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## HETEROPTERA FROM BEECH (*FAGUS SYLVATICA*) AND SILVER FIR (*ABIES ALBA*) TREES OF THE PRIMARY FOREST RESERVE RAJHENAVSKI ROG, SLOVENIA

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**Abstract** – Samples of the tree crown fauna were collected from silver fir and beech trees growing in the primary forest reserve Rajhenavski Rog in the Dinaric mountain region of Slovenia, using the method of insecticidal knockdown fogging. 24 species of Heteroptera were detected in the samples. 3 species were found for the first time in Slovenia and an additional 3 species were present in collections although not recorded.

**KEY WORDS:** Heteroptera, beech (*Fagus sylvatica*), silver fir (*Abies alba*), insecticidal knockdown fogging, Slovenia

**Izveček** – STENICE Z BUKEV (*FAGUS SYLVATICA*) IN JELK (*ABIES ALBA*) PRAGOZDNEGA REZERVATA RAJHENAVSKI ROG V SLOVENIJI

Vzorke favne v drevesnih krošnjah smo zbrali z jelk in bukev, ki rastejo v pragozdnem rezervatu Rajhenavski Rog v dinarskem hribovju Slovenije. Uporabljali smo tehniko zapraševanja z insekticidom. V vzorcih smo našli 24 vrst stenic (Heteroptera). Tri vrste so bile prvič najdene v Sloveniji, dodatne tri pa še nimajo objavljenih podatkov za državo.

**KLJUČNE BESEDE:** Heteroptera, bukev (*Fagus sylvatica*), jelka (*Abies alba*), insekticidno zapraševanje, Slovenija

## Introduction

Due to difficult accessibility, the canopy is still an almost unknown habitat. This is true for temperate regions to an even greater extent than for the tropics which gained much more attention due to their high species diversity (Erwin 1982; Floren & Linsenmair 1998; Stork 1991; Wagner 1997). Until today, insecticidal knockdown fogging provides the only possibility to collect free living arboreal arthropods in an almost quantitative way. Investigations in German oak plantations showed that there exists an abundant and diverse fauna in the trees with many Red List species and species new to science (Kessler 1998; Tschorsnig & Floren 2000; Horstmann & Floren, in press; Floren & Schmidl 2000; Schmidl *et al.*, in prep.). Such faunistic data are the first step in the investigation of this »last biotic frontier« (Erwin 1983). The fogging study of beech and fir trees in a primary forest reserve in Slovenia is part of a project which aims at understanding how anthropogenic disturbance changes arboreal arthropod communities (Floren & Linsenmair 1999; Floren *et al.* 2001). In this paper, we focus on the arboreal Heteroptera fauna.

## Methods

Field work was conducted in the primary forest reserve Rajhenavski Rog near Kočevje in the Dinaric region of Slovenia, where a Dinaric fir and beech forest is growing (UTM: WL06). The forest is classified as *Abieti-Fagetum dinaricum*, with a few maple (*Acer pseudoplatanus*), elm (*Ulmus glabra*), lime (*Tilia platyphyllos*), and spruce trees (*Picea abies*). The forest lies 900 meters above sea level, 45°41'N, 15°01'E. Due to bad weather conditions, canopy fogging could be carried out only on four days, from 25.–28.6.1999. During this time we collected the arthropod communities from 12 silver fir trees (*Abies alba*) and 7 beech trees (*Fagus sylvatica*) that were growing close to the border of the reserve. Tree heights were between 30 and 40 meters.

Fogging was performed in a tree specific way by choosing trees that showed little crown overlap with neighboring trees. Natural pyrethrum was used as an insecticide (in a 1.5% concentration and diluted in highly raffinated white oil) which is completely biodegraded within hours. Fogging was performed early in the morning for eight minutes per tree when there was little wind. All arthropods that dropped into the funnels two hours following fogging were collected and stored in 80% ethanol. For technical details see Floren & Linsenmair (1997). In order to sample almost complete arthropod communities, 80 to 90% of each crown projection area was covered with funnels arranged one meter above the forest floor.

## Results

In total 26,775 individuals of Heteroptera were collected; 22,773 on 12 fir trees (85.05% of the total) and 4002 on 7 beech trees (14.95% of the total). The mean relative proportion of Heteroptera in a community on fir trees was 19.29% (Standard Deviation, SD 4.94) and was highly significantly different from the mean proportion of Heteroptera on beech trees, 7.64% (SD 1.82) (MannWhitney-test,  $p < 0.001$ ). The collected samples contained mostly nymphs of Heteroptera while the proportion of adults varied between a minimum 6% and a maximum 20%. Larvae could not always be identified. The members of the Miridae family, which were the most numerous representatives of Heteroptera in samples, were mostly legless and hairless due to the crowding with many other specimens in alcohol. Sometimes the only way to identify them correctly was the examination of the genitalia. Because of this, we were not able to find the exact numbers of specimens of each species in the samples. But the species present with adult specimens could be listed completely. We found many interesting species, some of them for the first time in Slovenia. Some species, thought to be rare, occurred in great numbers in the canopy.

Samples collected from fir trees were not only richer in specimens than samples of the beech tree fauna, but also had more species (tables 1 and 2). This was also reflected in the number of species that occurred exclusively on *Abies* (9 of the 23) and *Fagus* (one species, *Temnostethus pusillus*). We were not able to achieve a complete isolation of the tree crowns, however. Many species known to live only on conifers were found also in beech tree samples and *vice versa*. However, the supposed host tree of a species can be found by comparing the percents of samples from each tree species that contained the species in question. All species whose host plant is known were present in a greater percentage of samples from their host tree than from the other tree species.

Tables 1 and 2 list the species collected from both tree species. In total, 24 species were found. Three species were found for the first time in Slovenia and an additional three have no published records for the country.

**Tab. 1:** Heteroptera species collected from 12 *Abies alba* trees. Heteroptera were classified into the following groups: Herbivores (H); Predators (P); Mixed: species that eat plants as well animals (M); Tourists: species that are not known to occur on the examined plants (T).

Tree No.:	1	2	3	7	8	9	10	11	12	13	18	19	Group
<i>Loricula elegantula</i> (Bärensprung 1858)	•	•		•			•			•	•	•	P
<i>Actinonotus pulcher</i> (Herrich-Schäffer 1835)					•			•			•		H?
<i>Phytocoris hirsutulus</i> Flor 1861	•			•					•			•	M?

Tree No.:	1	2	3	7	8	9	10	11	12	13	18	19	Group
<i>Pinalitus atomarius</i> (Meyer-Dür 1843)	•	•	•	•	•	•	•	•	•	•	•	•	H?
<i>Pinalitus viscicola</i> (Puton 1888)											•		H?
<i>Orthotylus obscurus</i> Reuter 1875											•	•	H?
<i>Cremnocephalus alpestris</i> Wagner 1941	•	•	•	•	•	•	•	•	•	•	•	•	M
<i>Amblytylus nasutus</i> (Kirschbaum 1856)							•						T
<i>Atractotomus kolenatii</i> (Flor 1860)	•	•	•	•	•	•	•	•	•	•	•	•	H
<i>Parapsallus vitellinus</i> (Scholz 1847)											•		H?
<i>Psallus ambiguus</i> (Fallén 1807)		•		•			•		•				T
<i>Psallus varians</i> (Herrich-Schäffer 1841)	•			•	•			•					T
<i>Acompocoris alpinus</i> Reuter 1875			•			•	•	•	•	•	•	•	P
<i>Anthocoris confusus</i> Reuter 1884				•	•								P
<i>Anthocoris nemoralis</i> (Fabricius 1794)	•	•									•		P
<i>Temnostethus gracilis</i> Horváth 1907				•									P
<i>Temnostethus wichmanni</i> Wagner 1961											•		P
<i>Orius horvathi</i> (Reuter 1884)	•				•								P
<i>Orius laticollis</i> (Reuter 1884)	•	•	•			•	•			•			P
<i>Orius</i> sp. (Dohn 1863)				•				•					P
<i>Empicoris baerensprungi</i> (Linnaeus 1758)								•					P
<i>Empicoris vagabundus</i> (Linnaeus 1758)												•	P
<i>Pentatoma rufipes</i> (Linnaeus 1758)		•										•	T

**Tab. 2:** Heteroptera species collected from 7 *Fagus sylvatica* trees. Grouping as in table 1.

Tree No.:	4	5	6	14	15	16	17	Group
<i>Loricula elegantula</i> (Bärensprung 1858)	•	•	•	•	•	•	•	P
<i>Phytocoris hirsutulus</i> Flor 1861	•	•	•	•	•	•	•	M?
<i>Pinalitus atomarius</i> (Meyer-Dür 1843)						•		T
<i>Cremnocephalus alpestris</i> Wagner 1941			•				•	T
<i>Atractotomus kolenatii</i> (Flor 1860)	•	•	•	•	•		•	T
<i>Psallus ambiguus</i> (Fallén 1807)	•	•		•	•	•	•	M
<i>Psallus varians</i> (Herrich-Schäffer 1841)	•	•	•	•	•	•	•	H?
<i>Acompocoris alpinus</i> Reuter 1875				•				T
<i>Anthocoris confusus</i> Reuter 1884	•	•	•	•	•		•	P
<i>Anthocoris nemoralis</i> (Fabricius 1794)	•							P
<i>Temnostethus gracilis</i> Horváth 1907	•	•	•	•	•		•	P
<i>Temnostethus pusillus</i> (Herrich-Schäffer 1835)	•		•					P
<i>Orius horvathi</i> (Reuter 1884)			•				•	P
<i>Orius laticollis</i> (Reuter 1884)		•						P
<i>Orius</i> sp.	•			•	•		•	P
<i>Pentatoma rufipes</i> (Linnaeus 1758)	•	•	•	•	•	•	•	H

## Comments on the species collected

### Microphysidae

#### *Loricula elegantula* (Bärensprung 1858)

Only a single male specimen of this predatory species had been found in Slovenia before: Gradišče pri Lukovici (VM71), 12. 6. 1996, under the bark of a *Malus* tree (unpublished data). In the samples from beech trees in Rajhenavski Rog, this species is very numerous, represented by both sexes and larvae. In samples from fir only males were found.

### Miridae

#### *Actinonotus pulcher* (Herrich-Schäffer 1835)

A Pannonic species known from several sites in Slovenia. Represented only by single specimens found in three samples from fir trees.

#### *Phytocoris hirsutulus* Flor 1861

A rarely found species. One specimen had been collected by a light trap in Kočevje already before, 27. 7. - 4. 8. 1979 (unpublished data), but was misidentified as *P. dimidiatus*. In the samples from beech trees it is numerously represented by both sexes and larvae which lead to the conclusion that this tree species is its host.

*Pinalitus atomarius* (Meyer-Dür 1843)

A species known to live on conifers. It is numerous in the samples from fir trees. This is the first record of this species in Slovenia.

*Pinalitus viscicola* (Puton 1888)

Lives on *Viscum*, a parasitic plant which grows in the tree crowns. It was collected in the eastern part of Slovenia before: Krško, Anovec (WL49), 1. 8. 1996; Stara vas - Bizeljsko (WL59), 6. 8. 1996. It is represented by two specimens in a sample from fir. We suppose that its host plant grew in the fogged tree.

*Orthotylus obscurus* Reuter 1875

Already known from Kočevje, its only known locality in Slovenia. Present in two samples from fir.

*Cremnocephalus alpestris* Wagner 1941

Known from mountain regions in Slovenia. Very numerous represented in the samples from fir.

*Amblytulus nasutus* (Kirschbaum 1856)

Only one specimen of this species, which is not known on trees, has been detected in a sample from fir. It lives in the grass and its occurrence in the tree is exceptional.

*Atractotomus kolenatii* (Flor 1860)

Known in Slovenia only from Kočevje, this species lives on conifers. It is among the most numerous species in samples from fir.

*Parapsallus vitellinus* (Scholz 1847)

One sample from fir contained specimens of this species, which lives on conifers.

*Psallus ambiguus* (Fallén 1807)

Well represented in the samples from beech.

*Psallus varians* (Herrich-Schäffer 1841)

Present in all samples from beech.

## **Anthocoridae**

*Acomporis alpinus* Reuter 1875

Predatory species living on conifers. Well represented in the samples from fir.

*Anthocoris confusus* Reuter 1884

Well represented in the samples from beech. Predatory species.

*Anthocoris nemoralis* (Fabricius 1794)

Some specimens were found in samples, more on those from fir. Predatory species.

*Temnostethus gracilis* Horváth 1907

Well represented in the samples from beech. Predatory species.

*Temnostethus pusillus* (Herrich-Schäffer 1835)

A few specimens are present in the samples from beech. Predatory species.

*Temnostethus wichmanni* Wagner 1961

Pannonic species known only from the Balkans and Central Europe, living on *Picea* (Péricart 1972). Predatory species. Two specimens were found in a sample from fir. First record of the species in Slovenia.

*Orius horvathi* (Reuter 1884)

Some melanised specimens were found in samples from both fir and beech. Predatory species. First record of the species in Slovenia.

*Orius laticollis* (Reuter 1884)

Several specimens were found in samples from fir. Predatory species.

*Orius* sp.

Probably lighter coloured specimens of *O. horvathi*, but all *Orius* specimens collected are females that are difficult to identify. They could also be *O. vicinus*.

## Reduviidae

*Empicoris baerensprungi* (Dohrn 1863)

Only one specimen from Slovenia was known before. Four specimens were found in a sample from fir. Predatory species.

*Empicoris vagabundus* (Linnaeus 1758)

One specimen of the species had already been found in the Slovenian coast. It is a representative of the form *pilosus* (Fieber), while the specimen found in a fir sample is the first record of a typical *vagabundus* in Slovenia. Predatory species.

## Pentatomidae

*Pentatoma rufipes* (Linnaeus 1758)

Best represented species of Heteroptera in samples from beech, but mostly with larvae and only a few adults.

## Discussion

Insecticidal knockdown fogging proved to be an effective method to collect arboreal Heteroptera. All fogging samples were dominated by far by nymphs but we collected many more bugs from fir trees than from beech trees. On *Abies* Heteroptera provided almost 20% of all arthropods and were numerically the dominant order, followed by Psocoptera (16.5%), Hymenoptera (13.8%) and Diptera (10.9%). In contrast, Heteroptera were found with just 8% in communities on beech, where Thysanoptera (28.5%) and Homoptera (18.9%) were dominant (Floren, unpublished data). These differences on the order level indicate structural differences in arthropod communities on fir and beech trees which are analysed in greater detail elsewhere (Floren, in preparation).

The total number of adult Heteroptera was rather low, indicating that the time of fogging was too early in order to collect the greatest species diversity. Adults were determined in 24 species of which three were found for the first time in Slovenia:

*Pinalitus atomarius*, frequent on *Abies alba*, *Temnostethus wichmanni* and *Orius horvathi*. Two species had already been found in the country, but the records have not been published yet: *Loricula elegantula* and *Phytocoris hirsutulus*, both frequent on *Fagus sylvatica*. *Pinalitus viscicola* has only been mentioned for the country in the Catalogue of the Heteroptera of the Palaearctic region, without more precise records. Some rarely found species have been collected in great numbers, for example *Phytocoris hirsutulus* and *Loricula elegantula*. *Actinonotus pulcher*, *Orthotylus obscurus*, *Atractotomus kolenatii* and *Empicoris baerensprungi* are also rare in Central Europe.

The dominant species on fir trees were *Pinalitus atomarius*, *Cremnocephalus alpestris* and *Atractotomus kolenatii*. On beech, the dominant species were *Loricula elegantula*, *Phytocoris hirsutulus*, *Psallus ambiguus*, *Psallus varians* and *Pentatoma rufipes*. Relatively high number of predatory species were present. Among 22 species from fir, 10 were predatory, as well as 8 of the 15 species collected from beech.

The fauna of the Dinaric beech and fir forest in the Kočevje region has proved to be rich in species which are present in Slovenia only in mountains or are even absent from other regions. The cause for such a result is the relatively high altitude with a cold climate. The number of species is not high, but some species are present in high numbers of individuals.

To our knowledge, this is the first study which is mainly concerned with the arboreal fauna of Heteroptera on fir and beech trees. Faunistic data as such form the basis for our analysis of the diversity, structure, and dynamics of arboreal arthropod communities in primary and anthropogenically disturbed forests in Central Europe (compare Floren & Linsenmair 2001). By including the canopy as a habitat of many forest arthropods, such investigations allow a better understanding of how forest ecosystems function.

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