Fakultät für Forst- und Umweltwissenschaften der Albert-Ludwigs-Universität Freiburg

Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg

Freiburger
Forstliche
Forschung

Berichte

Biotic Risks and Climate Change in Forests

10th IUFRO Workshop of WP 7.03.10 “Methodology of Forest Insect and Disease Survey in Central Europe”, September 20-23, 2010
Freiburg, Germany

Proceedings

Heft 89

BERICHTE
FREIBURGER FORSTLICHE FORSCHUNG

Heft 89

Biotic Risks and Climate Change in Forests

Forest Research Institute of Baden-Württemberg
Department of Forest Protection

2011

ISSN 1436 - 1566

Publisher:

Fakultät für Forst- und Umweltwissenschaften der Albert-Ludwigs-Universität Freiburg and

Forstliche Versuchs- und Forschungsanstalt (FVA) Baden-Württemberg

Editors (eds.):

Horst Delb and Silvia Pontuali

All papers in this publication were submitted electronically and have been edited to achieve a more or less uniform format. Each author is responsible for the content and form of his own paper.

Cover design:

Bernhard Kunkler Design, Freiburg

Print:

Self-publishing FVA, Freiburg

Order to:

Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg

Wonnhaldestraße 4

D-79100 Freiburg im Breisgau, Germany

Phone: +49 761/ 4018-0 • Fax: +49 761/ 4018-333

E-Mail: fva-bw@forst.bwl.de

Internet: www.fva-bw.de

www.biotic-risks-2010.de

Printed on 100% chlorine-free bleached paper.

Preface

The tenth regular workshop of the IUFRO Working Party WP 7.03.10 "Methodology of Forest Insect and Disease Survey in Central Europe" was held in Freiburg im Breisgau, Germany, September 20-23, 2010. It was organized and hosted by the Forest Research Institute of Baden-Württemberg, Department of Forest Protection. The workshop topics focused to the following themes: Biotic Risks and Climate Change in Forests, with respect of three subtopics in context to Climate Change: 1) Risk assessment of actual and introduced pests and diseases; 2) Survey of actual and introduced pests and diseases and 3) Information platform on pests and diseases occurrence in Central Europe.

All together 77 participants attended the meeting. During the scientific program, 29 oral and 29 poster presentations were organized as well as a guided tour through the historical part of the city of Freiburg. The whole day field excursion introduced us the local forest protection highlights of the famous Black Forest - including the strictly protected forest reserve Napf with its bark beetle situation.

Our working group is mainly engaged in biotic influences to the forest health condition in Central Europe, but although researchers from elsewhere are welcome to attend. Meetings are an ideal platform to exchange information on methods and techniques in forest protection, conducting of forest pest and disease survey and advisory service, which have a long tradition within European forest research institutes and faculties. It is a unique platform for both, forest entomologists and forest pathologists to meet together in one place to discuss and share experiences, practices and scientific results.

The IUFRO group wish to express their gratitude to the German colleagues who perfectly organized the fruitful meeting in Freiburg: Dr. Horst Delb, Silvia Pontuali and staff from the Forest Research Institute of Baden-Württemberg (FVA). Our special thanks go to Prof. Konstantin von Teuffel, director of the institute, who hosted us in Freiburg and to Dr. Hansjochen Schröter, section leader of forest protection, for his impressive contribution at the Black Forest excursion. We also thank the organizers and Renate Krieg for bringing the manuscripts together and preparing the proceedings.

Milos Knizek

Beat Forster

Wojciech Grodzki

Coordinator and deputy coordinators of WP 7.03.10

Participants of the Workshop at the excursion to the Black Forest, Feldberg-Stübenwasen, September 22nd, 2010

The first outbreak of *Ips duplicatus* (Coleoptera, Curculionidae, Scolytinae) in Romania

Nicolai Olenici[1], Mihai-Leonard Duduman[1,2], Valentina Olenici[1], Olivier Bouriaud[1], Romică Tomescu[3], Cristian Rotariu[4]
[1]Forest Research and Management Institute, Experimental Station for Norway Spruce Silviculture, Romania
[2]"Ştefan cel Mare" University of Suceava, Faculty of Silviculture, Suceava, Romania
[3] Forest Research and Management Institute, Voluntari, Romania
[4]Forest Direction Suceava, 1 Mai No. 6; 720224 – Suceava, Romania
Email: olenicifp@yahoo.com, mduduman@gmail.com, ro_tomescu2003@yahoo.fr, rotariu_cristian@yahoo.com

Introduction

Ips duplicatus (Sahlberg, 1836) is an invasive species in Europe (TURCANI *et al.* 2001, ZÚBRIK *et al*. 2006, DAISIE 2009, SAUVARD *et al*. 2010) extending southwards its natural range from the northern parts of the continent, where it was firstly described (PFEFFER & KNÍŽEK 1995, PIEL *et al*. 2006). However, it has drawn little attention from forest protection perspective until recently, when several mass outbreaks occurred in Czech Republik, Slovakia and Poland (HOLUŠA 2001, KNÍŽEK 2001, TURCANI *et al.* 2001, GRODZKI 2003, KNÍŽEK *et al.* 2006). A similar situation was in Romania, where the species was repeatedly observed between 1948 and 1967 (NEGRU & CEIANU 1957, VASILIU *et al.* 1978), but only in the last years did it gain over some consideration due to increasing attacks on Norway spruce (*Picea abies* (L.) H. Karst.) plantations located at low altitudes (OLENICI *et al.* 2009).

Because little is known about the status of this species in Romania, the purpose of this paper is to present our knowledge of *I. duplicatus* distribution in Romania and to draw a preliminary picture of its first outbreak in the north-eastern part of the country.

Material and methods

Information concerning the species distribution in Romania was extracted from literature as well as from direct field collection and trapping of the adult beetles with synthetic pheromone baited traps. Data about the bark beetles and *Pristiphora abietina* (Christ) outbreaks in the spruce plantations growing outside of the spruce' natural range in Suceava county were collected from forest protection reports annually produced by forest districts which manage such stands. Other information about tree stand (composition, age) and site condition (site type, soil type, altitude, slope declivity and aspect) were taken over from forest management plans. Meteorological records from the meteorological station Suceava and standardization precipitation index (SPI) developed by MCKEE *et al*. in (1993) were used to characterize the climatic situation in the study zone. To analyse the tree vigour decline, we used increment cores extracted from the trees at breast height and processed in the laboratory for past growth analysis using standard dendrochronological techniques (e.g., *Fritts* 1976).

Results

Ips duplicatus distribution in Romania.

The species was firstly found in 1948 in Rarău Massif and then in many other places of the Eastern Carpathians or the Moldavian Plateau (NEGRU & CEIANU 1957, VASILIU *et al.* 1978). In 1965 it was also found in the Southern Carpathians, at Voineasa, Vâlcea county (Figure 1). All places have an altitude ranging between 175 m and 1000 m, excepting Rarău, Giumalău and Lucina, which exced 1200 m, while the insectes have mainly been found on Norway spruce, but in three situations on other tree species like *Pinus sylvestris* L. and *Pinus strobus* L., respectively.

The double spined spruce engraver has been found after 2005 in several other places, in the natural range of the spruce but especially in spruce plantation located outside its natural range, at altitudes varying between 340 m and 500 m, at Zamostea, Feteşti, Calafindeşti, Dolhasca (Suceava county), where the insect population reached the epidemic level in the last years. Along an altitudinal transect (340 m-1280 m) between Zamostea (in Suceava Plateau) and Giumalău (in Rarău-Giumalău

Mountains), the captures collected during the whole season 2010 in pheromone traps declined from about 12,000 beetles/traps at Zamostea, to 0.3 beetles/trap at Giumalău, confirming the results published by Holuša (2004), who noted a similar trend in Beskid Mountains.

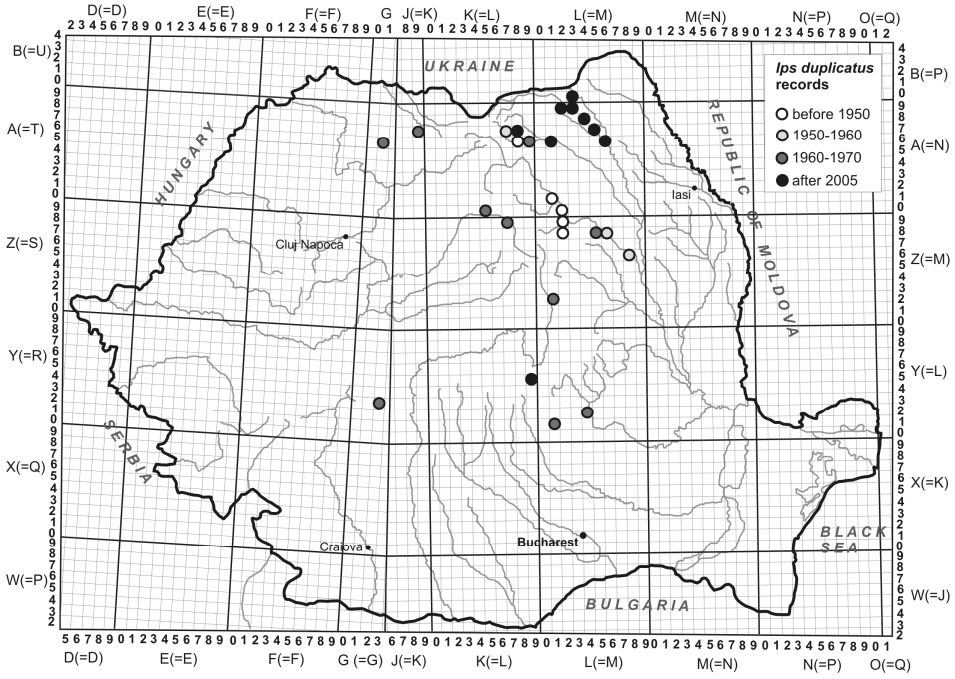

Figure 1: Old and new records of Ips duplicatus in Romania

Dynamics and amplitude of the first outbreak

Although present in the mountain zones of the country for several decades, *Ips duplicatus* was never a "problem" of forest protection due to its low population level. Furthermore, it has been practically overlooked being confounded with *Ips typographus* (L.) and *Ips amitinus* (Eichh.), which are the most important bark beetles in our spruce forests. However, it became after the year 2000 an important pest in the spruce plantation growing in the hilly region of the Suceava county (north-eastern part of Romania). Most of these stands (1745.6 ha) were installed in beech and sessile oak forests in order to produce pulpwood in a short rotation (40 years) and are 30-50 years old today. In the last decade of the 20th century only scattered trees have been found attacked by bark beetles in these tree stands, but their number steadily increased after 2000 up to about 50,000 trees (12,000-14,000 m^3) in 2007-2009 (Figure 2), the total area of forest affected reaching 1525.7 ha. In the main infestation area (473.8 ha), at Zamostea, Calafindeşti, Zvorişte and Feteşti, *Ips duplicatus* is the most abundant species, but *Ips typographus*, *Polygraphus poligraphus* (L.), *Pityogenes chalcographus* (L.) *Pityophthorus pityographus* (Ratz.) are also present, and within two tree stands (38.6 ha) a high frequency of trees infested by *Dendroctonus micans* (Kugelann) was reported.

Factors favouring the ongoing outbreak.

The rapid increase of local bark beetle populations in the last years raises some questions about the factors that could favour such a phenomenon. Because the main increase occurred after 2002, one could suspect that it is linked to bringing high quantities of infested wood in the area from mountain zone (50 km away), where about 7 million cubic meters were affected by a severe windstorm in 6-7 March 2002 and wood extraction was hardly finished in 2004 (SIMIONESCU *et al.* 2007). However, several foci were already active since 2000-2001, and extended rapidly before the bark beetles' outbreak in the mountain area, suggesting that some tree stands became very susceptible to these pests.

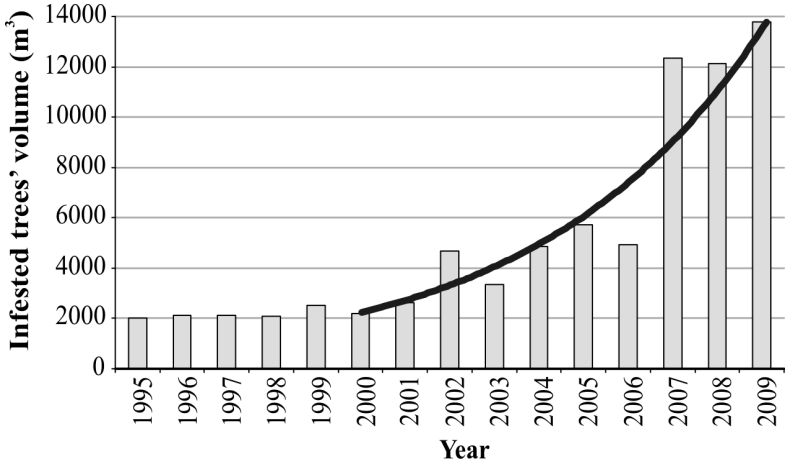

Figure 2: Volume of standing trees infested by bark beetles in spruce plantations

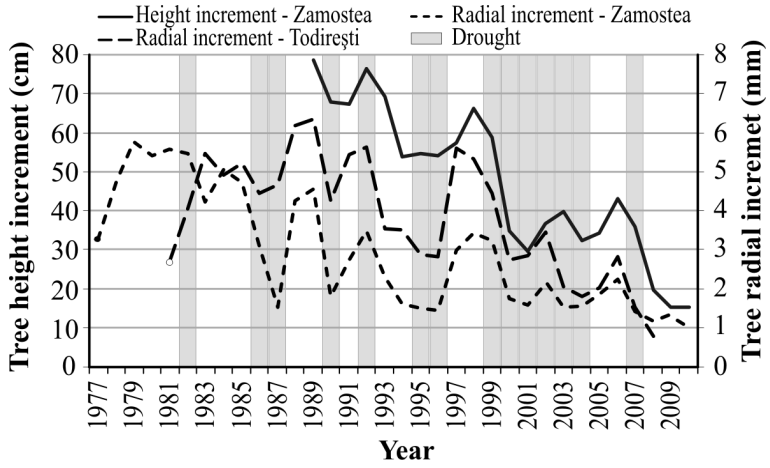

Figure 3: Dynamics of radial and tree height increment in two spruce stands from the studied area (Zamostea – high stem density; Todireşti – moderate stem density)

Tree ring analysis and measurements of tree height increment confirm that trees had been suffering at least since the year 2000 (Figure 3). Past growth analysis showed that they had been severely affected by drought in 1986-1987, 1990, 1992, 1995-1996, when SPI values for May and/or June/July indicated moderate, severe or extreme drought. However, trees had partly recovered by 2000. During the period 2000-2004, they suffered from water deficit at the beginning of growing season each year, and the tree vigor declined dramatically, especially after the hot summer of 2007. In addition, an attack of *Pristiphora abietina* was for the first time reported, in 2003. Litter analysis and careful observations on tree architecture revealed that little spruce sawfly was present in the stands studied and that trees had been defoliated since 1993-1994, but this fact was overlooked by lack of visibility, due to trees height and the close canopy of plantations. The population density and the defoliation degree were variable, but all the young spruce stands have been affected. In some stands with high population density, chemical treatments were undertaken in 2004-2005. Thereafter populations declined, mainly due to unfavorable weather conditions during the flight period, and no other treatments were applied, so that slight to moderate defoliation occurred.

Because the bark beetle attack in the last decade was very uneven in the studied area, one can suppose that such differences between tree stands are due to the site and tree stand characteristics. Contrary to usual expectations, the highest rate (m^3/ha) of trees killed by bark beetles was not registered at the lowest altitudes and/or on the southern slopes (Tables 1-2). This is probably because only a small area of spruce plantations is in the first altitudinal step and some of these stands are in the close proximity of Siret meadow, where trees benefit from an increase of air humidity.

On the other hand, the terrain slope is reduced (mostly under 15[9]) and the slope exposition has little influence on insolation. More important seem to be the edaphic conditions.

Table 1: Altitudinal distribution of spruce plantations in the studied area and volume of trees killed by bark beetles in the period 2002-2009 (mean ± standard deviation)

Specification	Altitude (m)			Total
	201-300	301-400	401-500	
Tree stands' area	36.1	961.5	748.0	1745.6
Volume (m^3/ha)	19.4 ± 24.9	34.2 ± 44.2	20.1 ± 37.9	26.9 ± 41.1

Table 2: Distribution of spruce plantations in the studied area according to slope orientation and volume of trees killed by bark beetles in the period 2002-2009 (mean ± standard deviation)

Specification	Slope orientation									Total
	N	NE	E	SE	S	SV	V	NV	Plane	
Tree stands' area	203.9	321.7	45.7	308.5	122.4	47.4	179.5	145.3	371.2	1745.6
Volume (m^3/ha)	52.1± 45.5	17.1± 31.3	28.0± 67.5	9.7± 21.8	18.3± 43.7	17.7± 24.2	8.3± 20.0	24.7± 49.3	44.3± 39.8	26.9± 41.1

Table 3: Distribution of spruce plantations in the studied area according to soil types/subtypes and the volume of trees killed by bark beetles in the period 2002-2009 (mean ± standard deviation)

Specification	Soil types according to FAO soil classification							Total
	Luvisol			Albeluvisol			Cambiso	
	Subtypes of soil according to Romanian soil classification							
	2201	2205	2209	2401	2405	2407	3101	
Tree stands' area	281.4	32.5	194.3	777.6	19.3	302.1	138.4	1745.6
Volume (m^3/ha)	12.0 ± 24.6	1.5 ± 0.6	42.7 ± 57.8	32.9 ± 41.9	9.0 ± 11.6	24.0 ± 49.0	21.6 ± 24.0	26.9± 41.1

Note: 2201 – preluvosol tipic, 2205 – preluvosol pseudorenzinic, 2209 – preluvosol pseudogleic, 2401 – luvosol tipic, 2405 – luvosol lithic, 2407 – luvosol pseudogleic, 3101 – eutricambosol tipic.

Most of these soils have a high content of clay, and some are affected by periodical water stagnation at their surface (soil subtypes 2209 and 2407). In the stands growing on pseudogleic soils, the trees developed their roots superficially (at most up to a depth of 50 cm) and during the drought periods were most severely affected, becoming very susceptible to beetles attack (Table 3).

As expected, under water deficit conditions, high levels of stem density became an aggravating factor leading to trees debilitation. Stands having more than 2000 trees/hectare at the age of 30-50 years suffered the most intense attacks (Figure 4). The worst situation was in the stands with a density of 2800-3200 trees/ha at 40 years, on pseudogleic soils, repeatedly defoliated by *Pristiphora abietina*. In such situations up to 1000 trees/hectare were incidentally cut after bark beetles' attack in the last eight years.

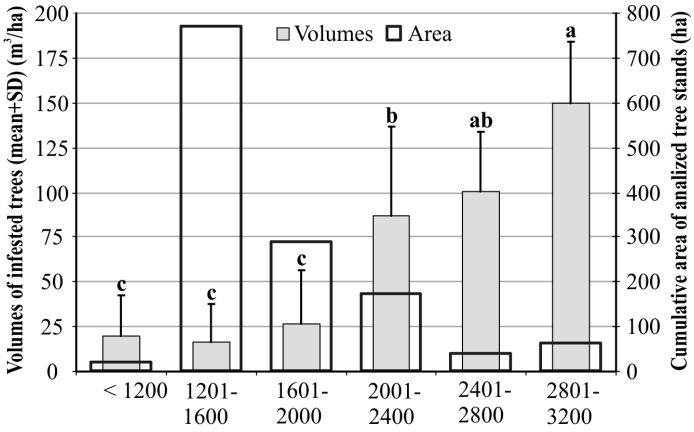

Figure 4: Distribution of spruce plantations in the studied area according to stem density and mean volume of trees killed by bark beetles in the period 2002-2009 (mean + standard deviation)

Because the attack was very intense especially at the new edges of the stands, created after harvesting previously attacked trees, a clear cut of the stands resulted. This behavior of Ips duplicatus adults was previously mentioned by MRKVA (1995) and GRODZKI (1999).

The exponential increase of damages in the last ten years is partly explained by the rapid development of the insects in the study area. During the season 2010, largely characterised by a rainy weather, the beetles succeeded to develop two complete generations.

Conclusions

The actual outbreak of *Ips duplicatus* in the north-eastern part of Romania takes place in Norway spruce plantations of 30-50 years situated outside of the tree species natural range. It begun after severe tree debilitation, caused by repeated episodes of drought and high temperatures during the growing season. The main foci are within very dense tree stands growing on pseudogleic soils, and which were repeatedly defoliated by *Pristiphora abietina*. The current extent of the damages urges adoption of efficient measures, and harvesting of these highly susceptible stands as soon as possible seems to be the main sollution of the problem, because thining of such stands would predispose them in a higher degree to windthrow, and operatively cutting and removing or debarking of newly infested trees became economicaly not sustainable.

Acknowledgements

This work was carried out in the frame of the projects: PN 09460201 – “Dynamics and control of harmful insects’ populations in forest ecosystems in the context of environmental factors’ changes” and PN 09460103 – “Analysis of factors determining absorption and emission of greenhouse gases in the forestry sector,” funded by The Ministry of Education, Research, Youth and Sports within the program GEDEFOR: “Sustainable management of forest ecosystems in the context of global environmental changes”. The research was also sustained by the National Council of Scientific Research in Higher Education (CNCSIS-UEFISCSU) through the project number PN II-RU code PD_563/2010: “The role of the main volatile substances characteristic for Norway spruce in the answer of bark beetles *Ips typographus* and *Ips duplicatus* to their aggregative pheromones”. We thank our colleague Gheorghe Ştefan for processing of increment cores and measuring of tree ring width. We are also grateful to all people from Forest Direction Suceava who helped us in conducting this research.

References

DAISIE (2009): Handbook of Alien Species in Europe. Springer, Dordrecht, 399 pp.

EPPO/CABI (1996): *Ips duplicatus*. In: SMITH, I.M.; MCNAMARA, D.G.; SCOTT, P.R.; HOLDERNESS, M. (eds.): Quarantine pests for Europe. 2nd edition. CAB International, Wallingford, UK, 323-325

FRITTS, H.C. (1976): Tree rings and climate. Academic Press, London, 567 pp.

GRODZKI, W. (1999): Problematika výskytu lýkožrouta severského *Ips duplicatus* (Sahlberg) (Coleoptera: Scolytidae) na území Polska. Zpravodaj ochrany lesa 5, 13–15.

HOLUŠA, J. (2004): Health condition of Norway spruce *Picea abies* (L.) Karst. stands in the Beskid Mts. Dendrobiology 51, suppl., 11-15

MCKEE, T.B.; DOERSKEN, N.J.; KLEIST, J. (1993): The relationship of drought frequency and duration to time scales. Preprints, 8th Conference on Applied Climatology, 17-22 January, Anaheim, CA, 179-184

MRKVA, R. (1995): Nové poznatky o bionomii, ekologii a hubení lýkožrouta severského. Lesnická práce 74, 5–7

NEGRU, Ş.; CEIANU I. (1957): Contribuțiune la recunoaşterea lui *Ips duplicatus* Sahlb. (Coleoptera, Ipidae) şi a vătămării produse. Analale Universității „C.I. Parhon" Bucureşti, Seria Ştiințele Naturii 13, 157-160

OLENICI, N.; DUDUMAN, M.-L.; TULBURE, C.; ROTARIU, C. (2009): *Ips duplicatus* (Coleoptera, Curcilionidae, Scolytinae) – un dăunător important al molidului din afara arealului natural de vegetație. Revista pădurilor 124(1), 17-24

SAUVARD, D.; BRANCO, M.; LAKATOS, F.; FACCOLI, M.; KIRKENDALL, L.R. (2010): Weevils and Bark Beetles (Coleoptera, Curculionoidea). Chapter 8.2. In: ROQUES A. *et al*. (eds.): Alien terrestrial arthropods of Europe. BioRisk 4(1), 219–266

PIEL, F.; GRÉGOIRE, J.C.; KNÍŽEK, M. (2006): New occurrence of *Ips duplicatus* Sahlberg in Herstal (Liege, Belgium). Bulletin OEPP 36, 529–530

PFEFFER, A.; KNÍŽEK, M. (1995): Expanze lýkožrouta *Ips duplicatus* (Sahlb.) ze severské tajgy. Zpravodaj ochrany lesa 2, 8–11

SIMIONESCU, A.; VLĂDESCU, D.; MIHALCIUC, V.; OLENICI, N.; CHIRA, D.; NEGURĂ, A.; FILIP, Ş.; TULBURE, C.; ROTARIU, C.; LUPĂŞTEAN, D. (2007): Starea de sănătate a arboretelor de răşinoase din județul Suceava la 5 ani de la calamitatea naturală din martie 2002. Revista Pădurilor 122(4), 27-36

TURCANI, M.; CSOKA, G.; GRODZKI, W.; ZAHRADNIK, P. (2001): Recent invasions of exotic forest insects in Eastern Central Europe. IUFRO World Series 11, 99–106. Vienna (AT)

VASILIU, M.; ZAHARIA, D.; IGNAT, C. (1978): Catalogul scolitidelor din colecția „Ştefan Negru" a Muzeului Județean Suceava (Coleoptera, Scolytoidea). Studii şi Comunicări, Ştiințele Naturii. Muzeu Județean Suceava, 37 - 52

ZÚBRIK, M.; KUNCA, A.; TURČANI, M.; VAKULA, J.; LEONTOVYC, R. (2006): Invasive and quarantine pests in forests in Slovakia. EPPO Bulletin 36, 402 - 408