

Natural enemies of burnets (Lepidoptera, Zygaenidae)
2nd Contribution to the knowledge of hymenoptera parазizing burnets
(Hymenoptera: Braconidae, Ichneumonidae, Chalcididae)

by

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Abstract: New trophic relationships between Braconidae, Ichneumonidae, Chalcididae, Pteromalidae, Encyrtidae, Torymidae, Eulophidae (Hymenoptera) and burnets (Lepidoptera, Zygaenidae) collected in selected regions of southern Poland are considered.

Introduction

Over 30 species of insects from the family Zygaenidae (Lepidoptera) occur in Central Europe. The occurrence of sixteen of them was reported in Poland (DĄBROWSKI & KRZYWICKI, 1982; DĄBROWSKI, 1998). Most of these species are decidedly xerothermophilous, i. e. they inhabit dry, open and strongly insolated habitats. Among the species discussed in this paper *Zygaena (Zygaena) angelicae* OCHSENHEIMER, *Z. (Agrumenia) carniolica* (SCOPOLI) and *Z. (Zygaena) loti* (DENIS & SCHIFFERMÜLLER) have the greatest requirements in this respect, and they mainly live in dry, strongly insolated grasslands situated on lime and chalk subsoil. The remaining species occur in fresh and moist habitats, e. g. in forest meadows and peatbogs. Due to overgrowing of the habitats of these insects with shrubs and trees as a result of natural succession and reforestation, or other antropogenic activities (urbanization, land reclamation) their numbers decrease, and they become more and more rare and endangered.

During many years of investigations concerning the family Zygaenidae their primary and secondary parasitoids belonging to several families of Hymenoptera were reared. The host species were as follows: *Adscita (Adscita) statices* (L.), *Zygaena (Mesembrynus) brizae* (ESPER), *Z. (Mesembrynus) minos* (DENIS & SCHIFFERMÜLLER), *Z. (Agrumenia) carniolica* (SCOPOLI), *Z. (Zygaena) loti* (DENIS & SCHIFFERMÜLLER), *Z. (Zygaena) viciae* (DENIS & SCHIFFERMÜLLER), *Z. (Zygaena) ephialtes* (L.), *Z. (Zygaena) angelicae* OCHSENHEIMER, *Z. (Zygaena) trifolii* (ESPER), *Z. (Zygaena) loniceriae* (SCHEVEN). The parasitoids from the families Ichneumonidae, Braconidae, Chalcididae, Pteromalidae, Encyrtidae, Torymidae, and Eulophidae are presented in this paper. The data concerning parasitoids from the family Tachinidae (Diptera) attacking Zygaenidae were published earlier (KARCZEWSKI & DĄBROWSKI, 1973).

Material and methods

The material for this study was collected during 1962–2001 in the following regions of southern Poland: the Beskid Orawsko-Podhalański Mountains, Beskid Śląski Mountains, Beskid Mały Mountains, Orawa – Nowy Targ Basin, Vistula Valley, Śląsk Upland, Olkusz Upland, Miechów Upland, Sandomierz Upland, Przemyśl Submontane Region, and the Pieniny Mountains. The

collected material was taken to the laboratory where rearing took place at room temperature. Hymenoptera were identified using keys of BOUČEK & GRAHAM (1978), and those edited by MEDVEDEV (1978, 1986), and the catalogue by YU & HORSTMANN (1997a, b). The insect specimens may be found in the collections of the authors of this paper. The geographical regions are given according to KONDRACKI (2000).

Results

A total of 392 parasitoid specimens belonging to 51 species from 7 families of Hymenoptera were reared from pupae of Zygaenidae (Table 1). From among the parasitoid species reared the following 14 are new for Poland: *Campoletis ebeninus* (GRAV.) (Ichneumonidae), *Aleiodes bicolor* (SPIN.), *Aleiodes esebecki* HARTIG, *Meteorus unicolor* (WESM.), *Cotesia limbatus* MARSH., *Cotesia geryonis* MARSH., *Cotesia glomeratus* L., *Cotesia zygaenarum* MARSH. (Braconidae), *Brachymeria rugulosa* FOERSTER, *Brachymeria secundaria* RUSCHKA (Chalcididae), *Copidosoma boucheanum* RATZ., *Copidosoma geniculatum* DALMAN (Encyrtidae), *Monodontomerus viciellae* FOERSTER (Torymidae), and *Neochrysocharis aratus* WALKER (Eulophidae).

In the case of 10 species of Zygaenidae 51 new trophic associations were discovered. The greatest number of these associations was observed between 10 species of Zygaenidae and 24 species of Ichneumonidae. The trophic associations were a little less numerous in the case of 6 species of Zygaenidae and 12 species of Braconidae, and the least numerous were the associations between 2 species of Eulophidae and *Zygaena* (*Zygaena*) *lonicerae* (SCHEV.).

From among all parasitoids reared during this study 43 species, i. e. 84.3%, were the primary parasitoids, and 8 species, i. e. 15.7%, were the secondary parasitoids attacking the pupae of Zygaenidae parasitized by the primary parasitoids. For the first time a host species was found for the following 9 species of parasitoids: *Lysibia marginata*, *Medaphron afflictor*, *Triclistus niger* (BRIDGMAN), *Listrognathus mengersseni* (SCHMIED.), *Campoplex multicinctus* (GRAV.), *Mesochorus vittator* ZETT., *Ichneumon submarginatus* (GRAV.) (Ichneumonidae), *Neochrysocharis aratus* WALKER, and *N. cuprifrons* ERDÖS (Eulophidae) (Table 1).

Apechthis capulifera (KRIECHB.), *Gelis areator* (PANZ.), *Campoletis ebeninus* (GRAV.), *Pristomerus orbitalis* HOLMR. (Ichneumonidae), *Aleiodes esebecki* HTG., *R. testaceus* (F.), *Charmon extensor* (L.), *Meteorus ictericus* (NEES), *Cotesia limbatus* MARSH. (Braconidae), *Brachymeria intermedia* NEES., *B. rugulosa* FOERSTER, *B. secundaria* RUSCHKA (Chalcididae), *Dibrachys affinis* MASI, *Pteromalus puparum* (L.) (Pteromalidae), *Copidosoma albipes* (WEST.), *C. boucheanum* RATZ., *C. geniculatum* DALMAN (Encyrtidae), *Monodontomerus aereus* WALKER, and *M. minor* RATZ. (Torymidae) are the parasitoid species whose hosts belong not only to Zygaenidae but also to other families.

Agrothereutes fumipennis (GRAV.), *A. hospes* (TSCHEK), *Charops cantator* (DE GEER), *Schenkia graminicola* (GARV.), *Iseropus stercorator* (F.), *Itoplectis curticauda* KRIECHB., *I. viduata* (GRAV.), *Lysibia nana* (GRAV.), *Erigorgus fibulator* (GRAV.), *Mesostenidea ligator* (GRAV.), *Mesostenus funebris* (GRAV.), *M. obnoxius* (GRAV.) (Ichneumonidae), *Aleiodes bicolor* (SPIN.), *Bracon nigratus* (WESM.), *Meteorus unicolor* (WESM.), *Zelex chlorophthalmus* (SPIN.), *Cotesia geryonis* MARSH., *A. zygaenarum* MARSH. (Braconidae), *Pteromalus vibulenus* WALKER (Pteromalidae), and *Monodontomerus viciellae* FORST. (Torymidae), were already known as parasitoids of Zygaenidae, however, their hosts were the species of Zygaenidae other than those found in the material collected in southern Poland.

The reared adults of Ichneumonidae belonged to 8 subfamilies: Pimplinae (4 species), Cryptinae (12 species), Cremastinae (1 species), Metopiinae (1 species), Campopleginae (2 species), Mesochorinae (1 species), Anomaloninae (2 species), and Ichneumoninae (1 species). In the case of Braconidae they belonged to 5 subfamilies: Rogadinae (3 species), Braconinae (1 species), Chormontinae (1 species), Euphorinae (3 species), and Microgastrinae (4 species). In the case of Chalcididae the reared parasitoids belonged to the subfamily Chalcidinae (3 species).

In the case of Pteromalidae the reared parasitoids belonged to the subfamily Pteromalinae (4 species).

In the case of Encyrtidae the reared parasitoids belonged to the subfamily Encyrtinae (3 species).

In the case of Torymidae the reared parasitoids belonged to the subfamily Toryminae (3 species).

In the case of Eulophidae the reared parasitoids belonged to the subfamily Entedoninae (2 species).

Table 1: New trophic relations between parasitoids and burnets (Lepidoptera, Zygaenidae)

Parasitoid				Host species	Locality	Collection data
Species	Number of specimens	Primary	Secondary			
Ichneumonidae						
Pimplinae						
<i>Apechthis capulifera</i> (KRIECHB.)	2	+		<i>Z. (Z.) filipendulae</i> (L.)	Macelak - Pieniny Mts	20.VIII.1978
<i>Iseropus stercorator</i> (F.)	2	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Puścizna Wielka - Orawa - Nowy Targ Basin	10.V.1962
<i>Itoplectis curticauda</i> KRIECHB.	9	+		<i>Z. (Z.) viciae</i> (D. & S.)	Sromowce Niżne - Pieniny Mts	9.VII.1999
<i>Itoplectis viduata</i> (GRAV.)	6	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Łapsze Niżne - Pieniny Mts	10.VII.1972
Cryptinae						
<i>Agrothereutes hospes</i> (TSCHEK)	3	+		<i>Z. (M.) minos</i> (D. & S.)	Ojców - Olkusz Upland	6.VII.1995
<i>Agrothereutes fumipennis</i> (GRAV.)	8	+		<i>Z. (Z.) angelicae</i> OCHS., <i>Z. (A.) carniolica</i> (SCOP.), <i>Z. (Z.) filipendulae</i> (L.), <i>Z. (M.) minos</i> (D. & S.)	Grodzisko - Olkusz Upland	10.V.1962
<i>Gelis areator</i> (PANZER)	1		+	<i>Z. (Z.) loniceræ</i> (SCHEV.) Ichneumonidae, Braconidae	Klucze - Olkusz Upland	10.VII.1972
<i>Listrognathus mengersseni</i> SCHMIEDEKNECHT	1	+		<i>Z. (A.) carniolica</i> (SCOP.)	Klonów - Miechów Upland	10.07.2001
<i>Lysibia marginata</i> BRIDGMAN	2	+		<i>Z. (Z.) viciae</i> (D. & S.)	Niepołomice - Vistula Valley	2.VI.2000
<i>Lysibia nana</i> (GRAV.)	4		+	<i>Z. (Z.) loniceræ</i> (SCHEV.), Braconidae	Grodzisko - Olkusz Upland	10.VII.2001

Parasitoid						
Species	Number of specimens	Primary	Secondary	Host species	Locality	Collection data
<i>Medophron afflictor</i> (GRAV.)	8	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Glanów - Olkusz Upland	22.VIII.1978
<i>Mesostenidea ligator</i> (GRAV.)	4	+		<i>Z. (M.) brizæ</i> (ESPER), <i>Z. (Z.) loniceræ</i> (SCHEV.)	Rybotycze - Przemysł Submontane Region	30.VI.2001
<i>Mesostenus funebris</i> (GRAV.)	3	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Krościenko - Pieniny Mts	2.VIII.1997
<i>Mesostenus obnoxius</i> (GRAV.)	3	+		<i>Z. (A.) carniolica</i> (SCOP.)	Glanów - Olkusz Upland	10.VII.2001
<i>Schenkia graminicola</i> (GRAV.)	1	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Ojców - Olkusz Upland	12.VII.1995
Cremastinae						
<i>Pristomerus orbitalis</i> HOLMGREN	2	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Macelak - Pieniny Mts	22.VIII.1978
Campopleginae						
<i>Campoletis ebeninus</i> (GRAV.)	3	+		<i>Z. (Z.) trifolii</i> (ESPER)	Nature reserve Kajasówka - Olkusz Upland	10.VII.1972
<i>Campoplex multicinctus</i> (GRAV.)	1	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Klucze - Olkusz Upland	10.VII.1972
<i>Charops cantator</i> (DE GEER)	2	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Macelowa Góra - Pieniny Mts	20.VIII.1978
Anomaloniinae						
<i>Atrometus insignis</i> (FOERST.)	4	+		<i>Z. (Z.) angelicae</i> OCHS.	Sromowce Niżne - Pieniny Mts	1.VIII.1994
<i>Erigorgus fibulator</i> (GRAV.)	2	+		<i>Z. (Z.) ephialtes</i> (L.)	Ojców - Olkusz Upland	4.VIII.1994
Metopiinae						
<i>Triclistus niger</i> (BRIDGMAN)	3	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Klucze - Olkusz Upland	10.VII.1972
Mesochorinae						
<i>Mesochorus vittator</i> ZETT.	12	+		<i>Z. (A.) carniolica</i> (SCOP.), <i>Z. (Z.) viciae</i> (D. & S.), <i>Z. (Z.) loti</i> (D. & S.)	Klucze - Olkusz Upland	10.VII.1970
Ichneumoninae						
<i>Ichneumon submarginatus</i> (GRAV.)	1	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Klucze - Olkusz Upland	10.VII.1970
Braconidae						
Rogadinae						
<i>Aleiodes bicolor</i> (SPIN.)	7	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Puścizna Wielka - Orawa - Nowy Targ Basin	20.VIII.1984
<i>Aleiodes esebecki</i> HTG.	5	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Puścizna Wielka - Orawa - Nowy Targ Basin	22.VIII.1984
<i>Aleiodes testaceus</i> (F.)	20	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Wista - Beskid Śląski Mts	5.VIII.1994

Parasitoid						
Species	Number of specimens	Primary	Secondary	Host species	Locality	Collection data
Braconinae						
<i>Bracon nigratus</i> (WESM.)	23	+		<i>Z. (M.) minos</i> (D. & S.)	Krościenko – Pieniny Mts	1.VIII.1995
Charmontinae						
<i>Charmon extensor</i> (L.)	18	+		<i>Z. (Z.) filipendulae</i> (L.)	Beskid Orawsko – Podhalański	22.VIII.1984
Euphorinae						
<i>Meteorus ictericus</i> (NEES)	14	+		<i>Z. (Z.) viciae</i> (D. & S.)	Madohora Nature Reserve – Beskid Mały Mts	3.VIII.1993
<i>Meteorus unicolor</i> (WESM.)	15	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Beskid Orawsko – Podhalański	25.VI.2001
<i>Zele chlorophthalmus</i> (SPIN.)	9	+		<i>Z. (M.) minos</i> (D. & S.)	Miechów – Miechów Upland	2.VIII.1994
Microgasterinae						
<i>Cotesia limbatus</i> MARSH.	4	+		<i>Z. (Z.) filipendulae</i> (L.)	Krościenko – Pieniny Mts	1.VI.2000
<i>Cotesia geryonis</i> MARSH.	3	+		<i>Z. (M.) brizae</i> (ESPER)	Rybotycze – Przemyśl Submontane Region	25.VI.2001
<i>Cotesia glomeratus</i> L.	7	+		<i>Z. (Z.) trifolii</i> (ESPER)	Kajasówka Nature Reserve – Olkusz Upland	10.VII.1972
<i>Cotesia zygaenarum</i> MARSH.	4	+		<i>Z. (M.) brizae</i> (ESPER)	Rybotycze – Przemyśl Submontane Region	27.VII.1972
Chalcididae						
Chalcidinae						
<i>Brachymeria intermedia</i> NEES.	41	+		<i>Z. (A.) carniolica</i> (SCOP.), <i>Z. (Z.) loniceræ</i> (SCHEV.), <i>Z. (Z.) angelicae</i> OCHS.	Puścizna Wielka – Orawa – Nowy Targ Basin, Sandomierz – Sandomierz Upland	13.VIII.1970
<i>Brachymeria rugulosa</i> FÖRST.	7	+		<i>Z. (Z.) viciae</i> (D. & S.)	Krościenko – Pieniny Mts	9.VI.1998
<i>Brachymeria secundaria</i> RUSCHKA	5		+	<i>Z. (Z.) loniceræ</i> (SCHEV.), Ichneumonidae, Braconidae	Madohora Nature Reserve – Beskid Mały Mts	7.VI.1991
Pteromalidae						
Pteromalinae						
<i>Dibrachys affinis</i> MAS1	10		+	<i>Z. (Z.) trifolii</i> (ESPER), Ichneumonidae, Braconidae	Kajasówka Nature Reserve – Olkusz Upland	10.VII.1972
<i>Pteromalus chrysos</i> (WALKER)	9		+	<i>Z. (Z.) ephialtes</i> (L.), <i>Z. (Z.) loniceræ</i> (SCHEV.), <i>Adscita (A.) statices</i> (L.), Braconidae	Klucze – Olkusz Upland	1.VII.1972
<i>Pteromalus puparum</i> (L.)	7	+		<i>Z. (Z.) loniceræ</i> (SCHEV.), <i>Z. (A.) carniolica</i> (SCOP.)	Kajasówka Nature Reserve – Olkusz Upland	20.II.1976
<i>Pteromalus vibulenus</i> WALKER	8		+	<i>Z. (Z.) trifolii</i> (ESPER), Ichneumonidae	Krościenko – Pieniny Mts	25.VIII.2001

Parasitoid						
Species	Number of specimens	Primary	Secondary	Host species	Locality	Collection data
Encyrtidae						
Encyrtinae						
<i>Copidosoma albipes</i> (WEST.)	9	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Wisła – Beskid Śląski Mts	7.VIII.1998
<i>Copidosoma boucheanum</i> RTZ.	4	+		<i>Z. (Z.) trifolii</i> (ESPER)	Krościenko – Pieniny Mts	23.VI.1997
<i>Copidosoma geniculatum</i> DALMAN	8	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Glanów – Olkusz Upland	10.VII.1972
Torymidae						
Toryminae						
<i>Monodontomerus aereus</i> WALKER	16		+	<i>Z. (Z.) loniceræ</i> (SCHEV.), Braconidae	Wisła – Beskid Śląski Mts	7.VIII.1998
<i>Monodontomerus minor</i> RATZ.	12		+	<i>Z. (Z.) loniceræ</i> (SCHEV.), Braconidae	Klucze – Olkusz Upland	1.VII.1972
<i>Monodontomerus viciellæ</i> FÖRST.	3	+		<i>Z. (A.) carniolica</i> (SCOP.)	Mydlniki – Vistula Valley	3.VIII.1995
Eulophidae						
Entedoninae						
<i>Neochrysocharis aratus</i> WALKER	8	+		<i>Z. (Z.) loniceræ</i> (SCHEV.)	Sromowce Niżne – Pieniny Mts	21.VIII.1998
<i>Neochrysocharis cuprifrons</i> ERDÖS	15	+		<i>Z. (M.) brizæ</i> (ESPER)	Rybotycze – Przemysł Submontane Region	1.VII.1972

Discussion

The greatest number of parasitoid species was reared from the pupae of *Zygaena (Zygaena) loniceræ* (26), distinctively less from *Z. (Agrumenia) carniolica* and *Z. (Mesembrynus) brizæ* (6 each), *Z. (Zygaena) trifolii* (6), *Z. (Zygaena) viciæ* (5), *Z. (Mesembrynus) minos* (4), *Z. angelicæ* (3) and *Z. ephialtes* (2), *Z. loti* and *Adscita (Adscita) statices* (1 each). For 9 parasitoid species Zygaenidae were found to be their hosts for the first time. Out of these parasitoids *Campoplex multicinctus* is a cosmopolitan species (KASPARYAN, 1981), *Lysibia marginata* and *Medophron afflictor* have a wide Eurosiberian range (AUBERT, 1974), *Mesochorus vittator* and *Ichneumon submarginatus* are limited to Europe, while *Neochrysocharis aratus* and *N. cuprifrons* so far are known from England, Slovakia, and Hungary.

About 3100 species of Ichneumonidae are known to occur in Poland (KAŻMIERCZAK, MS). This study enlarged this list by one species (Table 1).

There are 1032 species of Braconidae known from Poland (CELARY et al., 1997). This paper supplemented this number by 6 new species.

Chalcididae is one of the least known families, and from Poland 9 species of these insects were reported (CELARY et al., 1997). This study added further 2 species.

The family Pteromalidae is only fragmentary known, and from Poland 265 species have been reported so far (CELARY et al., 1997). All parasitoid species from this family reared from Zygaenidae were already known in Poland.

Table 2: Phenology of Zygaenidae investigated.

Month Genus (Subgenus) species	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
<i>Adscita</i> (A.) <i>statices</i> (L.)												
<i>Zygaena</i> (M.) <i>brizae</i> (Esp.)												
<i>Zygaena</i> (M.) <i>minos</i> (DEN. & SCHIFF.)												
<i>Zygaena</i> (M.) <i>purpuralis</i> (BRÜNNICH)												
<i>Zygaena</i> (A.) <i>carniolica</i> (SCOP.)												
<i>Zygaena</i> (Z.) <i>loti</i> (DEN. & SCHIFF.)												
<i>Zygaena</i> (Z.) <i>viciae</i> (DEN. & SCHIFF.)												
<i>Zygaena</i> (Z.) <i>epialtes</i> (L.)												
<i>Zygaena</i> (Z.) <i>angelicae</i> OCHSENH.												
<i>Zygaena</i> (Z.) <i>filipendulae</i> (L.)												
<i>Zygaena</i> (Z.) <i>trifolii</i> (Esp.)												
<i>Zygaena</i> (Z.) <i>lonicerae</i> (SCHEV.)												

 egg;  caterpillar;  pupa;  moth.

Encyrtidae, including parasitoids and hyperparasitoids of Homoptera, Hymenoptera, and Lepidoptera, is a little known family of Hymenoptera. A Polish list of these insects includes 132 species (CELARY et al., 1997). This study enlarged this list by one species.

Also one species is added to the list of 76 species of Torymidae occurring in Poland (CELARY et al., 1997) (1500 species in the world).

There are only 5 species of Eulophidae known to occur in Poland (over 40 species in the world), and this study enlarged this number by two species.

Due to decreasing numbers of Zygaenidae (DĄBROWSKI & KRZEWICKI, 1982) the monophagous parasitic Hymenoptera are also endangered.

It would be of purpose to continue the studies concerning parasitic Hymenoptera. The knowledge about this group of insects is not adequate in Poland. We do not know the exact number of their species nor their hosts.

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