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***PIMPLINAE, DIACRITINAE, POEMENIINAE*
AND *RHYSSINAE* PARASITOID SUBFAMILIES
(*HYMENOPTERA, ICHNEUMONIDAE*)
OF REFUGIUM HABITATS IN AGRICULTURAL LANDSCAPE
OF CENTRAL WIELKOPOLSKA**

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ABSTRACT. The study was carried out in 1999-2001 in shrubs and road borders in the agricultural landscape of complex structure near Lisówki. The species of 38 *Pimplinae* were found (27.7% of the country's fauna of this subfamily and 59.4% those found in Wielkopolska), three species of *Rhyssinae* and one species of subfamilies *Diacritinae* and *Poemeniinae* each. Two species new for Wielkopolska were found, namely *Deuteroxorides elevator* (Panzer) (*Poemeniinae*) and *Megarhyssa perlata* (Christ) (*Rhyssinae*). A high similarity 51.3% of the species composition between *Pimplinae* shrubs and road borders was found.

Key words: ichneumonid, refugium habitats, agricultural landscape, Wielkopolska

Introduction

Refugium habitats of shrubs and road borders belong to important elements that enhance agricultural landscape. They maintain biodiversity and stimulate the mechanisms of self-control in agrocenoses. They become places of wintering and dispersion on the neighbouring fields, the source of food and a feeding habitat of entomophages' alternative hosts, including parasitoids of the *Ichneumonidae* family (*Hymenoptera, Apocrita*). In Poland the data on *Ichneumonidae* of those habitats are only fragmentary (**Strawiński** 1957, **Kościelska** 1959). In Wielkopolska studies of *Ichneumonidae* of refugium habitats are in progress and their results were presented in earlier publications by **Piekarska-Boniecka** (1999, 2005) and **Piekarska-Boniecka** and **Wilkaniec** (2001). In 1999-2001 those studies were continued in the agricultural landscape of complex structure and their results are presented herein.

The aim of the study was to define the quality and quantity structure of selected sub-families of *Ichneumonidae* (*Pimplinae*, *Diacritinae*, *Poemeniinae* and *Rhyssinae*) which live in shrubs and road borders in agricultural landscape of complex structure.

Material and methods

The study was carried out in 1999-2001 in the fields near Lisówki (UTM: XT19). It was a village 26 km away from Poznań, situated in the buffer zone of the Wielkopolska National Park. The agricultural landscape of the area was highly mosaic, as the share of refugium habitats was about 10% of the total area. The study was conducted in midfield shrubs and in the border of a dust road. The shrubs were composed of *Pruno-Crataege* (*Crataegus laevigata* (Poir) D.C.), the common hawthorn (*C. monogyna* Jacq.) and the spindle (*Evonymus europaeus* L.). Among border and ruderal communities patches of *Convolvulo-Agrophyretum* were numerous. On the road border the communities of *Convolvulo-Agrophyretum* were predominant. Under the roof of trees and bushes there were border communities. Among trees the most frequent was the white willow (*Salix alba* L.), and among bushes the same species as in the shrubs and common the elderberry (*Sambucus nigra* L.) and the dog rose (*Rosa canina* L.).

Ichneumonidae were caught from May to October each year of the study by means of yellow Moericke traps. In every spot five traps were placed at the height of 1-1.5 m above the ground. The insects were collected from the traps every ten days.

The structure of communities was described on the basis of the following indices:

- index of dominance (D),
- Shannon's index of species diversity (H') (Shannon and Weaver 1963):

$$H' = - \sum_{i=1}^S \frac{n_i}{N} \log_2 \frac{n_i}{N}$$

while: n_i – number of specimens of i species in the community,

N – total number of specimens and composed of,

S – number of species.

- Pielou's index of species evenness distribution (Pielou 1966) (J'):

$$J' = \frac{H'}{H_{\max}} = \frac{H'}{\log_2 S}$$

while: S – the number of species in the community.

- Simpson's index of species abundance (Simpson 1949) (d):

$$d = \frac{S-1}{\log N}$$

while: S – the number of species in the community,

N – the total number of specimens in the community.

The community structure was compared by means of the following indices:
 – in terms of quality – Marczewski-Steinhaus’s index (**Marczewski** and **Steinhaus** 1959) (*MS*)

$$MS = \frac{c}{a + b - c} \times 100\%$$

where: *a*, *b* – the number of species in the first and second community,
c – the number of species common in both compared communities.

– in terms of quality and quantity by evaluating, with Hutcheson’s test (**Hutcheson** 1970), the importance of differences between the compared communities’ selected values of Shannon’s index of species diversity (*H'*) at the importance level of $\alpha = 0.05$.

Results

During the three-year research in refugium habitats of the agricultural landscape near Lisówki in 540 samples 227 specimens were caught of 43 species of selected *Ichneumonidae* subfamilies (Table 1). Those were the representatives of *Pimplinae*, *Diacritinae*, *Poemeniinae* and *Rhyssinae*. *Pimplinae* subfamily was predominant with 261 specimens of 38 species. Those made up 27.7% of the domestic fauna of this subfamily and 59.4% those found in Wielkopolska. One species of the subfamilies *Diacritinae* and *Poemeniinae* each were caught. One subfamily was represented by *Diacritus aciculatus* (5 specimens), and the other one *Deuteroxorides elevator* (7 specimens). 3 species of *Rhyssinae* representatives were found (4 specimens). Due to the low population of subfamilies *Diacritinae*, *Poemeniinae* and *Rhyssinae*, quality and quantity characteristics was not made for those communities on the basis of the indicators.

Table 1
A list of *Pimplinae*, *Diacritinae*, *Poemeniinae* and *Rhyssinae* species caught in refugium habitats of agricultural landscape in 1999-2001
Wykaz gatunków *Pimplinae*, *Diacritinae*, *Poemeniinae* i *Rhyssinae* odłowionych w środowiskach ostojowych krajobrazu rolniczego w latach 1999-2001

Species Gatunek	Number of specimens in environment Liczba osobników w środowisku		
	shrubs zakrzewienia	road border przydroże	total ogółem
1	2	3	4
<i>Pimplinae</i>			
<i>Acropimpla pictipes</i> (Grav.)	1	–	1
<i>Apechthis compunctor</i> (L.)	–	1	1
<i>Apechthis quadridentata</i> (Thoms.)	1	–	1
<i>Apechthis rufata</i> (Gmel.)	1	1	2
<i>Delomerista mandibularis</i> (Grav.)	–	1	1

Table 1 – cont.

1	2	3	4
<i>Dolichomitus agnoscendus</i> (Roman)	5	2	7
<i>Endromopoda detrita</i> (Holmgr.)	7	14	21
<i>Gregopimpla inquisitor</i> (Scop.)	–	2	2
<i>Hybomischos septemcinctorius</i> (Thunb.)	–	2	2
<i>Itopectis alternans</i> (Grav.)	6	14	20
<i>Itopectis maculator</i> (F.)	4	7	11
<i>Liotryphon caudatus</i> (Ratz.)	–	1	1
<i>Liotryphon crassiseta</i> (Thoms.)	2	5	7
<i>Liotryphon punctulatus</i> (Ratz.)	–	3	3
<i>Paraperithous gnathaulax</i> (Thoms.)	–	1	1
<i>Perithous divinator</i> (Rossi)	–	3	3
<i>Perithous scurra</i> (Panzer)	1	2	3
<i>Pimpla aquilonia</i> Cresson	5	7	12
<i>Pimpla contemplator</i> (Muell.)	15	4	19
<i>Pimpla flavicoxis</i> Thoms	4	7	11
<i>Pimpla hypochondriaca</i> (Retz.)	5	6	11
<i>Pimpla melanacrius</i> Perkins	32	2	34
<i>Pimpla spuria</i> (Grav.)	5	–	5
<i>Polysphincta tuberosa</i> Grav.	1	–	1
<i>Scambus annulatus</i> (Kiss)	2	8	10
<i>Scambus nigricans</i> (Thoms.)	10	1	11
<i>Scambus pomorum</i> (Ratz.)	–	1	1
<i>Schizopyga circulator</i> (Panzer)	4	–	4
<i>Schizopyga frigida</i> Cresson	1	–	1
<i>Theronia atalantae</i> (Poda)	–	2	2
<i>Tromatobia oculatoria</i> (F.)	1	8	9
<i>Tromatobia ovivora</i> (Bohem.)	–	1	1
<i>Zaglyptus multicolor</i> (Grav.)	1	4	5
<i>Zaglyptus varipes</i> (Grav.)	16	7	23
<i>Zatypota albicoxa</i> (Walker)	1	1	2
<i>Zatypota bohemani</i> (Holmgr.)	1	1	2
<i>Zatypota gracilis</i> (Holmgr.)	–	7	7
<i>Zatypota percontatoria</i> (Muell.)	1	2	3
Diacritinae			
<i>Diacritus aciculatus</i> (Voll.)	2	3	5
Poemeniinae			
<i>Deuteroxorides elevator</i> (Panzer)	5	2	7
Rhyssinae			
<i>Megarhyssa perlata</i> (Christ)	–	1	1
<i>Rhyssella aproximator</i> (F.)	–	1	1
<i>Rhyssella obliterated</i> (Grav.)	–	2	2
Total – Ogółem	140	137	277

In the shrubs 26 species of *Pimplinae* were found and 133 specimens of this subfamily were caught. In this spot also *Diacritus aciculatus* (2 specimens) (*Diacritinae*) and *Deteroxorides elevator* (5 specimens) were found (*Poemeniinae*) (Table 1, 2). Among *Pimplinae* three species were eudominants, namely *Pimpla melanacrias* (24.1%), *Zaglyptus varipes* (12%) and *Pimpla contemplator* (11.3%). Two species were dominant, i.e. *Scambus nigricans* (7.5%) and *Endromopoda detrita* (5.3%) (Fig. 1).

Table 2
Biocenotic indices characterising the communities of *Pimplinae* caught in refugium habitats of agricultural landscape in 1999-2001

Wskaźniki biocenotyczne charakteryzujące zgrupowania *Pimplinae* odłowione w środowiskach ostojowych krajobrazu rolniczego w latach 1999-2001

Environment Środowisko	Number of specimens Liczba osobników	Number of species Liczba gatunków	H^*	J^{**}	d^{***}
Shrubs Zakrzewienia	133	26	3.67	0.78	11.79
Road border Przydroże	128	32	4.37	0.87	14.76

* H' – Shannon’s index (Shannon and Weaver 1963).

** J' – Pielou’s index (Pielou 1966).

*** d – Simpson’s index (Simpson 1949).

* H' – wskaźnik różnorodności gatunkowej Shannona (Shannon i Weaver 1963).

** J' – wskaźnik równomierności rozkładu częstości gatunków Pielou (Pielou 1966).

*** d – wskaźnik bogactwa gatunkowego Simpsona (Simpson 1949).

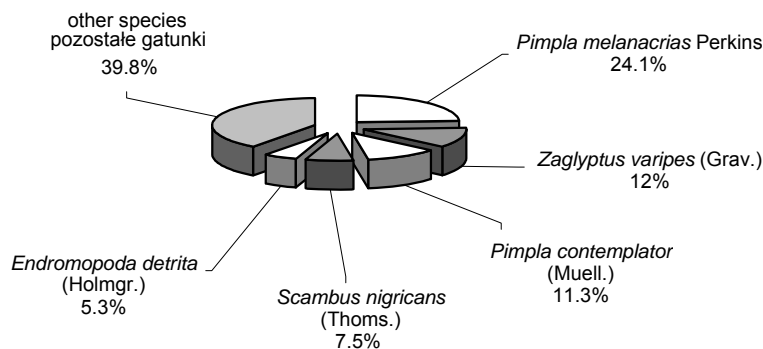


Fig. 1. Dominance structure of *Pimplinae* community caught in shrubs in 1999-2001

Ryc. 1. Struktura dominacyjna zgrupowania *Pimplinae* odłowionego w zakrzewieniach w latach 1999-2001

On the road border 32 species *Pimplinae* were found and 128 specimens of this subfamily were caught, as well as all species of other subfamilies in individual specimens (Table 1, 2). Among *Pimplinae* two following species were eudominant: *Endromopoda detrita* (10.9%) and *Itopectis alternans* (10.9%), and seven species were dominant, namely *Scambus annulatus* (6%), *Tromatobia oculatoria* (6%), *Itopectis maculator* (5.3%), *Pimpla aquilonia* (5.3%), *Pimpla flavicoxis* (5.3%), *Zaglyptus varipes* (5.3%) and *Zatypota gracilis* (5.3%) (Fig. 2).

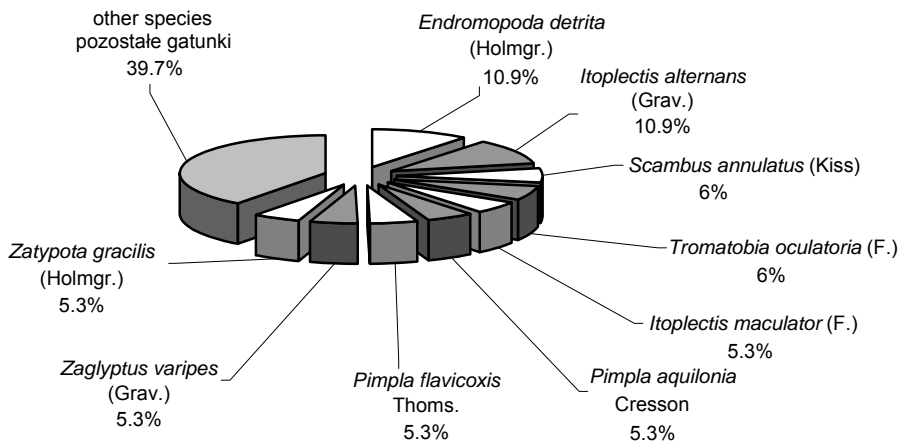


Fig. 2. Dominance structure of *Pimplinae* community caught in road border in 1999-2001
Ryc. 2. Struktura dominacyjna zgrupowania *Pimplinae* odłowionego na przydrożu w latach 1999-2001

Greater diversity of the species observed on the road border was confirmed by Shannon's index of species diversity (H') and Simpson's index of species abundance (d), which reached higher value in that habitat than in shrubs. The distribution of the population of *Pimplinae* communities in both habitats was homogenous and similar, as Pielou's index of evenness (J') reached high and very similar values (Table 2).

Among 38 *Pimplinae* species caught in refugium habitats 20 species occurred simultaneously in both spots, 12 species were found only on the road border, and six species in the shrubs. When comparing *Pimplinae* communities in terms of quality by means of Marczewski-Steinhaus's species similarity index (MS) it was shown that the species composition of *Pimplinae* in both habitats was the same in 51.3%.

When comparing the communities in terms of quality and quantity, evaluating H' values by **Hutcheson's** test (1970) they were found to be similar.

The species of *Pimplinae* found belong to ecto- and endoparasitoids of larvae and pupae of *Lepidoptera*, *Coleoptera*, *Diptera*, *Hymenoptera* as well as egg masses and adults of *Arachnida*. A representative of *Poemeniinae* is an ectoparasitoid of xylophagous larvae of *Coleoptera* and *Lepidoptera*. *Rhyssinae* belong to ectoparasitoids of xylophagous larvae of *Symphyta* and the biology of *Coeloptera*. *D. aciculatus* is not known.

Among dominating *Pimplinae* species the predominant were parasitoids of exo- and endophytophages *Micro-* and *Macrolepidoptera*, among which were species of *Pimpla* and *Scambus* genera. Another group were parasitoids of predators, which included *Tromatobia oculatoria*, *Zatypota gracilis* and *Zaglyptus* species. Polyphages included spe-

cies of *Itopectes* generum. *Endromopoda detrita* is a parasitoid of exo- and endophytophages *Micro-* and *Macrolepidoptera*, *Diptera* and *Symphyta*.

For the first time in Wielkopolska region *Deuteroxorides elevator* (*Poemeniinae*) and *Megarhyssa perlata* (*Rhyssinae*) were found; in agricultural habitat those were *Paraperithous gnathaulax* and *Zatypota bohemani* (*Pimplinae*) and *Rhyssella approximator* (*Rhyssinae*).

Discussion

The research has confirmed that refugium habitats of agricultural landscape were attractive places for *Ichneumonidae*. The 227 specimens of 43 species of selected subfamilies were caught. The role of the areas not cultivated in the agrocenoses as habitats of gathering parasitoids of *Ichneumonidae* family in order to search for food, the habitats used to spread onto the neighbouring fields from and hence their greater influence on the number of phytophages that feed there were presented in their studies such authors as **Emden** (1963), **Lewis** (1969), **Ryszkowski** and **Karg** (1991), **Landris** and **Haas** (1992), **Jervis et al.** (1993), **Idris** and **Grafius** (1995) and **Dyer** and **Landris** (1996, 1997).

The study has helped to find that the road borders were more diversified in terms of *Ichneumonidae* species than shrubs. On the other hand, the number of *Ichneumonidae* in both spots were similar. Current studies have confirmed the role of road border habitats of *Ichneumonidae*, as previous research by **Piekarska-Boniecka** (2005) showed that on field borders and road borders in agricultural landscape of Wielkopolska the communities were of highest species diversity. The importance of road and field borders in Wielkopolska as habitats that attract entomophages were also presented in the study by **Grabarkiewicz** and **Trojanowski** (1998). The authors found that properly formed field roads and borders constitute bridges between fields and so increase the number of *Syrphidae*.

Conclusions

Refugium habitats of agrocenoses in the form of road borders and midfield shrubs are the habitat of parasitoids of *Ichneumonidae*. Consequently, they help increase the species diversity in that habitat. Those entomophages are among factors that effectively limit the number of phytophagous species in fields. That is why agrocenoses should be organized in such a way that the non-cultivated elements constitute at least 10% of their area.

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PARAZYTOIDY Z PODRODZIN *PIMPLINAE*, *DIACRITINAE*, *POEMENIINAE*
I *RHYSSINAE* (HYMENOPTERA, ICHNEUMONIDAE) ŚRODOWISK
OSTOJOWYCH KRAJOBRAZU ROLNICZEGO ŚRODKOWEJ WIELKOPOLSKI

Streszczenie

Badania prowadzono w latach 1999-2001 w krajobrazie rolniczym o strukturze złożonej w okolicach Lisówek. Badaniami objęto parazytoidy z wybranych podrodzin *Ichneumonidae* (Hymenoptera, *Apocrita*), zasiedlających środowiska ostojowe w postaci zakrzewień i przydroży śródpolnych. Wykorzystano metodę odłowu imagines do żółtych pułapek Moerickego.

Stwierdzono występowanie 43 gatunków *Ichneumonidae*, należących do czterech podrodzin. Zdecydowanie dominowała podrodzina *Pimplinae*, której odłowiono 38 gatunków. Stanowiły one 27,7% gatunków fauny krajowej i 59,4% wykazanych z Wielkopolski. Pozostałe podrodziny, do

których należały *Diacritinae*, *Poemeniinae* i *Rhyssinae*, były reprezentowane przez pojedyncze gatunki.

Wykazano większą różnorodność gatunkową *Pimplinae* na przydrożu niż w zakrzewieniach. W środowisku tym odłowiono 32 gatunki, natomiast w zakrzewieniach – 26. Potwierdziły to wartości wskaźników różnorodności gatunkowej Shannona (H') i bogactwa gatunkowego Simpsona (d).

Stwierdzono równomierny i podobny rozkład liczebności *Pimplinae* w obu środowiskach, ponieważ wskaźniki równomierności rozkładu częstości gatunków Pielou (J') przyjęły duże i zbliżone do siebie wartości.

Ustalono w 51,3% podobieństwo składu gatunkowego obu zgrupowań *Pimplinae*. Wykazano, że zgrupowania te były podobne pod względem struktury jakościowo-ilościowej.

Stwierdzono dwa nowe gatunki *Ichneumonidae* dla Wielkopolski – *Deuteroxorides elevator* (Panzer) (*Poemeniinae*) oraz *Megarhyssa perlata* (*Rhyssinae*).