

**Parasitic wasps of the *Pimplinae*, *Poemeniinae* and
Diacritinae (Hymenoptera, Ichneumonidae)
subfamilies at Kórnik Arboretum**

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ABSTRACT

The research was carried out in 2005 – 2007 in the area of the Kórnik Arboretum and covered parasitoids of the *Pimplinae*, *Poemeniinae* and *Diacritinae* (Hymenoptera, Ichneumonidae) subfamilies, which control a number of plant-damaging phytophages. The quality and quantity composition of the parasitoids was defined, and the characterization of *Pimplinae* communities was carried out on the basis of the following biocenotic indices: Shannon's diversity index H' , Pielou's evenness index J' and Simpson's diversity index d . The *Pimplinae* communities were compared in terms of quality using the method of the Marczewski-Steinhaus MS index. Thirty-one species of *Pimplinae* were found; they account for 23.3% of the national fauna and 43.0% of species reported for Wielkopolska. Three species of *Poemeniinae* and one species of *Diacritinae* were

also found. Among *Pimplinae* the prevailing species were those which decrease the number of pests belonging to exo- and endophytophages of *Micro-* and *Macrolepidoptera*. The dominants were: *Pimpla contemplator* (Muelle.) – 24.9%, *Pimpla flavicoxis* Thoms. – 12.3%, *Pimpla insignatoria* (Grav.) – 9.1%, *Itopectis maculator* (F.) – 6.3% and *I. alternans* (Grav.) – 5.9%. *Poemeniinae* included *Poemenia brachyura* Holmgr. and *P. herctica* (Grav.), belonging to parasitoids of xylophages. *Diacritinae* were represented by *Diacritus aciculatus* (Voll.), whose trophic links are not yet known.

INTRODUCTION

Kórnik Arboretum has been long known in Poland and abroad for its collection of alien species of trees and bushes. In terms of the number of taxons (over 3,000), it is one of the largest dendrological collections in Central Europe. The most valuable are the oldest specimens of trees and bushes, first introduced for cultivation in Poland by Tytus and Jan Działyński in the years 1826 – 1880. Among them are magnificent specimens of bald cypress (*Taxodium distichum* Rich.), Greek fir (*Abies cephalonica* Loud.), eastern white pine (*Pinus strobus* L.), Austrian pine (*Pinus nigra* Arn.), ginkgo (*Ginkgo biloba* L.), plane tree (*Platanus × hispanica* Münchh.), black walnut (*Juglans nigra* L.), hickories (*Carya ovata* (Mill.) K. Koch, *C. laciniata* (F. Michx.) Loun.), tuliptree (*Liriodendron tulipifera* L.), magnolia (*Magnolia acuminata* (L.) L.), silver linden (*Tilia tomentosa* Moench), honeylocust (*Gleditsia triacanthos* L.), and many more. Up till now no research has been carried out in the area that would help to get acquainted with parasitic entomofauna. That is why research was begun in order to define the quality and quantity composition of parasitoids belonging to selected subfamilies of *Ichneumonidae* (*Hymenoptera*, *Apocrita*). Parasitic wasps of the *Ichneumonidae* family are effective factors controlling the population abundance of other insects, including phytophages (Thompson 1957, Wahl 1993, Yu and Horstmann 1997).

MATERIAL AND METHODS

The study was carried out in 2005 – 2007 in the area of the Kórnik Arboretum (UTM: XT49). It covered plant collections growing in the old and new part of the Arboretum and in the Experimental Forest of Zwierzyniec. The oldest part of the Arboretum contains the old castle park of 38 ha surface area, located on low and muddy areas, with wetlands, water bodies and ancient forest, composed of mainly indigenous species. It comprises rich collections of linden trees (*Tilia*), birches (*Betula*), hazels (*Corylus*), viburnum (*Viburnum*), chestnut trees (*Aesculus*) and numerous coniferous species there. The new part of the Arboretum, 8 ha in area, is

located on the slope of the Kórnickie Lake valley. It comprises rich collections mainly of low growing, colourful coniferous trees and bushes of various forms (*Juniperus*, *Picea*, *Pinus*, *Abies*, *Chamaecyparis*, *Thuja*). Deciduous bushes also grow there (*Cotoneaster*, *Evonymus*, *Rhododendron*, *Calluna*, *Erica*), as well as collections of decorative apple trees (*Malus*), pear trees (*Pyrus*), forsythias (*Forsythia*), meadowsweet (*Spiraea*) and lilacs (*Syringa*). The Experimental Forest of Zwierzyniec is located on the other bank of Kórnickie Lake. It is an old mixed forest with some hundred-year-old oak trees (*Quercus robur* L.), hundred-year-old pine trees (*Pinus sylvestris* L.) and beeches (*Fagus sylvatica* L.). Dendrological tree collections take up an area of 4 ha and include new collections of coniferous trees (*Abies*, *Picea*, *Chamaecyparis*, *Cryptomeria*, *Calocedrus*, *Pseudotsuga*, *Tsuga*, *Taxus*), many species and cultivars of evergreen rhododendrons (*Rhododendron*) and species and cultivars belonging to the following genera: *Acer*, *Magnolia*, *Cornus*, *Liquidambar*, *Hamamelis*, *Viburnum*, *Stewartia* and others.

Parasitoids were caught from May to October of each year of the study, in 10 selected spots both in the old and new part of the Arboretum as well as in five spots in the Experimental Forest of Zwierzyniec. The method of Moericke's yellow traps was applied (Moericke 1953). Parasitic wasps were collected in 10-day intervals. The insects caught in a 10-day period in one trap were considered to be a sample.

Parasitoid communities were characterised on the basis of the following biocenotic indices: Shannon's index of diversity H' (Shannon and Weaver 1963), Pielou's evenness index J' (Pielou 1966) and Simpson's species diversity index d (Simpson 1949). The parasitoid communities were compared in terms of quality using the MS index of Marczewski-Steinhaus (Marczewski and Steinhaus 1959).

RESULTS AND DISCUSSION

During the three-year study 1,317 samples were collected and as a result 222 specimens belonging to the *Pimplinae* subfamily, five specimens of the *Poemeniinae* subfamily and one specimen representing the *Diacritinae* subfamily were caught. Among them 31 species of *Pimplinae* (Table 1), three species of *Poemeniinae* and one species of *Diacritinae* were found. The species of *Pimplinae* make up 23.3% of the national fauna of the subfamily and 43.0% of the species reported for Wielkopolska. The species of the genera *Acropimpla*, *Delomerista*, *Dolichomitrus*, *Endromopoda*, *Gregopimpla* and *Liotryphon* are larval ectoparasitoids of *Lepidoptera*, *Coleoptera*, *Hymenoptera* and *Diptera*. The species of the genera *Apechthis* and *Pimpla* belong to pupae endoparasitoids of *Lepidoptera*, *Coleoptera* and *Hymenoptera*. The species of the genera *Itopectis* and *Theronia* are polyphagous pupae endoparasitoids. The other species of the genera *Clistopyga*, *Polysphincta*, *Tromatobia*, *Zaglyptus* and *Zatypota* belong to ectoparasitoids of *Arachnida*.

Table 1. List of *Pimplinae* caught in the Kórnik Arboretum in 2005 – 2007

No	Species	Environment							
		Old Arboretum		New Arboretum		Zwierzyniec		Total	
		Number of specimens (N)	Domination index (D) (%)	Number of specimens (N)	Domination index (D) (%)	Number of specimens (N)	Domination index (D) (%)	Number of specimens (N)	Domination index (D) (%)
1	2	3	4	5	6	7	8	9	10
1	<i>Acropimpla pictipes</i> (Grav., 1829)	2	2.7	1	1.0	-	-	3	1.3
2	<i>Apechthis compuncator</i> (L., 1758)	1	1.3	-	-	-	-	1	0.4
3	<i>Apechthis quadridentata</i> (Thoms., 1877)	-	-	2	2.0	2	4.1	4	1.8
4	<i>Apechthis rufata</i> (Gmel., 1790)	1	1.3	3	3.1	5	10.2	9	4.1
5	<i>Clistopyga incitator</i> (F., 1793)	1	1.3	-	-	-	-	1	0.4
6	<i>Delomerista mandibularis</i> (Grav., 1829)	1	1.3	-	-	-	-	1	0.4
7	<i>Dolichomitus</i> sp.	-	-	1	1.3	-	-	1	0.4
8	<i>Endromopoda detrita</i> (Holmgr., 1860)	4	5.3	2	2.0	-	-	6	2.7
9	<i>Gregopimpla inquisitor</i> (Scop., 1763)	2	2.7	5	5.1	3	6.1	10	4.5
10	<i>Itopectis alternans</i> (Grav., 1829)	6	8.0	6	6.1	1	2.0	13	5.9
11	<i>Itopectis maculator</i> (F., 1775)	1	1.3	9	9.2	4	8.2	14	6.3
12	<i>Liotryphon crassisetia</i> (Thoms., 1877)	2	2.7	-	-	2	4.1	4	1.8
13	<i>Liotryphon punctulatus</i> (Ratz., 1848)	1	1.3	3	3.1	-	-	4	1.8
14	<i>Pimpla contemplator</i> (Muell., 1776)	13	17.4	32	32.7	10	20.4	55	24.9
15	<i>Pimpla flavicoxis</i> (Thoms., 1877)	10	13.4	11	11.3	6	12.2	27	12.3
16	<i>Pimpla insignatoria</i> (Grav., 1807)	7	9.4	4	4.1	9	18.5	20	9.1
17	<i>Pimpla melanacrias</i> (Perkins, 1941)	-	-	1	1	-	-	1	0.4
18	<i>Pimpla rufipes</i> (Mill., 1759)	1	1.3	-	-	1	2.0	2	0.9
19	<i>Polysphincta boops</i> (Tschek, 1869)	1	1.3	3	3.1	3	6.1	7	3.2
20	<i>Scambus brevicornis</i> (Grav., 1829)	-	-	1	1.0	-	-	1	0.4
21	<i>Scambus calobatus</i> (Grav., 1829)	6	8.0	1	1.0	-	-	7	3.2
22	<i>Scambus inanis</i> (Schrank, 1802)	-	-	1	1.0	1	2.0	2	0.9
23	<i>Scambus nigricans</i> (Thoms., 1877)	2	2.7	1	1	-	-	3	1.3
24	<i>Theronia atalantae</i> (Poda, 1761)	1	1.3	-	-	2	4.1	3	1.3
25	<i>Tromatobia ornate</i> (Grav., 1829)	-	-	1	1.0	-	-	1	0.4
26	<i>Tromatobia ovivora</i> (Bohem., 1821)	-	-	2	2.0	-	-	2	0.9
27	<i>Zaglyptus multicolour</i> (Grav., 1829)	6	8.0	3	3.1	-	-	9	4.1
28	<i>Zaglyptus varipes</i> (Grav., 1829)	2	2.7	-	-	-	-	2	0.9
29	<i>Zatypota albicoxa</i> (Walker, 1874)	1	1.3	1	1.0	-	-	2	0.9
30	<i>Zatypota gracilis</i> (Holmgr., 1860)	3	4.0	3	3.1	-	-	6	2.7
31	<i>Zatypota percontatoria</i> (Muell., 1776)	-	-	1	1.0	-	-	1	0.4
Total number of specimens		75	100.0	98	100.0	49	100.0	222	100.0
Number of species		23		24		13		31	

Such a pattern of trophic connections of the subfamilies of *Pimplinae* suggests that the dominants were ectoparasitoids (11 species) and endoparasitoids (11 species) that can control the number of endo- and exophytophages of *Lepidoptera*, *Coleoptera*, *Hymenoptera* and *Diptera*. The other group of parasitoids (9 species) were species limiting the number of predatory *Arachnida*.

The family *Poemeniinae* included *Deuteroxorides elevator* (Panzer, 1799) – one specimen, *Poemenia brachyura* (Holmgr., 1860) – two specimens and *Poemenia herctica* (Grav., 1829) – two specimens. These are ectoparasitoids of xylophagous *Coleoptera* of the *Cerambycidae* family and the larvae of *Aculeata* of the *Sphecidae* family. The species found make up for 30.0% of Polish fauna and 50.0% of those caught in Wielkopolska. The representative of the *Diacritinae* subfamily *Diacritus aciculatus* (Voll., 1878), the only species occurring in Europe, is a parasitoid of unknown biology.

In relation with a low number of parasitoids of the *Poemeniinae* and *Diacritinae* subfamilies, the characteristics of parasitoid wasp communities on the basis of biocenotic indices was carried out only for the *Pimplinae* subfamily.

A very similar species diversity of *Pimplinae* was reported for the old and new part of the Arboretum, as 23 and 24 species were caught there (Table 2). Considerably fewer species were caught in Zwierzyniec (13). This may be explained by a smaller number of samples taken from that habitat. This sample of species diversity was confirmed with the values of Simpson's species diversity index d and Shannon's diversity index H' (Table 2).

Table 2. Biocenotic indices characterising communities of *Pimplinae* caught in the Kórnik Arboretum in 2005 – 2007

Environment	Number of samples (n)	Number of specimens (N)	Number of species (S)	d^*	H'^{**}	J'^{***}
Old Arboretum	537	75	23	11.55	3.64	0.87
New Arboretum	525	98	24	11.79	3.96	0.79
Zwierzyniec	255	49	13	7.09	3.32	0.90
Total	1317	222	31	-	-	-

* d – Simpson's index (Simpson 1949)

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

*** J' – Pielou's index (Pielou 1966)

A similar abundance of *Pimplinae* communities in the old and new part of the Arboretum was found (75 and 98 individuals) and a smaller one was reported for the community at Zwierzyniec – 49 individuals (Table 2). The differences in the numbers of individuals resulted first of all from a smaller number of samples taken from Zwierzyniec. The values of Pielou's evenness index J' indicate that the

Pimplinae communities in the old part of the Arboretum showed even and similar number distributions. This is proven by high and very similar values of the J' index. Only in the community of the new part of the Arboretum did the J' index show a slightly lower value (0.79). This community had a definite eudominant, namely *Pimpla contemplator* (32.7%), the species occurring in higher numbers than other species in the community.

Five species numerous occurring in the Arboretum as a whole were found. The eudominants were *Pimpla contemplator* (24.9%) and *Pimpla flavicoxis* (12.3%). The dominants were *Pimpla insignatoria* (9.1%), *Itopectis maculator* (6.3%) and *I. alternans* (5.9%).

The dominance structure of *Pimplinae* communities caught in particular habitats of the Arboretum did not significantly differ from the structure of species numerous occurring in the Arboretum as a whole (Table 1). In the community of the old part of the Arboretum the species *Endromopoda detrita* was also a dominant. In the new part of the Arboretum the species *Gregopimpla inquisitor* was also numerous. In Zwierzyniec dominants also included *Gregopimpla inquisitor* and *Apechthis rufata*.

An analysis of the trophic relations of dominant *Pimplinae* species proved that they control the population size of phytophages belonging to *Micro-* and *Macrolepidoptera* and *Hymenoptera* and *Coleoptera*. References show that they control the population size of 64 parasites of *Lepidoptera*, seven belonging to *Hymenoptera* and five to *Coleoptera* (Meyer 1936, Thompson 1957, Oehlke 1967, Aubert 1969, Herting 1975, 1976, 1977, Fitton et al. 1988, Yu 1999). The parasitoid hosts are representatives of the families *Agonoxenidae*, *Arctiidae*, *Choreutidae*, *Coleophoridae*, *Geometridae*, *Gracillariidae*, *Lasiocampidae*, *Lymantriidae*, *Incurvariidae*, *Sesiidae*, *Sphingidae*, *Tortricidae*, *Yponomeutidae* (*Lepidoptera*), also *Cephidae*, *Diprionidae*, *Tenthredinidae* (*Hymenoptera*) and *Attelabidae*, *Cerambycidae*, *Curculionidae* (*Coleoptera*). A detailed list of host species was presented in the study by Piekarska-Boniecka (2005).

Studies showed that eight species (25.8%) caught in the Arboretum as a whole were stable species, as they were found in all of the studied habitats. Those included *Apechthis rufata*, *Gregopimpla inquisitor*, *Itopectis maculator*, *I. alternans*, *Pimpla contemplator*, *P. flavicoxis*, *P. insignatoria* and *Polysphincta boops*.

As a result of the studies it was found out that the *Pimplinae* communities of particular habitats varied in terms of species composition. This may be explained with the diversity of plants that create those biocenoses. The most similar species composition of *Pimplinae* occurred in the old and new part of Arboretum, where the Marczewski-Steinhaus index MS was 52.0%. Others had lower values of this index, i.e. 44.0% for communities in the old part of the Arboretum and in Zwierzyniec and 37.0% for communities in the new part of the Arboretum and in Zwierzyniec.

The results of the study added eight species to the list of parasitoids of the *Pimplinae* subfamily with trophic relations with decorative plants found in urban areas of Wielkopolska. Previous studies carried out in the Botanic and Dendrological gardens in Poznań did not report them (Piekarska-Boniecka 2004). Species new for those habitats are: *Apechthis compunctor*, *A. quadridentata*, *Endromopoda detrita*, *Scambus brevicornis*, *S. nigricans*, *Theronia atalantae*, *Tromatobia ornata* and *Zaglyptus varipes*. Current and previous studies by Piekarska-Boniecka (2004) indicate that in the urban greenery of Poznań and Kórnik 44 *Pimplinae* species were listed. They made up 33.1% of those reported from Poland and 61.1% of those reported from Wielkopolska. The conducted studies confirmed the occurrence of parasitoids of the remaining subfamilies in those habitats.

CONCLUSIONS

1. The plants of the Kórnik Arboretum constitute an attractive habitat for parasitoids of the *Pimplinae*, *Poemeniinae* and *Diacritinae* (Hymenoptera, Ichneumonidae) subfamilies.
2. Thirty-one species of *Pimplinae* were found there; they made up 23.3% of national fauna and 43.0% of the species reported for Wielkopolska, three species of *Poemeniinae* and one species of *Diacritinae*.
3. Parasitoids control the population abundance of phytophagous plant-damaging species of *Lepidoptera*, *Coleoptera*, *Hymenoptera* and *Diptera*. The dominants were the parasitoids limiting the population of endo- and exophytophages of *Micro-* and *Macrolepidoptera*.

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PASOŻYTNICZE BŁONKÓWKI Z PODRODZIN *PIMPLINAE*,
POEMENIINAE I *DIACRITINAE* (HYMENOPTERA, ICHNEUMONIDAE)
ARBORETUM KÓRNICKIEGO

Streszczenie: Badania prowadzono w latach 2005 – 2007 na terenie Arboretum Kórnickiego. Badaniami objęto parazytoidy z podrodzin *Pimplinae*, *Poemeniinae* i *Diacritinae* (Hymenoptera, Ichneumonidae), regulujące liczebność gatunków fitofagicznych, uszkadzających rośliny. Określono skład ilościowy i jakościowy parazytoidów, dokonano charakterystyki zgrupowań *Pimplinae* w oparciu o następujące wskaźniki biocenotyczne: wskaźnik ogólnej różnorodności gatunkowej Shannona H' , wskaźnik równomierności rozkładu częstości Pielou J' i wskaźnik bogactwa gatunkowego Simpsona d . Porównano zgrupowania *Pimplinae* w kategoriach jakościowych wskaźnikiem Marczewskiego-Steinhausza MS . Stwierdzono 31 gatunków *Pimplinae*, które stanowią 23,3% fauny krajowej i 43,0% gatunków wykazanych z Wielkopolski., 3 gatunki *Poemeniinae* i 1 gatunek *Diacritinae*. Wśród *Pimplinae* dominowały gatunki obniżające liczebność szkodników zaliczanych do egzo- i endofitofagów *Micro-* i *Macrolepidoptera*. Dominatami były: *Pimpla contemplator* (Muelle.) – 24,9%, *Pimpla flavicoxis* Thoms. – 12,3%, *Pimpla insignatoria* (Grav.) – 9,1%, *Itopectis maculator* (F.) – 6,3% i *I. alternans* (Grav.) – 5,9%. Do *Poemeniinae* należały *Poemenia brachyura* Holmgr. i *P. herctica* (Grav.), zaliczane do parazytoidów ksylofagów. Przedstawicielem *Diacritinae* był *Diacritus aciculatus* (Voll.), którego powiązania troficzne są jeszcze nie znane.

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