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Hoplothrips carpathicus PELIKÁN, 1961 (Thysanoptera: Phlaeothripidae) – a new thrips species in the Polish fauna

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ABSTRACT. *Hoplothrips carpathicus* PELIKÁN, 1961 was recorded for the first time in Poland in two localities: in the Białowieża National Park and in the Bieszczady National Park. It was captured using IBL2 screen traps at both sites. The diagnostic characteristics of the macropterous females found in Poland were compared with the micropterous holotype described in Slovakia. Key features are illustrated and data on the distribution of this species in Europe is appended.

KEY WORDS: thrips, mycophagous species, screen traps, Białowieża National Park, Bieszczady National Park.

INTRODUCTION

The order Thysanoptera is divided into two suborders: Terebrantia and Tubulifera. The latter contains only one family – Phlaeothripidae – divided into two subfamilies – Phlaeothripinae and Idolothripinae. The genus *Hoplothrips* AMYOT & SERVILLE, 1843 belongs to the former and is represented by at least 130 species worldwide, 20 in Europe and 10 in Poland (MOUND & WALKER 1986, KUCHARCZYK 2007, VIERBERGEN 2013 and the first co-author's unpublished data). All *Hoplothrips* species are fungivorous and live mostly on decaying wood or in leaf litter. They feed on fungal hyphae and their maxillary stylets are narrow (2-3 μm wide), whereas species of the subfamily Idolothripinae, which ingest fungal spores, have maxillary stylets with a food canal at least 5-10 μm wide (TREE et al. 2010). Several species of this genus are colonial and polymorphic. Macropterous,

brachypterous and apterous forms of females and males are known in their populations. Two forms – oedymerous and gynaecoid – occur in males: they are characterized by the allometry of some body parts. The biology of some species involves subsocial behaviour and male infighting (CRESPI 1986, KOBRO & RAFOSS 2006).

Adult polymorphism and variation of features are the reason for the difficulties in identifying *Hoplothrips* species (MOUND et al. 1976), but all of them share several similarities, which are listed in detail by MOUND & WALKER (1986). The most important ones are: small compound eyes most often occupying about ¼ of the length of the head; 8-segmented antennae with clearly separated segments VII and VIII; usually three and four sense cones on antennal segments III and IV, respectively; parallel-sided forewings with duplicated cilia at the apex. In most of the species males have a glandular area on abdominal sternite VIII.

Hoplothrips carpathicus was described by JAROSLAV PELIKÁN in 1961 on the basis of two wingless females. They were collected on 23 June 1956 by L. LAUTERER from the bark of *Fagus sylvatica* LINNAEUS, 1753 in eastern Slovakia (Vihorlat Mountain – 900 m amsl, Inner Eastern Carpathians) (PELIKÁN 1961).

On the basis of PELIKÁN'S description, *H. carpathicus* was included in keys for the identification of European species prepared by PRIESNER (1964) and SCHLIEPHAKE & KLIMT (1979). In the latter, *H. carpathicus* as well as two other species noted in Poland, *Hoplothrips caespitis* (UZEL, 1895) and *Maderothrips* (*Hoplothrips*) *longisetis* (BAGNALL, 1910), are identifiable by two sense cones on both antennal segments III and IV. KOBRO & RAFOSS (2006) have taken into account *H. carpathicus* in a key for eight *Hoplothrips* species known from Norway. The identification of these species is based on a few metric characters, which are the same for both males and females. According to this key, *H. carpathicus* is distinguishable by such characters as short mediolateral seta on the pronotum (< 110 μm), the distance between D1 setae on tergite IX is shorter than the width of the basis of segment X (tubus) and these setae are longer than 140 μm, antennal segment VIII longer than 75 μm, antennal segment III and almost always antennal segment IV with two large sense cones.

This paper supplies faunistic data on the occurrence of *H. carpathicus* in Poland and compares the metric characters of macropterous females found in Poland with those of the micropterous holo- and paratype described by PELIKÁN from Slovakia. The key characteristics of *H. carpathicus* are illustrated, and data on its distribution in Europe is appended.

MATERIALS AND METHODS

Specimens of *H. carpathicus* were found at three sites in the Białowieża National Park and six sites in the Bieszczady National Park. All specimens were captured using IBL2 screen traps suspended about a metre above the ground. An aqueous solution of ethylene glycol was used in the traps. The traps at all the sites were emptied every two weeks. The materials gathered in the traps in the Białowieża Forest come from the Forestry Research Institute's collection; they were kindly donated by Prof. J. GUTOWSKI. The insects were collected between 1999 and 2001 during research into the migration of cambiophagous beetles across the border between the strict reserve and managed forests in forest compartments 374D/403B and 454C, and also during monitoring research in compartments 288A/318C (Table 1) (GUTOWSKI & KRZYSZTOFIAK 2005).

Table 1. Data relating to the materials examined.

UTM Square	Forest compartment/ Trap No.	No. of females	Collection date
FD 84	288C/318A	1	21.06. 2000
FD94	374D/403B	1	6.06.2000
FD94	454C	2	22.06.1999
FD94	454C	2	4.07.2000
FD94	454C	5	18.07.2000
FD94	454C	1	27.06.2001
FD94	454C	1	11.07.2001
FV 23	trap1 (804 m amsl)	1	16.07.2013
FV 23	trap 3 (880 m amsl)	1	22.08 2013
FV 23	trap 4 (912 m amsl)	1	20.08. 2012
FV 23	trap 5 (936 m amsl)	12	20.08.2012
FV 23	trap 5 (936 m amsl)	1	16.07.2013
FV 23	trap 7 (1046 m amsl)	1	20.08.2012
FV 15	trap 11 (785 m amsl)	1	5.08.2013
FV 15	trap 11 (785 m amsl)	3	23.08.2013

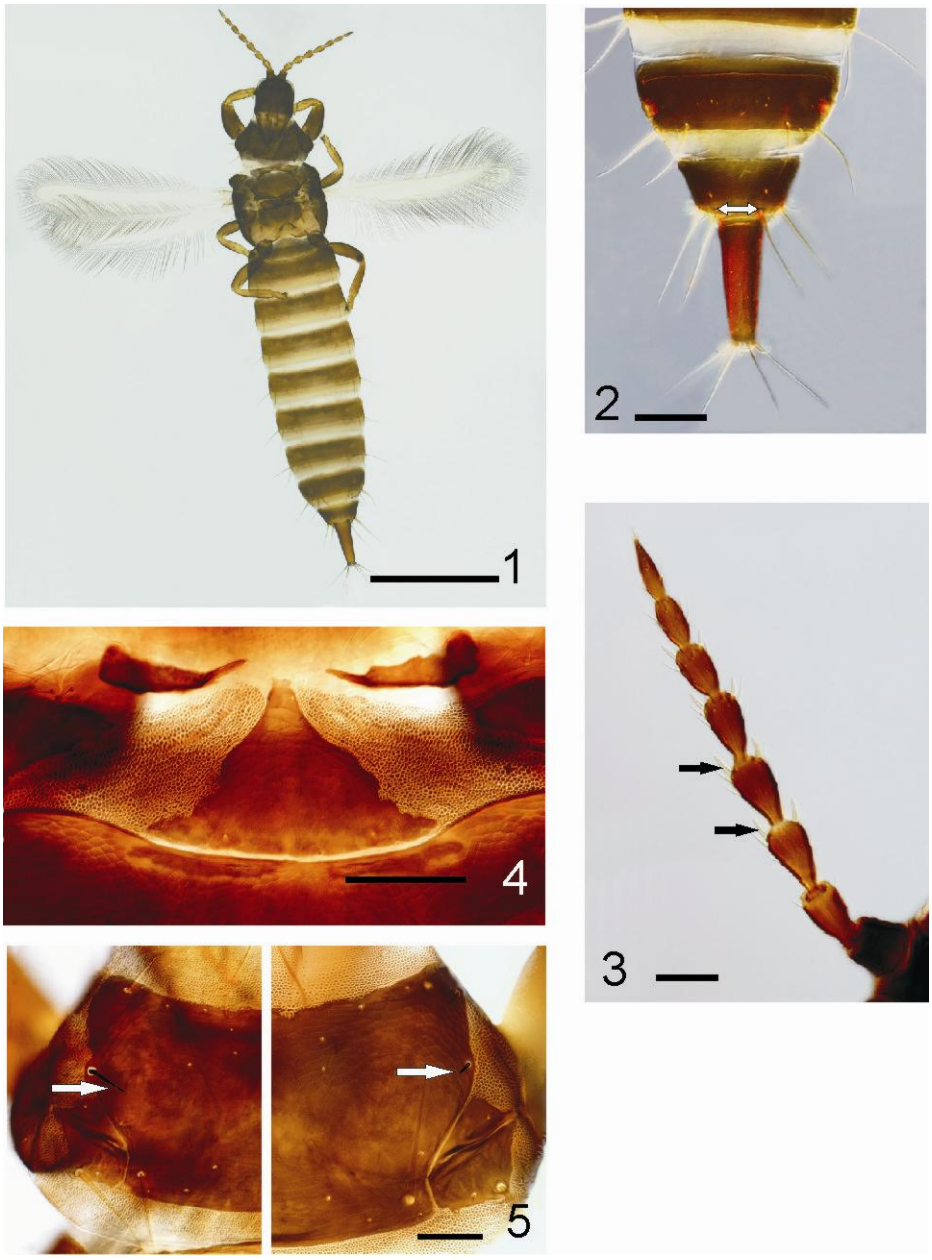
In 2012 and 2013 twenty screen traps were deployed in the Bieszczady NP along two trails: one from Wołosate village to Tarnica Mt. (traps 1-10) and the other from Zatwarnica to the Orłowicz Pass (traps 11-20). *H. carpathicus* was found at five sites along the former

trail and at one along the latter (Table 1). In the Białowieża NP screen traps were deployed in forest communities with dominant Norway Spruce (*Picea abies* (LINNAEUS, 1753) KARSTEN, 1881), whereas in the Bieszczady NP traps were hung on *Betula pendula* ROTH, 1788 (trap 1), *Picea abies* (traps 4, 5), *Fagus sylvatica* (traps 3, 7) and *Larix decidua* MILLER, 1768 (trap 11) in the lower forest zone, which is dominated by *Fagus sylvatica* with artificial plantings of Norway Spruce and larch. After removal from the traps all specimens were preserved in 70% ethanol and mounted in Berlese fluid or Canada Balsam for identification (MOUND & KIBBY 1998). 35 morphological characters used by PELIKÁN (1961) and one used by KOBRO & RAFOSS (2006) were measured for eleven specimens, the best preserved ones, collected in both study areas and compared with the measurements of the holotype.

Species were identified according to the key by KOBRO & RAFOSS (2006), and morphological analyses and the figures (Figs 1-5) were prepared using an Olympus BX 61 microscope with differential interference contrast (DIC) and an Olympus DP72 camera. The materials examined are deposited in the collection of the Department of Zoology, Maria Curie-Skłodowska University, Lublin.

RESULTS

To date 13 females of *H. carpathicus* have been collected using screen traps in the Białowieża NP and 21 in the Bieszczady NP. From all traps several specimens were collected, except trap No. 5 in the Bieszczady Mts., where 12 specimens were found (Table 1). In contrast to the micropterous holotype, all specimens known from Poland are macropterous (Fig. 1). According to the data given by PELIKÁN, some measurements of body parts and setae in the macropterous form differed from the corresponding measurements in the micropterous holotype. On average, the total body length of macropterous specimens was greater than that of the holotype. Other characters in which the holotype differs from the specimens we analysed include the length and width of prothorax (greater in the micropterous form), and the length and width of the pterothorax (larger in the winged form). In addition, the sense cones on antennal segments III and IV are longer in the macropterous form, and in some specimens there were three sense cones on antennal segment IV. The length and width of the pelta (the first abdominal tergite) were smaller in the winged form, and their pronotal mediolateral setae varied in length (Figures 3, 4, 5; Table 2).



Figs 1-5. 1 – *Hoplothrips carpathicus* female habitus, 2 – abdominal segments VIII-X, distance between D1 setae marked, 3 – antenna, inner sense cones on 3rd and 4th segment marked, 4 – shape of pelta, 5 – pronotum with mediolateral seta – normal size (left), microseta (right). Scale bars: Fig. 1 – 300 µm, Figs 2-5 – 50 µm.

Table 2. Comparison of characteristics of *Hoplothrips carpathicus* holotype (paratype) (H / P) and specimens collected in the Białowieża NP and the Bieszczady NP (own data, n=11) (measurements in μm). Min. – minimal value, Max. – maximal value, Aver. – average value, ±SD – standard deviation.

Characteristics	**H / P**	**Own data**			
		Min.	**Max.**	**Aver.**	**±SD**
Total body length	2600	2500	3250	2757.3	217.4
Length of head	290 (265)	210	250	242.3	12.1
Width of head	275	230	310	281.8	24.5
Length of ocelli	18	25	30	27.3	2.6
Length of postocular seta	120 (125)	110	130	116.4	8.7
Length of antennae	593-600	545	635	597.3	26.4
Length of antennal s. I	73	50	70	59.1	7.1
Length of antennal s. III	81	75	90	82.7	5.3
Length of antennal s. IV	70-73	75	85	79.5	2.7
Length of antennal s. VIII	81-84	75	85	78.2	4.6
Width of antennal s. I	51 (70)	45	55	48.6	3.9
Width of antennal s. III	48-50	45	50	47.3	2.6
Width of antennal s. IV	48-51	40	50	45.0	1.8
Width of antennal s. VIII	23-24	20	25	20.5	1.5
Length of inner sense cone on antennal s. III	16-19	25	30	26.4	2.3
Length of outer sense cone on antennal s. III	20	25	35	28.9	3.5
Length of inner sense cone on antennal s. IV	20-24	20	30	27.3	3.4
Length of outer sense cone on antennal s. IV	22-24	27.5	35	30.5	1.9
Length of prothorax	285 (260)	175	225	213.2	18.6
Width of prothorax	500 (525)	375	475	457.3	34.7
Length of anteroangular setae	48-54	45	75	54.1	10.2
Length of mediolateral setae	51-57	15	55	44.5	14.9
Length of posteroangular setae	102-108	110	150	126.4	12.0
Length of epimeral setae	102-108 (122)	110	135	122.7	8.8
Length of pterothorax	405	460	550	483.2	31.4
Width of pterothorax	570 (525)	485	665	611.4	59.6
Length of wing	30	1020	1400	1132.3	110.3
Length of pelta	143 (132)	110	145	130.5	11.7
Width of pelta	286 (282)	200	250	230.5	20.0
Length of D1 on s. IX	167 (181)	190	225	208.2	11.0

Table 2. Continued.

Characteristics	H (P)	Own data			
		Min.	Max.	Aver.	±SD
Length of D2 on s. IX	200-205 (214)	205	260	232.7	17.2
Length of D3 on s. IX	182 (167)	175	250	223.6	22.3
Length of tube	272 (256)	230	295	267.7	30.6
Width of tube at base	114 (124)	105	130	115.0	10.7
Width of tube at tip	57 (48)	50	70	55.5	7.5

DISCUSSION

In Norway KOBRO & SOLHEIM (2002) collected both micropterous and macropterous forms of *H. carpathicus* from dead birch (*Betula pendula*). Branches of birch were infested with *Pseudospiropes longipilus* (CORDA, 1837) HOLUBOVA-JECHOVA, 1973, the common fungus of that tree (BROWN et al. 2008). Those authors suggested that *H. carpathicus* forages on this fungus. Using Berlese funnels they obtained almost three thousand specimens, both males and females. They supposed that the tree had been inhabited by this species for several years. *H. carpathicus* was found sporadically on *Picea abies* and *Pinus sylvestris* LINNAEUS, 1753 (KOBRO & RAFOSS 2006). In Finland it was caught in window traps deployed on dead aspen (*Populus tremula* LINNAEUS, 1753) trees (KETTUNEN et al. 2005). In Germany (Hessen, Vogelsberg Mts.) single specimens of *H. carpathicus* were caught several times in 1990 and 1991 in eclectors on the trunks of dead beech trees (ZUR STRASSEN 1994). During our research we found this species in both coniferous (the Białowieża NP) and deciduous forests (the Bieszczady NP), in the latter in traps hung on different trees – *Betula pendula*, *Picea abies*, *Fagus sylvatica* and *Larix decidua*.

The concealed lifestyle and dispersed occurrence of mycophagous thrips is a reason why they are difficult to find in their natural habitat. Populations of fungivorous thrips species usually remain in the same place and produce mainly apterous or brachypterous forms until the habitat is exhausted of the fungi. A larger proportion of macropterous specimens was recorded when the abundance of food decreased or the population density increased (KOBRO & RAFOSS 2006, and observations made by the first author while rearing *Hoplothrips pedicularius* (HALIDAY, 1836)). The winged specimens caught in the screen traps in the Białowieża Forest and in the Bieszczady Mts. were probably migrating forms from populations living on the dead wood in the vicinity of the traps.

In his description of the new species from Slovakia PELIKÁN (1961) wrote that the female (holotype) was apterous, but in listing the features of the pterothorax he stated that the wings were reduced to small pads (30 μm long). Moreover, the apterous forms are devoid of ocelli but these were present in the holotype and measured 18 μm. KOBRO & RAFOSS (2006) referred to the form with substantially reduced wings as the micropterous form. During our study we collected only females with fully developed wings and ocelli (Fig. 1; Table 2).

Compared to the data given by PELIKÁN (1961) in his species description, some measurements of body parts and setae observed in the macropterous form differed from the micropterous holotype. The average total body length of macropterous specimens was greater than that of the holotype but less than that of the macropterous forms collected in Norway by KOBRO & RAFOSS (2006). Those authors selected 13 characters which are useful for the identification of *Hoplothrips* species. The length of the mediolateral seta on the pronotum is a key feature: it was 51-57 μm, 44.5 μm (average), and 60 μm in the Slovakian, Polish and Norwegian specimens, respectively. In our materials this feature was highly variable, with values between 15 and 55 μm (Fig. 5; Table 2). The ratio between the distance of D1 setae on abdominal segment IX and the width of the tube basis is a key character distinguishing *H. carpathicus* from *H. unicolor* VUILLET, 1914: it is below one in the former and above one in the latter species. However, the first value was not measured by PELIKÁN in the holotype (Fig. 2; Table 2). Moreover, in the former species seta D1 is at most equal to the length of the tube, whereas in the latter it is longer than the tube (ZUR STRASSEN 1994).

The presence of two sense cones on antennal segments III and IV is a descriptive characteristic of *H. carpathicus*, but among the specimens studied a few had three (two longer and one short) sense cones on segment IV (Fig. 3). ZUR STRASSEN (1994) also observed the variability of this feature in specimens collected in Germany: the wingless forms had two and winged forms three sense cones on this segment. KOBRO & RAFOSS (2006) in their identification key used the formulation "almost always two large sense cones on antennal segment IV", which may suggest that they noticed this variability in Norwegian specimens as well.

To date, apart from Norway, Finland, Germany and Poland, where *H. carpathicus* was caught at a few sites and in larger numbers, this species has been recorded only once from single samples in such countries as Slovakia, Sweden, Ukraine and Montenegro (Fig. 6) (PELIKÁN 1961, DYADECHKO 1964, ZUR STRASSEN 1994, SCHLIEPHAKE 2001, VASILIU-OROMULU et al. 2001, KETTUNEN et al. 2005, KOBRO & RAFOSS 2006, KETTUNEN 2008, FEDOR et al. 2012). Although this species occurred in large numbers in Norway, it was found sporadically (KOBRO & SOLHEIM 2002). In Germany it was placed on the Red List with the category endangered (EN) (SCHLIEPHAKE & ZUR STRASSEN 1998). In Scandinavia

and in the Białowieża NP *H. carpathicus* was recorded most often in coniferous forests, while in the Bieszczady NP and the other countries mainly from beech forests. Our use of screen traps in the Białowieża NP and the Bieszczady NP yielded *H. carpathicus* at several sites over a period of several years, indicating that this species is a constant constituent of the decaying-wood fauna in our study areas. The data given in the literature and the one added to as a result of our studies, confirm the boreal-montane range of *H. carpathicus*.

Fig. 6. Distribution of *Hoplothrips carpathicus* in Europe.

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