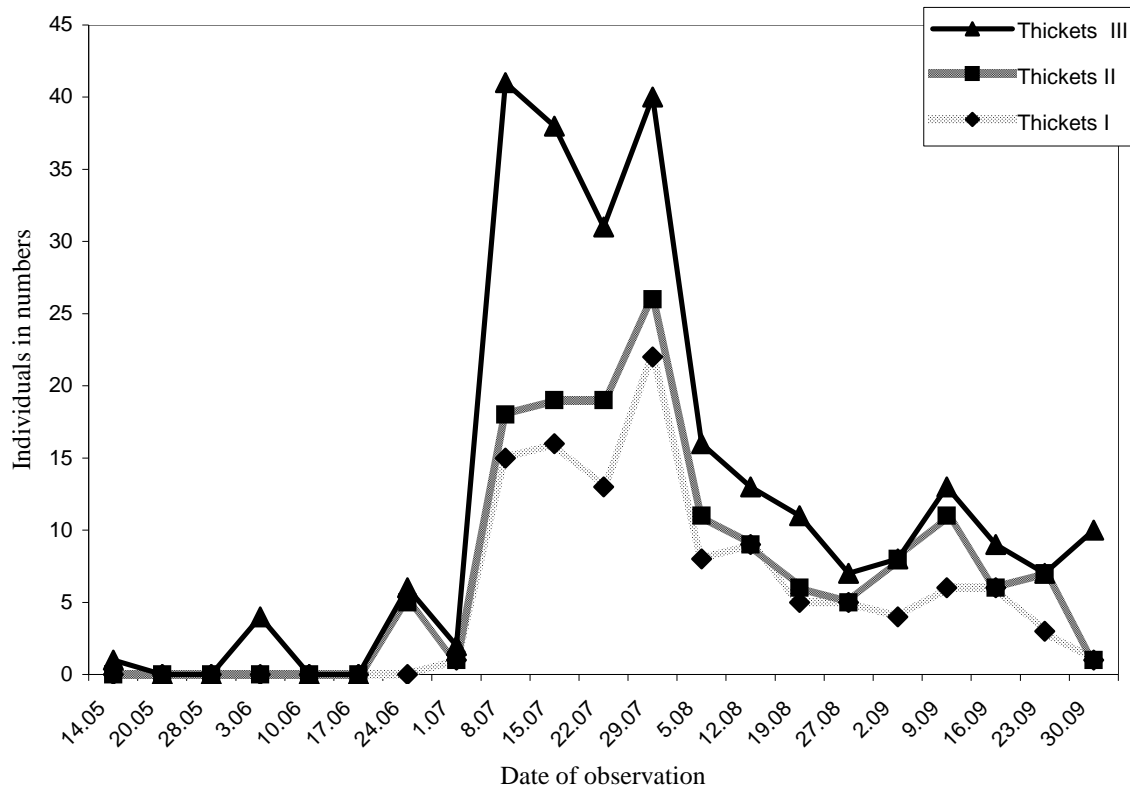


Figure 2. Dynamics of Coccinellidae presence in midfield thickets in 2002

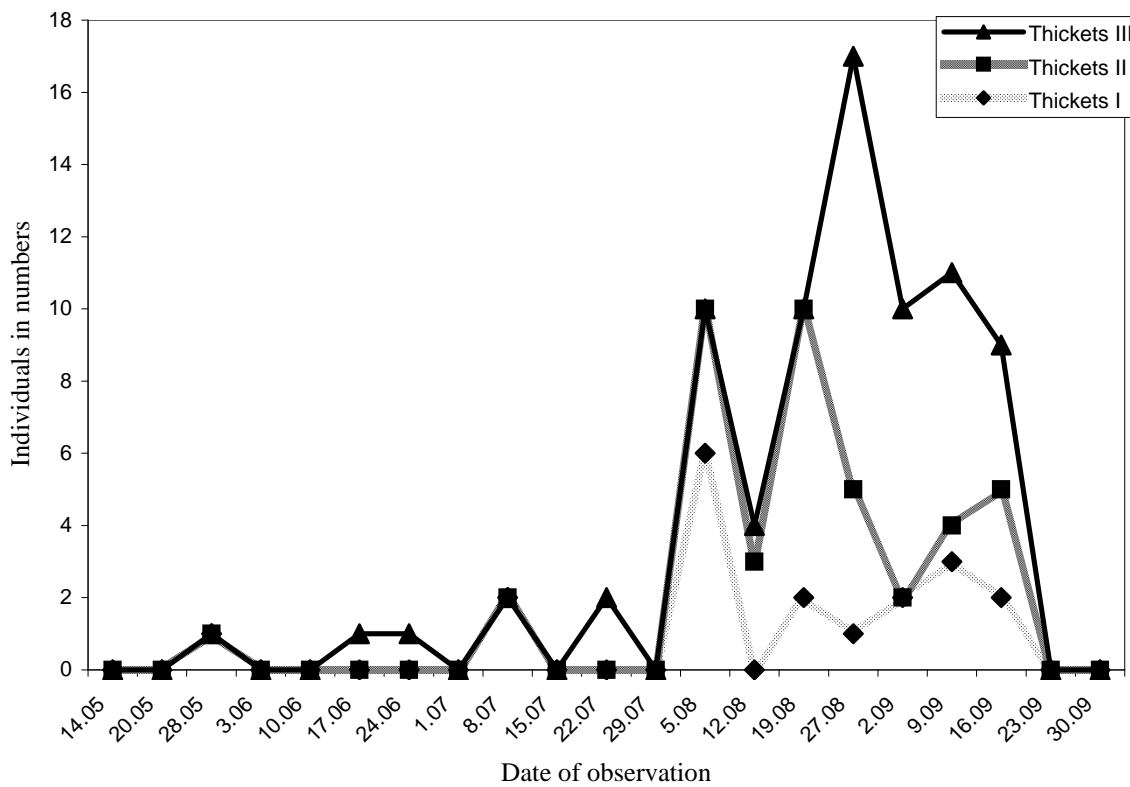


Figure 3. Dynamics of Coccinellidae presence in midfield thickets in 2003

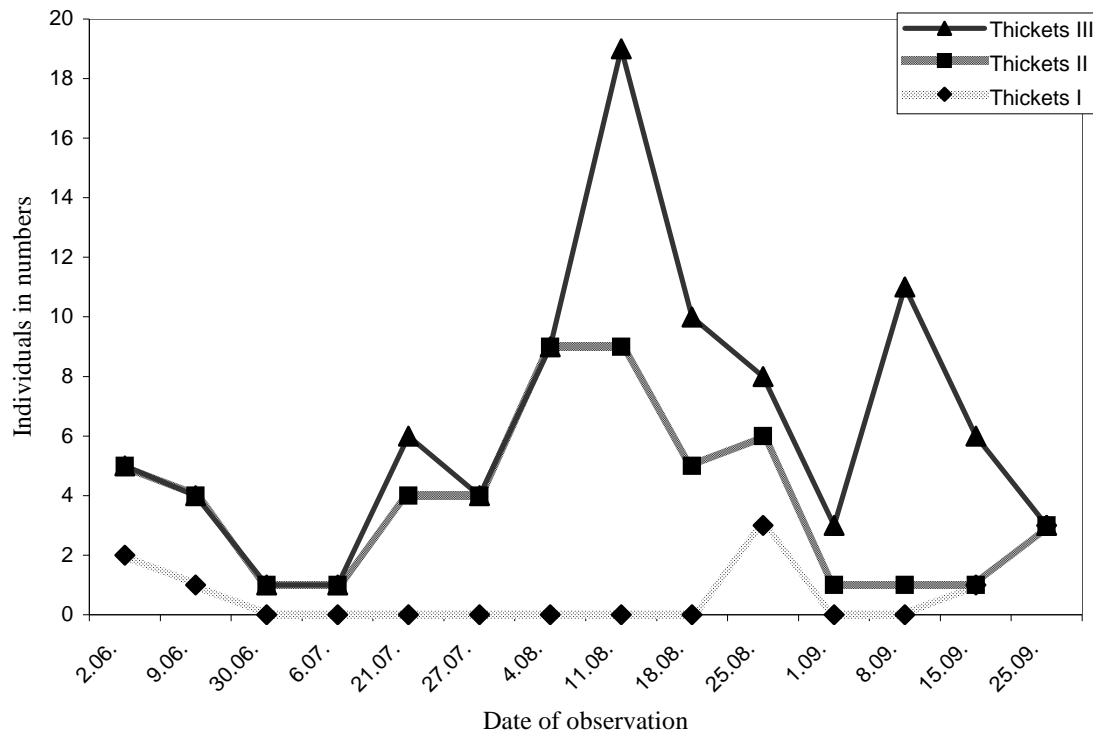


Figure 4. Dynamics of Coccinellidae presence in midfield thickets in 2004

In comparison with the previous year the peak number of ladybirds took place much later, i.e. since mid – August until mid – September. Until that time as an effect of sweep net usage only single specimens were registered.

In the last year of the research, 2004, both in thickets I and II first ladybirds were recorded in the beginning of June (Fig. 4). In thickets III coleopterons were present in the third decade of June. The least numerous were the Coccinellidae in thickets I. At two times the maximum numbers of ladybirds were registered at 50 sweeps of the net in the discussed thickets (3 specimens in each). Most coleopterons were caught in total in thickets II, and twice (4<sup>th</sup> and 11<sup>th</sup> of August) their maximum number was registered (9 specimens each time). In the case of thickets III the peak number was also recorded at two times of the catches i.e. 11<sup>th</sup> July and 8<sup>th</sup> September.

## Discussion

Midfield thickets surrounded by field crops and other agrarian waste land in agroecosystems may play a positive role in biological pest control. Such structures are places of refuge and overwintering as well as a source of additional nutrient for various groups of beneficial fauna, including the Coccinellidae (BARCZAK *et al.*, 2000; HODEK & HONEK, 1996; PANKANIN-FRANCZYK & BILEWICZ-PAWIŃSKA 2000). In Poland there has been no research concerning this group of insects living in close proximity to crop fields, in particular there is no data concerning their species composition. The Coccinellidae are a family of coleopterons which are trophically diversified. Essentially, they are considered to be predatory coleopterons (SLOGGET & MAJERUS, 1999; BARCZAK *et al.*, 2000; EVANS, 2003). In Poland they are exemplified by popular *Coccinella septempunctata*. Apart from predators in particular communities there are also species feeding on mixed nutrient. These include polyphagous species, in which one may also include a species of the *Tytthaspis* genus. *Subcoccinella vigintiduopunctata*. *Subcoccinella vigintiduopunctata* and *Cynegetis impunctata* are also regarded as typical phytophagous species. Moreover, a great importance is assigned to the ladybird which feeds on spawn of fungi hyphae *Psyllobora vigintiduopunctata* (BIELAWSKI, 1959). The studied thickets differed extensively with respect to

dominance and trophic structure of the Coccinellidae living there. In the research that was carried out, the structure of dominance seems to be interesting because of visible changes among eudominants in the following years. Each year different species were found on the top of the domination ladder. In 2002 *P. vigintiduopunctata* dominated amounting to 27.6% of all species. The following species dominated: *C. septempunctata*, *C. quatuordecimpunctata*, *Hippodamia notata* and *Propylea quatuordecimpunctata*. In the following year of the research the class of eudominants was represented by *Coccinulla quatuordecimpunctulata*, *C. septempunctata* and *Tytthaspis sedecimpunctata*. In the last year of the research (2004), herbivorous species was a dominant, considered to be a potential pest, *S. vigintiquatuorpunctata*, which in previous years was not observed in none of the research sites, and *P. vigintiduopunctata* was a fungivorous species.

A diversified number dynamics of ladybirds may be connected with weather conditions of particular years, and the proximity of crops neighbouring with the thickets. Midfield thickets surrounded by agrocenosis enables an exchange of entomofauna. It also allows to maintain appropriate ecological relation of phytophag – predator. Weather conditions also had an important influence on the presence of Coccinellidae. In 2002 and 2004 favouring climate could cause an increase in the number of insects, while intense rainfall in 2003 and lower temperatures could limit the number of ladybirds. Taking into account a large share of *P. vigintiduopunctata* in 2002, which was a warmer year and thus better for fungi development, since 2003 one can suggest that weather conditions were one of the factors that determined the dynamics of ladybird appearance in the present research. HONEK (1982) also claims that plant density is another important factor. Plant density changes the microclimate inside the crop during the entire growth season (HORN, 1981; TAMAKI *et al.*, 1981). Supposedly also in the studies on uncultivated thickets, where one can find wild grown plant species this phenomenon can be observed. Plants which occur in given thickets may have a significant influence as a source of nutrient as they are an attractive habitat for ladybirds in terms of nutrient quality. It may be concluded that the large number of *S. vigintiquatuorpunctata* in 2004 could have been conditioned by the kind of plants which may be regarded as a factor attracting them to a given site. The presence of plants of the *Chenopodium* spp. genus in thickets III may have contributed to the presence of this species, as BIELAWSKI (1959) believes that this herbivorous species, apart from Fabaceae (Papilionaceae) prefers plant species of the *Chenopodium* spp. genus.

The results of the obtained research suggest that midfield thickets because of their unique nature constitute a refugial habitats for the Coccinellidae. Thus the research oriented towards as wide as possible an application of the method of protection of beneficial entomofauna should be continued.

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## **Biedronki (Coleoptera, Coccinellidae) zarośli śródpolnych**

### **Streszczenie**

Badania nad biedronkami, uznawanymi za jedne z najbardziej efektywnych afidofagów, miały na celu scharakteryzowanie zgrupowań chrząszczy z rodziny Coccinellidae występujących w różnego typu zaroślach śródpolnych. Obserwacje prowadzono w latach 2002–2004, w okresie od maja do października, w Tomaszkowie koło Olsztyna. W wyniku przeprowadzonych badań odłowiono łącznie 425 osobników należących do 15 gatunków Coccinellidae, z których większość należała do drapieżców, w mniejszej części występowały polifagi i biedronki roślinożerne. Występowanie niektórych gatunków biedronek wiązało się z charakterem badanych zarośli, a w szczególności z występującą tam roślinnością. Szczyty aktywności biedronek kształtowały się różnie w poszczególnych latach badań i w dużej mierze uzależnione były od warunków atmosferycznych.