

## The fauna of cambioxylophagous insects on Scots pine trees declined after spells of drought in 2003

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**ABSTRACT:** The paper deals with cambioxylophagous insects on Scots pine (*Pinus sylvestris* L.) trees. Research was conducted in forest stands growing on steep slopes on the left bank of the Otava River about 1 km north of Písek. These are nearly unmanaged stands of a special-purpose function with the natural occurrence of Scots pine. In total, twenty standing trees at 60 to 160 years of age that died after the spell of drought in 2003 were analysed. The composition of the community of cambioxylophagous insects was recorded in detail. The frequencies of occurrence of particular insect species were determined. In total, 34 species of cambioxylophagous insects were recorded. The order Coleoptera was quite a dominant group and within the order bark beetles (Scolytidae) and longhorn beetles (Cerambycidae) prevailed. The median of the species developing on one tree was 11. *Tomicus piniperda* (L.) was markedly the most frequent species with the frequency of occurrence 90%. Based on the composition of the communities of cambioxylophagous insects the potential importance of the insect in the decline of the analysed Scots pine trees was evaluated. Cambioxylophagous insects probably played a secondary role there.

**Keywords:** community; cambioxylophagous insects; Scots pine; drought spell

At present, Scots pine (*Pinus sylvestris* L.) is the second most widespread tree species accounting for an about 17.5% proportion. However, its natural occurrence is estimated to be 5.6% only. Pine stands occurred naturally only on the subsoil of sandy sediments, serpentine, peat, and on the outcrops of crystalline rocks (so called relict pine forests) and even on limestone. To a certain extent, Scots pine occurred also as an admixture in some other forest communities, for example in stunted oak forests (PRŮŠA 2001). The refuges of Scots pine were e.g. the most extreme rocky sites in canyons of larger rivers in the area of the crystalline complex. For example, the canyon of the Otava River is relatively rich in relict pine and stunted oak forests with the natural occurrence of Scots pine. The best preserved parts of these ecosystems are included in particularly protected parts of nature (nature reserves Krkavčina and Výří skály near Oslov, and natural monuments Dubná and Kopaniny). Communities of many insect

species nutritionally related to pine can be expected just at locations where stands with the natural occurrence of Scots pine have been preserved.

In 2003, the amount of precipitation in Southern Bohemia in February–April was only 49 mm, i.e. not even a half of the long-term normal value, and similarly in June to September, the amount of precipitation was 172 mm, which is only something above a half of the normal amount of precipitation. Already in that year, increased dieback of Scots pine occurred at a number of places in this country. It culminated in 2004 and continued in some places still in 2005. The dieback affected particularly older trees. Pine trees growing on extreme sites of the Otava River canyon are adapted to the permanent lack of water for a long time. Nevertheless, increased dieback of old pines occurred even there after the disastrous dry weather in 2003.

Only a small number of mainly older papers deals with the study of communities of cambioxylopha-

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gous insects on Scots pine. KROGERUS (1927) studied insect communities and their succession on pine stumps. He found that stumps were colonised by the particular insect species depending on the stage of decomposition. NOVÁK (1942) dealt with the quantification, ecology and evaluation of economic importance of the particular species of bark beetles on Scots pine in relation to the snow disaster in the area of Písek district in winter 1939/1940. KUDELA and WOLF (1964) analysed in detail the cambioxylophagous fauna of 115 newly declined pine trees due to air-pollution damage. WALLACE (1953) studied the ecology of the insect fauna of pine stumps in various stages of rot in England. VÄISÄNEN et al. (1993) studied the fauna of cambioxylophagous beetles in pine/spruce stands of Central Finland. Communities of saproxylophagous beetles in Northern Finland were studied in detail by SIITONEN (1994). However, he paid attention to spruce stands in particular. Recently, SIMANDL (1995) dealt with communities of beetles of the storey of crowns of pine stands.

The study of the community of cambioxylophagous insects makes it possible to obtain a basic overview of the species that coexist in the community and that predominate in it. Basic findings on the community of cambioxylophagous insects can be used in many aspects. In this case, it was possible to estimate the importance of cambioxylophagous insects in the dieback of pine after 2003.

## MATERIAL AND METHODS

Research in the cambioxylophagous fauna related to Scots pine was carried out in selected stands on steep slopes of the Otava River with SE to E aspect. The area of investigation was situated in the South-Bohemian Region, former Písek district, cadastre of the village of Topělec, natural forest region 10 – Central-Bohemian Upland (PRŮŠA 2001).

The study included particularly stands of relict rocky pine forests in the forest type 0Z1, stunted oak forests with Scots pine as an admixture in forest

types 1Z3, 1Z7 and 1Z8. In some cases, also Scots pine admixed in oak/hornbeam forests, in scree-woods and artificially established spruce forests (forest types: 2S9, 2C1, 3S9, 3A3 and 3J1) neighbouring with previous ecosystems was involved. In all cases, these are special-purpose forests with an increased soil-conservation function that were left to their natural development (at present nearly free of any management).

To determine the composition of insect species and their frequency of occurrence and also to determine ecological relationships between the particular species of cambioxylophagous insects and host trees, the method of sample trees was used. Standing trees aged about 60–160 years that died in 2003 and 2004 were analysed. These trees were attacked by cambioxylophagous insects mostly as late as in 2004, which made it possible to determine exactly the particular species. Sample trees were processed in the course of the growing season 2004. In total, 20 sample trees were analysed in detail.

The sample trees were felled and barked (including branches). During barking, the presence of the particular species of cambioxylophagous insects was determined on stems and branches. These data served as a basis for the calculation of the frequency of occurrence of the particular species. For better assessment of the effect of cambioxylophagous insects on the dieback of Scots pine the frequency of occurrence was recorded in each of the species in terms of “significant occurrence” or “insignificant occurrence”. “Insignificant occurrence” is the sporadic occurrence of several individuals or feed marks, i.e. such an attack that could not result in the physiological weakening of a tree.

## RESULTS AND DISCUSSION

In sample trees at the studied locality, the development of 34 cambioxylophagous species of insects (Table 1, Fig. 2) was noted on Scots pine (*Pinus sylvestris* L.). Mostly 15 species were found on one tree,

Table 1. The distribution of recorded species among the particular higher taxa

Order	Number of species (%)	Family	Number of species (%)
Hymenoptera	1 (3)	Siricidae	1 (3)
		Buprestidae	4 (12)
		Anobiidae	2 (6)
Coleoptera	33 (97)	Cerambycidae	12 (35)
		Curculionidae	3 (9)
		Scolytidae	12 (35)
Total	34 (100)	–	34 (100)

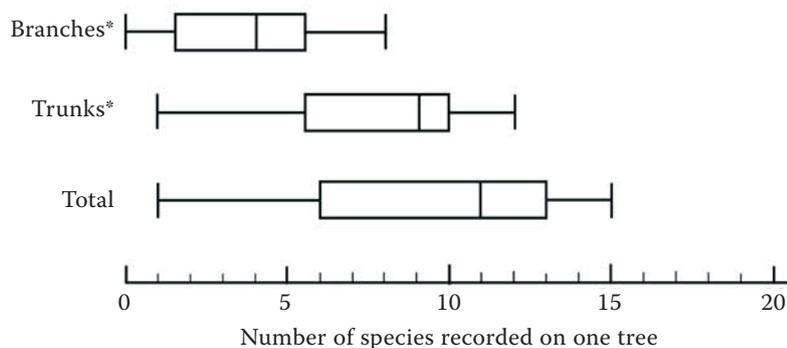


Fig. 1. The distribution of the number of species recorded on branches and trunk of one tree and in total on one tree  
\*Apical parts of trunks with a diameter smaller than 5 cm are considered as branches

the median was 11 (Fig. 1). In total the development of 20 species was recorded on branches and 27 species on tree trunks. Mostly 12 species were found on one tree trunk, where the median was 9, and mostly 8 species developed on the branches of one tree, where the median was only 4 (Fig. 1). Beetles (Coleoptera) were the markedly dominant order. In total, 33 species were found, which corresponds to 97% of all determined species (Table 1). The remaining species (3%) belonged to the order Hymenoptera, family Siricidae. Within the family, Scolytidae and Cerambycidae were most abundant. In each of the families, the occurrence of 12 species was noted, which represents in total 70% of all determined species (Table 1). Buprestidae included 4 species, Curculionidae 3 species and Anobiidae 2 species. During the study of the insect fauna on pine stumps in England, WALLACE (1953) also found beetles to be a dominant group. He found 70 species of beetles, however, only 10 of them were xylophagous species. Scolytidae and Curculionidae are mentioned as dominant families in the first stage of the decomposition of stumps. In the study of subcortical beetles in pine/spruce stands in Central Finland, VÄISÄNEN et al. (1993) found 55 species (not only cambioxylophagous) in virgin-type forest stands and surprisingly more (78) species in commercial stands, where they found a markedly higher proportion of Scolytidae compared to virgin-type forests (50% of all species against 5%).

The highest frequency of occurrence (90%) was observed in *Tomicus piniperda* (L.), which was missing only in two out of the twenty processed sample trees (Fig. 2). The limits of the frequency of occurrence 50% were reached only in further 4 species, namely in *Pissodes piniphilus* (Hbst.), *Tomicus minor* (Htg.), *Rhagium inquisitor inquisitor* (L.) and *Pityophthorus pityographus pityographus* (Ratz.). Similarly, in the study of cambioxylophagous insects in pines damaged by air pollution (KUDELA, WOLF 1964), *Tomicus piniperda* was the most frequent species. *Pissodes* Germ. spp. are mentioned by the authors as the second most frequent taxon. Similarly NOVÁK (1942) reported *Tomicus piniperda* and *T. minor* as

dominant species on pines damaged by a snow disaster. In the study of the insect fauna on pine stumps in England, WALLACE (1953) found the following dominant species in the first stage of the pine stump decomposition: *Hylastes ater* (Payk.), *Hylurgops palliatus* (Gyll.), *Tomicus piniperda*, *Hylobius abietis* (L.) and *Pissodes castaneus* (Deg.).

The occurrence of the relatively rare species *Buprestis octoguttata* L. and of the thermophilic species *Chrysobothris igniventris* Reitt. is worth mentioning (Fig. 2). The latter species occurred in crowns and on stems of the diameter even over 10 cm. BÍLÝ (1989) reported its development only in branches, namely in the warmest areas of the Czech Republic. Somewhat surprising is the abundant occurrence of *Acanthocinus griseus griseus* (F.) (45% of sample trees; Fig. 2), which according to SLÁMA (1998) develops on pine quite exceptionally. Cambioxylophagous insects were also accompanied by a number of other insect species. Their more detailed study, however, was not the aim of this paper. Nevertheless, it is suitable to mention the abundant occurrence of *Pytho depressus* (L.). In this country, this beetle is considered to be a rare glacial relict that occurs only in mountain spruce and some relict pine forests.

As for the found species, particularly *Ips acuminatus* (Gyll.) and *Pityogenes chalcographus* (L.) are regarded as aggressive and dangerous. However, *Tomicus minor*, *T. piniperda*, *Pissodes piniphilus* and *Melanophila cyanea* are also considered to be dangerous. The capability of these species to cause the death of healthy trees is uncertain. The low potential of *Pityogenes chalcographus* to cause separately the dieback of healthy spruce (*Picea abies* [L.]) trees was proved by research carried out by HEDGREN (2004). Similarly, *Ips acuminatus* is a secondary pest which attacks particularly weakened trees (e.g. due to drought) or newly declined trees (e.g. trees after felling, breaks, windfalls etc.). During outbreak, it can attack even seemingly quite healthy trees (MRÁČEK 1995). *Ips acuminatus* occurred with the frequency of significant occurrence only 5% (Fig. 2). *Pityogenes chalcographus* was somewhat more fre-

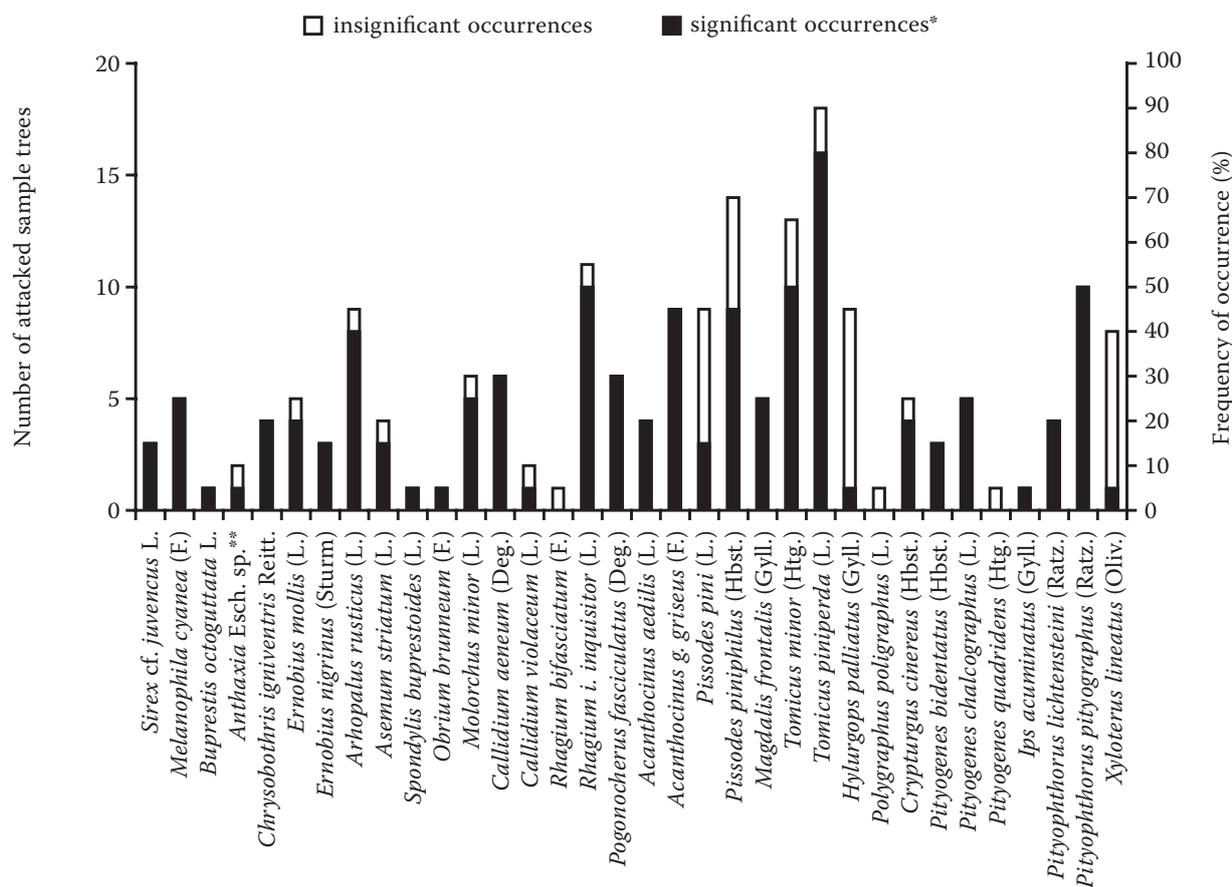


Fig. 2. The frequency of occurrence of recorded species

\*Insignificant sporadic occurrences of several individuals or feed marks that could not affect the physiological condition of the tree are disregarded (see the Material and Methods section)

\*\*The species is not exactly determined, but it is one of the following species of the genus *Anthaxia* (*Melanthaxia* Richt.) that occur in the locality: *A. godeti* Lap. et Gory; *A. helvetica* Strierl.; *A. quadripunctata* (L.) and *A. similis* (Sound.)

quent reaching the frequency of occurrence 25%. The highest frequency of significant occurrence was recorded in *Tomicus piniperda* and *T. minor*. Both the species are considered to be secondary, however, they can accelerate the disintegration of otherwise damaged stands. It is of interest that in the north of Europe, *T. piniperda* behaves considerably more aggressively being able to attack seemingly quite healthy trees (LÄNGSTRÖM, HELLQVIST 1992). *Pissodes piniphilus* showed the high frequency of significant occurrence (45%). According to KUDELA (1974), it is a secondary species, however, in the case of outbreak it is able to attack nearly healthy trees. It is the most aggressive species of the genus *Pissodes*. ESCHERICH (1923) evaluated the species in a similar way, however, he stated that serious damage was caused particularly in younger pole-stage stands. Some other species able to attack living but rather weakened trees (e.g. *Melanophila cyanea* [F.], *Pityogenes bidentatus* [Hbst.] and *P. quadridens* [Htg.]) did not occur very often and

the frequency of their significant occurrence did not reach 30%. The high frequency of significant occurrence (at least 30%) was reached by numerous secondary species which attacked only dying or dead trees: *Pityophthorus p. ptyographus*, *Rhagium i. inquisitor*, *Acanthocinus g. griseus*, *Pogonocherus fasciculatus* (Deg.), *Arhopalus rusticus* (L.) and *Callidium aeneum* (Deg.).

## CONCLUSION

In total, 34 species of cambioxylophagous insects were recorded. It forms a species-rich community of nearly unmanaged forests with the natural occurrence of Scots pine. Considering the applied methodology the species related exclusively to underground parts of trees and the species colonising more rotten wood were not recorded. Of course, certain more rare species were not found. It would be necessary to process more sample trees for their detection. However, the composition of the com-

munity of cambioxylophagous insects on standing newly declined pines at the locality under study was described in detail. In this community, beetles (Coleoptera) predominate absolutely and within this order Scolytidae and Cerambycidae prevail.

It is very questionable to evaluate the causes of the dieback of pines after drought in 2003 retrospectively. Nevertheless, on the basis of the determined composition of cambioxylophagous insects it is possible to estimate the rate of participation of the insect species in the dieback of analysed pines. In some cases, cambioxylophagous insects could significantly accelerate their dieback, however, it was not probably its primary cause. Generally, it is possible to conclude that particularly *Pissodes piniphilus*, *Tomicus piniperda* and *T. minor* were most important for accelerating the dieback of pines weakened by drought, mainly with respect to the high frequency of their occurrence and, in comparison with the other secondary species, high potential to attack still living trees. Markedly aggressive species (*Ips acuminatus* and *Pityogenes chalcographus*) occurred surprisingly rarely on dead pines. Thus, their significant outbreak did not take place and the species did not endanger living pines even in the subsequent year.

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## Fauna kambioxylofágního hmyzu na borovicích lesních odumřelých po průsušcích v roce 2003

**ABSTRAKT:** Práce pojednává o kambioxylofágním hmyzu na borovici lesní (*Pinus sylvestris* L.). Výzkum probíhal v porostech ležících na strmých svazích nad levým břehem řeky Otavy necelý 1 km severně od města Písku. Jde o téměř neobhospodařované porosty zvláštního určení s přirozeným zastoupením borovice lesní. Analyzovali jsme celkem 20 stojících stromů ve věku 60–160 let, které odumřely po suchu v roce 2003 (v letech 2003 a 2004). Bylo podrobně zachyceno složení společenstva kambioxylofágního hmyzu a zjištěny frekvence výskytů jednotlivých druhů. Celkem bylo zaznamenáno 34 druhů kambioxylofágního hmyzu. Zcela dominantní skupinou byl řád brouci (Coleoptera) a v jejich rámci pak kůrovci (Scolytidae) a tesaříci (Cerambycidae). Výrazně nejčastějším druhem byl *Tomicus piniperda* (L.) s frekvencí výskytu 90 %. Na základě zjištěné skladby společenstev kambioxylofágního hmyzu

byl zhodnocen význam, který mohl tento hmyz mít při odumírání analyzovaných borovic. Kambioxylofágní hmyz zde pravděpodobně sehrál druhotnou roli.

**Klíčová slova:** společenstvo; kambioxylofágní hmyz; borovice lesní; přísušek

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