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Abstract

Proceedings of the Third Meeting of Forest Protection and Forest Phytosanitary Experts, October 14-16, 2009, Vienna, Austria

Native pests and diseases, invasive alien species and especially the problems with ash dieback were again the reason of an expert meeting at the Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW) which was held from 14th to 16th October 2009 in Vienna. For this occasion 66 participants from 16 Central, South and North European countries and Turkey took the opportunity for an exchange of information. As practiced during the two meetings before, most of the time was dedicated to discussions and informal talks. Papers of the oral and poster presentations are provided in this issue.

Content

Preface

Between October, 14th and 16th 2009 the Third Meeting of Forest Protection and Phytosanitary Experts was held in Vienna at the Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW).

On this occasion 66 participants from 16 countries out of Central and Northern Europe, and even two experts of the Asian part of Turkey, discussed current forest protection problems, unknown abiotic and biotic damages in different tree species, and the current situation of invasive pest species in their countries. Special emphasis was given on the ash dieback phenomenon, which has become a major disease in European forests. Furthermore, invasive alien species played a major role in presentations and discussions. Because of unforeseeable problems, it took nearly three years to publish the given presentations. Therefore, it has to be kept in mind that some conclusions, especially those dealing with ash dieback may no longer represent the current state of knowledge.

For February 2013, the Fourth Meeting of Forest Protection and Phytosanitary Experts is planned to be held in Vienna at the Federal Research and Training Centre for Forests, Natural Hazards and Landscape.

Christian Tomiczek

Major Forest Damaging Agents in Slovakia

Andrej Kunca, Milan Zúbrik, Roman Leontovyč, Jozef Vakula, Bohdan Konôpka, Andrej Gubka, Juraj Galko, Valéria Longauerová, Christo Nikolov, Slavomír Find'o, Juraj Varínsky and Peter Kaštier

Abstract

In the first half of the 1990s, after the breakdown of the communist regime in Slovakia in 1989, the State forests enterprise began to return forests to previous owners; so they cut less, even incidental felling was reduced (1.5 mil. m^3 – 50 %). There were major wind calamities (2002, 2004 and 2007) and new restricting law on nature protection in 2002. All these three factors significantly contributed to the present enormous bark beetle calamity (mostly *Ips typographus*) in Norway spruce forests over whole Slovakia. The major fungal damaging agent in Slovakia is *Armillaria* sp. Ash dieback caused by *Chalara fraxinea* has been causing damage in large areas since 2004.

Keywords | pest agents, bark beetles, ash dieback, wind calamity

Kurzfassung

Die wichtigsten Faktoren für Forstschäden in der Slowakei

In der ersten Hälfte der 1990er Jahre, nach dem Zusammenbruch des kommunistischen Regimes in der Slowakei (1989), begann der Staatsforstbetrieb, Wälder an die früheren Besitzer zurückzugeben. Die Folge war ein geringerer Einschlag, auch die Zufallsnutzungen gingen zurück (1,5 – 5 Mio. m^3 – 50 %). Es gab große Windwurfkalamitäten (2002, 2004 und 2007) und ein neues einschränkendes Naturschutzgesetz im Jahr 2002. Diese drei Faktoren trugen hauptsächlich zu den enormen Borkenkäferkalamitäten (in erster Linie *Ips typographus*) in Fichtenwäldern, verteilt über die ganze Slowakei, bei. Der wichtigste pilzliche Schaderreger ist *Armillaria* sp. Das Eschentriebsterben durch *Chalara fraxinea* verursacht seit 2004 Schäden auf großer Fläche.

Schlüsselwörter | Forstschädlinge, Borkenkäfer, Eschentriebsterben, Windwurfschäden

Introduction

Forest coverage of Slovakia is 1.9 mil. ha and that is 40 % of the total area of the Slovak republic. The most common tree species is European beech (*Fagus sylvatica*, 31 %), followed by Norway spruce (*Picea abies*, 26 %), oak (*Quercus* spp., 13 %), pine (*Pinus* spp., 7 %), and other tree species (23 %). Slovakia is situated in Central Europe and has five neighboring countries: Ukraine, Poland, the Czech Republic, Austria and Hungary.

Incidental felling

Looking back to the 1980s, averaged annual incidental felling was about 2 mil. m^3 (35 % of total felling). In the first half of the 1990s, after the breakdown of the communist regime in Slovakia in 1989, the State forests enterprise began to return forests to previous owners; cut less, even incidental felling was reduced (1.5 mil. m^3 – 50 %). There were major wind calamities in November 2002 (0.5 mil. m^3), on November 19, 2004 (named Alžbeta, 5.3 mil. m^3; Kunca and Zúbrik 2006) and on August 23, 2007 (named Filip, 1.2 mil. m^3). Another important factor influencing incidental felling was a new law on nature protection that came into force in 2002. So all three major wind calamities mentioned above (from 2002 through 2007) were not processed completely due to a long administration process to get exceptions from large restrictions. As a result the cumulative bark beetle calamity has been rising till now. Incidental felling has increased from 2 mil. m^3 in 2002 to 5 mil. m^3 in 2008 (Figure 1). The only responsible pest agent is bark beetle (Kunca et al. 2009a, b).

But the bark beetle calamity arose not only in protected areas (national parks, NATURA 2000) but also in production forests. There were several reasons for this situation, such as insufficient network of forest roads and lack of money to process all calamity wood. State as well as non state owners processed only the wood they were able to sell immediately. If this was not possible, damaged or infested wood was left in the stands.

Reasons for bark beetle calamity

One of the major historical mistakes was abandoning the practice of debarking Norway spruce logs. This took place in the late 1970s in order to lower expenses on wood production. This idea was strengthened by a new bark beetle control attempt with massive use of pheromone traps. Later researchers proved that pheromone traps can decrease population of bark beetles by not more than 30 %. Industrial emissions, global climate change (climate warming), economical depression, personal restructure of State forests enterprise (decreasing employment from approx. 9,000 in 1999

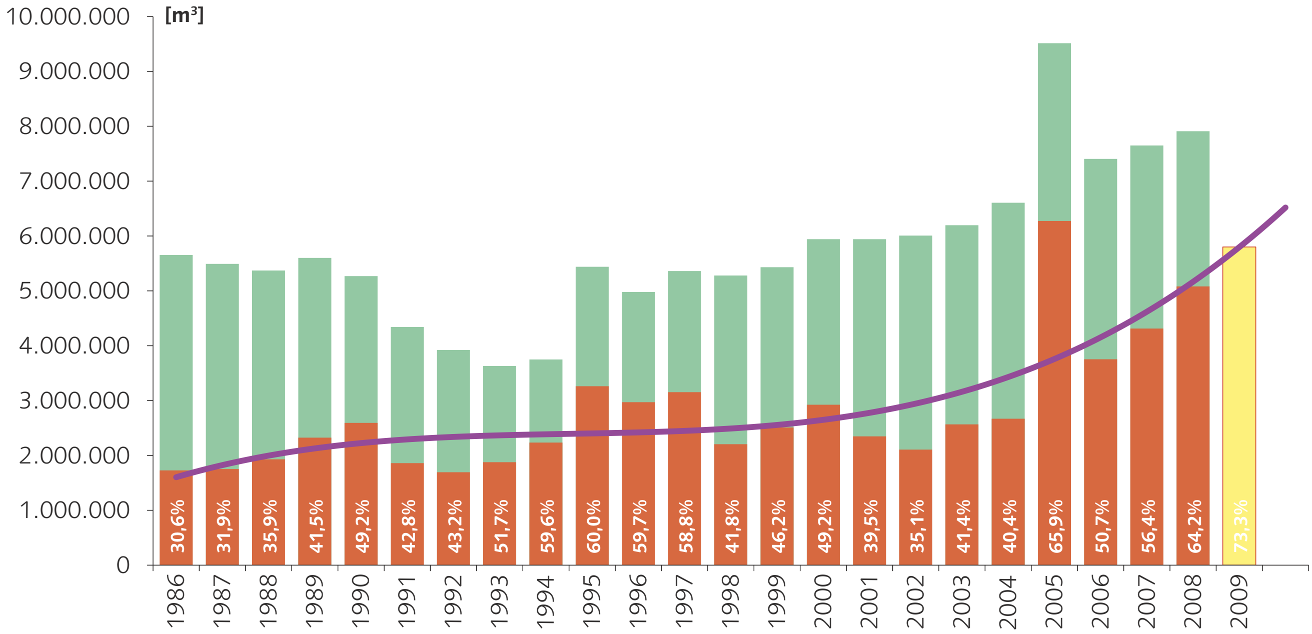

Figure 1: Development of total and incidental (red) felling (yellow; extrapolation for 2009).

Abbildung 1: Entwicklung der Gesamtnutzung und der zufälligen Nutzungen (rote Anteile) in der Slowakei (gelb: Hochrechnung für 2009).

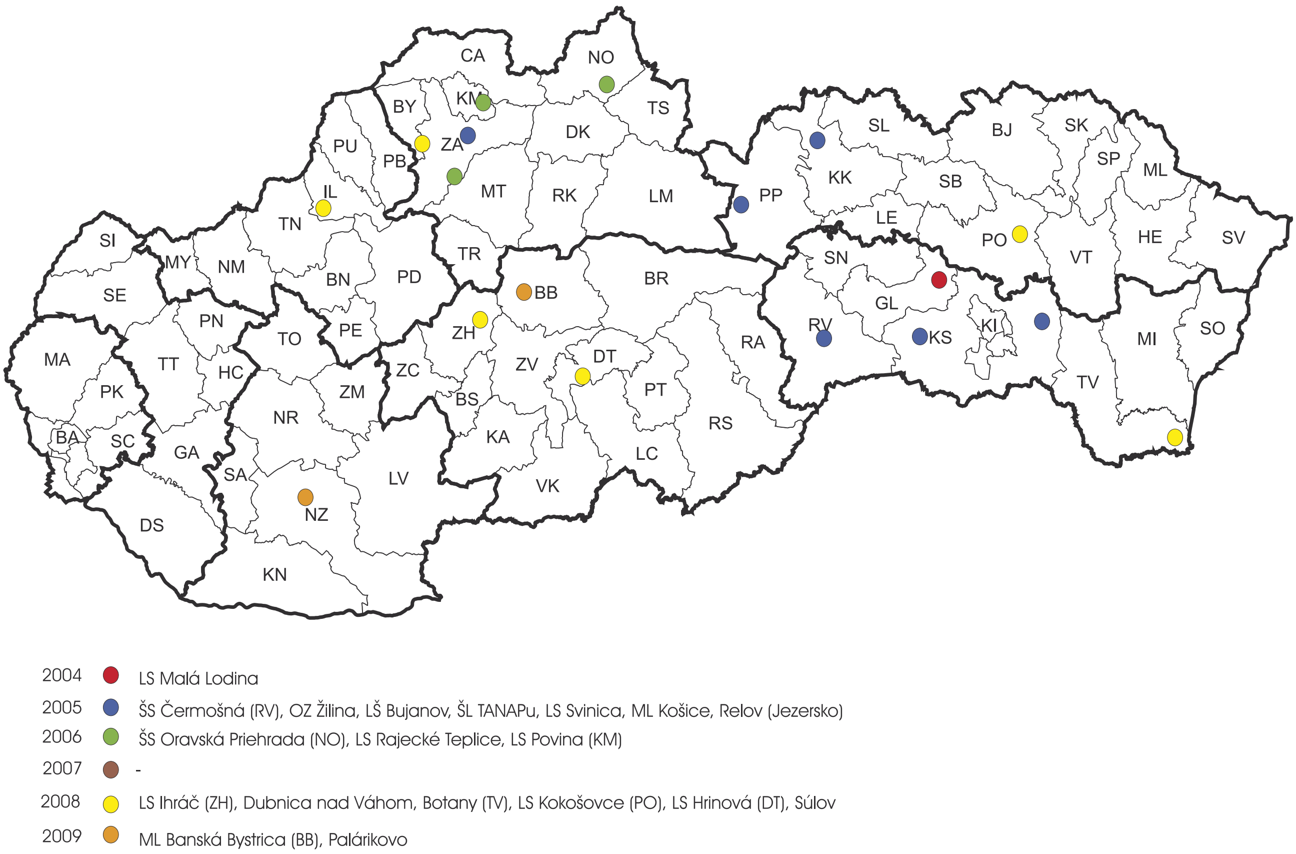

Figure 2: Occurrence of ash dieback from 2004-2009. Colors indicate year of first record.

Abbildung 2: Auftreten des Eschentriebsterbens zwischen 2004 und 2009. Die Farben kennzeichnen das Jahr des Erstnachweises.

to 3,000 in 2008) added to bad forest management. As there are still less people employed in forest enterprises, core activities like silviculture, forest protection management, felling etc. are carried out by external companies that have different relation to proper forest work. As a result infected wood is not debarked or properly treated with insecticides; wood debris after felling is not fired or chipped in time and the main motive of work is the amount of wood stated in the agreement not the amount of calamity wood still standing in the forest (Kunca et al. 2007).

The most dangerous bark beetle is the Spruce bark beetle *Ips typographus*. Then there are *Pityogenes chalcographus*, *Ips duplicatus* and *Ips amitinus* (Kunca and Zúbrik 2008; Vakula et al. 2008; Zúbrik et al. 2008). Forest research specialists set up a monitoring of these species (*I. duplicatus* monitoring since 2001) and inform foresters about the results by "Signal reports" every one to two months on up to ten pages distributed by email to more than 200 foresters.

Fungal diseases

The main fungal pest agent is *Armillaria* sp. It mostly occurrs on Norway spruce (*Picea abies*) in mountains. Many times it is accompanied by *Heterobasidion annosum*. We have some localities with *Phytophthora alni* ssp. *multiformis* such as Malužina (proved in 2005). Oak dieback is connected with *Ophiostoma* and *Ceratocystis* spp. as well as with *Phytophthora* sp. and climatic stress. The new dieback of ash (*Fraxinus excelsior*) has been devastating large areas since 2004 (Figure 2). The fungus *Chalara fraxinea* is the main reason and is follwowed by bark beetle *Leperisinus fraxini*.

Abiotic pest agents

Wind is the most dangerous abiotic damaging agent. The largest wind calamity happened on November 19, 2004 (5.3 mil. m^3), smaller wind calamities were in October and November 2002 (0.5 mil. m^3) and on August 23, 2007 (1.2 mil. m^3). Smaller calamities are caused by snow (winter 2005/2006) or ice (1999). Drought is the most important physiological abiotic pest agents. It occurred in 2000 and 2003.

Other pest agents

The volume of wood damaged by emissions is decreasing. There are some fires but not as important as in southern Europe. Game damage is located in areas where they have enough food.

Conclusions

Bark beetles and wind are the most important pest agents in Slovakia. The control of bark beetles is influenced by a strict law on protected areas and a bad forest management – that is cheaper but not functioning. We expect to have more bark beetle calamity till the coverage of Norway spruce will decrease from 26 % (515,000 ha) in 2000 to 10 % (200,000 ha) in 2030.

Acknowledgements

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The Current Forest Protection Situation in the Southwest of Germany

Horst Delb

Abstract

Altogether the forest protection situation during the vegetation period of 2009 was less critical than in the years before. This was mainly due to favourable weather conditions. The oak processionary moth seems to be causing permanent problems. Cockchafers continue to be a serious threat for forest regeneration within stands of the Northern Upper Rhine Valley. Recently, considerable damage of European silver fir stems is caused by wolly aphids accompanied by a subsequent weevil infestation. For the first time ever ash dieback has been observed as an important disease.

Keywords | forest protection, bark beetle, incidental felling, forest pests, climate change

Kurzfassung

Die aktuelle Waldschutz-Situation im Südwesten Deutschlands

Insgesamt war die Waldschutzsituation während der Vegetationsperiode 2009 vergleichsweise entspannt. Dies kann auf die weitgehend günstige Witterung zurückgeführt werden. Der Eichenprozessionsspinner scheint sich zum Dauerproblem zu entwickeln. Der Maikäfer ist nach wie vor für die Verjüngung der Wälder in der nördlichen Oberrheinebene eine große Gefahr. Beachtliche Schäden verursachen derzeit Tannenstammläuse in Verbindung mit Rüsselkäfern. Daneben spielt auch das erstmals festgestellte Eschentriebsterben eine bedeutende Rolle.

Schlüsselwörter | Forstschutz, Borkenkäfer, Zufallsnutzungen, Waldschädlinge, Klimawandel

Introduction

The current situation in the Southwest of Germany in 2009 can be assessed according to advisory activities, annual forest pest monitoring, observations in certain long term investigation areas and the consideration of incidental felling statistics. In this paper, the most important topics are presented.

Bark beetles and Norway spruce

On Norway spruce, bark beetles (mainly *Ips typographus*) cause by far the most damage. E.g., in Rhineland-Palatinate, incidental felling due to insects from 1999 to 2008 amounted 96 %.

Reviewing incidental felling statistics for the past eleven years (Figure 1), the year 2001 after the winter gale “Lothar” 1999 in Baden-Württemberg (Figure 1a) and the years close to the drought periods in 2003 and 2006 (Figures 1a and 1b) demonstrate outstanding amounts of damaged trees.

Despite the winter gale “Kyrill” in January 2007 in Rhineland-Palatinate subsequent serious economic losses due to bark beetle infestation could be limited by effective and powerful control measures and tree processing methods. Additionally, the considerably rainy weather conditions especially in 2007 supported resistance of the forests. This continued trough to 2009. Dry and warm weather conditions at the end of the vegetation period in 2009 did not initiate any further bark beetle damage.

Forest pests on other tree species

The infestation of beech by bark breeding beetles (*Agrilus viridis*, *Taphrorychus bicolor*) in Baden-Württemberg triggered by the dry years of 2003 and 2006 significantly decreased during the last two years.

Tree losses caused by oak splendour beetle (*Agrilus biguttatus*) decreased as well. This can mainly be related to the absence of supra-regional outbreaks of defoliators. However, notable defoliation by caterpillars of the European oak leaf-roller (*Tortrix viridana*) occurred in the northeast of Baden-Württemberg in spring 2009. Additionally, there are some indications that gypsy moth (*Lymantria dispar*) might reach conspicuous densities again in the next few years.

Meanwhile, the oak processionary moth *(Thaumetopoea processionea)* is permanently present almost throughout the entire oak forest area (Figure 2). Serious defoliation is observed more frequently. Only in the northern part of Rhineland-Palatinate, no defoliation has been noticed although climatic conditions are rather favourable.

The cockchafer (*Melolontha* sp.) is still a persistent and continues to be a serious problem in forest stands of the northern Upper Rhine Valley. Root feeding of cockchafer grubs causes considerable losses affecting the forest regeneration. In this area, the dominating pine trees in the upper story are frequently weakened by mistletoe and subsequently attacked by bark

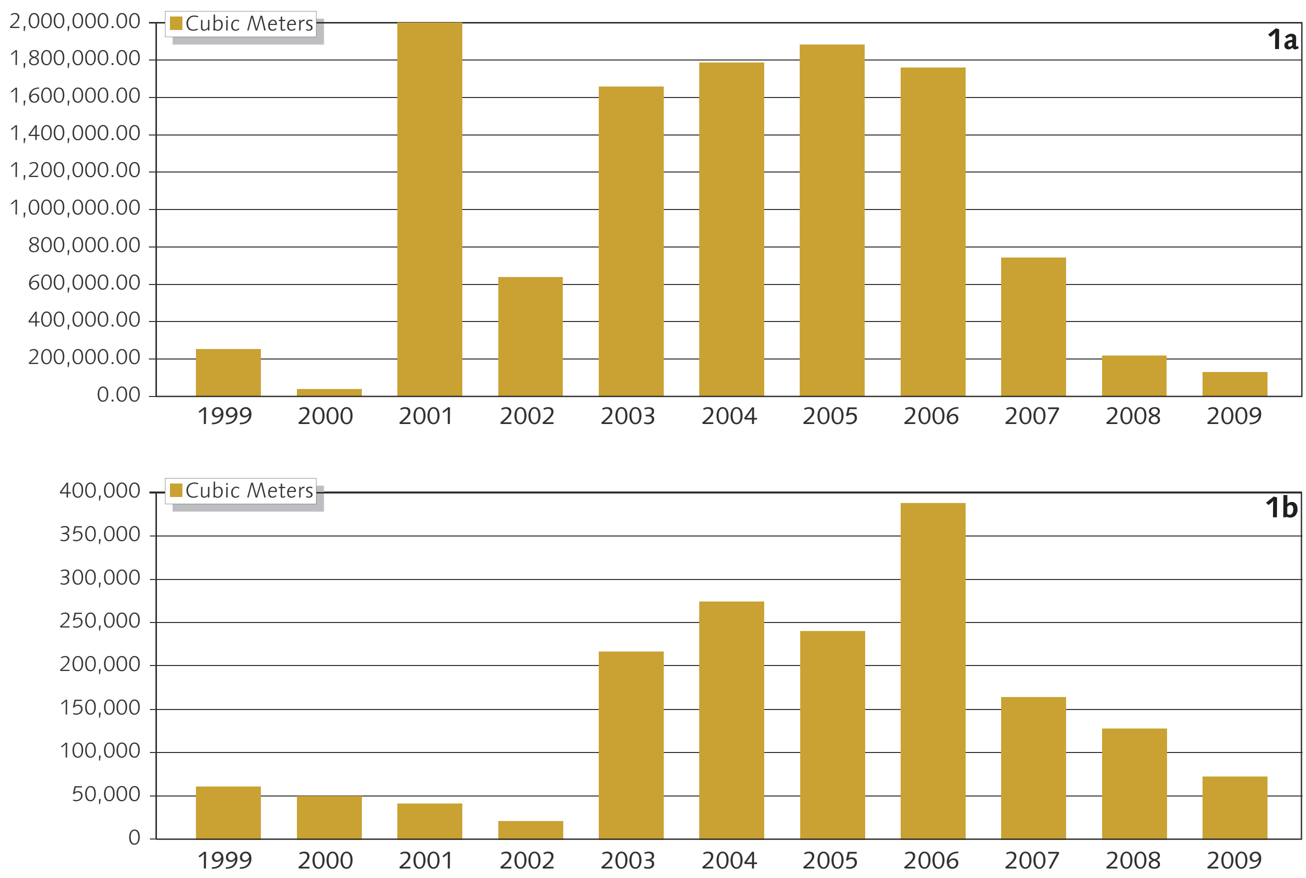

Figure 1: Incidental felling due to insect damage in Baden-Württemberg (1a: Norway spruce) and in Rhineland-Palatinate (1b: all tree species), 1999-2009 (Source: ForstBW and Landesforsten Rhineland-Palatinate).

Abbildung 1: Durch Insektenschäden verursachter Holzeinschlag in Baden-Württemberg (1a: Fichte) und Rheinland-Pfalz (1b: alle Baumarten), 1999-2009 (Quelle: ForstBW und Landesforsten Rheinland-Pfalz).

beetles. Hence, there is considerable concern about the loss of young trees and the lack of regeneration.

Since 2007, woolly aphids *(Dreyfusia* sp.*)* have become more abundant in European silver fir stands in Baden-Wuerttemberg (John 2009). The phloem sucking of aphids at stems may weaken the trees considerably. Subsequently trees are attacked and finally killed by the European fir weevil (*Pissodes piceae*; Figure 3).

In the Southwest of Germany, the importance of quarantine organisms increases steadily. For example, the Asian long-horned beetle (*Anoplophora glabripennis*) infested living trees at the Rhine harbour of Straßbourg/France close to the border to Baden-Wuerttemberg in 2008. Furthermore living larvae were found in packaging wood at the Zweibrücken Airport in Rhineland-Palatinate in 2009.

The ash dieback caused by the fungus *Chalara fraxinea* has also become relevant in the Southwest of Germany (Metzler 2009). The first reported damage and definitive symptoms appeared in spring 2009 mainly in regeneration areas. Because of the high ratio of ash in plantations the Upper Rhine Valley is predominantly affected.

Conclusions

Altogether the forest protection situation during the vegetation period of 2009 was less critical. This can be deduced first and foremost from the amount of incidental felling due to Norway spruce bark beetle attack compared to the previous years. Nevertheless, it is commonly accepted that gales and drought periods are supposed to occur more frequently in the context of climate change. The significance of these abiotic incidences for the occurrence and better development of harmful pests is reflected in the trends of the last ten years. Accordingly it can be assumed that the forest protection situation may return to a critical status again rapidly. Moreover, new diseases and invasive insects as well as periodic outbreaks of native species threaten forest health. Hence, the alertness of qualified forest protection experts still will be required.

Figure 2: Map of Forest Districts (red colour) where oak processionary moth, occurred from 2000-2009.

Abbildung 2: Karte der Forstbezirke (rote Farbe) mit Vorkommen des Eichenprozessionsspinners 2000-2009.

German – Deutsch

Einleitung

Die aktuelle Situation 2009 kann während des Jahres anhand von Beratungsfällen, der jährlichen Schädlingsüberwachung, von Beobachtungen auf Versuchsflächen und mit Hilfe von Statistiken zum Schadholzanfall beurteilt werden. Im Folgenden wird ein kurzer Überblick zu den wichtigsten Themen gegeben.

Borkenkäfer und Fichte

Quantitativ verursachen Borkenkäfer an Fichte, hauptsächlich der Buchdrucker (*Ips typographus*), die mit Abstand höchsten Schäden. So beträgt in Rheinland-Pfalz der Anteil der Fichte beim zwischen 1999 und 2008 durch Insektenschäden verursachten Holzeinschlag rund 96 %.

Bei Betrachtung des durch Insektenschäden in den letzten elf Jahren verursachten Holzeinschlags (Abbildung 1) ragen das Jahr 2001 nach dem Orkan „Lothar" 1999 in Baden-Württemberg (Abbildung 1a) und die Jahre um die Dürren 2003 und 2006 (Abbildung 1a und 1b) heraus.

In Rheinland-Pfalz haben vor allem die in der Vegetationsperiode 2007 vergleichsweise regenreiche Witterung und die konsequente Aufarbeitung des Sturm- und Käferholzes schwer wiegendere Schäden nach dem im Januar 2007 aufgetretenen Sturm „Kyrill" verhindert. Dies setzte sich bis in das Jahr 2009 fort. Das trocken-warme Wetter zum Ende der Vegetationsperiode hatte keine gravierenden Auswirkungen mehr.

Sonstige Schaderreger und Baumarten

Bei der Buche war die Befallssituation durch Rindenbrüter während der Vegetationsperiode entspannt. Die in Baden-Württemberg nach den Trockenjahren 2003 und 2006 gestiegene Populationsdichte des Buchenprachtkäfers (*Agrilus viridis*) und des Kleinen Buchenborkenkäfers (*Taphrorychus bicolor*) geht seit zwei Jahren insgesamt wieder zurück.

Gegenüber den Vorjahren sind auch bei der Eiche dem Prachtkäfer (*Agrilus biguttatus*) weniger Bäume zum Opfer gefallen. Dies ist vor allem auf die in den letzten Jahren ausgebliebenen überregionalen Massenvermehrungen blattfressender Raupen zurückzuführen. Jedoch hat der Eichenwickler (*Tortrix viridana*) im Frühjahr 2009 im nordöstlichen Baden-Württemberg wieder starke Fraßschäden verursacht. Zudem mehren sich die Anzeichen, dass der Schwammspinner (*Lymantria dispar*) wieder stärker in Erscheinung treten könnte.

Der Eichenprozessionsspinner (*Thaumetopoea processionea*) tritt in den Eichenwäldern mittlerweile fast flächendeckend und dauerhaft auf. Immer häufiger bewirken die Raupen auch Kahlfraß. Nur in den nördlichen Landesteilen von Rheinland-Pfalz ist er trotz teils günstiger klimatischer Voraussetzungen noch nicht aufgetreten (Abbildungen 2).

Ein weiteres Dauerproblem ist der Maikäfer (*Melolontha* sp.) in der nördlichen Oberrheinebene. Die durch den Engerlingsfraß entstehenden Wurzelschäden können vor allem an der Waldverjüngung zu erheblichen Ausfällen führen. Da die dort vorherrschenden Kiefern

Figure 3: Galleries of European silver fir weevil (*Pissodes piceae*).

Abbildung 3: Brutbild des Weißtannenrüsselkäfers (*Pissodes piceae*).

im Oberstand durch Mistelbefall zum Teil erheblich geschwächt sind und von Rindenbrütern befallen werden, ist der Verlust der Verjüngung für die Waldwirtschaft besonders besorgniserregend.

An Weißtannen treten in Baden-Württemberg seit 2007 in zunehmendem Maße Läuse auf (*Dreyfusia* sp.; John 2009). Die Stammlaus schwächt die betroffenen Bäume offenbar so sehr, dass es in der Folge zu einem Befall durch den Tannenrüsselkäfer (*Pissodes piceae*; Abbildung 3) und dem Absterben betroffener Tannen kommen kann.

Die Bedeutung von Quarantäne-Schadorganismen nimmt auch in Südwestdeutschland stets zu. Besonders erwähnenswert ist das bereits 2008 festgestellte Auftreten des Asiatischen Laubholzbockkäfers (*Anoplophora glabripennis*) in Straßburg/Frankreich an stehenden Bäumen im Rheinhafen, unmittelbar an Baden-Württemberg angrenzend. Außerdem wurden am rheinland-pfälzischen Flughafen Zweibrücken 2009 in Verpackungsholz lebende Larven gefunden.

Das durch den Pilz *Chalara fraxinea* ausgelöste Eschentriebsterben spielt auch in Südwestdeutschland eine große Rolle (Metzler 2009). Die ersten nennenswerten Schäden sind im Frühjahr 2009 vor allem auf Verjüngungsflächen aufgetreten. Die Oberrheinebene ist aufgrund des hohen Eschenanteils besonders betroffen.

Fazit

Insgesamt war die Waldschutzsituation während der Vegetationsperiode 2009 relativ entspannt, was vor allem das Ausmaß des durch Borkenkäfer verursachten Fichtenschadholzes im Vergleich zu den Vorjahren zeigt. Doch wird infolge der zu erwartenden Klimaänderungen gemeinhin von häufigeren Orkanen und sommerlichen Dürreperioden ausgegangen. Welchen bedeutenden Einfluss derartige Ereignisse für das Schädlingsgeschehen haben, zeigt die Entwicklung in den letzten zehn Jahren. Vor diesem Hintergrund muss ständig davon ausgegangen werden, dass die Situation schnell wieder ins kritische Gegenteil umschlagen kann. Außerdem spielen immer wieder neue Krankheiten, Dauerschädlinge und zyklisch wiederkehrende Massenvermehrungen eine bedeutende Rolle. Deshalb ist weiterhin eine ständige Aufmerksamkeit qualifizierter Waldschutzexperten erforderlich.

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Current Health Situation of Oak in Bavaria

GABRIELA LOBINGER

Abstract
In the warm and dry regions of Northern Bavaria regular mass propagations of oak pests occur. Since some years, expansion of the range as well as increase population densities of the oak processionary moth *(Thaumetopoea processionea)* has been observed. Besides the damage of oak due to defoliation the caterpillar's urticating hairs cause health problems for humans. Prognosis and well-aimed control measures turn out to be difficult for lack of experience with this pest insect. In 2009, a new constellation of damaging agents with combined feeding of *Tortrix viridana* and *T. processionea* followed by massive oak mildew infestation occurred, which requires intense prognosis activities and special control measures in 2010.

Keywords | oak pests, oak processionary moth, prognosis, control

Kurzfassung
Aktuelle Situation der Eiche in Bayern

In den warm-trockenen Regionen Nordbayerns kommt es regelmäßig zur Massenvermehrung von Eichenschädlingen. Seit einigen Jahren werden dort räumliche Ausbreitung und dauerhaft erhöhte Populationsdichten beim Eichenprozessionsspinner beobachtet. Neben regional starkem Fraß an Eiche verursachen die giftigen Brennhaare der Raupe gesundheitliche Beeinträchtigungen. Schadensprognose und situationsgerechte Bekämpfungsmaßnahmen gestalten sich mangels Erfahrung mit diesem Schädling schwierig. Die 2009 neu aufgetretene Fraßkombination von Eichenwickler, Eichenprozessionsspinner und Eichenmehltau erfordert intensive Prognosemaßnahmen und gezielte Bekämpfungsaktionen 2010.

Schlüsselwörter | Eichenfraßgesellschaft, Eichenprozessionsspinner, Prognose, Bekämpfung

Introduction

Oak stands of the warm and dry regions of Northern Bavaria are the areas of mass propagation of oak leafroller *(Tortrix viridana)*, winter moth *(Erannis defoliaria)* and gypsy moth *(Lymantria dispar)*. Now the oak processionary moth *(Thaumetopoea processionea)* has also become established in this region. The development of *T. processionea*-infestation and the special pest situation on oak 2009 is shown.

Oak processionary moth in Bavaria: range, damage and control measures

Since some years the oak processionary moth showed a clear tendency to expand its range. Moreover, massive feeding damage and high infestation levels partly occur also within forest stands at the hot spots. . This situation causes problems for forestry practice because there is hardly any experience concerning the consequences of feeding damage for the oak and the population dynamics of the insect. In addition to the human health hazard posed by the urticating hairs of the caterpillar, outbreaks cause disturbance of the recreational function of the forests and of forest management.

It could be shown that healthy oak trees can tolerate defoliation for several years without damage under favourable environmental conditions. However, there may be serious consequences for the trees under unfavourable weather or site conditions. A decision on the necessity of control measures requires knowledge of these correlations and of thresholds and limiting factors for development and reproduction of *T. processionea*. E.g., eggs survive very low winter temperatures (-28 °C; personal communication N. Meurisse 2009) while young larvae are highly susceptible to low temperatures. There is only limited knowledge of the thresholds of older larvae, pupae and the moth as well as the impact of natural enemies. In 2009, numerous larvae and adults of *Calosoma sycophanta* (Figure 1) occurred at the nests and preyed in colonies of larvae. Also ovipositing tachinid flies (Figure 2) and

Figure 1: *Calosoma sycophanta* preying in a pupation nest of the oak processionary moth.

Abbildung 1: Großer Puppenräuber (*Calosoma sycophanta*) in Verpuppungsnest des Eichenprozessionsspinners.

Figure 2: Tachinid fly ready to oviposit on newly moulted larvae of the oak processionary moth.

Abbildung 2: Raupenfliege (Tachinidae) bereit für die Eiablage an frisch gehäuteten Raupen des Eichenprozessionsspinners.

large numbers of tachinid pupae were found at the oak processionary moth pupation nests.

A special problem with oak processionary moth is risk analysis and damage prognosis. Conventional methods like mapping of defoliation, counting of pupation nests and egg clusters are not practicable for the future. The aim is to develop a pheromone-based prognosis-system. A suitable pheromone lure and a trap type fitting for the flight behaviour of the moth are available; now a suitable design for trap installation has to be established and reliable correlations between trap-catches, infestation level and feeding damage have to be elaborated.

Decision for control measures against *T. processionea* in forests in Bavaria can be based on forest protection or on the preservation of forest functions. The latter implies that there are serious problems for human health because of proximity of infested areas to settlements or public facilities or that forest management is not possible. There are divergent opinions about the success of treatments. While feeding damage can be successfully prohibited in most cases disturbance of human health often continue despite the control measures, because urticating hairs in old nests remain active for several years. In addition, the treated areas are quickly resettled by the highly mobile moths. Outside forests biozide application and mechanical removal of nests are used for control. These methods are labour intensive and costly and are, hence, only suitable for small-scale application. Their efficiency is often low.

Special situation on oak in 2009 – outlook 2010

In 2009, partly massive feeding damage by *T. viridana* and several species of Noctuidae (*Orthosia* spp.) occurred already before leaf eruption. After pupation of the oak leafroller, foliage was renewed by regeneration shoots. At this early time the new leafs were heavily infested by oak mildew (*Microsphaera alphitoides*). After that, defoliation by *T. processionea* was observed in some areas. Because of good water supply repeated replacing shoots were produced which were highly susceptible to infection by oak mildew. In these areas, the oaks had a lack of assimilation during a long period of the vegetation time and they exhausted reserve material by repeatedly producing regeneration shoots. At the hot spots, control measures were performed on an area of 270 ha. To get an overview, the damage was mapped terrestrial and by airplane. Additionally, the pheromone-trap monitoring of *L. dispar* gave indication of a new progradation although the last control measures against gypsy moth were carried out just four years ago. In winter 2009/10, there will be monitoring activities for *T. viridana* and *T. processionea* and an expanded control of egg deposition of *L. dispar* in the endangered areas.

The constellation *T. viridana/T. processionea* is new and could have severe consequences for forest health similar to the combined feeding of *T. viridana* and *L. dispar*, because the oak has nearly no assimilation properties over most of the vegetation period. A complete defoliation by oak leafroller may also lead to a nutritional competition between herbivores preferring oak, because oak processionary moth is not able to feed on other hosts. The beginning progradation of *L. dispar* additionally complicates the situation. For the following years, detailed investigations on the consequences of different feeding constellations and the development of new strategies for prognosis and control will be necessary.

German – Deutsch

Einleitung

Die eichengeprägten Wälder der warm-trockenen Regionen Nordbayerns sind die Massenvermehrungsgebiete von Eichenwickler, Frostspanner und Schwammspinner. Nun hat sich hier auch der Eichenprozessionsspinner etabliert. Im Folgenden werden die Entwicklung von *Thaumetopoea processionea* sowie die spezielle Schädlingssituation an der Eiche 2009 dargestellt.

Eichenprozessionsspinner in Bayern: Verbreitung, Schadwirkung, Gegenmaßnahmen

Seit einigen Jahren zeigt der Eichenprozessionsspinner deutliche Ausbreitungstendenz sowie im Hauptverbreitungsgebiet massiven Fraß und hohe Besatzdichten teils auch innerhalb von Waldbeständen. Dies stellt die forstliche Praxis vor Probleme, da kaum Erfahrungen zur Auswirkung des Fraßgeschehens auf die Eiche und zum Massenwechsel des Insektes vorliegen. Zudem führt die Gesundheitsgefährdung durch die giftigen Brennhaare der Raupe zu Einschränkungen der Erholungsfunktion des Waldes sowie seiner Bewirtschaftung.

Es zeigte sich, dass vitale Eichen bei guten Bedingungen auch starken Fraß über Jahre schadlos überstehen, bei ungünstigen Witterungs- und Standortbedingungen oder Vorschädigung aber Folgeschäden eintreten können. Zur Beurteilung einer Bekämpfungsnotwendigkeit sind das Wissen über solche Zusammenhänge sowie die Kenntnis zu Ansprüchen und limitierenden Faktoren für Entwicklung und Vermehrung von *T. processionea* unverzichtbar. So überstehen zum Beispiel die Eier sehr tiefe Wintertemperaturen (bis -28 °C; mündliche Mitteilung N. Meurisse 2009) unbeschadet, Junglarven dagegen reagieren sehr empfindlich auf niedrige Temperaturen. Zu den Ansprüchen älterer Larvenstadien, Puppen und Falter gibt es kaum Detailwissen. Wenig bekannt ist auch über den Einfluss natürlicher Regulationsfaktoren. 2009 trat der Große Puppenräuber (*Calosoma sycophanta*; Abbildung 1) zahlreich als Larve und adulter Käfer an Nestern und Raupenprozessionen auf. Auch Raupenfliegen (*Tachinidae*) bei der Eiablage (Abbildung 2) sowie Tachinentönnchen in Verpuppungsnestern wurden vermehrt beobachtet. Pathogene spielten bislang keine Rolle.

Ein wesentliches Problem ist die Schadensprognose beim Eichenprozessionsspinner. Herkömmliche Methoden wie Fraßkartierung, Zählung der Verpuppungsnester und Eigelegezählung sind dauerhaft nicht praktikabel. Ziel ist die Entwicklung einer pheromongestützten Prognose. Hierfür gibt es einen geeigneten Lockstoff sowie einen dem Anflugverhalten des Falters angepassten Fallentyp; aussagefähige Korrelationen (Anflugzahlen : Besatzdichte : Fraßschaden) sowie ein Design für die Falleninstallation sind noch zu erarbeiten.

Die Bekämpfung des Eichenprozessionsspinners im Wald beruht in Bayern auf Waldschutzproblemen oder der Erhaltung der Waldfunktionen. Letzteres gilt bei erheblicher gesundheitlicher Beeinträchtigung aufgrund der räumlichen Nähe der Befallsgebiete zu Siedlungen oder öffentlichen Einrichtungen, oder wenn die Waldbewirtschaftung nicht mehr möglich ist. Allerdings wird der Bekämpfungserfolg unterschiedlich bewertet. Hinsichtlich der Fraßbelastung ist die Wirkung allgemein gut, während dadurch, dass die Brennhaare alter Gespinstnester jahrelang aktiv bleiben, die Gesundheitsbeeinträchtigung oft trotz Bekämpfung andauert. Auch werden behandelte Areale durch den sehr mobilen Falter schnell wiederbesiedelt.

Außerhalb des Waldes kommt neben der Ausbringung von Bioziden mit Bodengeräten vor allem die mechanische Entfernung der Nester zur Anwendung. Diese Verfahren sind aufgrund des hohen Kosten- und Arbeitsaufwandes nur punktuell einsetzbar, oft unzureichend und wirken nur kurzfristig.

Spezielle Schadsituation an der Eiche 2009 – Ausblick 2010

Im Jahr 2009 kam es zu teils massivem Fraß bereits an den Eichenknospen durch Eichenwickler (*Tortrix viridana*) und Laubholzeulen (*Orthosia* spp.). Nach der Verpuppung des Eichenwicklers erfolgte eine Wiederbelaubung durch Ersatztriebe. Schon sehr früh wurden die frischen Blätter vom Eichenmehltau (*Microsphaera alphitoides*) befallen. Danach trat regional starker Fraß durch den Eichenprozessionsspinner auf. Wegen der guten Wasserversorgung wurden wiederholt Ersatztriebe gebildet, die wiederum dem Mehltau zum Opfer fielen. In den betroffenen Gebieten waren die Eichen also nur über kurze Zeiträume assimilationsfähig und verbrauchten Reservestoffe durch wiederholte Nachtriebe. An den Brennpunkten erfolgten auf 270 ha Bekämpfungsmaßnahmen. Um einen flächigen Überblick zu erhalten, wurden die Schäden aus der Luft und terrestrisch kartiert. Zudem ergab die Pheromonprognose des Schwammspinners Hinweise auf eine neue Progradation, obwohl die letzten Bekämpfungsaktionen gegen *L. dispar* erst 2004/05 stattgefunden hatten. Im Winter 2009/10 wird mittels Zweigproben ein Monitoring für Eichenwickler und Eichenprozessionsspinner sowie eine erweiterte Eigelegeprognose des Schwammspinners durchgeführt.

Die Konstellation Eichenwickler/Eichenprozessionsspinner ist neu und kann, da die Eiche über einen großen Teil der Vegetationsperiode kahl gestellt ist, zu ähnlich schweren Folgen wie die Kombination Eichenwickler/Schwammspinner führen. Bei völligem Kahlfraß durch Eichenwickler ist aber auch eine Nahrungskonkurrenz zwischen den Arten zugunsten der Eiche denkbar, da der Eichenprozessionsspinner auf die Eiche als Fraßpflanze angewiesen ist. Die anlaufende Schwammspinner-Massenvermehrung erschwert die Situation zusätzlich. In den kommenden Jahren müssen die Folgewirkungen unterschiedlicher Fraßkonstellationen genau untersucht und situationsangepasste Prognose- und Bekämpfungsstrategien entwickelt werden.

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Current Disease Status in Swedish Forests

Pia Barklund

Extended Abstract

In the north of Sweden an outbreak of resin-top disease in Scots pine *(Pinus sylvatica)* was identified in 2004. The disease is widespread and mainly observed in young pine plantations. An inventory in a progeny trial 2006 revealed 30 % infection and wide genetic differences: The progeny from the most resistant plus trees exhibited no damage at all, whereas 75-100 % of the progeny from the most susceptible plus trees were found to be infected. In 2008, SLU carried out an inventory of the disease in the counties Norrbotten, Lappland and Västerbotten. The result indicated that a total of 130,000 ha young pine stands are affected by resin-top disease and within that area 33,000 ha more than 10 % of the stems are attacked.

Ash dieback in *Fraxinus excelsior* is spread in the whole area where ash is growing in Sweden. In an inventory performed 2009 more than 50 % of the ash trees were shown to be affected by the disease caused by *Chalara fraxinea*. The disease is worse in the southeast of the country where it first appeared.

Pine needle cast *(Lophodermium seditiosum)* attack on Scots pine was more aggressive and widespread close to its northern border in Sweden.

An unusually widespread outbreak of *Chrysomyxa ledi* on Norway spruce *(Picea abies)* occurred in the northern part of Sweden in the summer of 2009. In an area of some 1 million ha Norway spruce of all ages is affected with high frequency where the alternate host is growing. Birch rust in *Betula pendula* and *B. pubescens* caused by *Melampsoridium betulinum* was also very widespread, but less frequent than the former disease.

To give a full picture root rot in Norway spruce caused by *Heterobasidion parviporum* needs to be mentioned, as our most damaging disease. About 20 % of the Norway spruce harvested each year is infected by the fungus. To try to reduce the spread of *H. parviporum*, thinning stumps are regularly treated with Rotstop *(Phlebiopsis gigantea* spores). Because of the increased interest in using bio-energy, stump removal has become another way to also reduce the root rot inoculum.

Keywords | Sweden, ash dieback, *Chrysomyxa ledi*, *Heterobasidion parviporum*

Erweiterte Kurzfassung

Aktuelle Krankheitssituation in den schwedischen Wäldern

Im Norden Schwedens wurde 2004 ein Ausbruch des Kiefernrinden-Blasenrosts auf Waldkiefer (*Pinus sylvatica*) festgestellt. Die Krankheit ist weit verbreitet und wird hauptsächlich in jungen Kiefernplantagen beobachtet. Erhebungen in einem Herkunftsversuch 2006 zeigten, dass die durchschnittliche Prävalenz der Infektion 30 % betrug und die Wirtsbäume große, genetische Unterschiede zeigten: Die Nachkommen des resistentesten Plus-Baumes zeigten keinerlei Schädigung, während 75-100 % der Nachkommenschaft des empfindlichsten Plus-Baumes infiziert waren. Ein Survey in den Provinzen Norrbotten, Lappland und Västerbotten im Jahre 2008 durch die SLU zeigte, dass eine Fläche von 130.000 ha junger Kiefernbestände vom Kiefernrinden-Blasenrost betroffen ist. Davon sind auf 33.000 ha mehr als 10 % der Stämme befallen.

Das Eschentriebsterben an *Fraxinus excelsior* tritt im gesamten schwedischen Verbreitungsgebiet der Baumart auf. Einem Survey aus dem Jahre 2009 zufolge sind mehr als 50 % der Eschen von der durch *Chalara fraxinea* hervorgerufenen Krankheit betroffen. Die Effekte sind im Südwesten des Landes, wo die Krankheit als erstes aufgetreten ist, am stärksten.

Die Kiefernschütte durch *Lophodermium seditosum* an der Waldkiefer trat nahe der nördlichen Grenze in Schweden aggressiver und weiter verbreitet in Erscheinung.

Ein ungewöhnlich großflächiger Ausbruch des Fichtennadelrosts *Chrysomyxa ledi* fand im Sommer 2009 an der Fichte (*Picea abies*) im nördlichen Teil Schwedens statt. Auf ca. 1 Mio. ha waren Fichten aller Altersklassen überall dort stark betroffen, wo der Zwischenwirt vorkommt. Der Birkenrost *Melampsoridium betulinum* auf *Betula pendula* und *B. pubescens* war ebenfalls weit verbreitet, jedoch weniger häufig als obige Krankheit.

Für ein vollständiges Bild der Situation der Fichte muss der Wurzelschwamm *Heterobasidion parviporum* als der in Schweden schädlichste Krankheitserreger erwähnt werden. Etwa 20 % der jährlich geernteten Fichten sind damit infiziert. Um die Ausbreitung von *H. parviporum* einzudämmen, werden die Stöcke nach Durchforstungen regelmäßig mit Rotstop (Sporen von *Phlebiopsis gigantea*) behandelt. Aufgrund der steigenden Nachfrage nach Biomasse für die energetische Nutzung wurde die Stockrodung zu einem weiteren Weg, das Inokulum im Bestand zu reduzieren.

Schlüsselwörter | Schweden, Eschentriebsterben, *Chrysomyxa ledi, Heterobasidion parviporum*

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Silvicultural Strategies for Forest Stands with Ash Dieback

Iben Margrete Thomsen and Jens Peter Skovsgaard

Abstract

Chalara fraxinea ash dieback may have devastating consequences for the survival and wood quality of *Fraxinus excelsior*. In this paper we suggest alternative silvicultural strategies for forest stands with ash dieback. The relevant strategy depends on stand age and the degree of dieback. Generally, the strategy should be conservative, if the dieback is less severe. An operational approach would be to identify and mark healthy trees. In case of severe dieback, the suggested approach is to harvest remaining timber as soon as possible and replant the area.

Keywords | *Fraxinus excelsior, Chalara fraxinea, Hymenoscyphus pseudoalbidus*, silviculture

Kurzfassung

Waldbauliche Maßnahmen für Waldbestände mit Eschentriebsterben

Das Eschentriebsterben durch *Chalara fraxinea* könnte gewaltige Auswirkungen auf das Überleben und die Holzqualität der Gemeinen Esche haben. In diesem Artikel schlagen wir alternative waldbauliche Strategien für vom Eschentriebsterben betroffene Bestände vor. Die Maßnahme hängt vom Bestandesalter und der Intensität des Zurücksterbens ab. Im Allgemeinen sollte eine konservative Vorgehensweise gewählt werden, wenn das Zurücksterben nicht sehr stark ausgeprägt ist. Ein praktischer Zugang wäre die Identifizierung und Markierung gesunder Bäume. Im Falle von starkem Zurücksterben wird empfohlen, die übrig bleibenden Bäume raschest möglich zu ernten und die Fläche wieder aufzuforsten.

Schlüsselwörter | *Fraxinus excelsior, Chalara fraxinea, Hymenoscyphus pseudoalbidus*, Waldbau

Introduction

During recent years severe crown dieback has led to great concern for the future of ash (*Fraxinus excelsior* L.) in many parts of Europe. In Denmark, the disease was first noted in 2002, but soon became widespread in the whole country. Ash is a valuable species, economically, aesthetically and in relation to biodiversity and the forest ecosystem. The immediate impacts as well as the long-term consequences of the disease may be serious.

The hyphomycete *Chalara fraxinea* T. Kowalski is now considered a causal agent of the disease (Kowalski 2006), and the ascomycete *Hymenoscyphus pseudoalbidus* has been identified as the teleomorph of the pathogen (Queloz et al. 2011).

Primary and secondary agents of ash dieback

Ash dieback caused by *C. fraxinea* directly affects leaves, shots and bark. Usually, symptoms are confined to the crown, and only young trees may be killed immediately when the fungus attacks the main stem. For trees up to 40 years of age, the typical disease development is repeated shoot dieback in the crown and dry necroses of the bark on branches (Skovsgaard et al. 2010).

The main stem below the crown often remains healthy, and vigorous trees respond prolifically with regrowth of affected shoots and development of epicormic branches in the crown. While the development of new shoots delays the progress of the disease, accompanying attack by *Armillaria lutea* (syn. *A. gallica*), a common parasite of stressed trees, often results in a quite rapid decline.

In young ash stands, where the bark of the trees is still smooth and fairly thin, the attacks of *Armillaria* become visible shortly after ash dieback has weakened the trees. Often the first symptoms of *Armillaria* appear within one to three years after decline symptoms in the crown. The fungus spreads at the base of the tree, killing the cambium, and subsequently the whole tree gradually dies. During this process, the bark at the lower part of the stems of affected trees progressively changes from its normal green-gray to a conspicuously red-brown colour (Figure 1).

On older trees with thicker bark the attack by honey fungus (*Armillaria*) is initia20lly confined to the roots. Here, spots of bark and wood may die. These necroses can be found on the upper roots near the stem by scraping away the top soil or moss covering surface roots. Older trees with colonized cambium and discoloured wood beneath the bark has been observed even before the tree is clearly dying as judged by its crown decline (Figure 2) and by widespread *Armillaria* colonization of the roots. In addition to discolouration at the base of the stem due to *Armillaria* attack, epicormic branches may act as a port of discolouration in the stem due to *Chalara* infection.

Figure 1: White fans of honey fungus (*Armillaria*) mycelium below dead bark (a). Typical discolouration of wood at the base of the tree and accompanying fruitbodies of *A. lutea* (b).

Abbildung 1: Weiße Myzelfächer von Hallimasch (*Armillaria*) unter der toten Rinde (a). Typische Holzverfärbung an der Stammbasis und zugehörige Fruchtkörper von *A. lutea* (b).

Silvicultural strategies

Based on our experience from Denmark and Sweden, we recommend two separate silvicultural strategies for young and old stands of ash with dieback symptoms. For young stands, the main aim is to identify apparently resistant trees and promote their long-term survival and wood quality. For older stands, the aim is to delay the final harvest for as long as possible without jeopardizing wood quality. However, it should be noted that diameter growth will probably be negligible, as most of the energy of affected ash trees will be directed towards regeneration of shoots in the crown and resisting honey fungus attacks in the roots. In either case, severely infected stands should be cut and replanted. As a general rule, we suggest to inspect ash stands during the growth season because the identification of ash dieback is easier than at other times of the year. However, prolific regeneration of the crown by epicormic shoots may disguise the presence of dieback during the growth season, and in such cases the extent of the disease may actually be easier to detect during winter.

Depending on stand age, the frequency of infected trees and the degree of dieback, we suggest the following alternative procedures:

Severely infected young stands

1. Clearcut trees and replant.
2. Use ash trees as shelter and replant under these. Surviving ash trees may be left.

Young stands with a high percentage of healthy trees

1. Turn your back to the stand and hope for the best.
2. Mark healthy ash trees (paint on stems) during growth season. Mark at least 200 trees per ha and thin among the unmarked trees.

Older stands

- Inspect your stands for ash dieback during the growth season as well as in winter time.
- All trees with epicormic shoots on the stem should be felled as soon as possible, as *C. fraxinea* may

Figure 2: Ash tree at age of 70 years with severe crown dieback and prolific epicormic branching in the primary crown. The roots were colonized by *Armillaria*. The stem may still be used for timber, if the tree is cut immediately.

Abbildung 2: Siebzigjährige Esche mit starkem Zurücksterben der Krone und massiver Ausbildung von Ersatztrieben. Die Wurzeln waren von *Armillaria* befallen. Wenn der Baum rasch gefällt wird, kann das Holz des Stammes noch genutzt werden.

cause stem wood discolouration through infection of such shoots.

- Ash trees, where most of the primary crown is dead and survival is based on epicormic shoots in the crown, should be harvested within the next year.
- Ash trees, where more than 50 % of the primary crown is dead, should be considered for harvest.
- Ash trees with more than 75 % of the primary crown intact may be considered healthy enough to keep for several years, unless there are signs of honey fungus attack at the base of the trees.

Ideally, all ash stands should be inspected at least once a year. Any trees of high vitality and with only few symptoms of ash dieback should be left as potential seed sources. Remember to identify both male and female trees. Resistance to *C. fraxinea* ash dieback seems highly hereditable, so natural regeneration from healthy trees is one of the hopes for the future.

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Forest Protection Situation in Trentino (Northeastern Italy) in 2008-2009

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Abstract

The forest health of Trentino was strongly conditioned by rainfall in 2008 and snowfall in the winter 2008/09. Heavy attacks by insects (larch casebearer, aphids and larch bud moth) and foliar pathogens occurred on larch in 2008. The abundant precipitations favoured also rust infections on other species, while hampered insects such as bark beetles and pine processionary moth. The heavy snowfalls in winter 2008/09 caused several tree breakages, with high losses of timber. Few pests and diseases were recorded in 2009 vegetative season, with the exception of brown headed ash sawfly, pine processionary moth and chestnut gall wasp.

Keywords | forest health, monitoring, Northeastern Italy, pests, diseases

Kurzfassung

Waldschutzsituation im Trentino (Nordostitalien) in 2008-2009

Der Gesundheitszustand der Wälder im Trentino wurde stark von Regenfällen im Jahre 2008 und von Schneefällen im Jahre 2009 beeinflusst. Lärchen wurden von Insekten (Lärchennadel-Miniermotte, Blattläuse und Lärchenwickler) massiv angegriffen, und auch Pilzkrankheiten kamen an den Nadeln vor. Die reichlichen Niederschläge förderten die Infektion durch Rostpilze auch bei anderen Baumarten, sie behinderten jedoch die Entwicklung von Insekten, wie Borkenkäfer und Kiefernprozessionsspinner. Der starke Schneefall im Winter 2008/09 verursachte viele Bruchschäden mit einer großen Menge Schadholz. Wenige Insektenschäden und Krankheiten wurden während der Wachstumsperiode 2009 registriert; Ausnahme waren die Schwarze Eschenblattwespe, der Pinienprozessionsspinner und die Kastaniengallwespe.

Schlüsselwörter | Forstschutz, Monitoring, Nordostitalien, Schädlinge, Krankheiten

The Forest Tree Damages Monitoring (FTDM) is applied by FEM-IASMA and the Forest and Fauna Service in the woodland of the Autonomous Province of Trento (NE-Italy) since 1990. The data, collected by forest personnel following a standard methodology, are stored and transmitted by a WebGIS system that allows geo-referencing (Valentinotti et al. 2004; Salvadori and Maresi 2008). This continuous survey of the forest health allows the management of either emerging new problems or "traditional" ones.

In 2008 and 2009, the weather pattern strongly conditioned the forest health situation. The mean temperature in Trentino in these years was higher than the climatic average related to the period 1961-1990. Winter season 2007/08 was particularly warm, as well as the months of May and June. However, precipitation was the most interesting aspect: the year 2008 was definitely rainier than average (between +25 % and +50 % depending on the month considered), with rainfall in about one third of the days. Peaks of rainfall occurred in April and May and during fall. Winter 2008/09 was characterized by an unusually high snow cover, never recorded in the last two decades. The rainfall was regularly distributed in spring and summer 2009, but not as abundant as in the previous year. A warm fall protracted the vegetative season until the end of November.

From a phytopathological point of view, 2008 can be definitely defined as "the larch year", because of the numerous problems signalled on this species, in analogy to 2007 that was considered "the Norway spruce year", due to the damages caused by *Elatobium abietinum*, *Ips typographus* and other phytopathies. Many larch forests at middle and high altitudes showed heavy attacks by the larch casebearer (*Coleophora laricella*) in June 2008, while other ones showed aphid (*Adelges* sp. and *Sacchiphantes* sp.) damages. In these forests, also owing to local late frost events, widespread crown yellowing appeared due to *Meria laricis* infections. In the late summer, larch woods were affected by reddening caused by *Mycosphaerella laricina*. These fungi were favoured by abundant precipitation, which created optimal conditions for foliar pathogens almost everywhere. Moreover, in some high altitude larch forests, the larch bud moth (*Zeiraphera diniana*) appeared exactly ten years after its previous gradation.

Among the foliar pathogens, rust attacks were reported on many different species. In 2008, a new rust was observed in a grey alder thicket: microscopic investigations allowed to detect *Melampsoridium hiratsukanum* for the first time in Italy (Moricca and Maresi 2010).

On the other hand, weather hampered many insects and opportunistic pathogens related to the hydric stress

Figure 1: Larvae of *Tomostethus nigritus* (Hym. Tenthredinidae) on common ash.

Abbildung 1: Larven von *Tomostethus nigritus* (Hym. Tenthredinidae) auf Gemeiner Esche.

of their host plants, such as the spruce bark beetle (*Ips typographus*). After some years, characterised by heavy outbreaks, the damages caused by this insect diminished to usual levels in 2008. After two years of intense pullulation, also the population density of pine processionary moth (*Thaumetopoea pityocampa*) began their natural decline almost everywhere.

Because of the heavy snowfall in winter 2008/09, several tree breakages occurred with a timber amount higher than 110,000 m^3. *Pinus sylvestris* and *Fagus sylvatica* were the most affected species. On the other hand, *Picea abies* and *Abies alba* were the species most affected by windthrows, which was less than 30,000 m^3 in the two years. In the vegetative season of 2009, no heavy infestations of ambrosia beetles were reported, even where high amounts of coarse woody debris were still present in the forests. This is probably related to the unfavourable weather conditions. In fact, a relatively low number of pest and disease attacks were recorded; one of these was a severe defoliation of *Fraxinus excelsior* caused by the ash sawfly *Tomostethus nigritus* (Figure 1), which has never been observed in Trentino up to now.

Perhaps because of the severe winter, *Z. diniana* was no more present on larch in 2009. On the other hand, an unexpected increase of pine processionary population level appeared in some districts during the fall 2009. This was probably due to the very favourable weather conditions of September and October.

New foci of the chestnut gall wasp (*Dryocosmus kuriphilus*) occurred either in 2008 or in 2009. It has to be noticed that the eradication attempts carried out against this invasive insect have remained fruitless due to its rapid expansion.

In conclusion, weather anomalies (rainfall in 2008 and snowfall in winter 2008/09) were very effective in

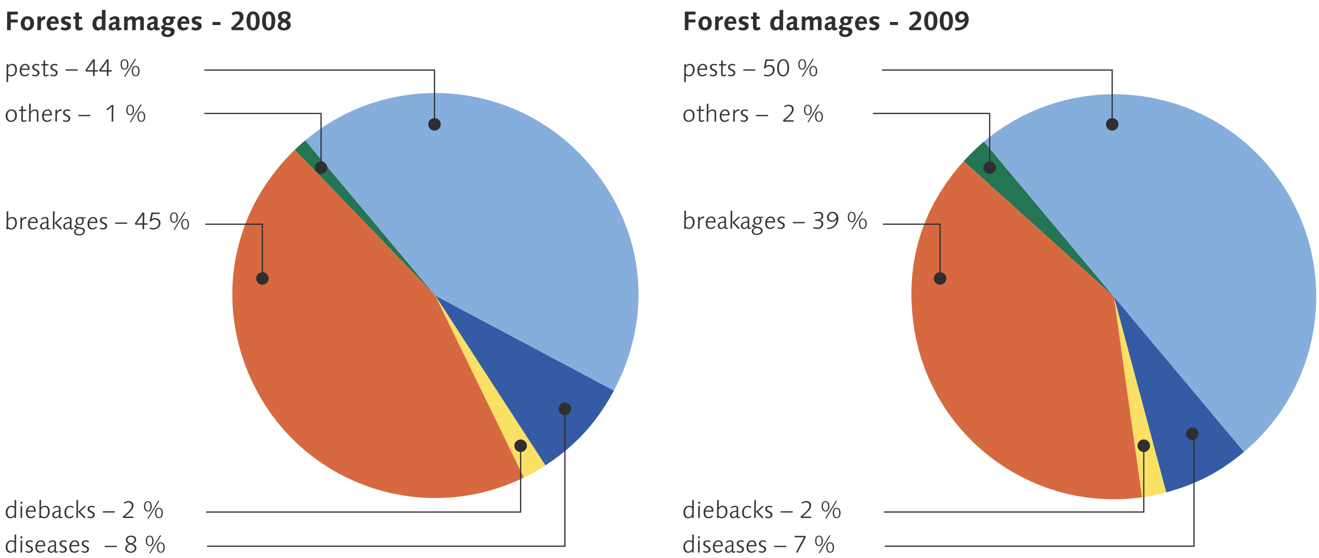

Figure 2: Percentage distribution of main damage causes recorded by mean of the Forest Tree Damages Monitoring in Trentino (2008-2009).

Abbildung 2: Anteil der Hauptschädigungsfaktoren, gemeldet durch das Waldschadensmonitoring im Trentino (2008-2009).

Table 1: Number of damage notifications collected in the Forest Tree Damages Monitoring database in the last five years.

Tabelle 1: Anzahl der Schädigungsmeldungen laut Waldschadensmonitoring-Datenbank in den vergangenen fünf Jahren.

Main kinds of damage agents	2005	2006	2007	2008	2009	average % 2005-09
insects						
leaf-eating insects on conifers	251	165	508	361	222	43.1
leaf-eating insects on broadleaves	15	9	7	17	40	2.5
sucking insects	0	1	50	4	0	1.6
bark and wood borers on conifers	266	228	145	42	19	20.0
bark and wood borers on broadleaves	1	2	1	1	0	0.1
fungi						
root diseases	1	0	1	1	0	0.1
crown diseases	24	11	29	81	38	5.2
other						
declines	8	12	27	19	9	2.1
mammals (game + rodents)	23	24	1	0	0	1.4
abiotic damages	57	20	89	442	228	23.9
Total records	**646**	**472**	**858**	**968**	**556**	**100**

affecting forest health (Figure 2). As reported in Table 1, the number of damage notifications in 2008-2009 markedly differ from the previous years (2005-2007): damage by pests decreased from 83 % to 46 %, while fungi damage varied from 3 % to 8 % and abiotic ones increased from 4 % to 44 %.

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Recent Outbreaks of *Gremmeniella abietina* in Slovenia

Nikica Ogris

Abstract

Brunchorstia dieback has been a recognised disease of conifers in Slovenia since the 1980s. However, the first large-scale outbreak occurred in 2006. The second outbreak followed in 2009. The affected regions were the Ljubljana basin, the Carinthia region and the Alpine region. The outbreaks were closely related to weather conditions; a higher intensity of the disease was induced by colder and longer winters. Austrian and Scotch pine were affected. Apothecia of *Gremmeniella abietina* were found for the first time in Slovenia.

Keywords | *Brunchorstia pinea, Pinus,* Scleroderris canker, apothecia, weather conditions

Kurzfassung

Triebsterben-Epidemien durch *Gremmeniella abietina* in Slowenien

Das Brunchorstia-Triebsterben ist in Slowenien seit den 1980er Jahren als Krankheit bei Nadelhölzern bekannt. Der erste großflächige Ausbruch der Krankheit wurde allerdings erst 2006 registriert. Eine zweite Epidemie folgte 2009. Die betroffenen Gebiete waren das Laibacher Becken, die Region Koroška und die Julischen Alpen. Die Epidemien stehen in engem Zusammenhang mit der Witterung, kältere und längere Winter bedingten eine stärkere Intensität der Krankheit. Sowohl Schwarzkiefer als auch Waldkiefer waren betroffen. Erstmals in Slowenien wurden Apothecien von *Gremmeniella abietina* nachgewiesen.

Schlüsselwörter | *Brunchorstia pinea*, Kiefer, Scleroderris-Krankheit, Apothecien, Witterung

Brunchorstia dieback of conifers caused by *Gremmeniella abietina* (Lagerb.) M. Morelet has been a known disease in Slovenia since the 1980s. However, in that period the disease was limited to individual trees in the central part of Slovenia. The first record of *G. abietina* in Slovenia dates back to the 1980s when it was found on a few Austrian pine trees (*Pinus nigra*) in Ljubljana (D. Jurc, unpublished data). The disease was also intercepted in forest nurseries, e.g. on *P. nigra* and *P. wallichiana* in the 1980s (Jurc 1996). The infected plants were destroyed in accordance with legislation. Another record is from 1991 when *G. abietina* was found on the dead branches of a single Norway spruce tree (*Picea abies*) near Ortnek (Jurc et al. 1991). Until 2006, only single occurrences of Brunchorstia dieback were recorded; in that year, the first large-scale outbreak of Brunchorstia dieback in Slovenia was noted (Ogris and Jurc 2006). Two regions were affected most: the Ljubljana basin and the Carinthia region. In the Ljubljana basin, the disease was most frequent on Scotch pine (*Pinus sylvestris*), but in the Carinthia region the outbreak was limited to Austrian pine (Ogris 2006). In the outbreak areas in 2006, an average 20 % of the crown died off, but it ranged up to 60 %. The second outbreak occurred again in the Carinthia region in 2009 (Ogris 2009). Additionally, a new region was affected: the Julian Alps along the Soča River (record from Bovec on Austrian and Scotch pine; Figure 1).

The outbreaks of *G. abietina* in Slovenia were strongly related to the weather conditions. The winter of 2005/06 was slightly colder, the level of snow cover was higher and snow cover lasted longer. Winter temperatures were 0.5 to 1 °C lower than the long-term average of 1971–2000. The snow cover lasted until the end of March in the valleys (usually to the beginning of February). The case in Slovenia is similar to those documented from Japan and the Swiss Alps. Epidemics of the disease in Japan in 1970 emerged following a prolonged period of snow cover and un-

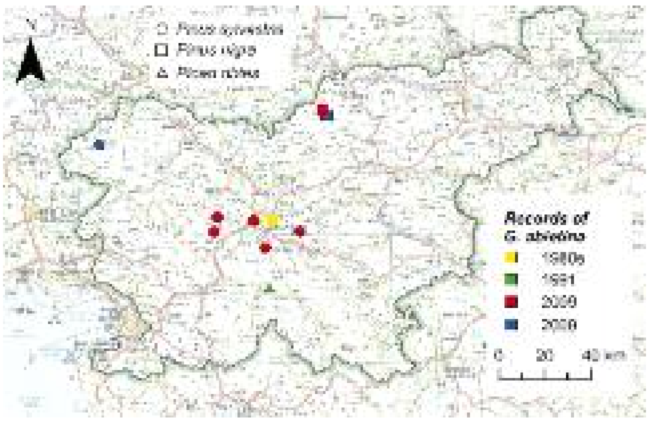

Figure 1: Records of *Gremmeniella abietina* in Slovenia to 2009. The records from the 1980s and 1991 refer to single occurrences of the disease. The records from 2006 and 2009 refer to large-scale outbreaks.

Abbildung 1: Meldungen von *Gremmeniella abietina* in Slowenien bis 2009. Die Meldungen aus den 1980ern und 1991 waren vereinzelte Vorkommen, die Berichte von 2006 und 2009 betreffen großflächige Ausbrüche.

usually low temperatures around 0 °C at the end of September and in the beginning of October in 1969 (Yokota et al. 1975b). In the case study from the Swiss Alps, the dieback level of *P. mugo* and *P. cembra* was strongly correlated to the duration of snow cover in the spring (Senn 1999). Outbreaks are triggered by these conditions because *G. abietina* is already growing at 0 °C while the host is still dormant (Yokota 1975a).

In 2009, we observed apothecia on Austrian pine samples from Žerjav (near Črna in the Carinthia region). Apothecia were brown to black and measured 0.5–1.2 mm. Asci were hyaline and measured 99–127 (110) × 8.7–10.8 (9.7) µm. The asci had eight ascospores. The ascospores were hyaline, with three to four cells, and measured 14.6–20.0 (17.0) × 4.5–5.9 (5.2) µm. To our knowledge, this is the first record of *G. abietina* apothecia in Slovenia. However, we do not know to which strains it belongs; most likely *G. abietina* in Slovenia is part of European-Alpine strain and not of North American or Asian because our strain has the characteristics of the European strain: it seldom produces apothecia and damages mature trees or saplings. Those characteristics differ from the North American strain, which affects mostly saplings up to 2 m height and produces numerous apothecia.

The symptoms for Brunchorstia dieback in Slovenia were dead and pitched buds, lesions in the bark that spread in direction from buds down the shoots, dieback of shoots (from one to three years old, most commonly one-year shoots; Figure 2), needle yellowing and browning (at early stage of the disease), needle shedding (at latter time), healthy needles on older parts of shoots. Pycnidia were located on the buds and needle scars. They measured 0.2–1.4 mm. Conidia were hyaline, curved, with three to five septa, and measured 28–51 × 3–4 µm. The morphological characteristics matched the description of *Brunchorstia pinea* (P. Karst.) Höhn., the anamorph of *G. abietina*.

Figure 2: Dead shoots of the current year are a typical symptom of Brunchorstia dieback. At the beginning, the needles are yellowing and browning. Later they fall off.

Abbildung 2: Tote Triebe des laufenden Jahres sind ein typisches Symptom des Brunchorstia-Triebsterbens. Zu Beginn sind die Nadeln gelblich und bräunlich, später fallen sie ab.

Recent outbreaks of *G. abietina* in Slovenia reflect suitable ecological conditions for the disease to develop. The expected spread risk is high on *Pinus* spp. and Norway spruce under favourable weather and site conditions. Therefore, a monitoring programme is in place, carried out by the Slovenian Forest Service. In the case of heavily damaged trees, sanitary felling is proposed. Such felling, however, is prohibited in protected areas.

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Bark Beetle Populations in Croatia in 2008-2009 – Monitoring Data and Research Observations

Milivoj Franjević, Milan Pernek and Boris Hrašovec

Abstract

An eruption of conifer bark beetle populations in Croatia that started after the drought year 2003 seems to be slowing down in 2008 and especially in 2009. According to the monitoring data and amount of timber that is being cut through salvage cuttings, spruce bark beetles are showing obvious three-year decline trend. This is even more pronounced with the silver fir bark beetles. It is hypothesized that this is a result of beneficial environmental conditions, buildup of natural enemy complex, reduction of host availability and intensive forestry activities. A newly recognized tree killing pest, *Tomicus destruens*, received special attention and through a detailed phenological screening it manifested a one year cycle in mid-Adriatic climatic conditions.

Keywords | bark beetles, outbreaks, *Tomicus destruens*, Croatia

Kurzfassung

Borkenkäfer-Populationen in Kroatien in den Jahren 2008-2009 - Überwachung und Forschung

Der dramatische Anstieg von Borkenkäfer-Populationen in Kroatien nach der Dürre im Jahr 2003 verlangsamte sich 2008 und insbesondere 2009. Anhand der Monitoringdaten und der Menge eingeschlagenen Käferholzes der letzten drei Jahre ist ein deutlich fallender Trend bei Fichtenborkenkäfern nachzuweisen. Diese Abnahme ist bei den Weißtannen-Borkenkäfern noch ausgeprägter. Wir vermuten, dass dies das Ergebnis von günstigen Umweltbedingungen, des Aufbaus des natürlichen Gegenspieler-Komplexes, der Reduzierung des Nahrungsangebotes und von intensiver Forstwirtschaft ist. Besonders beachtet wurde ein neuer gefährlicher Schädling, *Tomicus destruens*. Durch ausführliche phänologische Untersuchungen wurde ein einjähriger Entwicklungszyklus unter mitteladriatischen Klimabedingungen für diese Käfer festgestellt.

Schlüsselwörter | Borkenkäfer, Massenvermehrung, *Tomicus destruens*, Kroatien

Latest development of bark beetle populations in Croatian forests confirmed down slope trends in all of the major conifer tree species: Norway spruce, silver fir and pines. *Pityokteines* group of the silver fir bark beetles peaked in 2006 and dropped to population densities that are still above the average in 2009. Similar tendencies have occurred with the major spruce bark beetles, namely *Ips typographus* and *Pityogenes chalcographus*. This is evident in both, the amount of beetle killed trees (Figure 1) and the analysis of pheromone trap catches in the 2001-2009 period. Trap catches of the two major spruce bark beetles and the silver fir beetle *Pityokteines curvidens* (Pernek et al. 2006), declined in the past four years. At the same time collateral catches of predatory beetles (like *Thanasimus formicarius* and *Nemosoma elongatum*) have been rising steadily since 2006.

Compared with other European countries, Croatia has not suffered any of the dramatic climatic catastrophes that would initiate outbreaks through vast amount of fallen and windbroken trees. However, one negative climatic factor was definitively present as was the case within the rest of Europe – drought. It is considered today as being one of the crucial inciting factors in the last outbreak episode in Croatian forests. There were some other contributing factors such as sloppy post-cutting practice and coincidence of exceptional clearcuts in some parts due to the highway constructions. Development of the outbreak, namely its slowdown, is considered to be the result of less harmful climatic conditions and intensified forestry activity that returned to the good and for some time neglected forest protection practice. Also, the increase of predators and parasitoids, together with heightened percentage of diseased beetles, probably added to the slowing of the population outbreaks. Clearly, the whole process that evolved in Croatian conditions is not straightforward comparable with the rest of the European countries, not even with the closest neighbors like Slovenia and Bosnia and Herzegovina. Dynamics of outbreaks, especially the amount of forest area affected and timber volume attacked depends strongly on stand characteristics, species composition and structure being highly important. Close to natural composition and structure of mixed Croatian forests certainly contributed to less dramatic negative effects of recent bark beetle outbreaks.

One of the effects of heightened bark beetle populations in general focused scientific and operational interest on some less known and economically important bark beetles. Isolated but pronounced attacks of *Tomicus destruens* in Aleppo pine cultures on the Adriatic coast incited research on some aspects of its biology.

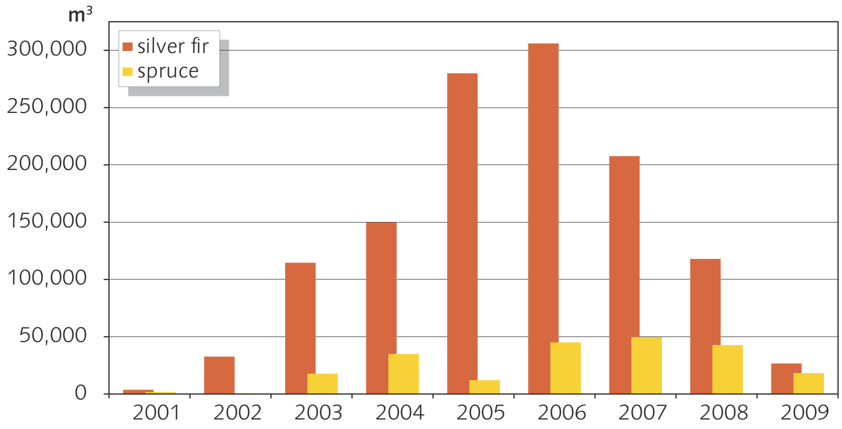

Figure 1: Amount of bark beetle attacked timber in 2001-2009.

Abbildung 1: Menge des Borkenkäfer-Schadholzes von 2001 bis 2009.

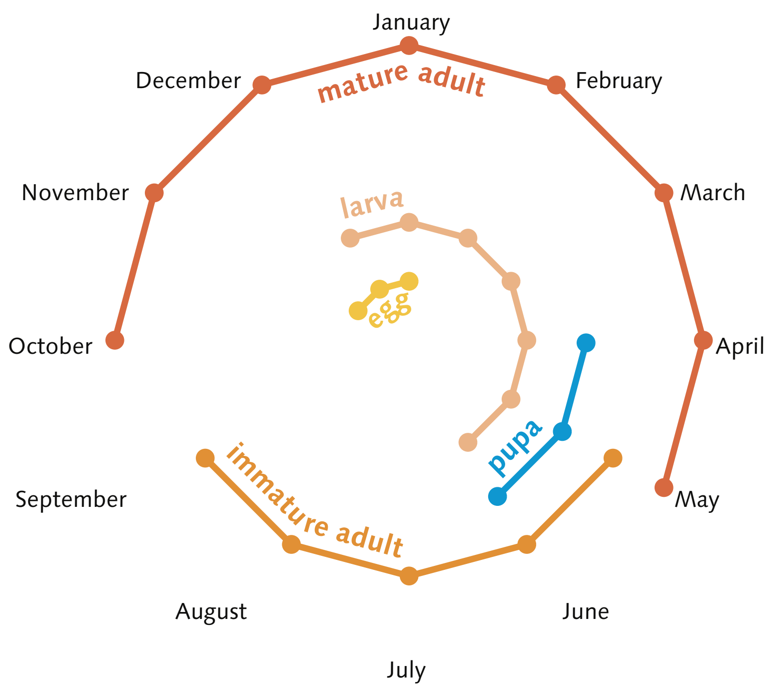

Figure 2: Development of *Tomicus detruens* during a one year monitoring period in experimental plot near Zadar, Croatia.

Abbildung 2: Entwicklungszyklus von *Tomicus detruens* während eines 1-Jahres-Beobachtungszeitraums auf einer Versuchsfläche bei Zadar, Kroatien.

During 2006-2007, monthly inspections were made at one isolated attack area near Zadar. Quantification of developmental stages was done via inspection of attacked timber, evidence of hibernating and estivating beetles, trap logs inspections and excavations of egg, larval, pupal and adult stages. These observations ascertained a clear case of one year developmental cycle with a three-months swarming period (October-December), larval development in winter and spring, and a cease of activity in summer due to estivation of new generation beetles (Figure 2). These findings conform to some research results and differ from others originating within the Mediterranean basin (Nanni and Tiberi 1997, Gallego et al. 2008, Sabbatini et al. 2008). It is worth noting that we did not observe mixed populations of *T. destruens* and *T. piniperda* in our research plot, as was the case in some of the mentioned reports. The research on *T. destruens* is continuing; in 2009 a new set of kairomonal traps was set up which will further confirm the flight period of adults and consequently, the number of generations (and potential sister broods) on the Croatian coast.

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Introduced or Overlooked? New Bark Beetle Species in Sweden (Coleoptera; Curculionidae)

Åke Lindelöw

Abstract

The bark beetle fauna in Sweden and other Scandinavian countries is rather well known and the number of new species discovered during the last 50 years is low. During the last decade several new species have been recorded. This article describes the changes in the bark beetle fauna since 2000. The causes of the changes are discussed.

Keywords | bark beetles, Sweden

Kurzfassung

Eingeschleppt oder übersehen? Neue Borkenkäferarten in Schweden (Coleoptera; Curculionidae)

Die Borkenkäfer-Fauna Schwedens und anderer skandinavischer Länder ist recht gut bekannt, die Anzahl an neu entdeckten Arten in den vergangenen 50 Jahren ist gering. Im letzten Jahrzehnt wurden einige neue Arten gefunden. Dieser Artikel beschreibt die Veränderungen in der Borkenkäfer-Fauna seit 2000. Die Gründe für die Veränderungen werden diskutiert.

Schlüsselwörter | Borkenkäfer, Schweden

There are four species of elm bark beetles known in Sweden. Widely distributed are *Scolytus laevis* (Chaupis 1873) and *S. triarmatus* (Eggers 1912), *S. multistriatus* (Marsham 1802) is rare on the mainland but the only species present on the island Gotland. *S. pygmaeus* (Fabricius 1787) is known by three specimens in the Natural Museum in Gothenburg (Leg. Mortonsson) found on the island Öland more than 100 years ago. *S. scolytus* (Fabricius 1775), a widely distributed species in Europe has recently been found to expand its range in Denmark (Hansen et al. 1995). Besides two specimens from Öland (Leg. Mortonsson ~1900), this species has now been found in 2006 and in numbers 2007, both in Skåne and Halland using flight interception traps attached to elm trees diseased with *Ophiostoma novo-ulmi*. Obviously *S. scolytus* have entered southern Sweden during the last decade. The establishment may be aided by the fact that many suitable host trees are available due to the Dutch elm disease killing a lot of elm trees in southern Sweden.

In 2004, *Xyleborinus alni* (Niisima 1909) was trapped in numbers in a partly dead willow (*Salix* sp.) in Stockholm (Lindelöw et al. 2006). The species has later been trapped in horse chestnut trees (*Aesculus hippocastanum*) in Stockholm area (Jonsell unpubl.). Males and females were found in galleries in rowan (*Sorbus aucuparia*) and beech (*Fagus sylvatica*) damaged by fire (Ericsson unpubl.) in Southern Sweden. The scattered records of *X. alni* indicate multiple introductions, although it cannot be excluded that the species is overlooked in between.

Another xyleborine ambrosia beetle of exotic origin in Northeast Asia is *Cyclorhipidion bodoanus* (Reitter 1913). This species was caught in numbers in 2007 in flight barrier traps attached on old hollow oak trees in Southeast of Sweden (Franck unpubl.). The first record in Europe is 1944; now it is spreading rapidly throughout Europe and is believed to influence both flora and fauna (Bussler and Schmidt 2007).

Importation of larch timber to Sweden is substantial in some years. The finding of *Pityophtorus pityographus* (Ratzeburg 1837) on dead larch trees along with the cerambycid *Tetropium gabrieli* Weise 1905 in larch stands not far away from one of the harbors Karlshamn (Ericsson 2010) is probably a result of spread and establishment by individuals coming from imported timber. The increasing area planted with larch in southern Sweden may favor future establishments of other bark and wood living species, e.g. *Ips cembrae* (Heer 1836).

Table 1: Introduced or native bark beetle species in Sweden, recorded since 2000.

Tabelle 1: Eingeschleppte oder einheimische, seit 2000 entdeckte Borkenkäferarten in Schweden.

Species	Year of detection	Origin	Pathway	Habitat
Scolytus scolytus	2006	Europe	unbarked timber	dead elm trees
Xyleborinus alni	2004	Asia	wood packing	dead broad leaf trees
Cyclorhipidion bodoanus	2007	Asia	wood packing	hollow oak trees
Pityophtorus pityographus	2007	Europe	unbarked larch timber	dead larch trees
Trypodendron laeve	pre 1900	native	-	dead spruce or pine
Trypophloeus dejevi	2008	native	-	*Salix myrcinifolia*

I. cembrae was found established in Denmark in 1995 and has since spread in the country (Ravn and Harding 1995).

Due to taxonomic confusion the distribution of *Trypodendron leave* (Eggers 1939) is still unclear in Europe. The species is described from Japan by Eggers. Strand (1946) described the species *T. piceum* (Strand 1946). Later, *T. piceum* was synonymised with *T. proximum* (Niisima 1909) by Pfeffer (1989). Holzschuh (1990) found *T. leave* in traps on imported timber and considered this species to be an exotic species. Mandelshtam and Popovichev (1999) describe the differences between *T. leave* and *T. proximum* and it seems clear that *T. leave* is the widely distributed species in Europe and *T. proximum* is an Asian species not found in Europe. Bussler and Schmidt (2008) consider *T. leave* as a native species in Germany. The oldest records in Scandinavia dates back to the mid 1900th century (Lindelöw in prep.). It seems reasonable that the species is native in Europe and has a wide distribution from Scandinavia in the West to the Far East.

The surprising detection of *Trypophloeus dejevi* Stark 1936 as a new bark beetle species in Sweden was made in 2007 (Lindelöw 2009) by examining the bark beetle collection of late Lars Huggert which was given to the Swedish Museum of Natural History. One specimen of this species was found in 1968 in Northern Sweden but wrongly determined as *T. bispinulus* Eggers 1927. In 2008, the species was found reproducing in *Salix myrcinifolia*. Obviously *T. dejevi* is a native species that has remained undetected until now.

In the coming years a number of bark beetle species can be expected to become established in Sweden. *Ips cembrae* will probably be one of these. Expanding its range in Denmark, the beetle has been found repeatedly in imported larch timber in harbors. An increasing area of larch stands in Sweden will provide suitable breeding material as dead and dying larch trees for *I. cembrae*. Mandhelstam (in litt.) has suggested *Anisandrus maiche* Stark 1936, a polyphagous xyleborine ambrosia species expanding to the West in Russia to establish in Scandinavia. This species was recently found in North America (Rabaglia et al. 2009). The speed of the expansion is however unknown. *Xylosandrus germanus* (Blandford 1894) and *Gnathotrichus materiarius* (Fitch 1858) are also to be expected. At least *G. materiarius* has reached Northern Germany.

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Newest Uninvited Insect Guests in the Hungarian Forests

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Abstract

Due to the increased international trade and the climate change, more and more non native insects appears in Hungary, some of them establishes and becomes significant pest. Most recent Hungarian examples are *Obolodiplosis robiniaea* and *Aproceros leucopoda*. On top of this – due to the environmental conditions becoming more favourable – a number of native insects have become pests during the last decade. Recent examples are *Chrysomela cuprea* and *Pheosia tremula*. Urban and roadside trees and plantations are particularly vulnerable from point of both invasive and native insect species.

Keywords | invasive insects, new pests, *Aproceros leucopoda, Chrysomela cuprea, Pheosia tremula*

Kurzfassung

Neue ungebetene Insekten-Gäste in den ungarischen Wäldern

Aufgrund des zunehmenden internationalen Handels und des Klimawandels kommen mehr und mehr nicht heimische Insekten in Ungarn vor, einige können sich etablieren und werden zu Schädlingen. Aktuell trifft dies in Ungarn auf *Obolodiplosis robiniaea* und *Aproceros leucopoda* zu. Da die Klimabedingungen für ihre Entwicklung günstiger werden, wurden im letzten Jahrzehnt auch einige heimische Insekten zu Schädlingen . Aktuelle Beispiele dafür sind *Chrysomela cuprea* und *Pheosia tremula*. Stadtbäume und Bäume entlang von Verkehrswegen sowie Plantagen sind besonders anfällig sowohl gegen invasive als auch heimische Insektenarten.

Schlüsselwörter | Invasive Insekten, neue Schädlinge, *Aproceros leucopoda, Chrysomela cuprea, Pheosia tremula*

Introduction

Invasive pests and pathogens are major threats on forest ecosystems all around the world. They often threaten both the native flora and fauna and also the economical productivity of the forestry sector. The explosively growing quantity of international trade increases the chance of the accidental introductions; the climate change is likely to provide more favourable environmental conditions for the introduced species' establishment and spread. A highly increased number of non native forest insect species appeared in Hungary in the last two decades. Some of the established species have the ability to become significant pests. An increasing number of native species earlier considered rare or having less importance are becoming severe pest in the Hungarian forests. This short paper reports a few examples of both, the newest non-native invasive insect species and native species that unexpectedly became pests.

Non-native invasive species

Locust gall midge (*Obolodiplosis robinia*) was first recorded in Hungary in autumn 2006 (Csóka 2006). It is now widespread and common everywhere in Hungary and can also be found in many European countries (Skuhrava et al. 2007, Tóth et al. 2009).

The zigzagging elm sawfly (*Aproceros leucopoda*), native in China and Japan, was first found in Hungary in summer 2003, but the species was only properly identified in 2009 (Blank et al. 2010). Only females are known, the species can have up to four generations per year. Its main host is *Ulmus pumila*, but was also recorded from other elm species as *U. campestris* and *U. glabra*. Its name is given after its typical serpentine chewing pattern (Figure 1). During 2009 it has been recorded from many locations in Hungary. Since 2006 it has been causing repeated defoliations of urban and roadside trees. It was recently found in several other European countries, such as Austria, Poland, Slovakia and Ukraine.

The oriental sweet chestnut gall wasp (*Dryocosmus kuriphilus*) is univoltine, known only from its asexual generation, and native to China. The female lays her eggs into buds, and the galls formed block the development of the shoots. The species is considered worldwide as a major pest of *Castanea*. It has been accidentally introduced to distant continents as North America and Europe. In Europe, it was first recorded in 2002 in Northern Italy. In May 2009 it was found on a single tree (height: ca. 6 m., diameter: ca. 12 cm) in a garden district at Budapests vicinity. The tree was bought from an international garden store chain in autumn 2008. Knowing the circumstances and the life history of the gall wasp, we assume that the tree was most likely carried from Italy to the store during autumn 2008.

Figure 1: Typical chewing pattern of *Aproceros leucopoda* larvae.

Abbildung 1: Typische Fraßmuster der Larve von *Aproceros leucopoda.*

Figure 2: Fully grown caterpillar of *Pheosia tremula*.

Abbildung 2: Ausgewachsene Raupe von *Pheosia tremula*.

Native species becoming pests

The leaf beetle *Chrysomela cuprea* was considered a rare species in Hungary until May 2006, when it totally defoliated 20 hectares young hybrid poplar plantation and caused 30 to 40 % defoliation in 40 hectares older stands at Monor (ca. 30 km SE of Budapest). Nine hectares of young plantation had to be replanted as a consequence of its damage (Hirka 2007, Hirka and Csóka 2007). In 2009 it caused again 90 hectares severe defoliation in older stands. Besides hybrid poplars the white poplar (*Populus alba*) was also damaged. Hardly anything is known about the life history of the species.

The notodontid *Pheosia tremula* is common and widespread in poplar and willow stands in Hungary. The moths are regularly caught by the traps of the Forestry Light Trap Network, but evident damage caused by this species has not yet been reported. Defoliation on 120 ha (including 90 ha total defoliation) was reported from Monor in September 2009 (Figure 2). *P. tremula* has two generations per year, and overwinters as pupa.

The buprestid *Coraebus florentinus* was known as an occasional xylophagous pest of oaks for a long time (Paszlawszky 1885), but its mass occurrences are rather rare. It attacks and kills 1.5-2 m long branches with 20-30 mm diameter. Main hosts are *Q. pubescens, Q. petraea* and *Q. robur*, but it is also found on *Q. cerris*. The species becomes practically "invisible" between its outbreaks, which is the reason why it was declared as protected species in Hungary. Its last damage was reported by Koltay and Leskó (1991). Following the severe drought in the first years of the new millennium and the country-wide outbreak of gypsy moth (2003-2006), it became common and abundant in many different regions in Hungary.

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Some New Immigrant Phytophagous Insects on Woody Plants in Slovenia

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Abstract

Analysis of alien phytophagous insects and mites introduced into Slovenia in the last two centuries shows that more that 130 introduced species can be considered pests of plants or their products. More than 50 % of them have been discovered in the last 20 years: Hemiptera, Lepidoptera, Coleoptera, Diptera, Thysanoptera, Hymenoptera and Acari. Some of them, which have appeared in the last fifteen years on woody plants, specifically *Dryocosmus kuriphilus*, *Leptoglossus occidentalis*, *Xylosandrus germanus* and *Cinara curvipes* are presented. Their influence to forests is discussed.

Keywords | invasive species, introduced pests, Slovenia

Kurzfassung

Einige neu eingewanderte phytophage Insekten an Gehölzen in Slowenien

Von den in den letzten zwei Jahrhunderten neu in Slowenien aufgetretenen, nicht-heimischen phytophagen Insekten und Milben sind über 130 eingeschleppte Arten Schädlinge von Pflanzen oder deren Produkten. Mehr als die Hälfte wurde in den letzten zwanzig Jahren entdeckt: Hemiptera, Lepidoptera, Coleoptera, Diptera, Thysanoptera, Hymenoptera und Acari. Einige von ihnen, die in den letzten fünfzehn Jahren an Gehölzen aufgetreten sind, im Besonderen *Dryocosmus kuriphilus*, *Leptoglossus occidentalis*, *Xylosandrus germanus* und *Cinara curvipes*, werden vorgestellt. Ihr Einfluss auf Wälder wird diskutiert.

Schlüsselwörter | invasive Arten, eingeschleppte Schädlinge, Slowenien

As in all of Europe, many serious pests in Slovenia originate from different regions of the world. It is assumed that 130 foreign insect and mites species, considered pests to plants and plant products, have been introduced to Slovenia since the 18th century (Seljak and Maček 2009). More than 50 % of them have been discovered in the last 20 years, the most numerous groups are Hemiptera (56.7 %), Lepidoptera (12.7 %), Coleoptera (11.2 %), Diptera (6.7 %), Thysanoptera (6.7 %), Hymenoptera (0.7%) and Acari (3.0 %). Of the introduced species, 32.8 % originate from Asia, 32.1 % from North America, 9 % from Africa, 9 % from South America, and 3.7 % from Australia and New Zealand, while 13.4 % are Mediterranean, cosmopolitan or species of uncertain origin. Hereafter are presented some immigrant phytophagous insect on woody plants which can affect Slovenian forests.

Figure 1: *Dryocosmus kuriphilus* (photo M. Jurc).

Abbildung 1: *Dryocosmus kuriphilus* (Foto M. Jurc).

Dryocosmus kuriphilus (Yasumatsu, 1951) (Hymenoptera: Cynipidae) was found in 2005 on ten saplings of *Castanea sativa* in four different places in Slovenia. It was introduced in 2004 from Italy with contaminated seedlings. *D. kuriphilus* is now established in Slovenia. According to the evaluation of the Slovenian Forest Service (SFS), there are approximately 253,000 ha of chestnut forests in Slovenia. Chestnut is ranked at the 8th place out of 45 tree species in the country; representing 1.5 % of total growing stock or 3.62 million cubic meters. Therefore, the potential damage caused by *D. kuriphilus* could be major, specifically in the production of wood, yield production and apiculture (Jurc 2009).

Leptoglossus occidentalis (Heidman, 1910) (Heteroptera: Coreidae) was found for the first time in 2003 in the Kras region. By 2004, it had already spread to the whole of SW Slovenia. It has been found in the *Pinus nigra* forests. In 2004, it was also found in Ljubljana (Jurc and Jurc 2005) and in October 2008 in Kidričevo on *Pinus sylvestris*. *P. nigra* and *P. sylvestris* are the most suitable host trees in Slovenia. According to the data of the SFS, the share of growing stock of coniferous trees represents 47.4 % of the total growing stock. *Pinus* spp. represent 8.711 millions of cubic meters of growing stock or 5.8 % of total. Considering

Figure 2: *Leptoglossus occidentalis* (photo D. Jurc).

Abbildung 2: *Leptoglossus occidentalis* (Foto D. Jurc).

Figure 4: *Cinara curvipes*, vivipari (photo M. Jurc)

Abbildung 4: *Cinara curvipes*, lebendgebärend (Foto D. Jurc).

this, the potential damage caused by *L. occidentalis* could be important.

Xylosandrus germanus (Blandford, 1894) (Coleoptera: Scolytinae) was first recorded in Slovenia on a *Castanea sativa* near Nova Gorica in 2000 (Jurc 2008). In 2009, it has been found on an *Abies alba* near Ljubljana. Many tree species (*Quercus* spp., *Juglans regia*, *Picea abies*, *Pinus sylvestris*) are susceptible to the attack by this beetle (Henin and Versteirt 2004). The influence to Slovenian forest could be major.

Cinara curvipes (Patch, 1912) (Homoptera: Aphididae) was detected for the first time in the spring of 2007 on a single silver fir tree (*Abies alba*) in

Figure 3: Wormhole caused by the female of *X. germanus* (photo M. Jurc).

Abbildung 3: Wurmstich verursacht durch das Weibchen von *X. germanus* (Foto M. Jurc).

Ljubljana, and in winter 2007 on two *Abies concolor* trees in a park in Muta. The host fidelity of *C. curvipes*, possible host switching and its eventual influence on silver fir forests are important. Silver fir is the third most widely distributed tree species in Slovenia. The share of *A. alba* in total growing stock is 7.5 % or more than 11 million cubic meters. In the case of the aphid spreading into these forests, we can expect our forest to be considerably affected (Jurc et al. 2009).

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Monochamus alternatus – the Next Alien Causing Trouble

Ullrich Benker

Abstract

The Japanese pine sawyer beetle *Monochamus alternatus* is the most important carrier of the pine wood nematode *Bursaphelenchus xylophilus*, causing wilt disease of *Pinus* species. This longicorn beetle is native to Japan, China, Taiwan, Korea, and Laos. In 2009, the plant protection service could observe two different ways of introduction of this potentially invasive beetle to Bavaria. The first case was through wood packaging material, a well known way for different beetles travelling from Asia to Europe. A second beetle was introduced inside a kids' table, which was produced for a German discounter.

Keywords | Japanese pine sawyer beetle, pine wilt disease

Kurzfassung

***Monochamus alternatus* –**
der nächste Exote verursacht Ärger

Der Bockkäfer *Monochamus alternatus* ist der Hauptüberträger des Kiefernsplintholznematoden *Bursaphelenchus xylophilus*, dem Verursacher der Kiefernwelke. Sein natürliches Verbreitungsgebiet reicht von Japan, China, Taiwan und Korea bis Laos. Im Jahr 2009 konnten vom Amtlichen Pflanzenschutzdienst zwei verschiedene Einschleppungswege dieser potenziell invasiven Art nach Bayern beobachtet werden. Zum einen erfolgte diese über Holzverpackungsmaterial, einer bereits von anderen Käfern bekannten Reisemöglichkeit aus Asien. Zum anderen war ein Käfer erfolgreich über einen Spielzeugtisch, produziert für einen deutschen Discounter, eingereist.

Schlüsselwörter | *Monochamus alternatus*, Kiefernwelke

Scientific classification and morphology

The Japanese pine sawyer beetle *Monochamus alternatus* Hope, 1842 belongs to the cerambycid subfamily Lamiinae, tribe Lamiini – like the Asian longhorn beetle *Anoplophora glabripennis* (Motschulsky, 1853) and the citrus longhorn beetle *Anoplophora chinensis* (Forster, 1771). Unlike the two *Anoplophora* spp. already present in Europe that develop in deciduous wood, *Monochamus* spp. attack exclusively coniferous hosts. Of approximately 100 *Monochamus* spp. worldwide, five species are native to Europe. Three species occur frequently – the small white-marmorated longicorn *M. sutor* (L., 1758), the sawyer beetle *M. sartor* (L., 1787), and the black pine sawyer beetle *M. galloprovincialis* (Olivier, 1790). Two other species, *M. saltuarius* Gebler, 1830, and *M. urussovi* (Fischer von Waldheim, 1806), are less abundant. *M. alternatus* is not native to Europe and is recognized as potentially invasive species. Synonyms of *M. alternatus* are *Monochamus tesserula* Bates, 1873, and *Monohammus tesserula* White, 1858. Two subspecies have been described: *M. alternatus alternatus* Hope, 1842 and *M. alternatus endai* Makihara, 2004.

M. alternatus can relatively easily be determined according to morphological characters. Based on the shape of the body with a length of 15-28 mm and width of 4.5-9.5 mm it cannot be distinguished from European *Monochamus* species. However, the orange-brown coloration of the body and the brown antennae are very distinct. On each elytrum, the beetle shows five clear longitudinal bands with grey and black marks. Three black stripes on the protergum with intermittent orange-brown bands are further characters (Figure 1). Typically for the genus, males are smaller and slimmer than females. Their antennae, however, reach twice the length of the body, while female antennae are equal or slightly longer than the body.

Natural enemies

There are several natural enemies known from *M. alternatus*; their efficiency, however, is usually limited. The entomopathogenic fungus *Beauveria bassiana* (Balsamo) Vuillemin, 1912, has already been tested and applied (Enda et al. 1989). The bark beetle *Cryphalus fulvus* Niijima, 1907, is involved in transmission of the fungus.

Among insects, parasitoids that search their hosts in the feeding galleries of *M. alternatus* are of primary importance. Larvae of *Dastarcus helophoroides* (Fairmaire, 1881) (synonym *Dastarcus longulus* Sharp, 1885), family Bothrideridae (previously Colydiidae) have been recorded as ectoparasitoids of larvae and pupae of *M. alternatus* (Ogura et al. 1999; Urano 2006). There are several braconid and bethylid species that develop ectoparasitically on various cerambycid species including *M. alternatus*. Important braconid parasitoids are *Ontsira palliatus* (Cameron, 1881), *Zombrus bicolor* (Enderlein, 1912), and particularly *Bracomorpha ninghais* (Wang et al. 2009). Two bethylids have been recorded from *M. alternatus*: *Sclerodermus guani* Xiao & Wu, 1983, and *Sclerodermus sichuanensis* Xiao, 1994 (Smith et al. 2007).

Figure 1: Japanese pine sawyer beetle, *Monochamus alternatus*.

Abbildung 1: Der Bockkäfer *Monochamus alternatus*.

Pest potential

Seventeen *Pinus* species are known to be hosts for the *M. alternatus*. In Japan, its main hosts are Japanese red pine *P. densiflora* Siebold & Zucc., 1842, Japanese black pine *P. thunbergii* Parl., 1868, and Okinawa pine *P. luchuensis* Mayr, 1894. Masson's pine *P. massoniana* Lambert, 1803, is the main host in China. Moreover, *M. alternatus* accepts other conifers; three *Picea* species as well as one *Abies*, *Cedrus*, and *Larix* species are known to be suitable hosts. These hosts also occur in Europe.

The pest potential of *M. alternatus* has to be rated relatively high since this species is the main vector of the pinewood nematode *Bursaphelenchus xylophilus* (Steiner and Buhrer, 1934). This quarantine organism is the causal agent of the notorious pine wilt disease that can cause mortality of infested trees. If *M. alternatus* should become established in Europe, a direct transmission of *B. xylophilus* to European pines or other host trees could occur. Native *Monochamus* species could then aid the further spread of the disease. In Europe, the pinewood nematode has been introduced to Portugal; there *M. galloprovincialis* has become the main vector (Naves et al. 2008).

Cases in Bavaria

On June 4, 2009, a container with imported goods from China was opened in the storage of a wholesaler in Augsburg. After detection of a living beetle, the workers closed the container immediately and sealed the ventilation slots and thus prevented escape of beetles. The shipment contained wood packaging material with a mark indicating methyl bromide fumigation. Also the papers included a certificate of this treatment. The container was then fumigated once again in Bavaria. The following inspection showed two dead female *M. alternatus*. The wood packaging material showed larval galleries and adult emergence holes.

In late June 2009, an oval emergence hole was detected on the leg of a white painted table made of coniferous wood (a piece of kids' furniture). A living male beetle was found nearby. The beetle was captured and the regional plant protection organization was informed. A larval gallery with coarse boring material became visible after cleaving the infested table leg. The tables were offered nationwide by a major German discount store. Internal random inspections of 1000 pieces of furniture following the detection of the beetle found four indications for longicorn beetle infestation – two in Bavaria and two in North Rhine-Westphalia. The infested table leg tested positive for nematodes; luckily, these belonged to the innocuous genus *Laimaphelenchus*.

German – Deutsch

Systematische Stellung und Morphologie

Der Bockkäfer *Monochamus alternatus* Hope, 1842, gehört wie der Asiatische Laubholzbockkäfer *Anoplophora glabripennis* (Motschulsky, 1853) und der Citrusbockkäfer *Anoplophora chinensis* (Forster, 1771) zur Unterfamilie der Lamiinae und zur Tribus der Lamiini. Im Gegensatz zu den beiden bereits in Europa bekannten *Anoplophora*-Arten, die sich in Laubholz entwickeln, besiedeln *Monochamus*-Arten ausschließlich Nadelhölzer. In Europa sind von den etwa 100 weltweit verbreiteten *Monochamus*-Arten fünf Arten heimisch. Drei Arten sind relativ häufig - sie werden aufgrund ihrer deutschen Namen auch als Handwerkerböcke zusammengefasst. Es handelt sich um den Schusterbock *Monochamus sutor* (L., 1758), den Schneiderbock *M. sartor* (F., 1787) und den Bäckerbock *M. galloprovincialis* (Olivier, 1790). Zwei weitere Arten, *M. saltuarius* Gebler, 1830, und *M. urussovi* (Fischer von Waldheim, 1806), kommen weniger häufig vor. *Monochamus* *alternatus* ist in Europa gebietsfremd und gilt als invasive Art. Als Synonyme werden für *M. alternatus* unter anderem noch *Monochamus tesserula* Bates, 1873, sowie *Monohammus tesserula* White, 1858, geführt. Von *M. alternatus* sind zwei Unterarten beschrieben worden: *M. alternatus alternatus* Hope, 1842 und *M. alternatus endai* Makihara, 2004.

Monochamus alternatus lässt sich relativ einfach mit Hilfe seiner morphologischen Merkmale bestimmen. Anhand seiner gesamten Körpergestalt, einer Körperlänge von 15-28 mm und einer Körperbreite von 4,5-9,5 mm ist er nicht von den einheimischen *Monochamus*-Arten zu unterscheiden. Aber durch seine orange-braune Körperfärbung und seine braunen Fühler fällt er sofort auf. Auch die fünf deutlich erkennbaren longitudinalen Bänder mit grauen und schwarzen Flecken auf jeweils einer Flügeldecke sind charakteristisch. Weitere Merkmale sind drei schwarze Streifen auf dem Protergum, die von zwei orange-braunen Bändern unterbrochen werden (Abbildung 1). Die Männchen sind, wie üblich bei der Gattung *Monochamus*, deutlich kleiner und schmaler als die Weibchen. Ihre Fühler haben dafür etwa zweifache Körperlänge, bei den Weibchen sind sie nur so lang oder minimal länger als der Körper.

Natürliche Feinde

Es gibt einige natürliche Feinde von *M. alternatus*, die allerdings in ihrer Effektivität zumeist begrenzt sind. Als pilzlicher Gegenspieler ist *Beauveria bassiana* (Balsamo) Vuillemin, 1912, bereits getestet und eingesetzt worden (Enda et al. 1989). Übertragen wird der Pilz von dem Borkenkäfer *Cryphalus fulvus* Niijima, 1907.

Unter den Insekten sind es vor allem parasitoide Arten, die in den Fraßgängen des Holzes ihrem Wirt *M. alternatus* nachstellen. Die Larven von *Dastarcus helophoroides* (Fairmaire, 1881)(synonym *Dastarcus longulus* Sharp, 1885), Familie Bothrideridae (früher zu Colydiidae), sind als Ektoparasitoide der Larven und Puppen von *M. alternatus* in Erscheinung getreten (Ogura et al. 1999; Urano 2006).

Unter den Brackwespen (Braconidae) und Plattwespen (Bethylidae) gibt es mehrere Spezies, die als Larval-Ektoparasitoide bei mehreren Bockkäfer-Arten, darunter auch *M. alternatus*, auftreten. Bei den Braconiden sind dies *Ontsira palliatus* (Cameron, 1881), *Zombrus bicolor* (Enderlein, 1912), vor allem aber *Bracomorpha ninghais* (Wang et al. 2009). Unter den Betyliden sind bisher zwei Arten, *Sclerodermus guani* Xiao & Wu, 1983, und *Sclerodermus sichuanensis* Xiao, 1994 als natürliche Feinde von *M. alternatus* bekannt (Smith et al. 2007).

Figure 2: Kid's table with oval exit hole of *Monochamus alternatus.*

Abbildung 2: Kindertisch mit ovalem Ausbohrloch von *Monochamus alternatus*.

Schadpotenzial

Im Englischen wird *Monochamus alternatus* als „Japanese pine sawyer beetle" bezeichnet. Es sind 17 *Pinus*-Spezies bekannt, die zu seinen Wirtspflanzen gerechnet werden. In Japan sind die Hauptwirte die Japanische Rotkiefer *P. densiflora* Siebold & Zucc., 1842, die Japanische Schwarzkiefer *P. thunbergii* Parl., 1868, und die Okinawa-Kiefer *P. luchuensis* Mayr, 1894. In China ist der Hauptwirt die Chinesische Rotkiefer *P. massoniana* Lambert, 1803. Des Weiteren werden auch andere Nadelholzbäume als Wirte angenommen – drei *Picea*-Spezies und je eine *Abies*-, *Cedrus*- und *Larix*-Spezies sind bekannt. Diese Wirte kommen auch in Europa vor.

Das Schadpotenzial von *M. alternatus* ist als relativ hoch einzuschätzen, da diese Art als Hauptüberträger des Kiefernholznematoden *Bursaphelenchus xylophilus* (Steiner und Buhrer, 1934), einem Quarantäneschadorganismus, gilt. Dieser Nematode verursacht die berüchtigte Kiefernwelke, die befallene Bäume zum Absterben bringen kann. Falls es *M. alternatus* gelingen sollte, Freilandpopulationen in Europa zu etablieren, wäre eine direkte Übertragung von *B. xylophilus* auf einheimische *Pinus*-Arten oder die oben erwähnten Wirtsbäume möglich. Europäische *Monochamus*-Arten könnten dann für eine weitere Verbreitung des Kiefernholznematoden sorgen. Aktuell ist in Europa nur eine Einschleppung von *B. xylophilus* in Portugal zu verzeichnen. Dort hat sich bereits *M. galloprovincialis* als Überträger in Szene setzen können (Naves et al. 2008).

Figure 3: Larval tunnels and coarse boring material in the cleaved table leg.

Abbildung 3: Larvengänge und grobes Genagsel im aufgespaltenen Tischbein.

Fälle in Bayern

Am 4. Juni 2009 wurde in einem Lager eines Großhandelsunternehmens in Augsburg ein Container mit Importware aus China geöffnet. Nach dem Entdecken eines lebenden Käfers verschlossen die Arbeiter sofort wieder den Container und verklebten die Lüftungsschlitze. Es gelang keinem Käfer die Flucht. Im Container befand sich Holzverpackungsmaterial, das eine Markierung über eine durchgeführte Methylbromid-Begasung trug. Den Transportunterlagen lag ein Zertifikat über die Begasung bei. Der Container wurde in Bayern erneut begast und nach dem Öffnen wurden zwei abgetötete weibliche Exemplare von *M. alternatus* gefunden. Das Holzverpackungsmaterial wies Ausbohrlöcher und Larvengänge auf.

Ende Juni 2009 wurde an einem bereits verkauften Kindermöbel, einem weiß lackierten Tisch aus Nadelholz, ein ovales Ausbohrloch am Tischbein und ein lebender männlicher Käfer, in der Nähe sitzend, entdeckt. Der Käfer konnte eingefangen werden und der Amtliche Pflanzenschutzdienst wurde informiert. Erst nach Aufspalten des Tischbeins wurde der Larvengang mit grobem Genagsel klar sichtbar (Abbildungen 2 und 3). Ein großer deutscher Discounter bot diese Kindertische bundesweit in seinem Sortiment an. Nach dem Käferfund ergab eine stichprobenartige interne Kontrolle von 1000 Möbeln in vier Fällen Hinweise auf Bockkäferbefall – zwei in Bayern, zwei in Nordrhein-Westfalen. Eine Untersuchung des Tischbein-Holzes auf Nematodenbefall lieferte zwar ein positives Ergebnis, glücklicherweise aber mit der harmlosen Gattung *Laimaphelenchus*.

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Citrus Longhorn Beetle Situation in Croatia – Two Years after the First Discovery

ANDRIJA VUKADIN AND BORIS HRAŠOVEC

Abstract

Twelve consecutive surveys of the quarantined nursery during 2008-2009 revealed 22 *Acer palmatum* plants and seven potted roses infested with citrus longhorn beetle (CLB) larvae in 2008, and another 38 infested maples in 2009. Not a single *Magnolia* plant from the same imported batch revealed any sign of CLB presence as of October 2009. A switch from maple to nearby roses was recorded. Artificial introduction of CLB larvae demonstrated that they can thrive in *Quercus*, *Robinia*, *Corylus*, *Malus* and fully develop in *Fagus sylvatica*. Not a single sign of CLB infestation has been recorded in the area surrounding the quarantined nursery.

Keywords | *Anoplophora chinensis*, Croatia, monitoring, hosts

Kurzfassung

Status des Citrusbockkäfers *Anoplophora chinensis* in Kroatien – zwei Jahre nach der ersten Endeckung

Im Zeitraum 2008-2009 wurden bei 12 aufeinander folgenden Surveys in der unter Quarantäne stehenden Baumschule in Kroatien, in der *Anoplophora chinensis* das erste Mal gefunden worden war, 22 Pflanzen von *Acer palmatum* und sieben Topfrosen mit *A. chinensis*-Larven im Jahr 2008 und weitere 38 befallene *Acer palmatum*-Pflanzen im Jahr 2009 entdeckt. Anzumerken ist, dass bis zum Oktober 2009 keine einzige Magnolie des selben Importes Befallsymptome zeigte. Ein Wechsel von Ahorn auf benachbarte Rosen wurde jedoch festgestellt. Die künstliche Einbringung von *A. chinensis*-Larven in verschiedene Hartholzarten zeigte, dass sie sich in *Quercus*, *Robinia*, *Corylus* und *Malus* entwickeln und in Buche die Entwicklung abschließen können. Kein einziges Symptom eines *A. chinensis*–Befalls wurde auf benachbarten Flächen zur Quarantäne-Baumschule entdeckt.

Schlüsselwörter | *Anoplophora chinensis*, Kroatien, Überwachung, Wirtpflanzen

First record of *Anoplophora chinensis* (Forster, 1771) alias citrus longhorn beetle (CLB) in Croatia dates to mid September 2007, when a large consignment from China revealed a presence of CLB larvae (Vukadin and Hrašovec 2008). As in many known cases before, Chinese export plant health certificate clearly stated that the plants were free of pests and diseases. Immediately, ban on plant relocation was issued, together with backtracking and isolation of small number (less than 50) of plants that were transferred to two nurseries inside Croatia (Zagreb and Split). No signs of CLB were ever recorded on these plants as of October 2009. All suspicious plants, clearly infested ones, and those with some signs of physiological problems were burnt on February 22nd 2008. Exactly 2692 *Acer palmatum* plants and all *Lagerstroemia* plants were destroyed. Interestingly, not a single magnolia plant, among 600 potted plants being the third plant species in the infested Chinese consignment, was found infested in a two-year year monitoring survey in spite of the fact of being shipped together with the highly infested batch.

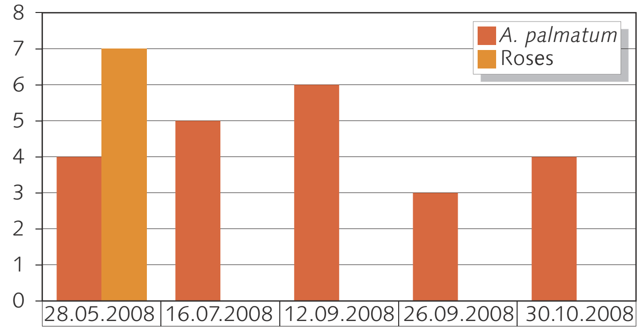

Figure 1: Number of nursery plants found infested with CLB larvae in 2008.

Abbildung 1: Anzahl von Baumschulpflanzen 2008, die von CLB-Larven befallen waren.

Aside from a ban on plant movement and selling of plants issued in September 2007 for the nursery of first record (Vukadin and Hrašovec 2008), starting with 2008, a phytosanitary survey has been initiated through six yearly *Anoplophora* targeted surveys conducted within the nursery of the first record and its respective surroundings. Apart from detecting 29 new CLB infested plants (Figure 1), a transfer to a new host was discovered. CLB larvae were discovered in seven rose plants (*Rosa* spp.) that were kept and grown as potted plants in the nursery prior to arrival of the Chinese consignment (Figure 2). These seven plants were dissected and larvae were excavated from the root collars. This important finding confirms a successful beetle transfer and life cycle completion on the Croatian territory, though reaching only the first newborn generation larvae. Infested plants were detected on May 28th

Figure 2: Nursery rose plants with clear signs of CLB larval presence (a) and fully grown larva in root collar (b).

Abbildung 2: Rose aus dem Pflanzgarten mit deutlichen Zeichen eines CLB-Larvenbefalls (a) und einer voll ausgewachsenen Larve im Wurzelhals (b).

2008 and the whole batch of roses (1430 potted plants) was burnt on June 2nd 2008. During the six surveys in 2008 inspection of the area surrounding the nursery resulted in no positive CLB signs of presence (larval frass, adults, exit holes or any other suspicious symptom). Surveys were conducted in a form of detailed visual control of all the woody plants in nearby private gardens and municipality greenery. The survey was continued in 2009 and resulted in 38 new *A. palmatum* plants found infested with CLB larvae (Figure 3). Again, six successive yearly surveys did not reveal any sign of CLB spread around the initial glasshouse holding the quarantined consignment. All positive findings were based on larval activity (woody frass at root collar) and all were destroyed upon detection.

Under the quarantine conditions, a set of experiments with larvae isolated from the infested maples in 2008 was set up. At that time the knowledge of possible hosts in European landscape was restricted, compared to most recent works (Haack et al. 2010). Less than a dozen larvae were artificially introduced in *Quercus robur, Robinia pseudoacacia, Corylus avellana, Malus domestica* and *Fagus sylvatica* branches or small potted plants. They all were successfully developing but only one larva reached adult stage in *Fagus sylvatica* branch. Other larvae did not reach pupation and this is attributed to a small number of trials and unsuitable condition of the material they were introduced into. Clearly, it seems that CLB is pronounced polyphagous but prefers living or moribund trees, not ones already dead and dried out.

The intensive survey is scheduled to continue in 2010 and decision will be made when to destroy the whole batch of infested maples from China. The most prudent way to handle this introduction under the given

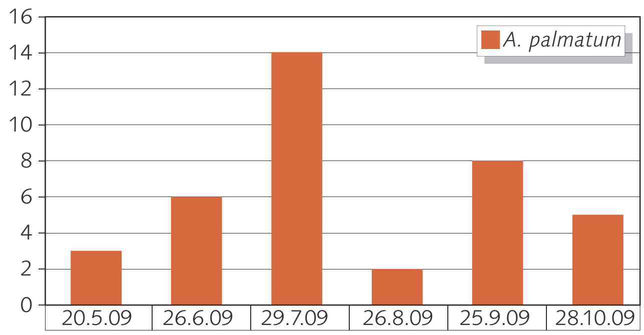

Figure 3: Number of nursery plants found infested with CLB larvae in 2009.

Abbildung 3: Anzahl von Baumschulpflanzen 2009, die von CLB-Larven befallen waren.

circumstance is probably to use the attractive power of *A. palmatum* plants for beetles, never detected but possibly present. It looks at this point that so far this was among the main reasons why CLB adults seemingly did not spread further away from their first Croatian eclosion microsite (quarantined nursery).

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Trace Analytical and Electroantennographic Examination of Volatiles Released by Potential Host Trees and Volatiles Induced by *Anoplophora glabripennis* Infestation

Martin Scholz and Stefan Schütz

Abstract

The Asian longhorned beetle (ALB) was introduced to several North American and European countries, causing huge damage to some cities' tree populations. In order to determine the host tree suitability of *Fagus sylvatica* and *Quercus robur*, volatile organic compounds (VOCs) from leaves of eight tree species were analyzed with GC/MS technique. Furthermore VOCs of wood infested with ALB was compared with those of uninfested wood and with those of wood infested with several European wood-boring insect species. Additionally, electroantennographic research was done with one of the major antagonists of ALB, *Dastarcus helophoroides*, to identify VOCs that are used by this insect to find trees infested with ALB larvae.

Keywords | *Anoplophora glabripennis, Fagus sylvatica, Quercus robur*, volatile organic compounds, host tree attraction

Kurzfassung

Spurenanalytische und elektroantennographische Untersuchungen von Volatilen potentieller Wirtsbäume sowie von durch Befall mit *Anoplophora glabripennis* induzierten Volatilen

Der Asiatische Laubholzbock (ALB) wurde in mehrere nordamerikanische und europäische Länder eingeschleppt und verursachte große Schäden an Stadtbäumen. Um die Eignung von *Fagus sylvatica* und *Quercus robur* als Wirtsbaum für den ALB abzuschätzen, wurden die Volatile (VOC) der Blätter von insgesamt acht Baumarten mittels mit Massenspektrometrie gekoppelter Gaschromatographie (GC/MS) untersucht. Weiterhin wurden die VOC von mit ALB-befallenem Holz mit jenen von gesundem Holz und mit heimischen holzbohrenden Insekten befallenem Holz verglichen. Zusätzlich wurden elektroantennographische Versuche mit einem natürlichen Antagonisten des ALB, *Dastarcus helophoroides,* durchgeführt, um VOC zu identifizieren, die dieses Insekt auf der Suche nach ALB-befallenen Bäumen nutzt.

Schlüsselwörter | *Anoplophora glabripennis, Fagus sylvatica, Quercus robur*, VOC, Wirtsbaumfindung

Volatiles released by host and non-host trees

The leaf volatiles of the preferred host trees *Acer platanoides, Acer pseudoplatanus,* and *Acer saccharum,* and of the unfavoured tree species *Gleditsia triacanthos, Ailanthus altissima,* and *Liquidambar styraciflua* were collected by the Closed Loop Stripping Analysis (CLSA) method and their constitution was observed with gas chromatography-mass spectrometry (GC/MS). The constitutions of these volatiles were compared with volatiles from *Fagus sylvatica* and *Quercus robur* to seek out the suitability of these two central European tree species for the ALB.

The research showed a vast variety among VOCs, but only 36 compounds regularly occurred in the different tree species' volatiles. Few compounds occurred in more than one species, the most important being (Z)-3-hexen-1-ol and (Z)-3-hexenyl acetate. Both substances were absent in the volatiles of *L. styraciflua* and (Z)-3-hexen-1-ol could not be found in *A. altissima*. Equal compounds connecting tree species with status as a host tree for ALB could not be found. According to the single substances in the VOC of the non-host tree species, *L. styraciflua* differed from *A. altissima* and *G. triacanthos*.

The two compounds known to be detected by ALB that also occur in the volatiles, (Z)-3-hexen-1-ol and (E)-2-hexenal (Li et al. 1999; Li et al. 2003), could not show any difference between the different tree species. Based on these two compounds, there is no difference between the tree species that provides a reliable indication of host tree suitability of *F. sylvatica* and *Q. robur*.

Based on these results, no reliable prediction of the host tree suitability of *F. sylvatica* and *Q. robur* can be made (Figure 1). VOCs of both species can be detected by the ALB, which is the first requirement for an infestation. Apparently, the ALB's host tree selection seems to be influenced by a mix of compounds rather than by only one compound of the volatiles. For example, (Z)-3-hexen-1-ol is reported to attract the ALB (Li et al. 2003). Since it also occurs in the VOC of *G. triacanthos*, it is unlikely that this compound alone causes the ALB to feed on/infest a certain tree. Moreover, since there is not a single common compound VOCs of *A. altissima*, *G. triacanthos*, and *L. styraciflua* in, there must be either more than one substance for repelling or different ways of repelling the ALB. Host tree selection by ALB females chewing oviposition sites might be at least partially influenced by the taste or constitution of the tree´s bark or sap. Most likely it is not the VOC alone that determines whether a tree becomes infested by the ALB or not.

Volatiles induced by *Anoplophora glabripennis* infestation

Since larvae of ALB feed deep inside the trunk of a tree, it is very unlikely to detect infestations before the adults eclose and leave their significant exit holes. Hence, eradication measures often need to be carried out over many years even in small infestation sites. Additionally, there are several native European insect species that cause similar larval damage to trees that also belong to ALB´s preferred host trees in Europe. Such insects are the leopard moth *Zeuzera pyrina*, poplar long-horned beetle *Saperda carcharias* or the European goat moth *Cossus cossus*.

A current project analyzes how much the VOCs of trees infested with ALB differ from healthy trees and trees infested with *Saperda carcharias* (Figure 2), *Zeuzera pyrina* and *Cossus cossus*. The samples were taken via the CLSA and Thermodesorption (TDS) methods from small stems of willow or poplar trees infested with the different insect species. The samples were then analyzed by GC-MS.

This project is still in progress but initial results show that there seem to be only minor differences between the VOCs of the different stems. There are hints that two substances might occur only in the VOCs of infested trees. These compounds might be sesquiterpenes (C-15 body) and do not seem to be related to a certain insect species but rather to an infestation of wood by a boring larva. These two compounds are only a minor part of the VOCs. The volatile concentrations released by infested wood in general seem to be very low compared to those of green-leaves.

In addition to the constitution of the VOC of infested wood, it will be determined how the natural enemy *Dastarcus helophoroides* utilizes infestation-induced VOCs during host-finding and parasitization of ALB larvae. This research is performed with the gas chromatographic-electroantennographic detection (GC-EAD) technique. Preliminary experiments show reactions of *D. helophoroides* to (Z)-3-hexen-1-ol, a common green-leaf volatile, and nonanal, one of the major compounds in the VOCs of wood-samples.

Figure 1: The general host tree suitability of European Beech (*Fagus sylvatica*) for the Asian Longhorned Beetle (*Anoplophora glabripennis*) remains uncertain (photo: Anna Plasil).

Abbildung 1: Die generelle Eignung der Rotbuche (*Fagus sylvatica*) als Wirtsbaum für den Asiatischen Laubholzbock (*Anoplophora glabripennis*) ist weiterhin unklar (Foto: Anna Plasil).

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German – Deutsch

Volatile von Wirts- und Nicht-Wirtsbaumarten

Die Blattvolatile der vom ALB bevorzugt befallenen Baumarten *Acer platanoides, Acer pseudoplatanus* und *Acer saccharum* sowie die der gemiedenen Baumarten *Gleditsia triacanthos, Ailanthus altissima* und *Liquidambar styraciflua* wurden über die Closed Loop Stripping Analysis (CLSA)-Methode gesammelt und mittels GC/MS auf ihre Zusammensetzung untersucht. Um die Attraktivität von *Fagus sylvatica* und *Quercus robur* für den ALB abzuschätzen, wurden Volatile dieser Baumarten ebenfalls gesammelt und mit jenen der anderen Baumarten verglichen.

Die Blattvolatile der beprobten Baumarten sind insgesamt sehr verschieden. 36 Substanzen finden sich regelmäßig in den Volatilen, die wichtigsten waren dabei (Z)-3-Hexen-1-ol und (Z)-3-Hexen-1-yl-acetat. (Z)-3-Hexen-1-ol kommt regelmäßig in den Volatilen aller Baumarten außer *L. styraciflua* und (Z)-3-Hexen-1-yl-acetat bei allen Arten außer *L. styraciflua* und *A. altissima* vor. Substanzen, die die Baumarten nach ihrem Status als Wirtsbaum für den ALB trennen, wurden nicht gefunden. Auf Basis der in den Volatilen der Nicht-Wirtsbaumarten gefundenen Substanzen unterscheidet sich *L. styraciflua* deutlich von *A. altissima* und *G. triacanthos*.

Aufgrund der zwei Substanzen in den Proben, von denen bekannt ist, dass sie vom ALB wahrgenommen werden können, (Z)-3-Hexen-1-ol und (E)-2-Hexenal (Li et al. 1999; Li et al. 2003), konnte kein Unterschied zwischen den verschiedenen Baumarten festgemacht werden. Die Attraktivität von *F. sylvatica* und *Q. robur* als Wirtsbaum für den ALB kann daher auf Grundlage dieser Untersuchungen nicht sicher prognostiziert werden. Die Volatile beider Arten können vom ALB wahrgenommen werden, was die erste Bedingung für einen Befall ist. Offensichtlich wird die Wirtsbaumwahl des ALB eher von einer Mischung aus verschiedenen Substanzen beeinflusst als nur von einem in den Volatilen vorkommenden Stoff. So wirkt beispielsweise (Z)-3-Hexen-1-ol attraktiv auf den ALB (Li et al. 2003), da es aber auch in den VOC von *G. triacanthos* auftritt, ist es unwahrscheinlich, dass diese Substanz allein dafür verantwortlich ist, dass der ALB an einem Baum frisst oder diesen befällt. Da die VOC von *A. altissima*, *G. triacanthos* und *L. styraciflua* nicht eine einzige Substanz gemeinsam haben, muss es umgekehrt auch mehr als nur eine auf den ALB anziehend wirkende Substanz oder unterschiedliche Wege der Repellenz geben. Die Wirtsbaumwahl insbesondere der die Eiablage-Grübchen herstellenden Weibchen scheint zumindest teilweise vom Geschmack und der Konsistenz der Rinde und des Baumsaftes zu sein. Sehr wahrscheinlich sind es nicht die VOC alleine, die beeinflussen, ob ein Baum vom ALB befallen wird oder nicht.

Figure 2: Larval damage caused by *Saperda carcharias* and other European insect species is similar to damage caused by Asian Longhorned Beetle (photo: Julia Schirmer).

Abbildung 2: Der Larvenschaden des Großen Pappelbockes (*Saperda carcharias*) und anderer europäischer Arten ist dem des Asiatischen Laubholzbockes sehr ähnlich (Foto: Julia Schirmer).

Durch ALB-Befall induzierte Volatile

Da die Larven des ALB tief im Holz eines Baumes fressen, ist es sehr schwierig, einen Befall vor dem Schlüpfen der Käfer zu entdecken. Die selbst bei kleinen Freilandausbrüchen oft mehrere Jahre dauernden Ausrottungsmaßnahmen der Behörden bezeugen dieses Problem. Weiterhin gibt es eine Reihe von einheimischen Insekten, die auch an vom ALB in Europa bevorzugten Baumarten einen vergleichbaren Larvenschaden verursachen. Dazu gehören das Blausieb (*Zeuzera pyrina*), der Große Pappelbock (*Saperda carcharias*) oder der Weidenbohrer (*Cossus cossus*).

Im Rahmen eines noch laufenden Projektes wird untersucht, inwieweit sich die VOC von ALB-befallenen Bäumen von denen gesunder Bäume und wie bzw. ob sich die VOC von mit *Saperda carcharias*, *Zeuzera pyrina* oder *Cossus cossus* befallenen Bäumen von jenen der ALB-befallenen Pflanzen unterscheiden. Die Proben werden dabei von mit den jeweiligen Arten befallenen Weiden- oder Pappelstecklingen über die CLSA- und Thermodesorptions-(TDS)-Methode genommen und anschließend durch GC-MS analysiert.

Erste Ergebnisse zeigen, dass zwischen den VOC der verschiedenen Stämme nur geringe Unterschiede vorhanden sind. Es gibt Hinweise auf zwei Substanzen, die offenbar nur in den VOC der befallenen Stämme auftreten. Es handelt sich dabei möglicherweise um zwei Sesquiterpene, die anscheinend nicht auf eine spezielle Insektenart beschränkt sind, sondern generell eher auf dem Befall mit holzbohrenden Larven beruhen. Die beiden gefundenen Substanzen machen im Duftspektrum des befallenen Holzes mengenmäßig nur einen kleinen Teil aus. Prinzipiell sind die von befallenem Holz abgegebenen VOC deutlich geringer als zum Beispiel jene von grünen Blättern.

Zusätzlich zu den Untersuchungen über die Zusammensetzung der VOC befallener Stämme wird erforscht, an welchen Substanzen aus diesem Duftspektrum sich *Dastarcus helophoroides*, ein natürlicher Antagonist des ALB, bei der Suche nach ALB-Larven im Holz orientiert. Diese Untersuchungen nutzen die Technik der mit Gaschromatographie gekoppelten Elektroantennographie (GC-EAD). Vorläufige Ergebnisse deuten auf Reaktionen von *D. helophoroides* auf (Z)-3-Hexen-1-ol hin, einen bedeutenden Grünblattduft, und Nonanal, einen Hauptbestandteil in den VOC der Holzproben.

Danksagung

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Alternative Detection Method for ALB and CLB

Ute Hoyer-Tomiczek and Gabriele Sauseng

Abstract

Despite intensive monitoring and eradication measures, the Asian longhorned beetle (ALB) *Anoplophora glabripennis,* present in Braunau since 2001, could not be eradicated. Therefore, a new eradication project started in July 2008, financed by the Provincial Government of Upper Austria. The detection of infested trees can be very difficult. In future, dogs could additionally be used for locating this alien pest in infested areas and wood packaging material. The Anoplophora detection dogs are trained at the Federal Research Centre for Forests (BFW) and are able to detect ALB and the citrus longhorned beetle (CLB) *Anoplophora chinensis*.

Keywords | Asian longhorned beetle, *Anoplophora glabripennis*, eradication project, Anoplophora detection dogs, *Anoplophora chinensis*

Kurzfassung

Alternative Erkennungsmethode für ALB und CLB

Der Asiatische Laubholzbockkäfer (ALB) *Anoplophora glabripennis* konnte trotz intensiver Monitoring- und Bekämpfungsmaßnahmen seit 2001 in Braunau nicht ausgerottet werden. Darum wurde im Juli 2008 ein vom Land Oberösterreich finanziertes, neues Bekämpfungsprojekt gestartet. Die Erkennung befallener Bäume ist sehr schwierig. In Zukunft sollen auch Hunde für die Feststellung des Quarantäneschädlings im Befallsgebiet und in Verpackungsholz eingesetzt werden. Die Anoplophora-Spürhunde werden am Bundesforschungszentrum für Wald (BFW) ausgebildet und können neben ALB auch den Citrusbockkäfer (CLB) *Anoplophora chinensis* erschnüffeln.

Schlüsselwörter | Asiatischer Laubholzbockkäfer, *Anoplophora glabripennis*, Bekämpfungsprojekt, Anoplophora-Spürhunde, *Anoplophora chinensis*

ALB infestation situation in Braunau/Inn

Despite all eradication efforts the Asian longhorn beetle (ALB, *Anoplophora glabripennis*) is still an unwelcome guest in Braunau/Inn in Upper Austria. The monitoring from the ground with binoculars or from a ladder turned out to be insufficient due to a high failing rate. The eradication project, running from July 2008 until end of 2011 and being financed by the authority of Upper Austria, is lead by the BFW and should result in the eradication of ALB based on more efficient monitoring and eradication methods. The monitoring with

Figure 1: Tree climbers are able to inspect tree crowns up to the outer crown areas for ALB infestation symptoms (photo: Christof Schweiger, BFW).

Abbildung 1: Baumsteiger können Baumkronen bis in den äußeren Kronenbereich nach ALB-Befallssymptomen absuchen (Foto: Christof Schweiger, BFW).

tree climbers is of special importance, because these can inspect the crowns from the upper side for infestation symptoms (Figure 1). Inspection by tree climbers increases the likelihood of finding of an infested tree from 30-60 % to 90 %.

The intensive grid-based monitoring in the whole town done by the ground staff and the tree climbers will be completed by mapping of all deciduous trees on public and private property as well as by registering in a special database. So far 4,900 trees were mapped on the spot, 4,085 trees were registered in the database, and 2,947 trees were inspected once. Altogether in the year 2009 thirteen trees and stumps with ALB infestation were detected and destroyed by felling, chopping and burning of the chopped material.

Areas with densely growing trees or young forest-like stands in the surrounding of known ALB infestation spots cause problems for monitoring. The inspection of such areas is very difficult, labour intensive and costly. Trees with oviposition sites or young larval stages could be easily overlooked. If preventive cuttings were carried out in such areas, those potentially infested trees were also destroyed. In the winter 2008/2009 preventive cuttings were done in Braunau on an area

Figure 2: Anoplophora detection dogs of the BFW: Andor, Jolly and Jackson (from left).

Abbildung 2: Anoplophora-Spürhunde des BFW: Andor, Jolly und Jackson (von links).

of 5.5 ha neighbouring ALB infestation sites. Preventive cuttings are emphasized by international experts as one of the most successful measures against ALB.

Developing an alternative detection method for *Anoplophora* species

With preventive cuttings a new problem arose, showing that a complete cycle of ALB development is possible in infested stumps. For efficient inspection of stumps among the ground vegetation a new method by using dogs for detection of ALB has been established at the Department for Forest Protection since February 2009. It is well known that dogs are used for detection of e.g. explosives, narcotics, fire accelerants, people or various biological materials (Browne 2006; Felgentreu 2004). Hence, dogs will detect with their extremely high sensible nose scent traces of ALB and further indicate them. Due to the close relationship of *Anoplophora chinensis* (citrus longhorn beetle, CLB) to ALB, the dogs could detect both. Dogs from breeds with high working willingness, endurance, and high drive to find the scent source – like hunting dogs - are requested for this task.

A complex dog training program has been implemented, using a reward system response with playing or food. Dog and handler work as a team; in a playful training setting the team will enjoy work. Anoplophora detection dogs are trained for searching different developmental stages of ALB and CLB in host plants and wood packing material. The imprinting process is done with scent material of all stages. With an active indication like scratching or barking the dog shows were the scent source is hidden. Training is performed under various conditions in different environments including ALB/CLB infested areas. The dogs learn to know which materials should be investigated and to work systematically through an area.

The three presented detection dogs Jackson, Jolly, and Andor (Figure 2) are to our knowledge up to now the only trained Anoplophora detection dogs worldwide being able to detect ALB and CLB in the ground and also up to a height of two and a half metres. For very high trees the cooperation with tree climbers is needed. Bad weather conditions, such as high temperature, drought and strong wind make the scenting much more difficult and need highly experienced teams.

The possible fields of action for ALB/CLB detection dogs are manifold. In areas of ALB/CLB infestation, the detection dogs could investigate stumps, younger trees, the stem of trees, and roots. Additionally the dogs could inspect wood packaging material and imported plants. Inspection of imported plants for CLB with detection dogs will become more and more important in view of the interceptions of CLB with imported plants in Europe in the last time. The detecting work of the dogs has to be seen always in addition to the visual inspection by inspectors or/and tree climbers.

German – Deutsch

ALB-Befallssituation in Braunau/Inn

Der ALB konnte trotz intensiver Monitoring- und Bekämpfungsmaßnahmen seit 2001 in Braunau nicht ausgerottet werden. Das bisherige Monitoring vom Boden mit dem Fernglas oder von der Leiter aus war aufgrund der hohen Fehlerquote unzureichend. Das seit Juli 2008 bis Ende 2011 laufende, vom Land Oberösterreich finanzierte Projekt steht unter der Leitung des Bundesforschungszentrums für Wald (BFW) und soll mittels effizienterer Monitoring- und Bekämpfungsmethoden zur Ausrottung des ALB führen. Besondere Bedeutung hat das Monitoring durch Baumsteiger, welche die Baumkronen von oben intensiv nach Befallssymptomen absuchen (Abbildung 1). Durch die Baumsteigerkontrollen erhöht sich die Wahrscheinlichkeit des Auffindens eines befallenen Baumes von 30-60 % auf 90 %.

Das intensive Raster-Monitoring in der gesamten Stadt durch Bodenpersonal und Baumsteiger wird durch die Kartierung sämtlicher Laubbäume im Stadtgebiet von Braunau in öffentlichem und privatem Besitz sowie deren Erhebung in einer speziellen Datenbank ergänzt. Bisher wurden 4.900 Bäume vor Ort kartiert, 4.085 Bäume in der Datenbank eingetragen und 2.947 Bäume einmal kontrolliert. Insgesamt wurden 2009 dreizehn Bäume und Baumstöcke mit ALB-Befall festgestellt und wie bisher durch Fällen, Verhäckseln und Verbrennen des Hackguts vernichtet.

Beim Monitoring bereiten dicht bestockte, schwer zugängliche, zum Teil junge waldähnliche Baumbestände im Nahbereich von bekannten ALB-Befallsherden immer wieder Probleme. Diese sind nur sehr schwierig und mit einem sehr hohen Aufwand an Personal, Zeit und Kosten zu kontrollieren. Bei Präventivschlägerungen werden potenziell auch Bäume vernichtet, die Eiablagen oder Junglarvenstadien aufweisen, die bei den Kontrollmaßnahmen leichter übersehen werden können. Im Winter 2008/2009 wurden in Braunau in an ALB-Befallsherde angrenzenden Gebieten Präventivschlägerungen auf einer Fläche von insgesamt 5,5 ha durchgeführt. Präventivschlägerungen werden von internationalen Experten als eine der erfolgreichsten Maßnahmen bei der Bekämpfung von ALB hervorgehoben.

Im Frühjahr 2009 wurden beim Monitoring ALB-befallene Stöcke auf den Flächen, die im Winter 2007/2008 präventiv geschlägert worden waren, festgestellt. In solchen Baumstöcken ist eine vollständige Entwicklung vom Ei bis zum ausgeschlüpften Käfer nachweislich möglich. Das Monitoring von Baumstöcken entlang von Straßen- oder Bahngleisböschungen inmitten der aufkommenden Bodenvegetation und den Stockausschlägen ist sehr zeit-, personal- und kostenintensiv. Hier stellt sich die Frage, wie man dieses Monitoring effizient durchführen kann.

Entwicklung einer alternativen Detektionsmethode für *Anoplophora*-Arten

Diese Problemstellung führte im Februar 2009 am Institut für Waldschutz des BFW zur Entwicklung einer neuen Detektionsmethode für ALB. Bekanntermaßen können Hunde Personen, Leichen, Drogen, Sprengstoff, Geld, geschützte Tierarten, Elfenbein und vieles mehr erschnüffeln (Browne et al. 2006; Felgentreu 2004). Künftig sollen Hunde mit ihrer feinen Nase kleinste Geruchsspuren verschiedener Entwicklungsstadien von ALB und – aufgrund der nahen Verwandtschaft – auch vom Citrusbockkäfer (CLB, *Anoplophora chinensis*) in Wirtspflanzen und Verpackungsholz aufspüren und anzeigen.

Für diese anspruchsvolle Nasenarbeit sind insbesondere solche Hunderassen geeignet, die durch jahrzehntelange Züchtung über eine hohe Nasenleistung, eine ausgeprägte Arbeitsbereitschaft, Ausdauer, hohen Finderwillen und Konzentrationsfähigkeit verfügen: Jagdhundrassen.

Hund und Hundeführer/in bilden ein Team. Durch den spielerischen Trainingsaufbau soll der Hund Freude an dieser Tätigkeit haben. Die positive Bestätigung erfolgt über Spiel oder Futtergabe. Am Anfang steht die Konditionierung auf das Geruchsmaterial. Besonders wichtig ist das Erarbeiten des individuellen Anzeigeverhaltens des Hundes. Um die Hunde an verschiedene Umwelteinflüsse und Störfaktoren zu gewöhnen, muss in unterschiedlichen Umgebungen trainiert werden. Auch das Training in Einsatz- und Befallsgebieten ist unumgänglich, weil hier der Hund lernt, welche Objekte er untersuchen und wie die systematische Suche ablaufen soll.

Die drei vorgestellten Spürhunde Jackson, Jolly und Andor (Abbildung 2) sind, soweit bekannt, weltweit bisher die einzigen Anoplophora-Spürhunde. Sie können ALB und CLB im Erdreich ebenso wie in einer Höhe von bis derzeit zweieinhalb Meter aufspüren. Für große Baumhöhen ist die Kooperation zwischen Baumsteiger und Spürhund nötig. Hohe Temperaturen, Trockenheit und starker Wind können das Training und auch den Einsatz von Spürhunden erschweren.

In Gebieten mit ALB- oder CLB-Befall werden die Hunde eingesetzt, um Baumstöcke, junge Bäume, die Stammbasis und Wurzeln jeglicher Laubbaumart zu kontrollieren. Die Untersuchung von importiertem Verpackungsmaterial durch die Spürhunde an der Einfuhrstelle, in Logistikzentren oder direkt beim Importeur kann diese Kontrollen wesentlich erleichtern. Ein weiteres Betätigungsfeld ist die Inspektion von importierter Pflanzenware. Dies ist insbesondere im Hinblick auf die immer wieder auftretenden Einschleppungen von CLB mit importierten Pflanzen aus Asien von großer Bedeutung. Besonders bei diesen Kontrollen ist die Effektivität der Spürhunde aufgrund der enormen Nasenleistung wesentlich höher als die der Inspektoren auf rein visueller Basis. Die Arbeit der Spürhunde ist immer in Ergänzung zur visuellen Erkennung von ALB und CLB durch Kontrolleure und Baumsteiger zu sehen. Die enge Zusammenarbeit mit der Zollbehörde, den Pflanzenschutzdiensten der Länder und der europäischen Staaten ist hierbei von wesentlicher Bedeutung.

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Research on *Anoplophora chinensis* in Lombardy (Italy)

Matteo Maspero, Costanza Jucker, Franck Hérard, Michael T. Smith, Mario Colombo, Beniamino Cavagna and Mariangela Ciampitti

Abstract

The citrus longhorned beetle (CLB) *Anoplophora chinensis* (Förster) (= *malasiaca*) (Coleoptera, Cerambycidae) was first discovered in Northern Italy in 2001 (Colombo and Limonta 2001; Maspero et al. 2007), where it is considered a serious threat to urban environments, nurseries and natural ecosystems. Since that time the number of interceptions of *A. chinensis* in the EU has significantly increased, specifically in grafted maple trees originating from the Far East. An eradication program against this quarantine pest is ongoing. Since its first discovery, studies have focused on the biology, ecology, behavior and biological control of CLB in Northern Italy, as well as development of chemical control and innovative techniques for detection of incipient populations. We report here key results of the first decade of these cooperative efforts.

Keywords | CLB, Northern Italy, chemical control, techniques for detection

Kurzfassung

Forschungsarbeiten über *Anoplophora chinensis* in der Lombardei (Italien)

Der Citrusbockkäfer (CLB) *Anoplophora chinensis* (Förster) (= *malasiaca*) (Coleoptera, Cerambycidae) wurde zuerst in Norditalien im Jahr 2001 entdeckt (Colombo and Limonta 2001; Maspero et al. 2007), wo er sich zu einer bedeutenden Bedrohung für die städtische Umwelt, Pflanzgärten und natürliche Ökosysteme entwickelte. Seit dieser Zeit stieg die Anzahl der Einschleppungen von *A. chinensis* in die EU signifikant an, speziell in veredelten Ahornbäumen aus dem Fernen Osten. Für diesen Quarantäneschädling läuft ein Ausrottungsprogramm. Seit seiner Entdeckung haben sich die Untersuchungen auf die Biologie, die Ökologie, das Verhalten und biologische Kontrollmechanismen für CLB in Norditalien konzentriert. Parallel dazu befasste man sich mit der Entwicklung von chemischen Bekämpfungsmöglichkeiten und innovativen Methoden zur Detektion der Anfangspopulation. Wir berichten von wesentlichen Ergebnissen aus dem ersten Jahrzehnt dieser Forschungsinitiativen.

Schlüsselwörter | CLB, Norditalien, chemische Bekämpfung, Detektionsmethoden

Life History

In Lombardy, screen-house studies were conducted within the infested zone around Parabiago to evaluate the CLB life history traits, including survival, fecundity, sex ratio, host tree preference, and external signs of attack (oviposition slits and exit holes). In addition, studies were initiated in 2009 to determine, if *Acer palmatum* trees with 1-2 cm diameter are suitable hosts for harboring CLB. Although work is still in progress, preliminary results provide evidence for oviposition, egg hatch and larval feeding, and thus trees with 1-2 cm diameter may represent a threat for movement and introduction of CLB through the nursery industry. Results are critically important for pathway risk assessment, plant protection and survey programs, and regulatory agencies.

Biological Control

In concert with CLB life history studies and the eradication program, biological control studies were initiated to explore, collect, identify and evaluate parasitoids as potential biological control agents of CLB. Exploration of the CLB-infested areas in Northern Italy was first conducted to inventory native natural enemies that have accepted CLB as a host. Eight native hymenopteran ectoparasitoids, belonging to five families, were found parasitizing early stage larvae. In addition, an egg parasitoid (Hym.: Eulophidae) of CLB was discovered at Parabiago, likely originating from the Far East and accidentally introduced with its host. This new species was described and named *Aprostocetus anoplophorae* (Delvare et al. 2004). Field studies were then conducted in 2008 near Parabiago, at Canegrate, in a CLB-infested woodlot of mixed deciduous tree species (e.g. *Acer campestre, Acer pseudoplatanus, Corylus avellana, Malus domestica, Prunus avium, Ulmus pumila*). Results showed that *A. anoplophorae* is host specific, strictly parasitizing *A. chinensis* and undergoes two to three generations per year from June to late August. Results from the sixty stumps sampled showed that 72 % of the 136 CLB eggs recovered were parasitized by *A. anoplophorae*. In addition, results also indicated that *A. anoplophorae* appears to be widely and firmly established throughout the major infestation around Parabiago, which is considered the site of the initial infestation of CLB in Northern Italy. Finally, *A. anoplophorae* was found to be gregarious, which is particularly advantageous for rearing in large numbers. Collectively, it appears that *A. anoplophorae* is the best candidate for biological control of CLB. Eradication of CLB remains the priority in Northern Italy, and central to successful eradication is early and effective survey and detection of CLB and infested hosts. However, the limitations of visual inspection for signs of attack put eradication at great risk. Therefore, based upon our results to date, release of *A. anoplophorae* throughout the areas where the parasitoid has not yet been found will help to contain CLB during the eradication effort. Furthermore, release of *A. anoplophorae* is the key element in both eradication and containment programs, when *A. chinensis* populations are low and infested trees difficult to detect using visual inspection, e.g. in areas that have only recently become infested and/or areas still harboring incipient populations after removal of all trees thought to be infested. Moreover, *A. chinensis* attacks many woody plants that are difficult to survey using visual inspection, including dense ground cover plants like *Cotoneaster horizontalis* and dense hedges of *Prunus laurocerasus*. In other words, *A. anoplophorae* possesses the ability to locate and parasitize *A. chinensis* when infested trees would otherwise go unnoticed.

In 2009, several new lines of research were initiated that aim to develop methods for early detection of *A. chinensis* and infested trees, and its direct control. In concert with biological control, these methods are essential when and where conventional visual surveys are destined to fail. In Northern Italy, *A. chinensis* has attacked a large number of trees (i.e. 10,000 from 2001 to 2009) among more than twenty tree species in different landscapes (e.g. urban, rural countryside) of varying levels of heterogeneity, and over an expanded and discontinuous geographic area. Towards this end, methods and technologies used in integrated adaptive strategies are of foremost importance. The proposed research program includes six objectives:

1. ***Where to Implement Detection, Survey and Control:*** Evaluation of the dispersal and population spread of adult of *A. chinensis* will result in development of predictive spatial-temporal models that will be used to establish boundaries inside of which to focus survey, detection and control strategies. Furthermore, the models will play the major role in making decisions of where to focus release of natural enemies. Because local landscape features (e.g. urban, residential, rural, homogeneous woodlots, heterogeneous woodlot-agriculture areas) greatly influence where CLB will spread, these models will be adaptable to the unique landscapes in Northern Italy and other areas at risk in Europe.

Figure 1: Franck Hérard looking for oviposition scars, Parabiago, July 2009.

Abbildung 1: Franck Hérard bei der Suche nach Eiablagestellen, Parabiago, Juli 2009.

Figure 2: Michael T. Smith and Matteo Maspero collecting data at Parco delle Cave, Milano (photo: Francesco Tomasinelli).

Abbildung 2: Michael T. Smith und Matteo Maspero bei der Datenerhebung, Parco delle Cave, Mailand Foto: Francesco Tomasinelli).

Figure 3: Michael T. Smith testing a sound detector at the base of a tree infested by CLB, Assago, July 2009.

Abbildung 3: Michael T. Smith beim Test eines Geräuschdetektors an der Stammbasis eines CLB-befallenen Baumes, Assago, Juli 2009.

2. ***When to Implement Detection, Survey and Control:*** Evaluation of the relative abundance and seasonal occurrence of adult CLB emergence will result in development of a predictive degree-day model that will be used to establish, when to implement survey, detection and control strategies, including when to release and conserve natural enemies for biological control of CLB.

3. ***How to Detect, Survey and Control:*** (a) Evaluate the host selection process of adult *A. chinensis* for development of methods for early detection and attract-and-kill of adult beetles, e.g. sentinel trees and artificial lures. (b) Investigate biology and behavior of *A. chinensis* larvae feeding within infested trees for development technologies for detection of infested trees, e.g. acoustic detection technologies. (c) Investigate adult *A. chinensis* behavior analysis of the key behaviors (e.g. mating, oviposition, and feeding), for development of technologies for detection and control of adult beetles, and/or protection of tree from attack. (d) Develop control methods for containing adult populations and/or protecting trees from attack, i.e. contact encapsulated insecticide (Demand).

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Ash Dieback in Norway

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Abstract

Winter damage caused by frost is frequently observed on common ash (*Fraxinus excelsior*) in Norway. In spring 2007, extensive winter damage most likely camouflaged ash dieback caused by *Chalara fraxinea*. In 2008, ash dieback caused by *C. fraxinea* had spread to large areas in the southern part of Norway. The disease was widespread in forests and nurseries, but also on roadside trees, and in gardens and parks. In 2009, the disease had spread to new areas; about 30 km into Rogaland county in south-western Norway and also further into some valleys in southeastern Norway.

Keywords | *Chalara fraxinea, Fraxinus excelsior*, emerging disease

Kurzfassung

Das Eschentriebsterben in Norwegen

In Norwegen treten durch Frost verursachte Winterschäden häufig an der Gemeinen Esche (*Fraxinus excelsior*) auf. Im Frühjahr 2007 wurden die ersten Anzeichen des durch *Chalara fraxinea* verursachten Eschentriebsterbens wahrscheinlich durch das umfangreiche Auftreten von Winterschäden verdeckt. 2008 hatte sich das Eschentriebsterben bereits auf große Gebiete im Süden Norwegens ausgebreitet. Die Krankheit war weit verbreitet in Wäldern sowie Baumschulen und kam auch in Parkanlagen, Gärten und bei Straßen- und Alleebäumen vor. 2009 dehnte sich die Krankheit auf neue Gebiete aus: Im Südwesten Norwegens drang sie rund 30 km in den Bezirk Rogaland vor, im Südosten breitete sie sich weiter in einigen Tälern aus.

Schlüsselwörter | *Chalara fraxinea, Fraxinus excelsior*, neue Pilzkrankheit

Winter damage in 2007

In spring 2007, extensive shoot dieback was observed on common ash (*Fraxinus excelsior*) in the southernmost parts of Norway, from Stavanger at the west coast to the Swedish border in the east (Anonymous 2007). Winter damage caused by frost was considered the cause, but since ash dieback caused by *Chalara fraxinea* was widespread in neighbouring countries, samples were collected for closer inspection. The inspection revealed no typical dieback caused by *C. fraxinea*, and the fungus was not isolated from the samples. Winter damage occurs frequently on common ash in Norway,

Figure 1: *Chalara fraxinea* was in all cases isolated from such typical necroses found on saplings and young trees.

Abbildung 1: In allen Fällen wurde *Chalara fraxinea* aus solchen typischen Nekrosen aus Schösslingen und Jungbäumen isoliert.

where this species reaches its northernmost distribution limit in Europe.

Ash dieback in 2008

In 2007, a tree nursery owner observed some dieback on ash trees, but considered it to be due to frost damage. In May 2008, the dieback had increased in the nursery, and plant pathologists were contacted. Upon inspection in the nursery, it was obvious that the dieback had been caused by a pathogen. Inspection in other nurseries in the Oslofjord area revealed that all nurseries, except one, had trees with typical dieback caused by *C. fraxinea*.

Also in the forests around the inspected nurseries ash trees were affected by dieback. A survey in southern Norway in 2008 revealed that dieback symptoms were present in a wide area from Ringsaker in Hedmark county in the north to the border between Vest-Agder and Rogaland county in the south, a distance of nearly 400 km. In addition to nurseries and forests, the symptoms were observed on trees along roads, and in gardens and parks.

The symptoms of ash dieback in Norway were as described among others by Kowalski and Holdenrieder (2008). Isolations revealed that *C. fraxinea,* as described by Kowalski (2006), was the cause of ash dieback in Norway (Talgø et al. 2009). The pathogen was readily isolated in May and June 2008 from bark and wood samples collected from typical young necroses on affected ash trees (Figure 1).

During the early summer survey in 2008, some old necroses were observed, necroses that must have been formed after infection in 2006. We did not observe many of these old necroses; however, the findings indicate that the disease has been present in Norway at least since 2006. The sampling of affected ash shoots after the winter damage in 2007, was limited, so attacks by *C. fraxinea* may well have been overlooked as they were camouflaged by winter damage.

Ash dieback in 2009

In 2009, ash dieback developed more seriously in already infected trees, and many previously healthy trees became infected. We also observed the first ash tree killed by the fungus, a sapling less than 3 m high. The disease had also spread to new areas; approximately 30 km into Rogaland county in southwestern Norway and further into some valleys in southeastern Norway. Most of the areas in southeastern Norway where common ash occurs in both pure and mixed forests are now affected (Figure 2).

Acknowledgements

Financial support was given by the Ministry of Agriculture and the Norwegian Forest and Landscape Institute. Olaug Olsen carried out the isolations, and Geir Østreng conducted part of the survey. The map with distribution of common ash was kindly given us by Michele Bozzano at EUFORGEN.

German – Deutsch

Winterschäden 2007

Im Frühjahr 2007 konnte in den südlichen Teilen Norwegens, von Stavanger an der Westküste bis an die schwedische Grenze im Osten, ein umfangreiches Triebsterben an der Gemeinen Esche (*Fraxinus excelsior*) beobachtet werden (Anonymous 2007). Man nahm an, dass die Ursache Frostschäden wären, doch da das durch *Chalara fraxinea* verursachte Eschentriebsterben in den Nachbarländern weit verbreitet war, wurden Proben von geschädigten Bäumen zur Analyse entnommen. Bei der weiteren Analyse konnte allerdings kein durch *C. fraxinea* verursachtes Triebsterben festgestellt und der Pilz nicht aus den Proben isoliert werden. Winterschäden treten in Norwegen häufig an der Gemeinen Esche auf, da diese hier ihre nördliche Verbreitungsgrenze in Europa erreicht.

Eschentriebsterben 2008

2007 beobachtete ein Baumschulbesitzer Triebsterben an einigen seiner Jungeschen, ordnete es jedoch erst als Frostschäden ein. Im Mai 2008 hatte das Triebsterben bei den Eschen in der Baumschule zugenommen, und der Besitzer nahm Kontakt mit Pflanzenpathologen auf. Bei einer Begehung der Baumschule wurde es deutlich, dass die Ursache des Triebsterbens ein Krankheitserreger sein musste. Eine kurze Inspektion anderer Baumschulen in der Oslofjord-Region offenbarte, dass in fast allen Baumschulen Jungeschen mit dem für *C. fraxinea* typischen Triebsterben vorkamen.

Auch in den umliegenden Wäldern waren die Eschen vom Triebsterben betroffen. Bei einer weiträumigen Untersuchung in Südnorwegen im Frühsommer 2008 wurden Krankheitssymptome in einem großen Gebiet von Ringsaker im Bezirk Hedmark im Norden bis zur Bezirksgrenze zwischen Vest-Agder und Rogaland im Süden beobachtet, eine Entfernung von fast 400 km. Außer in Baumschulen und Wäldern wurden die Symptome auch in Parkanlagen und Gärten und bei Stadt- und Alleebäumen gefunden.

Die Symptome des Eschentriebsterbens in Norwegen glichen jenen beschrieben von u. a. Kowalski und

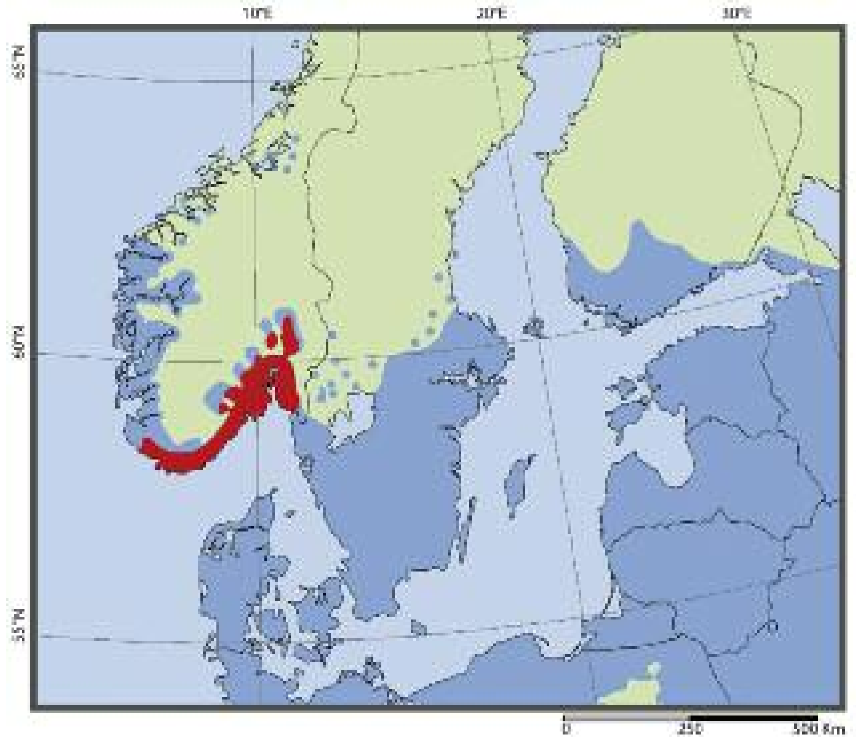

Figure 2: Distribution of ash dieback caused by *C. fraxinea* recorded until June 2009 in Norway (red colour), and distribution of common ash in Northern Europe (blue colour).

Abbildung 2: Verbreitung des Eschentriebsterbens, verursacht durch *C. fraxinea* und dokumentiert bis Juni 2009 (rot), und Verbreitung der Gemeinen Esche in Nordeuropa (blau).

Holdenrieder (2008). Isolierungen ergaben, dass *C. fraxinea*, wie von Kowalski (2006) beschrieben, die Ursache des Eschentriebsterbens in Norwegen war (Talgø et al. 2009). Im Mai und Juni 2008 konnte der Krankheitserreger problemlos aus dem Gewebe typischer, junger Nekrosen von geschädigten Eschen isoliert werden (Abbildung 1).

Bei der Untersuchung im Frühsommer 2008 wurden einige ältere Nekrosen bemerkt, die sich nach einer Infektion 2006 gebildet haben mussten. Wir konnten nicht viele dieser alten Nekrosen finden, dennoch bestätigen diese Funde, dass die Krankheit schon mindestens seit 2006 in Norwegen präsent gewesen sein muss. Da 2007 die Probennahme von geschädigten Eschentrieben begrenzt war, wurden die Angriffe von *C. fraxinea* wahrscheinlich übersehen, da sie durch das umfangreiche Auftreten von Winterschäden verdeckt wurden.

Eschentriebsterben 2009

2009 entwickelte sich das Eschentriebsterben dramatisch an den schon geschädigten Bäumen, und viele im Vorjahr noch gesunde Bäume wurden nun auch infiziert. Wir fanden auch die erste vom Pilz getötete Esche, ein Schössling von knapp 3 m Höhe. Die Krankheit dehnte sich dieses Jahr auf neue Gebiete aus: Im Südwesten Norwegens drang sie gut 30 km in den Bezirk Rogaland vor, im Südosten breitete sie sich weiter in einige Täler aus. Der größte Teil der Gebiete mit Eschenvorkommen im südöstlichen Norwegen ist inzwischen von der Krankheit betroffen (Abbildung 2).

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Ash Dieback – Situation in Bavaria and Germany

Jörg Schumacher, Sindy Leonhard, Ludwig Strasser and Rolf Kehr

Abstract

Ash dieback is currently one of the most important tree diseases in Germany. A countrywide distribution is already ascertained. *Fraxinus excelsior* and *F. angustifolia* of all ages and on various site types are affected in forests, in open landscape as well as in nurseries and urban plantings. The impact of damage still varies with a decreasing tendency from northern to southern regions. Significant economic losses were especially reported in nurseries and forests of Northern Germany. The article presents an overview of the situation in Bavaria based on preliminary data from an ongoing research project started in 2008 as well as results of a recent nursery investigation in Northern Germany. In a large number of three-year-old ash saplings the infection rate, invasion and spreading strategy of the pathogen inside of plant tissues were studied. Additionally, the role of soil-borne Oomycetes as possible primary or accompanying organisms in the disease process were examined. The results confirm the dominant role of *Chalara fraxinea* (teleomorph: *Hymenoscyphus albidus*) and rule out the role of pathogenic Oomycetes. The authors conclude that the fungus is able to spread very effectively in woody tissue as a parasite and does not originate from the root system.

Keywords | ash dieback, *Chalara fraxinea*, *Phytophthora* spp., invasion model

Kurzfasung

Eschentriebsterben – Situation in Bayern und Deutschland

Das Eschentriebsterben ist gegenwärtig eine der bedeutendsten Baumkrankheiten in Deutschland. Obwohl die Erkrankung bundesweit nachgewiesen ist, bestehen zwischen dem Norden und Süden deutliche Unterschiede im Schädigungsgrad. Die größten ökonomischen Schäden wurden bislang in der Forst- und Baumschulwirtschaft Norddeutschlands festgestellt. Von der Krankheit betroffen sind Eschen (*F. excelsior, F. angustifolia*) jeden Alters und auf unterschiedlichen Standorten im Wald, beim Landschaftsgehölz sowie im städtischen Grün. Der Artikel gibt einen Überblick zur aktuellen Situation in Bayern anhand rezenter Daten eines im Jahr 2008 begonnenen Forschungsprojektes und enthält neueste Ergebnisse aus einer Baumschuluntersuchung in Norddeutschland. Anhand dreijähriger Eschenpflanzen wurde die Infektionsrate und Ausbreitungsstrategie des Erregers im Pflanzengewebe sowie die mögliche Bedeutung bodenbürtiger Oomyceten untersucht. Die Ergebnisse bestätigen *Chalara fraxinea* (Teleomorphe: *Hymenoscyphus albidus*) als Haupterreger der Erkrankung und falsifizieren zugleich eine primäre Rolle pilzähnlicher Mikroorganismen im Krankheitsprozess. Die Autoren kommen zu dem Schluss, dass sich der Erreger verholzte Gewebe effektiv erschließt und die Primärinfektion oberirdisch erfolgt.

Schlüsselwörter | Eschentriebsterben, *Chalara fraxinea, Phytophthora* spp., Invasionsmodell

General situation and further investigations

Conspicuous symptoms of the disease have been observed in Germany at least since the year 2002. The causal agent was then confirmed for Germany (Schumacher et al. 2007) and for Bavaria (Leonhard et al. 2009) after the description of the recently found hyphomycete *Chalara fraxinea* by Kowalski (2006). So far, noteworthy economical lost was established especially on nursery saplings and young plantations but damage to older stands is increasing.

In Bavaria, the first survey in 2008 according to 182 requested announcements yielded 18 % of returns with distinct symptoms of which 71 % were subsequently confirmed as infected by *C. fraxinea*. In contrast, in all 24 stands with different site conditions selected for the Bavarian research project both typical symptoms and positive findings for the fungus could be found. In the Free State Bavaria the mostly infested geographical region is still the south-east even though symptoms and damage have been established in all sites with ash trees. An interesting outcome of the Bavarian project was the high agreement regarding the occurrence of the fungus between old assessed data (fruit-bodies of *H. albidus*) by Kriegelsteiner (1993) and recent results (isolations of *C. fraxinea*) by the research project.

In Northern Germany an investigation (cf. Schumacher et al. 2009, 2010) was carried out with 300 coeval nursery saplings in order to quantify the infection rate in different plant tissues and subcategory organs. Ten different *C. fraxinea* cultures were selected to check whether the fungus produces extracellular

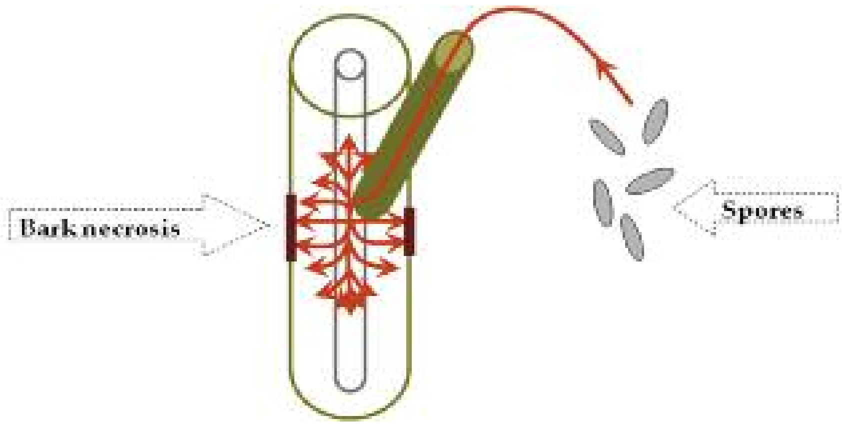

Figure 1: Probable way of invasion and spread of *Chalara fraxinea* in living ash trees.

Abbildung 1: Wahrscheinliche Eintritts- und Ausbreitungswege von *Chalara fraxinea* in einer lebenden Esche.

oxidases. Symptoms were assessed by measuring necrotic bark lesions and discolored wood.

Histological studies were processed by sectioning infected samples with a microtome in radial, tangential and longitudinal planes. In order to accentuate plant cell cytoplasma and fungal mycelium, sections were stained with aniline blue in lactic acid before microscopy. The involvement of Oomycetes in the disease process was verified by flooding saplings in large plastic tubs and by successive isolation of the pathogens with organic baits. In addition, serological proof (DAS-ELISA) based on zoospores was carried out by taking water samples. The extinction level was determined on microtiter plates with a photometer.

In 95 % of all nursery plants, *C. fraxinea* was isolated from symptomatic tissue. The fungus was present at a much higher rate in outer and inner sapwood than in the roots and stem bark. *C. fraxinea* was not isolated from asymptomatic tissue.

The differences between infection rates of root or bark and sapwood were highly significant. Whereas almost half of all positive findings of *C. fraxinea* originated solely in the stem, the fungus was not isolated once solely from the root of a sample tree. Therefore, *C. fraxinea* has no or only limited endophytic abilities and its pathogenesis is evidently induced in aboveground plant organs.

The results of the measurements showed significant correlation between bark necroses and discolored sapwood. Firstly, the size of bark necroses increased with the length of sapwood discoloration. Secondly, the length of sapwood discoloration is generally larger than the corresponding bark necrosis. Light microscopy of histological sections showed that hyphae were observed especially in the axial and paratracheal ray tissue containing primary metabolites (e.g. starch and fatty substances). Many hyphae were found in the radial parenchyma of the wood rays from the pith to the phloem. In axial direction, hyphae were observed mainly in the vessels, in the paratracheal parenchyma and in the pith. Tissue with intense discoloration also showed increasing amounts of hyphae in the fibre cells and in the phloem. Passage of hyphae from cell to cell mainly occurs through pits, apparently through mechanical pressure. This information leads to the presumed invasion model that the fungus initially invades the pith and vessels via the ray parenchyma where growth is fastest and subsequently outward towards the cambium and phloem triggering the colonization of secondary fungi in necrotic bark (e.g. Cech 2006a, 2006b, 2006c; Bakys et al. 2008; Kowalski and Holdenrieder 2008).

The investigations concerning the role of soil-born Oomycetes lead to the conclusion that the involvement of such pathogenic micro-organisms in the disease process can be ruled out. Neither the baiting tests nor the serological proof showed any signs of *Phytophthora* infections.

The test for extracellular oxidases with different geographic isolates showed a positive reaction for all strains on guajacol agar, but only for three isolates on tannin agar. The ability to degrade wood is not uncommon among Ascomycetes which are involved in natural pruning (Butin and Kowalski 1992). Fruiting of the teleomorph on petioles and shoots (Kowalski and Holdenrieder 2009) indicate that the fungus may originally belong to this ecological group.

Allgemeine Situation und weiterführende Studien

Auffällige Krankheitssymptome werden in Deutschland spätestens seit dem Jahr 2002 beobachtet. *C. fraxinea* wurde für Deutschland erstmalig im Jahr 2006 (Schumacher et al. 2007) und für Bayern im Jahr 2008 (Leonhard et al. 2009) nachgewiesen, nachdem der durch Kowalski (2006) neu entdeckte Hyphomycet beschrieben worden war.

Die größten ökonomischen Verluste sind bislang in Baumschulen und jungen Anpflanzungen zu beklagen; die Schäden in älteren Waldbeständen nehmen jedoch deutlich zu.

In Bayern ergab eine erste Erhebung im Jahr 2008, dass 18 % der Eschenbestände typische Symptome der neuartigen Erkrankung aufwiesen. In den symptomatischen Beständen konnte *C. fraxinea* zu 71 % nachgewiesen werden. Eine spätere Untersuchung offenbarte, dass die Krankheit mit unterschiedlicher Intensität bereits in allen Eschenbestockungen verbreitet war, wenngleich der Schwerpunkt weiterhin im Südosten des Freistaates liegt. Ein interessantes Ergebnis des Projektes ist die hohe Übereinstimmung zwischen älterem Datenmaterial (*H. albidus*-Fruchtkörper) von Kriegelsteiner (1993) und den aktuellen *C. fraxinea*-Nachweisen.

In Norddeutschland wurden insgesamt 300 gleichaltrige Baumschulpflanzen mit dem Ziel untersucht (cf. Schumacher et al. 2009, 2010), die tatsächlichen Infektionsraten in den verschiedenen Geweben (Rinde, äußerer und innerer Splint und Mark) und Organen (Wurzel, Spross) zu ermitteln. Mit zehn ausgewählten Pilzisolaten wurde die Fähigkeit zur Produktion extrazellulärer Oxydasen überprüft. Die Symptome wurden erhoben, indem sowohl die äußere Nekrotisierung in der Rinde als auch die innere Verbräunung des Holzkörpers vermessen worden ist.

Mikrotomschnitte aus der Quer-, Tangential- und Längsebene des infizierten Holzes wurden für histologische Studien angefertigt. Die Schnitte wurden für die Mikroskopie mit Anilinblau in Milchsäure zum Hervorheben von Hyphen und Zytoplasma angefärbt. Der Oomyceten-Nachweis wurde durch Flutung von Pflanzen in großen Plastikwannen mit anschließender Beköderung sowie anhand serologischer (DAS-ELISA) und photometrischer Verfahren durchgeführt.

Bei 95 % der Pflanzen konnte *C. fraxinea* aus symptomatischem Gewebe isoliert werden. Die Isolationsraten waren am höchsten im äußeren sowie inneren Splint und deutlich geringer in der Wurzel sowie Rinde. Diese Unterschiede erwiesen sich als hoch signifikant. In gesundem Gewebe wurde der Erreger dagegen nicht nachgewiesen. Während etwa die Hälfte aller Positivbefunde ausschließlich die oberirdischen Pflanzenteile betraf, wurde der Pilz in der Wurzel allein in keinem Fall nachgewiesen. Enge, proportionale Korrelationen bestehen ebenfalls zwischen den Rinden- und Holzverfärbungen. Der Erreger besitzt demnach kein oder lediglich ein eingeschränktes, endophytisches Potenzial. Die Ausdehnung der inneren Holzverbräunung ist dabei stets größer als die dazugehörige äußere Nekrotisierung der Rinde.

Die Auswertung der Mikrotomschnitte ergab, dass *C. fraxinea* vorzugsweise die mit Primärmetaboliten (vor allem Stärke, Fette, Nährsalze) angereicherten Gewebe besiedelt. Die radiale Ebene erschließt sich der Pilz zumeist über die Parenchymzellen der Holzstrahlen, wodurch er rasch vom zentralen Mark bis in das Phloem gelangt. Das Mark und die Gefäße ermöglichen dagegen die Ausbreitung in Längsrichtung. In einem späteren Stadium lässt sich *C. fraxinea* zunehmend auch in den Faserzellen sowie im Kambium und Phloem nachweisen. Die Ausbreitung von Zelle zu Zelle bzw. in ein benachbartes Gewebe erfolgt durch Penetration der Tüpfel mithilfe mechanischen Druckes. Diese Ergebnisse führen zu dem Invasionsmodell, dass der Pilz zunächst Mark, Gefäße und paratracheales Parenchym über die Holzstrahlen infiziert und erst nachfolgend das Kambium und Phloem, womit schließlich die Besiedlung durch sekundäre Rindenpilze induziert wird (z. B. Cech 2006a, 2006b, 2006c; Bakys et al. 2008; Kowalski und Holdenrieder 2008). Die Untersuchungen zu den bodenbürtigen Oomyceten ließen erkennen, dass pilzähnliche Mikroorganismen keine primäre oder maßgebliche Bedeutung im Krankheitsprozess einnehmen. Weder die Ködertests noch die serologischen Studien gaben Hinweise auf *Phytophthora*-Infektionen. Positive Oxydasereaktionen zeigten sich bei *C. fraxinea* uneingeschränkt auf dem Guajakol-Agar, jedoch nur für vier Teststämme auf dem Tannin-Agar. Die Fähigkeit zum Holzabbau ist verbreitet bei Ascomyceten der natürlichen Astreinigung (Butin und Kowalski 1992). Die Bildung des generativen Fruchtstadiums an den Blattstielen und Trieben (Kowalski und Holdenrieder 2009) könnte ein Hinweis auf die ursprüngliche Zugehörigkeit des Pilzes zu dieser ökologischen Gruppe sein.

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Monitoring of Ash Dieback in Austria

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Abstract

Results of ash dieback monitoring in Austria are presented. Between 2005 and 2009 dieback extended to all federal provinces of Austria. Monitoring in Lower Austria in 2007 revealed a lower disease intensity in eastern than in western parts. Mean dieback intensity was significantly higher in suppressed than in dominant ashes as well as in female individuals than in male ones. On nearly every monitoring site, few trees without or with weak symptoms were observed. Though dieback-intensity in Lower Austria generally increased from 2007 to 2009, there were still some sites with steady intensity.

Keywords | ash dieback, monitoring 2007 to 2009, Austria

Kurzfassung

Monitoring des Zurücksterbens der Esche in Österreich

Der Beitrag bringt Resultate zum Monitoring des Eschen-Zurücksterbens in Österreich. Zwischen 2005 und 2009 breitete sich das Zurücksterben in allen Bundesländern aus. In Niederösterreich waren 2007 die Befallsintensitäten im Osten geringer als im Westen, unterdrückte Eschen wiesen signifikant höhere Befallsintensitäten als dominante Eschen auf und weibliche Individuen waren stärker betroffen als männliche. Auf nahezu jeder Monitoringfläche befanden sich einige Bäume ohne oder mit nur geringen Symptomen. Obwohl die Zurücksterbensintensität in Niederösterreich von 2007 bis 2009 im Allgemeinen zunahm, stagnierte die Entwicklung bei einigen der Flächen.

Schlüsselwörter | Zurücksterben der Esche, Monitoring 2007 bis 2009, Österreich

History of ash dieback in Austria

In Austria, common ash (*Fraxinus excelsior*) is widespread in an area surrounding the Alps like a belt with the highest frequency in the Northern Limestone Alps as well as the Northern Prealps. In Tyrol and the central Alpine regions ashes are rarer. The *Chalara*-dieback appeared in 2005, when the phenomenon was reported from a few sites in the province Upper Austria on young ashes in plantations. Already in 1997, one finding of ash dieback associated with small bark necroses on previous years stem parts and a bark surface with dark discoloration was reported; this may be identical with the present *Chalara*-dieback. A few other existing records of dieback between 1990 and 1997 were associated with hail or other wounds. In 2006, numerous sites showed symptoms of ash dieback, primarily in Lower Austria and Styria, followed by Upper Austria and the other federal provinces in the subsequent years.

Methods

In 2007, the Federal Research Centre for Forests (BFW) started a monitoring programme on 50 plots in Lower Austria where crown dieback intensity was estimated (project funded by the federal government of Lower Austria). In addition to the monitoring, a few ashes were excavated and the root systems were cleaned with water in order to compare the density of root systems of healthy and diseased trees. In 2009, the Austrian Forest Inventory included ash dieback in the assessment program (1200 plots).

Results

Figure 1 illustrates the situation of ash dieback in Lower Austria in 2007. The map shows that on most of the sites average dieback intensity was below 25 % of the crown. On three sites there were no dieback symptoms at all. Furthermore, the intensity decreased significantly from west to east. No dead ashes were present on the majority of the sites. Ash bark beetle (*Leperisinus varius*) as the most probable secondary invader was present in most of the monitored stands. Dieback intensity showed a highly significant relation to the social position of the trees: suppressed individuals were more affected than dominant ones. The same refers to dieback percentage and gender: female ashes were more affected than male ones. Comparison of the root systems showed that trees without dieback had denser root systems than trees suffering from dieback (Figure 2).

Differences in ash dieback-intensity between 2008 and 2009 varied considerably among the sites in Lower Austria (Figure 3): the sites are assembled by regions, ordered from west to east (left to right). It is striking, that, although dieback intensified in most of the sites, some plots in the eastern parts which had been affected on a very low level in 2008, did not show any increase in disease intensity from 2008 to 2009 (Figure 3). On

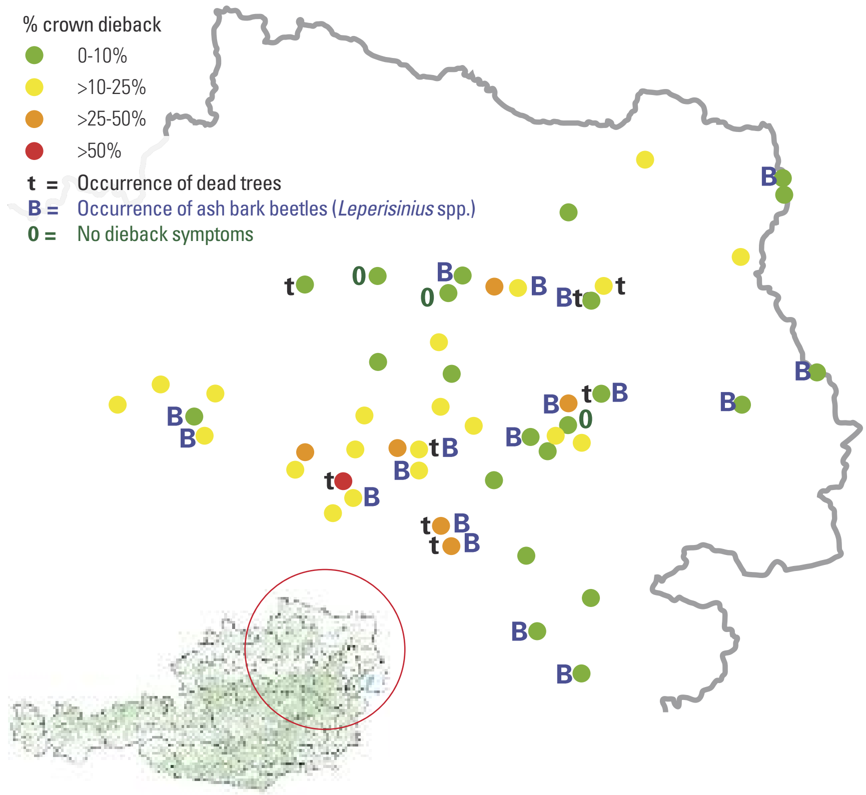

Figure 1: Situation of Ash dieback in Lower Austria in 2007.

Abbildung 1: Situation des Eschen-Zurücksterbens in Niederösterreich im Jahr 2007.

nearly every site - even if there is intense dieback, there are a few trees without or with very weak symptoms.

Preliminary observations as well as the first results of the Austrian Forest Inventory show, that ash dieback is currently present in all provinces of Austria, but in some areas of Carinthia and Tyrol there are no or only very few symptoms.

The highest intensity is observed in the Northern foothills of the Alps, the Northern Prealps in Lower Austria, in Upper Austria and Salzburg, as well as in most parts of Styria.

German – Deutsch

Geschichte des Eschen-Triebsterbens in Österreich

In Österreich ist die Gemeine Esche (*Fraxinus excelsior*) in einem die Alpen gürtelförmig umgebenden Areal weit verbreitet, wobei die dichtesten Vorkommen in den Nördlichen Kalkalpen und den Kalkvoralpen liegen. In Tirol und in den zentralalpinen Gebieten sind Eschen seltener.

Das aktuelle Eschen-Zurücksterben trat 2005 in Oberösterreich an gepflanzten Jungeschen in Erscheinung. 1997 wurde ein Fall von Zurücksterben mit kleinen Rindennekrosen auf vorjährigen Trieben und dunkel verfärbter Rindenoberfläche gemeldet, der möglicherweise bereits auf *Chalara fraxinea* zurückzuführen war. Wenige andere Fälle von Eschen-Zurücksterben zwischen 1990 und 1997 waren mit Hagelwunden oder sonstigen Verletzungen assoziiert. 2006 zeigten zahlreiche Bestände die Symptome des Triebsterbens, zuerst in Niederösterreich und in der Steiermark, 2007 bis 2009 gefolgt von Oberösterreich und den anderen Bundesländern.

Figure 2: Root system of one ash with dieback (a) and another without dieback (b); Lower Austria, 2007.

Abbildung 2: Wurzelsystem einer Esche mit Triebsterben (a) und einer anderen, gesunden Esche (b); Niederösterreich, 2007.

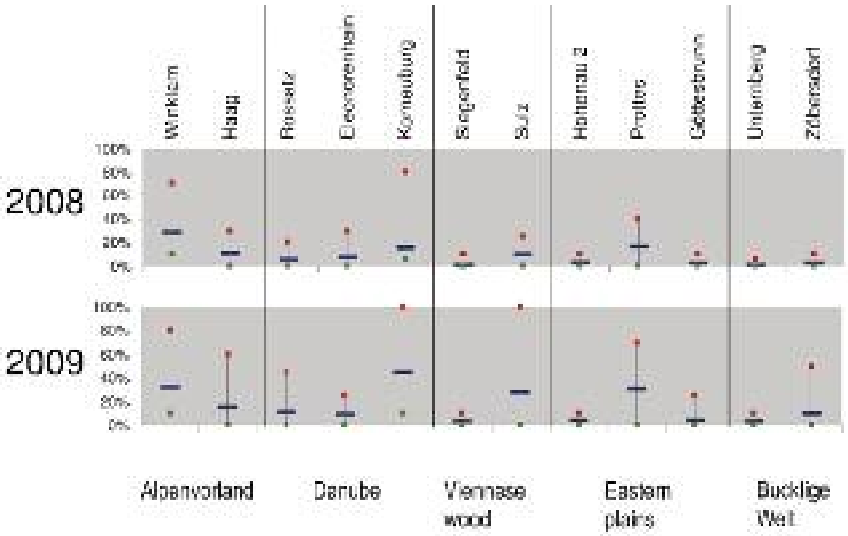

Figure 3: Ash dieback in Lower Austria, 2008-2009, crown dieback in %: mean values, minima and maxima.

Abbildung 3: Eschen-Zurücksterben in Niederösterreich, 2008-2009 (Zurücksterben der Krone in %: Durchschnittswerte, Minimum, Maximum).

Methoden

2007 begann das Bundesforschungszentrum für Wald (BFW) mit einem Monitoring auf 50 Standorten in Niederösterreich, bei dem die Intensität des Zurücksterbens der Kronen angeschätzt wurde (Projektfinanzierung durch das Amt der Niederösterreichischen Landesregierung).

Stichprobenartig wurden zusätzlich zu diesem Monitoring einige Eschen ausgegraben und freigespritzt, um die Dichte der Wurzelsysteme von gesunden und erkrankten Bäumen zu vergleichen. 2009 inkludierte die Österreichische Waldinventur das Zurücksterben der Esche in ihre Erhebungen (1200 Trakte).

Ergebnisse

Abbildung 1 veranschaulicht die Situation des Zurücksterbens der Esche in Niederösterreich im Jahr 2007. Die Karte zeigt, dass die Intensität mehrheitlich unter 25 % des Kronenvolumens lag. Auf drei Standorten wurde kein Zurücksterben festgestellt. Darüber hinaus nahm die Intensität von Westen nach Osten signifikant ab. Abgestorbene Eschen fehlten auf den meisten Flächen.

Der Bunte Eschen-Bastkäfer (*Leperisinus varius*) als der wahrscheinlichste sekundäre Schadorganismus war auf den meisten Standorten bereits vorhanden. Die Intensität des Zurücksterbens ergab eine hoch signifikante Beziehung zur sozialen Stellung der Eschen: Unterdrückte Individuen waren stärker betroffen als dominante. Ähnliches galt für die Beziehung Intensität des Zurücksterbens und Geschlecht: Weibliche Bäume waren stärker befallen als männliche.

Die stichprobenartigen Untersuchungen der Wurzeln ergaben bei vom Triebsterben verschont gebliebenen Bäumen dichtere Wurzelsysteme als bei erkrankten Bäumen (Abbildung 2).

In der Entwicklung der Befallsintensität zwischen 2008 und 2009 zeigten sich in Niederösterreich deutliche Unterschiede (Abbildung 3): Die Flächen wurden in Regionen zusammengefasst und von Westen nach Osten (von links nach rechts) geordnet. Generell nahm die Befallsintensität von 2008 bis 2009 zu. Auffällig ist jedoch, dass einige Flächen in den östlichen Regionen, die 2008 sehr gering betroffen waren, bis 2009 keinen Anstieg in der Befallsintensität aufwiesen (Abbildung 3).

Nahezu auf jeder Fläche – selbst wenn diese intensiv befallen war – fanden sich einzelne oder wenige Bäume ohne Symptome oder nur geringfügig erkrankte.

Nach Beobachtungen und den Erhebungen durch die Österreichische Waldinventur ist das Eschen-Zurücksterben mittlerweile in sämtlichen Bundesländern präsent. Allerdings sind in einigen Regionen Kärntens und Tirols wenige oder gar keine Symptome zu beobachten.

Die höchsten Befallsintensitäten finden sich im nördlichen Alpenvorland, in den nördlichen Kalkvoralpen in Niederösterreich, Oberösterreich und Salzburg sowie in den meisten Teilen der Steiermark.

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Ash Dieback in Hungary

András Koltay, Ilona Szabó and Gergely Janik

Abstract

The pathogen causing shoot dieback on ash (*Fraxinus excelsior*), *Chalara fraxinea*, was identified in Hungary for the first time in the first half of 2008 in Western Hungary, but probably it was present in ash stands years before that. The pathogen is widespread in Hungary according to surveys; especially in young ash stands, but also on older trees. It is present both in planted and natural grown ash forests. Mortality is significantly higher among young trees. The frequent sighting of the symptoms shows, that *Chalara fraxinea* is a serious threat for ash stands in Hungary.

Keywords | ash dieback, *Chalara fraxinea, Fraxinus*

Kurzfassung

Eschentriebsterben in Ungarn

Der Krankheitserreger *Chalara fraxinea*, der das Zurücksterben der Esche (*Fraxinus excelsior*) verursacht, wurde in Ungarn zum ersten Mal in der ersten Hälfte des Jahres 2008 in Westungarn identifiziert. Vermutlich war er aber schon Jahre davor in Eschenbeständen vorhanden, Das Pathogen ist in Ungarn weit verbreitet, laut Erhebungen besonders in jungen Eschenbeständen, aber auch an älteren Bäumen. Es kommt sowohl in gepflanzten als auch natürlich gewachsenen Beständen vor. Die Mortalität ist unter jungen Pflanzen deutlich höher. Das häufige Auftreten der Symptome zeigt, dass *Chalara fraxinea* eine ernste Bedrohung für die Eschenbestände Ungarns ist.

Schlüsselwörter | Zurücksterben der Esche, *Chalara fraxinea, Fraxinus*

Chalara fraxinea was identified for the first time in Hungary in the first half of 2008, in Western Hungary near Kapuvár and Sárvár, in four to six years old mixed (seed and coppice shoot) origin European ash (*Fraxinus excelsior*) stands (Szabó 2008). In the same time in Budapest, under an older Turkey oak–sessile oak–European ash stand we also detected the symptoms and the pathogen on the saplings of the natural regrowth. The local foresters first thought, that the wilting was caused by the frost, but in that period of time there were no frosty days. With the typical symptoms and the examinations of the collected samples, we were able to definitely identify the *Chalara fraxinea* as pathogen (Szabó 2009). This pathogenic fungus was also identified on narrow-leafed ash (*Fraxinus angustifolia*), from the samples of the western part of Hungary (Kirisits et al. 2009). In 2008-2009 we thoroughly researched the distribution of the pathogen in Hungary and the volume of the caused damages. As a result, we confirmed that the pathogen spread to the whole area of Hungary (Figure 1). It appears both in young and older stands, but it causes damages more frequently in two to ten years old forestations. Because of the characteristics of the symptoms and the measures of the dieback, we concluded, that the pathogen appeared in Hungary two to three years before. The degree of the infections in the examined forest stands is significantly diverse. The most severe infestation was observed in eastern Hungary, near Debrecen, in the summer of 2009. This European ash stand was ten years old, with 0.5 ha of area, and was planted with two years old saplings. Every single tree showed the symptoms of *Chalara fraxinea* infection (Figure 2). In the examined part of the forest stand, the mortality reached 37 %. Among the still living trees, the rate of the infected and died stem parts varied between 20-90 %. From the symptoms of the dead trees we diagnosed that the first infections in this area also occurred a few years ago. We do not know much about the environmental conditions assisting the infestation. The examinations of the infested forest stands of Western Hungary show that the infestation is more frequent on sites with frost-hollow, deep soil and plenty of water. In the same time we also noticed that the symptoms are also frequent on forest sites drier than average and exposed to extreme cold (Szabó et al. 2009). According to the surveys the fungus is more common in younger stands, but this can be affected by the fact that we have lesser amount of samples from older and bigger trees, for collecting samples and identifying them from large crowns is more difficult. After the survey in Bükk Mountains, northeastern Hungary, we found that the extent of the infection is at least the same on older or middle aged trees than on the youngest ones. Contrarily, in the western part of the country in mixed species forest stands we experienced mass and severe infections of the natural ash regrowth, while older trees showed only small degree of typical symptoms in their crowns.

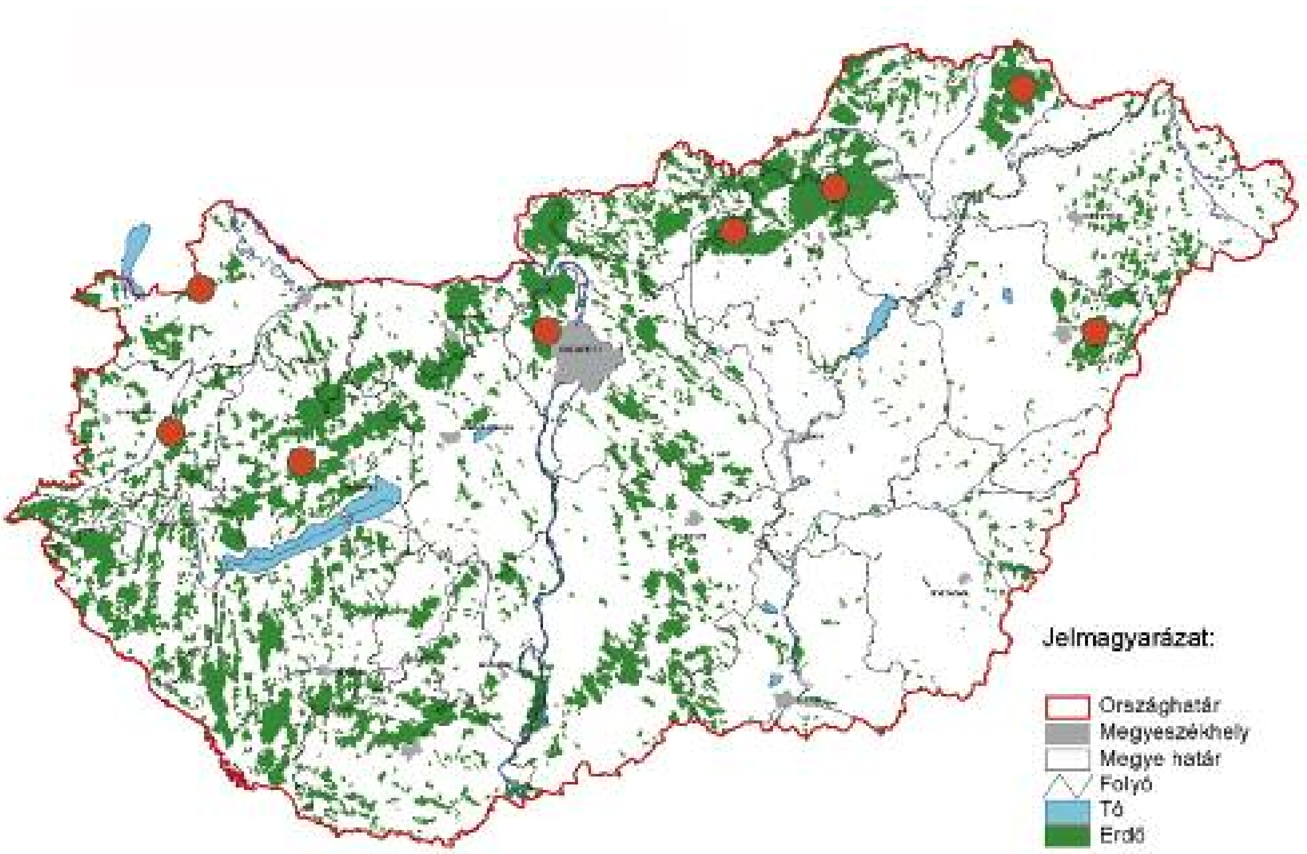

Figure 1: Confirmed incidence of *Chalara fraxinea* in Hungary, 2008-2009.

Abbildung 1: Nachweisliches Vorkommen von *Chalara fraxinea* in Ungarn, 2008-2009.

Figure 2: Heavily infected young ash stand near Debrecen.

Abbildung 2: Schwer erkrankter, junger Eschenbestand nahe Debrezin.

The complete death of older trees takes more time, so major mortality occurs on young, two to ten years old trees.

In the august of 2009 we surveyed the degree of *Chalara fraxinea* infestations in some forestries of the Bakony Mountains in different aged and in different tree-species composition forests. Based on this survey we pointed out that in the significant majority of the surveyed stands the rate of infected ash trees is under 5 %, and in only two forest-parts are there 5-10 % infestations (Table 1).

Conclusions

To summarize our researches to this point, it seems that the European and narrow-leafed ash forests are seriously endangered by *Chalara fraxinea* in Hungary, especially the young stands. The results of the extended life-cycle examinations of

Table 1: *Chalara fraxinea* infection frequency in Bakony Mountains, August 2009.

Tabelle 1: Häufigkeit von *Chalara fraxinea*-Infektionen im Bakony-Gebirge, August 2009.

Forest subcompartment	**Measure of shoot dying**			**Area/ha**	**Age**	**Tree species (%)**
	1	**2**	**3**			
Tés 9H	■			6,3	76	*Fagus 80; Carpinus 15; Fraxinus 5*
Tés 9I	■			4,2	76	*Fagus 100; Fraxinus natural regrowth in spots*
Tés 10B	■			18,8	112/7	*Fagus 100; Fraxinus natural regrowth in spots*
Várpalota 55G		■		2,7	9	*Q. cerris 40; F. excelsior 30; F. ornus 30*
Várpalota 55F	■			4,7	110/9	*Q cerris 40; Fagus 30; F. excelsior 20; Carpinus 10*
Várpalota 56D	■			5,2	8	*Q. petrea 50; Fagus 10; F. excelsior 15; Q. cerris 15; Carpinus 10*
Várpalota 57A	■			11,2	127/6	*Q. cerris 100; Fraxinus natural regrowth in spots*
Iszimér 63H		■		2,5	9	*Q. cerris 60; F. excelsior 30; F. ornus 10*
Nagyvázsony 92B	■			19,0	20	*Q. cerris 80; F. excelsior 5; F. ornus 10; Carpinus 5*
Ajka 8G	■			0,6	19	*F. excelsior 100*
Lókút 11A	■			2,6	11	*Q. petrea 40; Q robur 15; F. excelsior 35; Fagus 10*
Eplény 47B	■			17,7	16	*Q. cerris 40; Q. petrea 10; Fagus 15; Carpinus 30; F. excelsior 5*
Porva 16C	■			2,5	30	*F. excelsior 50; Fagus 10; Carpinus 40*
Zirc 41A	■			10,3	36	*F. excelsior 35; Fagus 15; Q. cerris 15; Carpinus 35*
Zirc 41C	■			8,0	44	*F. excelsior 35; Fagus 5; Q. cerris 20; Carpinus 20; Q. petrea 10; Acer 10*

Measure of shoot dying
1: *Chalara fraxinea* infection under 5 % on all of *Fraxinus excelsior* trees
2: *Chalara fraxinea* infection 5-20 % on all of *Fraxinus excelsior* trees
3: *Chalara fraxinea* higher than 20 % on all of *Fraxinus excelsior* trees

this pathogen indicate that we are defenceless against the pathogen infestation; we cannot effectively control the pathogen or decrease the severity of infestations. In the future, presumably natural selection will work among ashes, which will seriously affect us with mass mortality of trees. At the same time, it is our task to assist these processes with the selection of more resistant tree individuals and with their mass propagation for using them in forestry practice.

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Ash Dieback in Slovenia

Tine Hauptman, Nikica Ogris and Dušan Jurc

Abstract

The first symptoms of the disease were observed in 2006, and since then the disease has rapidly spread throughout Slovenia. Dieback thus far has affected common ash and narrow-leaved ash. In 2008, involvement of the fungus *Chalara fraxinea* T. Kowalski in ash dieback in Slovenia as a causal agent was confirmed. Further research revealed differences in strain pathogenicity and the possible resistance of individual trees. The first sanitary fellings of ash trees due to the fungus *C. fraxinea* were done; the situation is also very serious in forest nurseries.

Keywords | ash dieback, *Chalara fraxinea*, Slovenia

Kurzfassung

Eschentriebsterben in Slowenien

Die ersten Symptome der Krankheit wurden im Jahr 2006 beobachtet, und seitdem hat sich Krankheit rasch in ganz Slowenien verbreitet. Vom Zurücksterben betroffen sind die Gemeine Esche und die Schmalblättrige Esche. Im Jahr 2008 konnte die Beteiligung des Pilzes *Chalara fraxinea* T. Kowalski am Zurücksterben in Slowenien als ein Hauptgrund bestätigt werden. Weitere Untersuchungen lieferten Hinweise auf Unterschiede in der Pathogenität einzelner Stämme und in der möglichen Widerstandsfähigkeit von einzelnen Bäumen. Die ersten Kalamitätsnutzungen von Eschen wegen des Pilzes *C. fraxinea* wurden durchgeführt; die Situation ist auch in Forstgärten kritisch.

Schlüsselwörter | Eschentriebsterben, *Chalara fraxinea*, Slowenien

Native ash species in Slovenia

There are three native ash species in Slovenia. Common ash (*Fraxinus excelsior*) is widespread across the country, especially on rich, moist, loamy soils along rivers and streams. With 2,877,000 m^3, common ash represents 0.9 % of total growing stock in Slovenia. Flowering ash (*Fraxinus ornus*) is especially frequent and important in the Karst, where it is known as a pioneer species in newly forming forests on abandoned grasslands and in Austrian pine (*Pinus nigra*) plantations. Its growing stock is 924,000 m^3. Narrow-leaved ash (*Fraxinus angustifolia*) represents only 0.07 % (214,000 m^3) of total growing stock in Slovenia. It is an important tree species in northeastern part of the country, where it is a good replacement for black alder (*Alnus glutinosa*) trees affected by hydro-melioration. This species also occurs in other parts of Slovenia, but rarely (Kotar and Brus 1999, Gozdni fondi 2009).

Research of ash dieback in Slovenia

Ash dieback was first observed in northeastern Slovenia in 2006. The symptoms were shoot, twig and branch dieback, wilting, lesions in the leaves and bark, and grey to brown discoloration of wood (Ogris et al. 2009b). In 2007 and 2008, the symptoms of ash dieback extended throughout Slovenia. Dieback thus far has affected common ash and narrow-leaved ash, while no symptoms have yet been observed on flowering ash.

In spring 2007, we started collecting samples from ash trees showing symptoms of the disease from different parts of the country. To date, we have collected 93 different *C. fraxinea* isolates from 28 different locations (Figure 1). The first isolation of the fungus *Chalara fraxinea* T. Kowalski in Slovenia was also made in 2007; its pathogenicity was confirmed the following year (Ogris et al. 2009b). The teleomorph of this fungus, apothecia on fallen leaf petioles of *F. excelsior* from previous year, was first noticed in the end of May 2009 in Ljubljana (Ogris 2009). They were formed abundantly up to the beginning of July.

Pathogenicity tests, made in 2008 on *F. excelsior* and *F. angustifolia* shoots inoculated with two isolates, showed greater susceptibility of narrow-leaved ash and great differences in necrosis size caused by different isolates. This indicates that isolates may differ in pathogenicity (Ogris 2009). Differences in necrosis length also existed between specimens of the same ash species, so we decided to further investigate differences in the resistance of individual trees. In 2009, we made observation of 467 trees in a 20-year old clonal seed orchard of *F. angustifolia* in Hraščica (Prekmurje). Assessments of crown damage caused by *C. fraxinea* and statistical analyses of collected data showed large differences among trees of the same clone, but also statistically significant differences among some distinct clones. On the basis of this research, we assume that differences in the resistance of individual trees really exist. To prove or reject this assumption we performed pathogenicity tests. The experiment is still in progress and the results are not yet known.

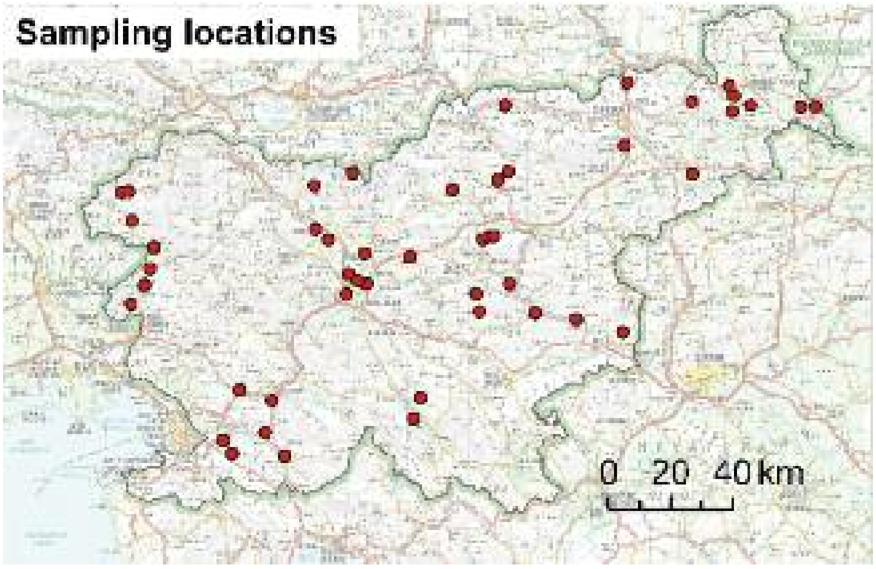

Figure 1: All sampling locations in Slovenia; the fungus *C. fraxinea* was successfully isolated from 28 of these locations.

Abbildung 1: Sämtliche Probenstandorte in Slowenien; der Pilz *C. fraxinea* wurde auf 28 von diesen Standorten erfolgreich isoliert.

Figure 2: Necrotic lesion on leaf petiole of *F. excelsior*.

Abbildung 2: Nekrotische Läsionen auf Blattstielen der Gemeinen Esche.

In addition to all the above-mentioned symptoms of the disease, premature leaf shedding of common and narrow-leaved ash was regularly observed in 2009. Numerous ash trees were already totally defoliated at the end of August and all fallen leaves showed necrotic lesions on petioles (Figure 2). Isolations proved *C. fraxinea* to be the causal agent (Ogris 2009a). This indicates a possible important role of leaf petioles necrosis in the disease cycle, already mentioned by other researchers (Kirisits et al. 2009).

Conclusion

The severity of the disease in Slovenia seems to be higher on sites with high relative air humidity, with lower temperatures and without direct sun exposure (Ogris 2008). Ash dieback occurs on trees of all ages. Mortality on heavily affected sites is especially common on saplings and young trees, although on some areas also mature trees have already died. At the beginning of 2009, the first sanitary fellings of ash trees due to *C. fraxinea* were performed (Ogris 2009). The situation is also very serious in forest nurseries, where cultivation of healthy ash seedlings has become almost impossible.

The fungus *Chalara fraxinea* has no special status on the list of harmful organisms in Slovenia. Nevertheless, as members of the Slovenian phytosanitary system, we proposed general directions to the Slovenian Forest Service regarding the management of common and narrow-leaved ash. We recommend stopping promoting ash species for planting. Ash should be replaced in plans for planting with *Acer pseudoplatanus* saplings or other ecologically similar tree species (e.g. on sandy soils near rivers, we recommend planting of *Populus* spp.). Sanitary felling of heavily damaged ash trees is taking place when encountered. The necessary changes should be executed through forest management and sylviculture plans.

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Genetic Variation in Susceptibility to Ash Dieback

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Abstract

In Denmark, assessment of clonal field trails indicated the presence of genetic resistance to ash dieback in some *F. excelsior* clones. Health score per clone (39 clones) was highly correlated between two study sites. Additionally, 101 families from open pollinated mother trees were tested at two sites (2008-2009) and initial results identify a low frequency of family groups showing significantly less symptoms. The results suggest that being a non-susceptible individual is genetically controlled. Recently initiated inoculation experiements will explore this further.

Keywords | *Chalara fraxinea*, genetic variation, susceptibility, resistance, *Hymenoscyphus pseudoalbidus*

Kurzfassung

Genetische Variation der Anfälligkeit gegenüber dem Eschentriebsterben

Felderhebungen von Klonversuchen in Dänemark haben gezeigt, dass bei einigen Klonen der Gemeinen Esche eine genetische Resistenz gegenüber dem Eschentriebsterben vorhanden ist. Die Gesundheitszustände gleicher Klone (50 Klonindividuen) auf zwei Versuchsflächen waren hoch korreliert. Zusätzlich wurden 101 Familien von frei bestäubten Mutterbäumen auf zwei Flächen getestet (2008-2009) und erste Ergebnisse zeigen Familiengruppen in geringer Häufigkeit, die signifikant weniger Symptome zeigen. Die Ergebnisse deuten daruf hin, dass Nichtanfälligkeit/Widerstandskraft/Resistenz von Individuen genetisch bestimmt ist. Mit kürzlich angelegten Inokulationsversuchen soll dies weiter untersucht werden.

Schlüsselwörter | *Chalara fraxinea*, genetische Variation, Anfälligkeit, Resistenz, *Hymenoscyphus pseudoalbidus*

Background

The health and viability of European common ash is presently threatened by a novel disease caused by the fungus *Chalara fraxinea* Kowalski (Kowalski 2006), the sexual form called *Hymenoscyphus pseudoalbidus* (Queloz et al. 2010). In Denmark the disease was first noted in 2002, and by 2005 it had become very common througout the country causing devastating harm (Thomsen et al. 2007, Skovsgaard et al. 2009).

Materials and Methods

The project utilizes established seed orchards and progeny trials. The clonal seed orchards were established in 1998 and consist of 39 clones each represented by 50 grafted ramets. Half of the ramets are grown at one site (Tuse Næs) and the other half at another site (Tapsøre). The progeny trials were establihed in 2002 with two-year old plants. The progeny trials include families from 101 open pollinated mother trees selected throughout Denmark. The families are likewise grown at two sites (Silkeborg and Randers). At each site the families are grown in four-tree-plots, and each family is replicated eight times in each trial (32 offspring per mother at each site).

We evaluted the health in the beginning of July over three years. The clonal trials were assessed in 2007, 2008, and 2009, while the progeny trials were assessed in 2008 and 2009. All living trees were assessed. However, in the clonal trials, trees with any dubious graftings in the clonal trials (potential rootstocks) were excluded from the analysis. Trees dead prior to the first assessment were also excluded as we could not determine if such trees had been killed by the fungus.

The health of each individual tree was scored according to defoliation of the crown. We used the following categories: Class 0: no symptoms, Class 1: 1-10 %, Class 2: 10-50 %, Class 3: > 50 %, Class 4: dead. Only results from the 2009 evaluation are presented below.

Data analysis

Presence of genetic vatiation within the seed orchards was tested by applying the model:

Dam_{ij} $Y = c_i + B_j + \varepsilon_{ij}$; where c_i is the effect of the clone (random effect $N(0, \sigma_g^2)$), B_j the effect of the block and ε_{ij} the residual assummed $N(0, \sigma_e^2)$.

The absence of genetic variation (corresponding to the null hyphotesis H_0:= 0) was tested by a standard F-test in a generalised linear analysis of variance model.

The linear model was extended including plot variance (block x family interaction) in the analysis of the progeny trials and the family variation was tested with the plot variance.

Narrow sense heritabilities were calculated from the estimated variance components (family variance,

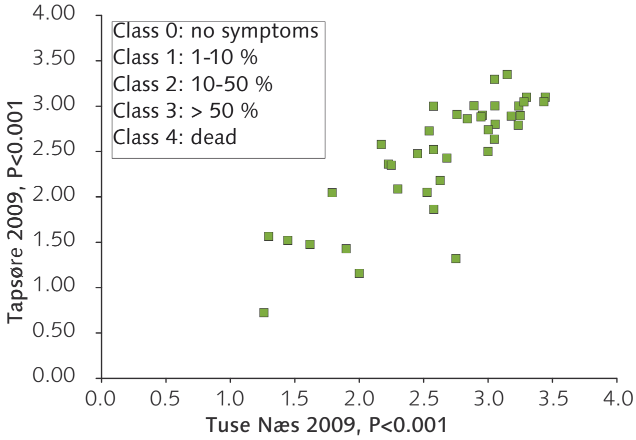

Figure 1: Correlation between the two clonal seed orchards (at Tuse Næs and Tapsøre in Denmark) in relation to health score. The tested clones are plotted by their average damage score at each of the two respective locations. Data from 2009.

Abbildung 1: Korrelation des Gesundheitszustandes zwischen zwei Klon-Samenplantagen (in Tuse Næs und Tapsøre in Dänemark). Für die untersuchten Klone sind die mittleren Schadensklassen der beiden jeweiligen Standorte dargestellt (Klasse 0: keine Symptome, Klasse 1: 1-10 %, Klasse 2: 10-50 %, Klasse 4: tot). Daten des Jahres 2009.

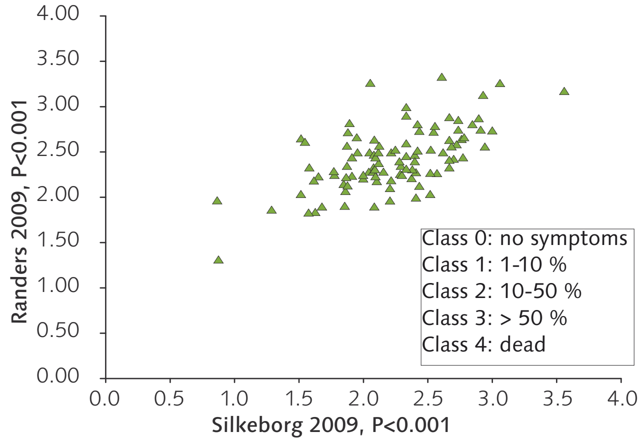

Figure 2: Correlation between the two progeny trials (at Silkeborg and Randers in Denmark) in relation to health score. The tested families are plotted by their average damage score at each of the two respective locations. Data from 2009.

Abbildung 2: Korrelation des Gesundheitszustandes zwischen zwei Herkunftsversuchen (in Silkeborg und Randers in Dänemark). Für die untersuchten Familien sind die mittleren Schadensklasse der beiden Standorte dargestellt (Klasse 0: keine Symptome, Klasse 1: 1-10 %, Klasse 2: 10-50 %, Klasse 4: tot). Daten des Jahres 2009.

plot variance and residual variance) in the progeny trials assuming that the families were half sibs.

Results

The two clonal trials revealed highly significant effects among clones in all studied years (P<0.001). The observed differences among clones were substantial indicating that the genetic variation is of large practical importance (2009; Figure 1). The correlations between sites were high even though the sites differed in ecological parameters (soil and precipitation). The same pattern was observed in the previous assessments (data not shown).

The two progeny trials revealed highly significant effects among families in both studied years (P<0.001). Also here, the observed differences among families was substantial indicating that the genetic variation is of large practical importance (2009; Figure 2). Narrow sense heritabilities in 2009 were correspondingly high, $h^2 = 0.56$ (0.10) at Randers and 0.49 (0.09) at Silkeborg. The correlations between sites were also high (Figure 2) even though the sites differed in environmetal conditions (mainly exposure to spring frost). The same pattern was observed in 2008 assessment (data not shown).

Conclusions and future work

The high correlations between sites both among ramets and half-sib families indicate that the genetically controlled resistance is consistent in different environments. The moderate to high narrow sense heritabilities further suggest that the trait is inherited from one generation to the following and only moderately influenced by the envionment.

The presented findings have recently been published (McKinney et a. 2011; Kjær et al. 2012).

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Current Research on Dieback of *Fraxinus excelsior* in Northern Europe

Rimvys Vasaitis

Abstract

Current research on dieback of *Fraxinus excelsior* in northern Europe focuses on: i) identity of dieback-causing fungus *Chalara fraxinea* and its potential invasiveness; ii) environmental factors that influence disease development; iii) genetic structure of *C. fraxinea* populations; iv) study infection biology and epidemiology of the fungus; v) long-term phytosanitary consequences of the epidemics; vi) genetic variation of susceptibility in *F. excelsior* and development programmes for breeding against *C. fraxinea*.

Keywords | *Fraxinus excelsior, Chalara fraxinea*, population genetics

Kurzfassung

Laufende Forschungsarbeiten am Zurücksterben der Gemeinen Esche in Nordeuropa

Die aktuelle Forschung zum Zurücksterben von *Fraxinus excelsior* in Nordeuropa konzentriert sich auf i) die Identität des verursachenden Pilzes *Chalara fraxinea* und seine potenzielle Invasivität; ii) die Umweltfaktoren, welche die Entwicklung der Krankheit beeinflussen; iii) die genetische Struktur der *C. fraxinea*-Populationen; iv) Untersuchungen zur Infektionsbiologie und Epidemiologie des Pilzes; v) die langfristigen phytosanitären Konsequenzen der Epidemie; vi) die genetische Variation der Anfälligkeit von *F. excelsior* und Entwicklungsprogramme zur Resistenzzüchtung gegenüber *C. fraxinea.*

Schlüsselwörter | *Fraxinus excelsior, Chalara fraxinea*, Populationsgenetik

Disease spread and status

Currently, severe dieback of *Fraxinus excelsior* L. is observed in most European countries, including Nordic – Baltic States. This is an emerging disease which results in massive tree mortality, and currently threatens the existence of *F. excelsior* in large parts of Europe. Characteristic for this phenomenon is a rapid stepwise pattern of its geographic spread over the continent. Starting in mid-1990s, the dieback of *F. excelsior* has firstly been observed in Lithuania (Juodvalkis and Vasiliauskas 2002) and eastern Poland (Przybyl 2002a). Then it emerged further northwards in Latvia (Talis Gaitnieks, pers. comm.), westwards in Kaliningrad district of Russia and southwards in Belarus (Dmitry Shabunin, pers. comm.). Since 1998 the dieback of *F. excelsior* has spread all over Poland (Przybyl 2002a), and in year 2002 the disease was for the first time recorded in northeastern Germany (Wulf and Schumacher 2005).

In Nordic countries, in year 2002 the disease had only been observed locally in southern Sweden, but in summer 2004 it spread throughout south-east and south, towards western and central parts of the country ultimately leading to severe symptoms and tree death almost over the whole area of species distribution (Barklund 2005, 2006). In 2003-2004, dieback of *F. excelsior* was first noticed in Denmark; during 2005-2008 rapid spread of the epidemics and massive decline were observed in many places of the country (Thomsen et al. 2007). Finally, in 2007-2008 dieback of *F. excelsior* has emerged in Norway (Talgo et al. 2008) and Finland (Jarkko Hantula, pers. comm.). Therefore, different stages of the epidemics are currently encountered in different areas of north Europe: initial phase in Finland and Norway, peak in Sweden and Denmark, and post-decline period (or chronic phase) in Latvia and Lithuania. This provides an opportunity to understand what has been the inciting factor of the damage, to evaluate long-term consequences and to forecast the future situation with *F. excelsior* stands in the region.

Causal agent

Recent studies had demonstrated that anamorphic fungus *Chalara fraxinea* T. Kowalski is the causal agent of the dieback (Bakys et al. 2009a, b; Kowalski and Holdenrieder 2009a). Initially, the fungus has been deemed as previously unknown and has been described as a new species in 2006 (Kowalski 2006). Yet more recently, based on similarity of ITS rDNA region, *C. fraxinea* was implied to be an anamorph of ascomycetous fungus *Hymenoscyphus albidus* (Roberge: Desm.) W. Phillips, and consequently has been assigned to that species (Kowalski and Holdenrieder 2009b). This is surprising, as *H. albidus* is common, native to Europe and a widespread saprotrophic fungus, known to decompose petioles of shed *F. excelsior* leaves in forest litter (Dennis 1981).

Identity and behaviour

However, the assignment of the pathogen to indigenous, common, widespread, and until recent seemingly harmless saprotroph does not solve the mystery of *Fraxinus* decline phenomenon. To start with, the identity of the fungus is still unclear. First, the proposed identity of dieback agent as *H. albidus* is to date based on a single genetic marker. Second, stepwise geographic patterns of spread of the dieback throughout Europe strongly imply invasiveness. Consequently, the pathogen could be: i) invasive hybrid, ii) invasive cryptic species, iii) invasive mutant. On the other hand, the fungus might indeed appear to be an indigenous *H. albidus*, and in this case it would likely be an oportunistic pathogen, infecting trees stressed by environmental factors. Consequently, the following hypotheses on dieback agent and environmental role in *F. excelsior* decline are investigated: i) the causal agent is an invasive fungus, or, ii) it is the indigenous *H. albidus*, the pathogenicity of which in certain populations and/or susceptibility to which of *F. excelsior* has been incited by environmental factors.

Population genetics

No matter whether the causal agent is invasive or indigenous, little is known what the modes of its reproduction and spread are. As the fungus produces both asexual conidia and sexual ascospores, this could lead to various degrees of genetic variation in its populations, one extreme being a single clone line and no genetic variation, while another, highly diverse populations comprised of genetically unique individuals. An interesting question to be checked is whether genetic variation in geographic populations of dieback-causing fungus is a dynamic character, and if so, to which extent. For example, one hypothesis could be that during the initial phase and peak of the epidemics few aggressive clonal lines do prevail in populations of the pathogen, while in devastated stands on weakened diseased trees there would be a higher genetic diversity. Then, it would also be of interest to compare those population structures with populations of *C. fraxinea* from geographic regions not yet affected by the disease. Such studies could significantly contribute to understanding the phenomenon of *F. excelsior* decline, and simultaneously could provide the answer whether the fungus is invasive or not. Current situation when different stages of the epidemics are observed in the Nordic – Baltic region creates a pre-requisite for this.

Infection biology and epidemiology

An interesting feature of *C. fraxinea* is the occurrence of this fungus in different parts of declining trees, as leaves, petioles, buds, bark and wood. This demonstrates the ability to colonize broad range of physiologically, biochemically and physically different plant tissues. Moreover, the fungus has also been isolated from symptomless *F. excelsior* petioles (Bakys et al. 2009b). The latter raises question if the observed were the initial yet latent infections, or *C. fraxinea* is also a natural endophyte of *F. excelsior*. The latter would imply universal infection biology and life style of the fungus, possessing the fascinating ability to act as an endophyte, pathogen and saprotroph. In order to clarify this phenomenon, healthy *F. excelsior* material from geographic regions distant from decline should be checked for endophytic presence of *C. fraxinea*. This is now possible by using *C. fraxinea* species-specific ITS primers (Johansson et al. 2009). Moreover, this method could be easily applied in studies on epidemiology of the disease and checking for presence of the pathogen in trade material.

Breeding for resistance

Preliminary evaluations of clonal seed orchards of *F. excelsior* in Denmark and Sweden, and progeny trials in Denmark have provided strong evidence for genetic variation in resistance against the dieback (Stener 2007, Olrik et al. 2007). The potential may therefore be available for breeding for resistance against the disease, if the genetic background is understood. Within the framework of this applied project we test if the observed patterns suggest gene variation of qualitative or quantitative nature, and how the initially observed variation between *F. excelsior* clones and progenies evolve over time.

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Pathogens of *Ips cembrae* (Coleoptera: Curculionidae: Scolytinae) in the Czech Republic and Poland: a Preliminary Study

Jaroslav Holuša, Karolina Lukášová and Wojciech Grodzki

Abstract

The large larch bark beetle, *Ips cembrae* (Heer, 1836), is one of the most destructive secondary pests of *Larix* spp. It has caused several local outbreaks in the Czech Republic and Poland during recent years. Up to now, 2,437 mature beetles were examined for the presence of pathogens in the period of 2007-2009. Beetles collected from pheromone traps and trap trees were kept in the refrigerator in plastic boxes with chips of larch bark. The whole tree was debarked at one site and beetles were collected from each one meter section. Beetles were dissected and the extracted gut was inspected under light microscope at middle and high magnification in water mount. Up to now, only five species of parasitic organisms have been found in the Czech Republic and southern Poland: two species of microsporidia (*Chytridiopsis typographi* Weiser, 1954 and *Nosema typographi* Weiser, 1956 – only in two adult beetles in 2007), two entomoparasitic nematodes and hymenopteran parasitoid.

The infection level of the widely distributed microsporidian pathogen *Chytridiopsis typographi* recorded in all examined *Ips* species is (probably) equal in landscape (but it could depend on the intensity of management). The prevalence in the samples varied between 10-30 %. The infection level of *C. typographi* was equal in one forest stand (hundreds of hectares) and it was also equal in beetles sampled in all parts of one stem. Females of *I. cembrae* were more frequently infected by *C. typographi* than males. Infection levels of the nematodes *Parasitorhabdus obtusa* Fuchs, 1915 and *Contortylenchus diplogaster* v. Listow, 1890 were equal (about 90 %) in beetles sampled in all parts of one stem.

Several specimens of *I. cembrae* were parasitized by larvae of chalcidids of the genus *Tomicobia* (Hymenoptera: Chalcididae). Parasitization by *Tomicobia* sp. (eggs, 1st instar of larvae, older larvae) was equal in beetles sampled in all parts of one stem. Based on the preliminary results it seems that one sample (e.g., 50-200 mature beetles from one tree) is representative for characterization of infection level in forests (with hundreds of hectares) for pathological studies.

Keywords | bark beetle, *Chytridiopsis typographi, Ips cembrae,* pathogen, *Tomicobia* sp.

Kurzfassung

Pathogene von *Ips cembrae* (Coleoptera: Curculionidae: Scolytinae) in Tschechien und Polen: Vorstudie

Der Große 8-zähnige Lärchenborkenkäfer, *Ips cembrae* (Heer, 1836), ist einer der destruktivsten sekundären Schädlingen bei Lärchen (*Larix* spp.). Er hat in den vergangenen Jahren mehrere lokale Massenvermehrungen in Tschechien und Polen verursacht. Bis dato wurden 2.437 ausgereifte Käfer aus den Zeitraum 2007-2009 auf den Befall mit Pathogenen untersucht. Die Käfer stammen aus Pheromonfallen und Fangbäumen, und sie wurden in Plastikboxen mit Lärchenrinde im Kühlschrank gelagert. Auf einem Standort wurde ein kompletter Baum entrindet und die Käfer aus jeweils 1-Meter-Stücken wurden gesammelt. Der sezierte Darm wurde als Nativpräparat unter dem Lichtmikroskop bei mittlerer und hoher Vergrößerung untersucht.

Bis jetzt wurden in Tschechien und im südlichen Polen nur fünf Arten parasitischer Organismen in *I. cembrae* gefunden – zwei Mikrosporidien (*Chytridiopsis typographi* Weiser, 1954 und *Nosema typographi* Weiser, 1956 – nur in zwei Käfern 2007), zwei entomoparasitische Nematoden und ein parasitischer Hautflügler.

Die Prävalenz der häufigen Microsporidie *Chytridiopsis typographi*, die aus allen untersuchten *Ips*-Arten dokumentiert ist, ist (vermutlich) in allen Gegenden gleich hoch (könnte aber von der Intensität der Bewirtschaftung abhängen). Die Infektionsrate bei den Proben schwankte zwischen 10 und 30 %. Die Stärke des Befalls durch *C. typographi* war innerhalb eines Waldbestandes (hunderte Hektar) gleich hoch und auch die Käfer aus allen Teilen des Probestammes waren gleich stark infiziert. Weibliche *I. cembrae* waren häufiger mit *C. typographi* infiziert als Männchen. Die Befallsintensität durch die Nematoden *Parasitorhabdus obtusa* Fuchs, 1915 und *Contortylenchus diplogaster* v. Listow, 1890 war in den Käfern des Probestammes gleich hoch (rund 90 %).

Mehrere Exemplare von *I. cembrae* waren durch Erzwespen-Larven der Gattung *Tomicobia* (Hymenoptera: Chalcididae) parasitiert. Die Parasitierungsrate durch *Tomicobia* sp. (in Eiern, Eilarven und älteren Larvenstadien) in den Käfern war ebenfalls in allen Teilen des Probestammes gleich hoch.

Nach den vorläufigen Ergebnissen scheint eine Probe (z. B. mit 50-200 ausgereiften Käfern von einem Baum) bei entomopathologischen Studien für die Bestimmung der Infektionsstärke in einem Bestand (mit hunderten Hektaren) repräsentativ zu sein.

Schlüsselwörter | Borkenkäfer, *Chytridiopsis typographi, Ips cembrae*, Krankheitserreger, *Tomicobia* sp.

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