

## ARTICLES

# On the pupal parasitoids of the pine looper, *Bupalus piniarius* (L.) (*Lepidoptera*, *Geometridae*) in Estonia

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Fourteen species of parasitoids and two hyperparasitic species were reared from *Bupalus piniarius* (L.) pupae collected in northern and south-eastern Estonia, mostly in 1992 and 1993. This report includes a check-list of the parasitoids, data on their abundance and their impact on host mortality.

**Keywords:** pine looper, *Bupalus piniarius*, parasitoids, hyperparasitoids, *Ichneumonidae*, *Tachinidae*.

## Introduction

The pine looper, *Bupalus piniarius* (L.) is a common and usually abundant native Lepidopterous defoliator of Scotch pine (*Pinus sylvestris* L.) in Estonia (Viidalepp, 1995). Outbreaks occur, however, rarely. Initial data on damage in pine stands caused by *B. piniarius* larvae have been presented by O. Daniel (1935): as a result of injury by this insect in northern Estonia in 1910-1912 15 hectares of pine stands were cut. According to published accounts (Daniel 1935, Mathiesen 1935, Mihkelson 1986) and our own data, during this century four large outbreaks of *B. piniarius* have occurred in northern Estonia (1910-1912, 1925-1930, 1980-1982, and 1991-1993) and three in south-eastern Estonia (1930-1932, 1979-1981, and 1990-1992).

Little information has been published on natural enemies of *B. piniarius* in Estonia. S. Mihkelson (1986) stated that 27.7% of the pupae were parasitized by ichneumonids (*Hymenoptera*, *Ichneumonidae*) and 26.3% by tachinids (*Diptera*, *Tachinidae*) in Vastseliina Forest District (south-eastern Estonia) in 1982. In 1983 the ichneumonids destroyed 17.0% and the tachinids destroyed 20.5% of the pupae in Lahemaa National Park (northern Estonia). Two parasitoids were studied by the author, viz. *Blondelia nigripes* (Fll.) and *Heteropelma calcator* Wesm. - these were the most abundant parasitoids in both, northern and south-eastern Estonia in 1982 and 1983. No data on egg and larval parasitoids of *B. piniarius* in Estonia.

## Materials and methods

This paper is based mainly on the material collected in south-eastern Estonia (Orava Forest District) in 1992-1993 and in northern Estonia (Käsmu and Sagadi Forest Districts) in

1993. Also, some parasitoids in our collection came from south-eastern and northern Estonia, obtained in 1982, 1983 and 1991.

Pupae of *B. piniarius* overwinter under forest litter on mineral soil. The overwintered pupae were collected in May, brought to the laboratory, and placed to glass vessels within a moist moss. Emerging *B. piniarius* and parasitoids in May and June were recorded daily, and in July, once every two or three days. The larvae of the tachinids left the skins of the pupae of *B. piniarius* before pupation. These larvae were picked up and placed separately in order to capture also their parasitoids - i.e. hyperparasitoids of *B. piniarius*. If no insects emerged from pupae of *B. piniarius* and puparia of tachinids, those were dissected in August to determine cause of death.

As material was collected in different localities and at different periods of time, adult emergence of *B. piniarius* and parasitoids began in different samples at different dates. To establish patterns of emergence of parasitoids, the date of first emergence of *B. piniarius* was taken as "a zero point" and daily emergence counts of the parasitoids were recorded thereafter.

## Results and discussion

We reared or found dead in the pupae of *B. piniarius* 14 species of parasitoids and two hyperparasitic species. One of the ichneumonid species was not identified (Table 1). The data on emergence of *B. piniarius* and more numerous parasitoids from 1992 and 1993 are illustrated on Figure 1.

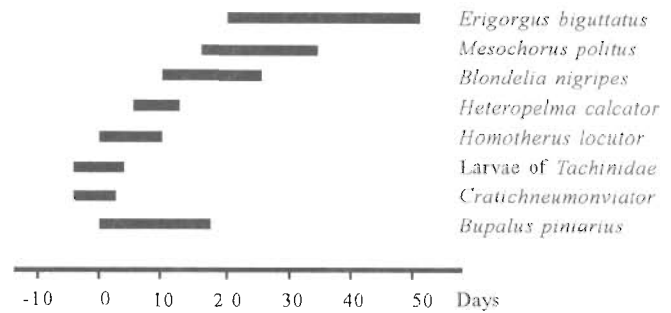
Two species of ichneumonids, *Cratichneumon viator* and *Homotherus locutor*, which started to emerge earlier or at

**Table 1.** Parasitoids and hyperparasitoids reared from pupae of *Bupalus piniarius* in 1982-1983 and 1991-1993

Species of Parasitoids and Hyperparasitoids	Year of collection					Total
	1982	1983	1991	1992	1993	
<b>Parasitoids</b>						
<i>Ichneumonidae</i>						
<i>Heteropelma calcator</i> Wesm.	21		2	37		60
<i>Erigorgus biguttatus</i> Grav.				38	32	70
<i>Poecilostictus cothurnatus</i> (Grav.)		11			3	14
<i>Cratichneumon viator</i> (Scop.)	1	7	2	13	4	27
<i>Cratichneumon dissimilis</i> (Grav.)		1				1
<i>Homotherus locutor</i> (Thunb.)	3	4	1	12	1	21
<i>Ichneumon gracilentus</i> Wesm.	9	9				18
<i>Aoplus ruficeps</i> (Grav.)				1		1
<i>Platylabus iridipennis</i> (Grav.)				1		1
<i>Coelichneumon sp. (?fasciatus</i> Gmel.)		1			1	2
<i>Ichneumonidae gen. et sp.</i>				1		1
<i>Tachinidae</i>						
<i>Senometopia pollinosa</i> (Mesn.)				6		6
<i>Blondelia nigripes</i> (Fil.)	17		13	190	13	233
<i>Blondelia inclusa</i> (Hart.)			1			1
<b>Hyperparasitoids</b>						
<i>Ichneumonidae</i>						
<i>Mesochorus politus</i> Grav.	4			29	1	34
<i>Gelis instabilis</i> (Först)	1					1

the same time as *B. piniarius*, are known to lay their eggs in the pupae and their larvae develop in the pupae of their hosts (Haeselbarth 1979). *B. piniarius* is a common host of these two parasitoids. *Aoplus ruficeps*, *Cratichneumon dissimilis*, *Ichneumon gracilentus*, *Platylabus iridipennis*, and *Coelichneumon fasciatus* develop in a similar way (Rasnitsyn 1981). *C. dissimilis* is a parasitoid of *B. piniarius* and *Panolis flammea* (Rasnitsyn 1981). *A. ruficeps* is known as a parasitoid of *B. piniarius* and some other *Geometridae*. Several species of *Noctuidae* are usual hosts of *C. fasciatus*, but it can develop also in pupae of *B. piniarius* (Haeselbarth 1979, Rasnitsyn 1981).

*Heteropelma calcator*, *Erigorgus biguttatus*, *Poecilostictus cothurnatus*, *Senometopia pollinosa* and *Blondelia nigripes* started to emerge later than *B. piniarius* (Figure 1). The first *P. cothurnatus* emerged even 28 days later than the first *B. piniarius*. All these five species are widely distributed parasitoids of *B. piniarius*. They lay eggs in (or on) host larvae but their larvae develop inside the pupae of the host (Klomp 1958, Kudler 1978, Haeselbarth 1979, Barbour 1988, Kolomiets 1994). Five species of parasitoids were recorded only once each (Table 1). One of these - *Blondelia inclusa* is



**Fig. 1.** Emergence of *Bupalus piniarius* and its parasitoids and hyperparasitoids in the laboratory in 1992 and 1993. The time when *B. piniarius* started to emerge was taken as a "zero point".

a parasitoid of *Diprionidae*, according to K. Escherich (1942) and H. Pschorn-Walcher (1982).

Hyperparasitic species *Mesochorus politus*, reared from tachinid pupae is treated by P. Steiner (1931) as parasitoid of *Blondelia nigripes*. *Gelis instabilis* is a parasitoid of several *Ichneumonidae* and *Braconidae* (Jonaitis 1981).

The pupal mortality in *B. piniarius* collected in the Orava Forest District in 1992 and in Käsmu and Sagadi Forest Districts in 1993 was high - imagoes emerged from less than 40 % of the pupae (Table 2). The mortality caused by the parasitoids was the highest in Orava - 57.5 % of all the pupae were destroyed. In Käsmu and Sagadi many pupae were injured by fungi and perished for other unknown reasons. It is possible that amongst injured and perished pupae, some were also parasitized by ichneumonids and tachinids.

**Table 2.** Causes of mortality of pupae of *Bupalus piniarius* collected in the Orava Forest District in 1992 and in the Sagadi and Käsmu Forest Districts in 1993 (N - number of specimens, % - percentage from total number of pupae of *B. piniarius*)

Parameter	Orava		Käsmu		Sagadi	
	N	%	N	%	N	%
Total number of pupae of <i>B. piniarius</i>	572	100	297	100	23	100
Emerged imago of <i>B. piniarius</i>	212	37.1	96	32.3	2	8.7
Parasitized pupae	329	57.5	67	22.6	5	21.8
Pupae infected by fungi	11	1.9	95	32.0	9	39.1
Pupae perished for other reasons	20	3.5	39	13.1	7	30.4

In the Orava Forest District tachinids were more numerous than ichneumonids - 70.2 % of all parasitoids were tachinids (Table 3) and at least 82.2 % of all tachinids were *Blondelia nigripes* (Table 4). In the Käsmu and Sagadi Forest Districts ichneumonids were more numerous than

tachinids. Especially numerous was *Erigorgus biguttatus* - at least 44.4 % of all parasitoids (Table 3).

**Table 3.** Parasitoids reared from 892 pupae of *Bupalus piniarius* collected in the Orava Forest District in 1992 and in the Käsmu and Sagadi Forest Districts in 1993 (N - number of specimens, % - percentage from parasitized pupae of *B. piniarius*)

Parasitoids	Orava		Käsmu, Sagadi	
	N	%	N	%
Total number of parasitized pupae of <i>B. piniarius</i>	329	100	72	100
<i>Heteropelma calcator</i>	36	11.0		
<i>Erigorgus biguttatus</i>	38	11.6	32	44.4
<i>Poecilostictus cothurnatus</i>			3	4.2
<i>Cratichneumon viator</i>	10	3.0	3	4.2
<i>Homotherus locutor</i>	8	2.4	1	1.4
<i>Aoplus ruficeps</i>	1	0.3		
<i>Platylabus iridipennis</i>	1	0.3		
<i>Coelichneumon</i> sp. (? <i>fastidius</i> )			1	1.4
<i>Ichneumonidae</i> gen. et sp.			1	1.4
Dead <i>Ichneumonidae</i> in the pupae of <i>B. piniarius</i>	4	1.2	16	22.2
<i>Tachinidae</i> gen. et sp.	231	70.2	15	20.8

If data from the present study are compared with those studied in Latvia in 1990 it appears that the most numerous species in Estonia and in Latvia were nearly the same (Šmits and Vilka, 1993). The most numerous parasitoid in Latvia was *B. nigripes* (38.2 %) and it was followed by the ichneumonids *E. biguttatus* (27.6 %), *C. viator* (18.1 %) and *H. calcator* (11.8 % of all parasitoids).

**Table 4.** Insects from puparia of *Tachinidae* parasitizing pupae of *Bupalus piniarius* collected in the Orava Forest District in 1992 and in the Käsmu and Sagadi Forest Districts in 1993 (N - number of specimens, % - percentage from total number of pupae of *Tachinidae*)

Parasitoids	Orava		Käsmu, Sagadi	
	N	%	N	%
Total number of larvae of <i>Tachinidae</i>	231	100	15	100
<i>Senometopia pollinosa</i>	6	2.6		
<i>Blondelia nigripes</i>	177	76.6	13	86.6
Dead imago of <i>B. nigripes</i> in the skins of the pupae	13	5.6		
Dead pupae of <i>Tachinidae</i>	5	2.2	1	6.7
<i>Mesochorus politus</i>	29	12.6	1	6.7
Dead pupae of <i>Ichneumonidae</i>	1	0.4		

The larvae of tachinids left the skins of pupae of *B. piniarius* and all these larvae pupated during few days. At

least 13.0 % of tachinid pupae were killed by hyperparasitoids in Orava and 6.7 % in Käsmu and Sagadi forest districts (Table 4). At least 96,8 % of hyperparasitoids were *Mesochorus politus*.

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## О кукольных паразитоидах сосновой пяденицы *Bupalus piniarius* (L.) (Lepidoptera, Geometridae) в Эстонии

Хейно Ыунап

### Резюме

Сосновая пяденица является обыкновенным и часто многочисленным видом в Эстонии. Однако, вспышки ее массового размножения случаются редко.

Из куколок сосновой пяденицы, собранных во время вспышки массового размножения весной 1992 и 1993 г. в Юго-Восточной и Северной Эстонии, выведено 14 видов паразитоидов – 11 видов ихневмонид (*Hymenoptera, Ichneumonidae*) и 3 вида тахинид (*Diptera, Tachinidae*). Также выведены 2 вида гиперпаразитических ихневмонид. Приведены список видов, данные об их численности и оценено влияние паразитоидов на смертность вредителя.

**Ключевые слова:** сосновая пяденица, *Bupalus piniarius*, паразитоиды, гиперпаразитойды, *Ichneumonidae*, *Tachinidae*.