

## Light traps' braconids (Hymenoptera, Braconidae) from the Mrtvý Luh bog (Central Europe, Bohemian Forest)

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### Abstract

Braconid data during three years (2000–2002) of light trapping from a Central European peat bog are revealed. 29 species of Braconidae are recorded from the Mrtvý Luh bog, the Šumava National Park (bog vegetation association: *Pino rotundatae-Sphagnetum*). The Braconidae composition, photodynamics, some ecological and zoogeographical aspects are given. Thirteen species – *Aleiodes esenbecki* (Htg.), *A. pallidor* (Thunb.), *A. procerus* (Wesm.), *Diospilus oleraceus* Hal., *Zele deceptor* (Wesm.), *Blacus forticornis* Haes., *B. radialis* Haes., *Pygostolus falcatus* (Nees), *Macrocentrus bicolor* Curt., *Apanteles decorus* Hal., *A. fulvipes* Hal., *A. infimus* Hal., *Asobara tabida* Nees – are new for the fauna of the Czech Republic. The species *Aleiodes geniculator* (Nees), *Diospilus dilatatus* Thoms., *Meteorus rubens* (Nees), *Homolobus discolor* (Wesm.), *H. infumator* (Lyle) and *Macrocentrus collaris* Spin. are new for Bohemia.

*Key words:* braconid wasps, peat bogs, photodynamics, ecology, zoogeography, Šumava Mts.

### INTRODUCTION

The Central European oligotrophic bogs originating from Holocene ecological succession are isolated ecosystems that are similar to subarctic wet forest tundra. In the southern latitude of temperate forest zone, such as South Bohemia (the Czech Republic, Bohemian Forest = Šumava Mts.), these bog habitats are discrete and characteristic azonal ecosystems. The Šumava National Park represents a large mountain forest complex in central Europe with several unique peat bogs serving as rescue islands for relict insect diversity (SPITZER 1992). The linkage between the insect community and the vegetation is more or less pronounced in some groups, which could be rather vulnerable due to environment changes.

There are records on some braconids being attracted by light traps in general and some of them seem to be typical phototactic species, e.g. species from genera *Aleiodes*, *Zele*, *Blacus*, *Homolobus*, *Macrocentrus*, *Charmon*, *Apanteles* (JAKIMAVIČIUS 1979, TOBIAS 1986, HUD-DLESTON & GAULD 1988). Some records of bog's Braconidae are known from one of the highland moor of Switzerland (PAPP 1982). Data on peat bog Hymenoptera in Finland and Canada are also available (KROGERUS 1960, FINNAMORE 1994). Some Ichneumonidae of European raised peat bogs in Byelorussia (TERESHKIN 1996) and hymenopterous fauna (Aculeata) from a raised bog in northern Germany (HAESELER 1987) are also recorded. Investigations of light trap braconids as well as other groups of insects are a part of general research of peat bog entomofauna of the Bohemian Forest.

## BOG HABITAT AND VEGETATION COMMUNITY

Being an isolated ecosystem similar in structure and function to subarctic wet forest-tundra (SPITZER 1992), Mrtvý Luh "(740 m a.s.l.)" peat bog includes habitats for some species communities closely related to boreal habitats. Such type of peat bogs can be classified as a vegetation association *Pino rotundatae-Sphagnetum* Kästner et Flössner 1933 sensu Neuhäusl 1972, with the presence of a succession of "continental" environment factors such as cold/warm and wet/dry (NOVAK & SPITZER 1972, SPITZER 1996). The peat bog conditions represent the interaction of local edaphic and montane climatic climax factors with variable similarities to the transitory zone near alpine timberline with dwarfed shrub vegetation typical for tundra and taiga (SPITZER 1992).

## MATERIAL AND METHODS

All braconids obtained from light traps were investigated during 2000–2002 in the strictly protected area of the Mrtvý Luh peat bog with a total area of almost 300 ha. The species composition and abundance of Braconidae have been monitored by BL-Pennsylvania light traps (8 W black light), installed for Lepidoptera investigations (SPITZER et al. 1999). Two light traps have been operated, corresponding to the different types of vegetation communities, in: a) one in the central part (treeless area), and b) another in the margin (forest belt). Central part is an opened unforested area with bog vegetation: *Sphagnum* spp., *Vaccinium uliginossum* L., *Eriophorum vaginatum* L. etc. Margins represent a forested area, especially from *Pinus mugo* s. lat. of a stand of about 3 m, with presence of *Molinia coerulea* L., *Carex rostrana* Stock., *Betula pubescens* Ehrh. s. lat. There is also one intermediate zone between center and margins with gradually transition from open area to forest, mainly covered by dwarf forest of *Pinus mugo*. The material has been collected by light traps with a frequency of every 1–2 weeks during vegetation period from April to September.

The taxonomic terms and nomenclature are used according to TOBIAS (1986) and BELOKOBYLSKIJ & TOBIAS (2000).

## RESULTS

73 specimens of 29 species were collected by light traps. It is important that the sex ratio is indicated by dominance of females, e.g. 48 ♀♀ (66.7%) and 25 ♂♂ (33.3%) (see Table 1). The identified species are related to 8 subfamilies: Rogadinae (6 sp.; 20.4%), Helconinae (2 sp.; 6.8%), Euphorinae (11 sp.; 37.9%), Macrocentrinae (3 sp.; 10.2%), Homolobinae (2 sp.; 6.8%), Charmontinae (1 sp.; 3.4%), Microgasterinae (3 sp.; 10.2%) and Alysiinae (1 sp.; 3.4%).

The species composition between central part and margins of every year shows presence of 15 species (28 ♀♀, 11 ♂♂) in 2000, 14 species (12 ♀♀, 9 ♂♂) in 2001 and 10 species (15 ♀♀, 5 ♂♂) in 2002. Eleven species were obtained from both traps (center and margin): *Aleiodes bicolor*, *A. circumscriptus*, *A. geniculator*, *A. pallidator*, *Zele deceptor*, *Blacus radialis*, *Pygostolus falcatus*, *Macrocentrus bicolor*, *M. resinellae*, *Homolobus discolor*, *Charmon extensor*.

Quantitative rank of braconids attracted by light traps reveals of an abundance of: by 9 individuals of *Pygostolus falcatus* (3, 2000; 6, 2001) and *Diospilus oleraceus* (8, 2000; 1, 2002), 7 individuals of *Zele deceptor* (6, 2000; 1, 2002), 6 individuals of *Aleiodes geniculator* (4, 2000; 2, 2001), 4 individuals of *Aleiodes pallidator* (2, 2000; 2, 2001), by 3 individuals of *Aleiodes bicolor* (2, 2000; 1, 2001), *Aleiodes circumscriptus* (2, 2000; 1, 2001) and *Charmon*

**Table 1.** List of light trapped braconid species (2000–2001) from the Mrtvý Luh bog.

Nr	Species	Peat bog collecting		Specimens			Hosts*
			Centre	Margin	Σ	+	
1.	<i>Aleiodes bicolor</i> (Spin.)	1♂ 20–23 Jun 2000, 1♀ 15–18 May 2001	1♀ 19–22 Jun 2000	3	1	2	L (p)
2.	<i>Aleiodes circumscriptus</i> (Nees)	2♂ 1–4 Aug 2000	1♂ 21–24 Aug 2001	3		3	L (p)
3.	<i>Aleiodes esenbecki</i> (Htg.)	1♂ 21–29 Aug 2001		1		1	L
4.	<i>Aleiodes geniculator</i> (Nees)	1♂ 1–4 Aug 2000, 1♂ 26–29 Jun 2001, 1♂ 26–29 Sep 2000.	2♂ 20–23 Jun 2000, 1♂ 25–28 Jul 2001	5		5	L (p)
5.	<i>Aleiodes pallidator</i> (Thunb.)	1♂ 1–4 Aug 2000, 1♂ 26–29 Sep 2000, 1♂ 26–29 Sep 2001	1♀ 21–24 Aug 2001	4	1	3	L (p)
6.	<i>Aleiodes procerus</i> (Wesm.)	1♂ 30 Jul –2 Aug 2002		1		1	–
7.	<i>Diospilus dilatatus</i> Thoms.	2♀ 9–12 Jul 2002		2		2	–
8.	<i>Diospilus oleraceus</i> Hal.	4♀ 25–28 Aug 2000, 4♀ 1–4 Aug 2000, 1♀ 30 Jul –2 Aug 2002		9	9		C (p)
9.	<i>Meteorus rubens</i> (Nees)		1♀ 29 May–11 Jun 2001, 1♂ 24–27 Jul 2001	2	1	1	L (p)
10.	<i>Meteorus unicolor</i> Wesm.	1♀ 25–28 Jul 2000		1	1		L
11.	<i>Zelex albidiarsus</i> Curt.		1♀ 29 May–11 Jun 2001	1	1		L (p)
12.	<i>Zelex deceptor</i> (Wesm.)		2♀ 25–28 Jul 2000, 2♀ 25–28 Aug 2000, 1♀ 7–10 Aug 2001	7	7		L (p)
13.	<i>Blacus exilis</i> (Nees)	1♀ 13–17 Jun 2002, 1♀ 30 Jul–2 Aug 2002		2	2		C
14.	<i>Blacus forticornis</i> Haes.	1♀ 26–29 Sep 2000		1	1		
15.	<i>Blacus humilis</i> (Nees)	1♀ 30 Jul–2 Aug 2002		1	1		C
16.	<i>Blacus nigricornis</i> Haes.	1♀ 1–4 Aug 2000		1	1		C
17.	<i>Blacus radialis</i> Haes.	1♀ 25–28 Jul 2000	1♂ 24–27 Jul 2001	2	1	1	
18.	<i>Blacus ruficornis</i> (Nees)	1♀ 9–12 Jul 2002		1		1	C
19.	<i>Pygostolus falcatus</i> (Nees)	1♂ 20–23 Jun 2000	1♀ 6–9 Jun 2000, 1♀ 9–12 Sep 2000, 1♀ 7–10 Aug 2001, 4♀ 21–24 Aug 2001, 1♂ 21–24 Aug 2001	9	7	2	C (p)
20.	<i>Macrocentrus bicolor</i> Curt.	1♀ 30 Jul –2 Aug 2002	1♀ 21–24 Aug 2001	2	1	1	L
21.	<i>Macrocentrus collaris</i> Spin.	1♂ 13–17 Jul 2002		1		1	L (p)
22.	<i>Macrocentrus resinellae</i> (L.)	1♀ 20–23 Jun 2000	1♀ 6–9 Jun 2000	2	2		L (p)
23.	<i>Homolobus discolor</i> (Wesm.)	1♀ 26–29 Sep 2000	1♀ 19–22 Sep 2000	2	2		L
24.	<i>Homolobus infumator</i> (Lyle)		1♀ 25–28 Jul 2000	1	1		L
25.	<i>Charmon extensor</i> (L.)**	1♀ 21–25 Aug 2000	1♀ 1–4 Aug 2000, 1♂ 24–27 Jul 2001	3	2	1	L (p)
26.	<i>Apanteles decorus</i> Hal.	1♀ 15–18 May 2001		1	1		L
27.	<i>Apanteles fulvipes</i> Hal.		1♀ 20–23 Jun 2000	1	1		L (p)
28.	<i>Apanteles infimus</i> Hal.	1♀ 1♂ 9–12 Jul 2002		2	1	1	L
29.	<i>Asobara tabida</i> Nees		1♀ 13–17 Jul 2002	1	1		D
	Total	24 species	16 species	73	48	25	

\* hosts: Lepidoptera (L), Coleoptera (C), Diptera (D); (p) – polyphagous (many host species).

\*\* from the central light trap was also obtained a specimen (1♀ 21–25 Aug 2000) with ovipositor shorter than body length, identified as *Ch. extensor* var. *brevicauda* Hellén. ACHTERBERG (1979) distinguishes in the Palearctic region 2 species: *Charmon cruentatus* Hal. and *Ch. extensor* L. TOBIAS (1986) considers only one species with some variations within species range.

*extensor* (2, 2000; 1, 2001), by 2 individuals of *Diospilus dilatatus* (2, 2002), *Meteorus rubens* (2, 2001), *Blacus exilis* (2, 2002), *B. radialis* (1, 2000; 1, 2001), *Macrocentrus bicolor* (1, 2001; 1, 2002), *M. resinellae* (2, 2000), *Homolobus discolor* (2, 2000) and *Apanteles infimus* (2, 2002), by 1 individual of *Aleiodes esenbecki* (1, 2001), *A. procerus* (1, 2002), *Zelex albidentarsus* (1, 2001), *Meteorus unicolor* (1, 2000), *Blacus forticornis* (1, 2000), *B. humilis* (1, 2002), *B. nigricornis* (1, 2000), *B. ruficornis* (1, 2002), *Macrocentrus bicolor* (1, 2001), *M. collaris* (1, 2002), *Homolobus infumator* (1, 2000), *Apanteles decorus* (1, 2001), *A. fulvipes* (1, 2000) and *Asobara tabida* (1, 2002) (see Table 1).

The species – *Aleiodes esenbecki*, *A. pallidator*, *A. procerus*, *Diospilus oleraceus*, *Zelex deceptor*, *Blacus forticornis*, *B. radialis*, *Pygostolus falcatus*, *Macrocentrus bicolor*, *Apanteles decorus*, *A. fulvipes*, *A. infimus* and *Asobara tabida* are new for fauna of the Czech Republic (ČAPEK & LUKÁŠ 1989, ČAPEK 1995). Six species – *Aleiodes geniculator*, *Diospilus dilatatus*, *Meteorus rubens*, *Macrocentrus collaris*, *Homolobus discolor* and *H. infumator* are new for Bohemia.

## DISCUSSIONS

It is quite important to take into consideration specificity of these habitats for ecological investigations as much possible with vegetation communities and their distribution. The presence of some geographical isolated populations among Lepidoptera, e.g. "geographical races" of tyrphobiontic taxa (ŠULA & SPITZER 2000), indicates also importance of Hymenoptera parasitica investigations of peat bogs.

## Photodynamics

A few data dealing with long-term phototactic activity of braconids are available. GAULD & HUDDLESTON (1979) and HUDDLESTON & GAULD (1988) investigated the nocturnal Ichneumonidea of the British Isles, indicating on species of six braconid genera regularly collected at light. JAKIMAVIČIUS (1979) has investigated the braconid wasps collected by a quartz lamp in Lithuania during 1969–1975. QUICKE (1992) reported a high incidence of braconids from subtribe Aphrastobraconia captured at light traps in Australia, suggesting that this group may include many crepuscular or nocturnal species. The Mrtvý Luh peat bog is more or less closed by forest and isolated by mountains. The microclimatic conditions are probably the basic factors on braconids photodynamics here. In the case of peat bogs with predominance of "forest tundra climate" – the strong variation of temperature during night and day, cold winters and wet and more or less warm summers, these conditions determine all development activity of insect communities. The braconid activity indicated by light traps in the Mrtvý Luh peat bog begins from the 2<sup>nd</sup> decade of May to the end of September. Most species are recorded from 3<sup>rd</sup> decade of June to the 3<sup>rd</sup> decade of September (see Table 2).

**Table 2.** Number of braconid species on light traps from April to September by decades (1, 2, 3) in central (C) and margin (M) parts.

	May			June			July			August			September									
	C		M	C		M	C		M	C		M	C		M							
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3							
2000					3	2	3		2		2	3	1	2				3	1		1	
2001		2				1	2			1			3	2	1	1	2		4			1

**Table 3.** Number of species and their percentage by zoogeographical groups.

	Palearctic & other regions outside				Within Palearctic region					
	C	H	P+Np	P+IA+E	Pp	Pt	Pl	E	Ec	En
Nr. sp.	1	5*	1	1	5	9	4	1	1	1
%	3.4	17.2	3.4	3.4	17.2	31.0	13.8	3.4	3.4	3.4

\* Including introduced species *Pygostolus falcatus*

## Ecological comparison of Braconidae and Lepidoptera

The bog Lepidoptera and vegetation of the Mrtvý Luh have been studied and some species are much more characteristic for the bog (see e.g. NOVÁK & SPITZER 1972). The linkage between insect community and vegetation association is very close, including some boreo-alpine cold adapted species generally associated with treeless habitats in Šumava peat bogs (SPITZER & JAROS 1998). Three ecological grouping of peat bog Lepidoptera can be distinguished (see SPITZER et al. 1999): a) tyrphobionts (highly stenotopic species with narrow tolerances obligatorily confined to peat bog habitats in the temperate zone); b) tyrphophilous (species better represented and more abundant in bogs than in other habitats), and c) tyrphophilous taxa (eurytopic and widely distributed species without any preference for bog habitat).

No tyrphobiontic braconids were found. Most of collected braconids from light traps are widely distributed being presented in many habitats, including peat bogs. These species have also a large number of known hosts, mainly from Lepidoptera (see Table 1). The *Macrocentrus resinellae* is typical for temperate forest zone. Such species like *Aleiodes bicolor*, *A. circumscriptus*, *A. geniculator*, *A. pallidator*, *Meteorus rubens*, *Charmon extensor*, *Homolobus discolor*, *H. infumator*, *Macrocentrus bicolor* are associated with many habitats within their range, being large distributed in forest and forest-steppe zones. The species – *Diospilus oleraceus*, *Blacus exilis*, *B. forticornis*, *B. humilis*, *B. nigricornis* were obtained only from the central part light trap and are, probably, closely associated with their hosts (small Coleoptera: Anobiidae, Attelabidae, Nitidulidae, Curculionidae, Chrysomelidae etc.) from the central treeless area and dwarf forest of the Mrtvý Luh bog. All these species seem to be tyrphoneutral taxa.

## Zoogeographical aspects

The most studied species are typically related to certain type of habitats and can cover diverse places within their range. One can distinguish some groups (see below), taking into consideration knowledge on braconid distribution (TOBIAS 1976, BALEVSKI 1980). Faunistic system/regions is given by UDVARDY (1975). See Table 3.

1. Species distributed in Palearctic realm and outside its borders (8 sp.; 27.6%): Cosmopolite (C) – *Homolobus infumator*; Holarctic (Palearctic+Nearctic) (H) – *Aleiodes pallidator*, *Zeleeceptor*, *Blacus exilis*, *B. humilis*, *Pygostolus falcatus*; Palearctic and Nepal (P+Np) – *Blacus radialis*, Indo-Australian and Ethiopian regions (P+I+E) – *Charmon extensor*.

2. Species large distributed within the Palearctic realm (14 sp.; 48.3%): Pan-Palearctic (almost all Palearctic, eurybiont species) (Pp) – *Aleiodes bicolor*, *A. geniculator*, *Homolobus discolor*, *Macrocentrus collaris*, *Blacus ruficornis*; Trans-Palearctic (from eastern to western borders of Palearctic realm, more or less eurybionts) (Pt) – *Aleiodes circumscriptus*, *A. procerus*, *Zelee albiditarsus*, *Meteorus rubens*, *M. unicolor*, *Macrocentrus bicolor*, *M. resinellae*, *Apanteles decorus*, *Asobara tabida*.

3. Species distributed within Palearctic realm (4 sp.; 13.8%): Europe, Caucasus, Central Asia and related territories (southern Siberia, Mongolia and/or Korea) (Pl) – *Diospilus oleraceus*, *D. dilatatus*, *Apanteles fulvipes*, *A. infimus*.

4. Species distributed in Europe (3 sp.; 10.3%): almost all Europe (E) – *Blacus nigricornis*; Europe and Caucasus (Ec) – *Blacus forticornis*; Central and North Europe (not in South Europe) (En) – *Aleiodes esenbecki*.

## CONCLUSIONS

1. The 29 species of Braconidae that were obtained during 2000–2002 year' lights trapping from the Mrtvý Luh bog (Bohemian Forest, Central Europe) are mostly generally distributed, not restricted to the bog only. All taxa of braconids from light traps belong to tyrphoneutral category, but not their local potential hosts (e.g. Lepidoptera).

2. Eight species – *Aleiodes pallidator*, *Zelex deceptor*, *Blacus exilis*, *B. humilis*, *B. radialis*, *Pygostolus falcatus*, *Homolobus infumator* and *Charmon extensor* are widely distributed in the Palearctic and outside the realm; eighteen species – *Aleiodes bicolor*, *A. circumscriptus*, *A. geniculator*, *A. pallidator*, *A. procerus*, *Diospilus oleraceus*, *D. dilatatus*, *Homolobus discolor*, *Zelex albiditarsus*, *Meteorus rubens*, *M. unicolor*, *Blacus ruficornis*, *Macrocentrus bicolor*, *M. resinellae*, *Apanteles decorus*, *A. fulvipes*, *A. infimus* and *Asobara tabida* are more or less largely distributed within the Palearctic realm. Most of these species are parasitoids of a large number of hosts, mostly Lepidoptera. Three species are distributed only in Europe: *Aleiodes esenbecki*, *Blacus forticornis* and *B. nigricornis*.

3. Thirteen species – *Aleiodes esenbecki*, *A. pallidator*, *A. procerus*, *Diospilus oleraceus*, *Zelex deceptor*, *Blacus forticornis*, *B. radialis*, *Pygostolus falcatus*, *Macrocentrus bicolor*, *Apanteles decorus*, *A. fulvipes*, *A. infimus*, *Asobara tabida* – are new for fauna of the Czech Republic. The species *Aleiodes geniculator*, *Diospilus dilatatus*, *Meteorus rubens*, *Homolobus discolor*, *H. infumator* and *Macrocentrus collaris* are new for Bohemia.

4. Undoubtedly, peat bogs are unique habitat islands for complex biodiversity and they play a great role in their specific communities with regards to habitat conservation.

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