Recent trends of forest health in Hungary

Gy. Csóka and A. Hirka

NARIC Forest Research Institute Department of Forest Protection Mátrafüred, Hungary e-mail: csokagy@erti.hu

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U.S. Senator James Inhofe (R-OK) (C) is greeted by a reporter as he arrives for the weekly Senate Republican caucus luncheon at the U.S. Capitol in Washington January 13, 2015.

By Sean Cockerham, McClatchy Washington Bureau



LePage I'll veto every



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Yearly deviations of the a Pálfai-Drought-Index from the 50 years (1967-2016) average (5.3)



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Yearly total forest damage in Hungary between 1962 and 2011 in percentage of the actual forested land



E R T I

%

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Area damaged by abiotic damage factors in Hungary between 1962 and 2011 in percentage of the forested land







Drought damage in forests in the last 50 years by regions



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Breakpoint analysis of the yearly forest drought damage in Hungary



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Two drought indices (Pálfai-Drought-Index on left and Forest-Aridity-Index on right) and the yearly area of the drought damage



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Early leaf abscission of beech in late July due to severe drought

(at ca. 650 meters above sea level)



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Canopy closure and health status of old beech stands









Yearly values and trend of the frost damage between 1961 and 2016



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Extensive frost damage in the Mátra mountains (May 2017)



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Not only the trees suffer...

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Yearly values and trend of storm-, snow-, and ice related damage

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Yearly values and trend of the bark beetle damage

Yearly values of the Pálfai-Drought-Index and the bark beetle damage between 1962 and 2011

ha

 $R^2 = 0.311$

8000

Yearly damage caused by forest insects and 3 years moving averages of PDI

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Already more than 20 years ago...

KLIMATIKUS ANOMÁLIÁKAT INDIKÁLÓ ERDEI ROVAROK

Csóka György-Leskó Katalin ERTI Erdővédelmi Osztály Gödöllő

1. BEVEZETÉS

A klimatikus tényezők, illetve azok változásai önmagukban is képesek behatárolni herbivor rovarfajok areáját, közvetlenül befolyásolják azok túlélési és szaporodási rátáját, generációszámát, viselkedését, fiziológiai folyamatait,...,stb. Közvetlen hatásuk mellett tápnövényükön, illetve természetes ellenségeiken keresztül közvetve is nagy mértékben hatnak a növényevő rovarok populációdinamikájára. Ezen direkt és indirekt hatások eredőjeként következhetnek be azok a változások, melvek az cgyes fajok elterjedésének és abundanciájának, ezáltal esetleg gazdasági jelentőségének megváltozásában nyilvánulnak meg. A klimatikus tényezők és a rovarok abundanciájának összefüggéseit már régóta, és igen sokan vizsgálják. Több, korábbi vélemény szerint klima, illetve annak anomáliái a rovarok populációdinamikájának fő mozgatórugói (GRAHAM, 1939, WELLINGTON, 1954, GREENBANK, 1956). Míg korábban a klimatikus tényezők direkt hatásai álltak az érdeklődés középpontjában, napjainkban a tápnövényen keresztül közvetített indirekt hatások (tápanyagtartalom, emészthetőség, kémiai védekezés,...,stb.) kapnak nagyobb figvelmet. Az újabb vizsgálatok eredményei alapján ugyanis feltételezhető, hogy ezek sok esetben a direkt hatásokét meghaladó jelentőséggel bírnak (WHITE,1974, MONTGOMERY,1985, MAJOR,1990). Habár a klimatikus tényezők közvetlen szerepét manapság már nemigen szokás túlértékelni, kétségtelen tény, hogy számos rovarfaj esetében döntő mértékben befolyásolják a népesség változásait.

Jelen dolgozat arra vonatkozóan próbáł hazai példákat szolgáltatui, hogy az utóbbi több, mint egy évtized extrém időjárása milyen hatást gyakorolt az erdei rovarok elterjedésére és populációdmamikájára.

2. MÓDSZER

A munkánkban szereplő eredmények az ERTI Erdővédelmi Figyelőszolgálata adatbázisának elemzése során születtek. E rendszert a 60-as évek elején Tallós Pál és Szontagh Pál indította be. Előbbi tragikusan korai haláláig, utóbbi 1988. évi nyugdíjazásáig vett részt a Figyelőszolgálat munkálban, melynek központja jelenleg Gödöllőn van.

Az Erdővédelmi Figyelőszolgátat több évtizetés adatsorai alapján kárttendvizsgálatokat végeztünk. A rendelkezésre álló adatsorok függvényében egyes fijokra eltérő időszak (19-33 év) kárterületi adatainak alakulását vizsgáltuk. A populációdinamikai vizsgálatoknák szokásos természetes alapú logaritmusta való átalakítást követőer regresszióanalísisi végeztűnk. Ennek során ara a kérdésre kerestűnk választ, hogy az tróbbi másfil évitzel estremí díjáírása hatással volt-e az erdészeti jelentőségű rovarfajok éves kártételt területeinek alakulására. Kiemelt figyelmet szenteltűnk a szakirodalom, és saját ismereteink szerint meleg-, és szárazságkedvelő fijokra, hiszen fibrieteleszönk szerin ezek esetben kell növekvő kártételt területeinek kelkel szárolumuk.

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NÖVÉNYVÉDELEM 32 (11), 1996

ASZÁLYOS ÉVEK – FOKOZÓDÓ ROVARKÁROK ERDEINKBEN

Csóka György

Erdészeti Tudományos Intézet, 3232 Mátrafüred, Pf. 2.

Az elmúlt évtized szokatlanul aszályos időjárása jelentős mértékben befolyásolta az erdei rovarok populációs fuktuációti. Igen nagy kárterülettel lépett fel pl. a Lymantria dispar, az Euproctis chrysorthoea. A Ermes quercus. a Neodiprion sertiléra. a Curculio fajók, és a fenyíköm élő száfajok is. Többüt esetében bebizonyosodott, hogy kárterületi expanziójuk elsősorban a szélsőséges időjárás következménye. Ezen túl azonban egyes antropogén hatások (pl. átgondolatlan vízrendezések, monokultárik létesítése) is a novekvő kárterületek tárvájba hatnak.

A kárterületi expanziók mellett számos olyan melegkedvelő rovarfaj lépett fel kártételi mértékben, amelyek kárt okozó tömeges elszaporodását korábbról nem ismertük. Ezek pl. a Tischeria fajok. Parectopa robiniella, Camerana ohridella, Nycteola asiatica.

A klíma és annak szélsőségei a rovarok elterjedésére és populációs fluktuációira egyaránt igen jelentős hatást gyakorolnak (Uvarov 1931. Andrewartha és Brich 1954, Wellington 1954, Kozár és Nagy 1986, Mattson és Haack 1987, Elias 1991, Csóka 1995). Több klimatikus összetevő, mint például a hőmérséklet, erős fagyok közvetlenül is befolyásolják a herbivor rovarok túlélési esélyeit és szaporodási sikerét. Ugyanezek a faktorok közvetve is befolvásoliák a rovarpopulációk népességét, mégpedig a tápnövényen, a természetes ellenségeken, járványokon és kompetitorokon keresztül. E hatásrendszer egyes összefüggései viszonylag részletesen ismertek, többségükről viszont alig tudunk valamit. Ezek súlya, jelentősége helytől, időtől, növény- és rovarfajtól függően jelentős mértékben változbat

Az utóbbi évüzedhen számos közlemény taglalja a növények aszály okozta stresszállagotat és a rajtuk élő rovarek populációdinamikája közötti pozitív összefüggéseket. Van azonban olyan vélemény is (Larsson 1989), hogy az aszálystressz jelentőségének igazolására szolgáló kíssérletek eredményei korántsem egyértelmíóen megyőzőek. Egyes kísérletek igazolták a pozitiv hatást (Cates és munkatársai 1983, Waring és Price 1990) másonkak azonban ez nem sikerült (Watt 1986, McCullogh és Wagner 1987). Többen hangsülyozták azt is, hogy a különbözt táplálkozáis csoportok (lombrágók, levélaknázók, gubacsokozók, kambiumfogyasztók) jelentősen eltérő módon reagálhatnak a tápnövény aszály okozta stresszállapotára.

Az említettekkel együtt is, igen sokszor megerősített tapasztalat - még akkor is, ha az egyes összetevők súlya egyelőre nem kellően tisztázott -, hogy az aszály maghatározó jelentőségű számos erdei rovarfaj gradációjának kialakulásában és lefolyásában. Ez egyben azt is jelentheti, hogy az esetlegesen gyakoribbá és súlyosabbá váló aszályok gyakoribb és nagyobb kiterjedésű rovargradációk előidézői lehetnek. Mivel azonban a hosszú időtartamú adatsorok ebben a vonatkozásban nem túl gyakoriak, az összefüggések számszerűsítése (pl. mely rovarfaj hogyan reagál az aszályra) sem egyszerű. Különösen érdekes lehetne ez most, amikor nyilvánvalóvá vált, hogy egyes erdei rovarfajok kárterületei számottevően emelkedtek az utóbbi egy-két évtizedben (Csóka 1994, 1995). Ezek például a levélsodró molyok (Tortricidae), aranyfarú pille (Euproctis chrysorrhoea), makkormányosok (Curculio spp.), fenyőrontó darázs (Neodiprion sertifer), fenyőkön élő szúk (Scolytidae).

Biologia, Bratislava, 52/2: 159-162, 1997

Increased insect damage in Hungarian forests under drought impact

György Csóka

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Forest Research Institute, Department of Forest Protection, H-3232 Mátrafüred, P. O. Box 2, Hungary; tel: +36-37-320129, fax: +36-37-320406, e-mail: h9441cso@ella.hu

> CSÓKA, G., Increased insect damage in Hungarian forests under drought impact. Biologia, Bratislava, 52: 159-162, 1997; ISSN 0006-3088.

> The increased frequency and severity of drought played a key role in provoking more serious outbreaks of several forest insects, leading to a significant expansion of the damaged territory. Populations of six species involved in this study showed significantly increasing trend over the last three decades. These are as follows: bark beetles on conifers, Curculio acorn weevils, Euproctis chrysorrhoea, Kermes quercus, pine sawflies, tortricid leafrollers. All of these species are known to prefer warm and dry conditions. The yearly value of area damaged in case of four pests (bark beetles on conifers, Cur-culio acorn weevils, Kermes quercus, pine sawflies) gave highly significant positive correlation with several drought indicating variables (yearly values, 2-, 3-, 4-years moving averages of forest drought damage and drought index) On top of the increasing damage, at least 20 species considered as thermo-, and xerophilous appeared as new forest pest in Hungary over the last 2 decades. These are for example: Cameraria ochridella (Lepidoptera), Parectopa robiniella (Lepidoptera), Phylloxera cerris (Homoptera), Nycteola asia tica (Lepidoptera), Tischeria spp. (Lepidoptera), However, it should not be concluded that drought stimulates damage expansion in all forest pests. Fac tors other than climate also can play significant role. These factors are for example the improper human managing activities as draining the water from the forests and planting pure and evenaged stands on sub-optimal sites. These factors and the climate extremes make each other's negative effects stronger.

Key words: Insects, new pests, damage, drought, human impacts

Introduction

The climate and its extremes can have outstanding impacts both on distribution and population fluctuations of inserts (WELLINGTON, 1984; KOZÁR, & NAGY, 1986; MATTSON & HAACK, 1987; ELIAS, 1991; CAMMELL & KNIGHT, 1992). Several climatic factors as temperature, rain, frost, etc. can affect the survival and reproductive success of forest insects directly. The same factors can affect the abundance of the pest populations indirectly, via

effects on the food plant, other herbivores, predators, parasitoids and pathogens.

These direct and indirect impacts together resulted in an expansion of areas damaged by several forest pests in the last one and a half decades when the climate was unusually dry and warm in Hungary.

The aim of this brief study was to decide which forest pests had expanded their damage are cas over the last 3 decades in Hungary. We also ia wanted to know whether there is any correlation

159

1994

1996

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...and we still do.

AZ ASZÁLYOSSÁG HATÁSA KOCSÁNYTALAN TÖLGYESEK ÉS BÜKKÖSÖK EGÉSZSÉGI ÁLLAPOTÁRA

CSÓKA GYÖRGY – KOLTAY ANDRÁS – HIRKA ANIKÓ – JANIK GERGELY

Kulcsszavak: aszály, tölgyesek, bükkösök, pusztulás, leromlás.

ÖSSZEFOGLALÓ MEGÁLLAPÍTÁSOK, KÖVETKEZTETÉSEK, JAVASLATOK

Megállapítható, hogy az aszályosság jelentős mértékben befolyásolja a kocsányos tölgyesek és bükkösök egészségi állapotát. Kocsánytalan tölgyesekben a "magányos" aszályos évek általában nem okoznak jelentős pusztulást, illetve leromlást, általában csak 2-3, egymást követő erősen aszályos év hatására mutatnak egészségi állapotromlást. A hatások gyakran 1-3 év eltolódással "kárláncolatokon" keresztül jelentkeznek.

A bükkösökben (különösen pl. a Dél-Dunántúlon) már egy-egy jelentősen aszályos év is számottevő állapotromlást idéz elő. Bükk-tájak közül Zala látszik legérzékenyebbnek az aszályosság hatásait tekintve. Ezt támasztja alá az a tény is, hogy Zala megyében 2004-ben 100 ezer m3-t is meghaladó egészségügyi termelést kellett végrehajtani a zöld karcsúdíszbogár (Agrilus viridis) és a bóbitás bükkszú (Taphrorychus bicolor) tömegszaporodása következtében. Mindkét faj tömegszaporodása egyértelműen köthető az előző évek súlyos aszályaihoz.

Ha az aszályos időszakok gyakorisága és időtartama növekszik, akkor az eddigieknél sűrűbben és nagyobb területen fellépő rovarkárra lehet számítani. Új, kevésbé ismert, vagy "elfeledett" rovarfajok válhatnak jelentőssé. Egyes fajok kártételei vertikálisan is terjedhetnek, és válhatnak rendszeressé az eddig kevésbé károsított erdőtípusokban is. Ez jelentős kihatású kárláncolatok kialakulásához is vezethet.

BEVEZETÉS

AZ ALKALMAZOTT MÓDSZER

A hazai kocsánytalan tölgyesek és bükkösök ökonómiai és ökológiai szempontból egyaránt kiemelkedő jelentőségűek. Ennek megfelelően egészségi állapotuk, illetve az abban csánytalan tölgy állományokban (1983-tól). bekövetkező változások kiemelt figyelmet élveznek. A kocsánytalan tölgyesek egészségi állapotának alakulásával a 80-as évek ele- éves adatsorok állnak rendelkezésre. A mojétől kezdődően számos szerző foglalkozott nitoring-parcellákat, illetve a rajtuk lévő (Igmándy et al., 1984; Führer, 1989; Csóka, mintafákat minden év szeptemberében egye-1992; Vajna, 1995; Standovár – Somogyi, 1998; Csóka et al., 1999). A bükkösök egészségi állapota is régen foglalkoztatja a kutató- elem zésben azonban ezeket a felvételeket kat (Tuzson, 1931; Szontagh, 1987, 1988, 1989; nem vettűk figyelembe. A mintafák egész-Leskó, 1993; Tóth et al., 1995; Barton, 1997).

Az ERTI Erdővédelmi Osztálya hosszabb ideje folytat erdővédelmi monitoring-vizsgálatokat magyarországi bükk (1992-től) és ko-Azaz 2005-tel bezárólag bükk esetében 14 éves, kocsánytalan tölgy esetében pedig 23 denként minősítettük. Égyes parcellákon tavaszi (május) minősítések is folytak, jelen ségi állapotának jellemzésére az 5 fokoza-

Ecology and Evolution

Forest insects and climate change: long-term trends in herbivore damage

Maartje J. Klapwijk¹, György Csóka², Anikó Hirka² & Christer Björkman¹ ¹Department of Ecology, Swedish University of Agricultural Sciences, Uppsala, Sweden ²Department of Forest Protection, Forest Research institute, Mätrafüred, Hungary

Abstract

Herbivory, Hungary, Lepidoptera, moths,

precipitation, temperature, variability,

Correspondence Maartie J. Klapwik, Department of Ecology

Swedish University of Agricultural Sciences, Uppsala, Ulis Våg 16, 75651, Sweden. Tel: +46 (0)18 672 367 Fax: +46 (0)18 672 890 E-mail: maartie.klaowik@slu.se Funding Information search was funded through Future Forests (a multidisciplinary research programme supported by Mistra, the edish Forestry Industry, SLU, Umeá University, and Skogforsk: M. J. Klapwijk and . Björkman) and the BACCARA project which received funding from the European Community's Seventh Framework Programme (FP7/2007 2013) under the grant agreement no. 226299, a grant from EU 7th IP BACCARA contract 226299 (M. J. Klapwijk and C. Björkman). Contribution of ka and G. Csóka was s research grant TAMOP-4.2.2 A-11/1/KONV.

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Introduction

In recent decades, changes in weather patterns have been observed, the most pronounced being an increase in ambient temperatures (Solomon et al. 2007). In addition, there is previous research that has recorded changes in species ranges, phenology of life cycles, and interactions (Walther et al. 2002; Parmesan and Yohe 2003; Menzel et al. 2006;

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observed climate change on herbivore damage to plants. However, sufficiently long time series in ecology are scarce. The research presented here analyzes a long-term data set collected by the Hungarian Forest Research Institute over the period 1961-2009. The number of hectares with visible defoliation was estimated and documented for several forest insect pest species. This resulted in a unique time series that provides us with the opportunity to compare insect damage trends with trends in weather patterns. Data were analyzed for six lepidopteran species: Thaumetopoea processionea, Tortrix viridana, Rhyacionia buoliana, Malacosoma neustria, Euproctis chrysorrhoea, and Lymantria dispar. All these species exhibit outbreak dynamics in Hungary. Five of these species prefer deciduous tree species as their host plants, whereas R. buoliana is a specialist on Pinus spp. The data were analyzed using general linear models and generalized least squares regression in relation to mean monthly temperature and precipitation. Temperature increased considerably, especially over the last 25 years (+1.6°C), whereas precipitation exhibited no trend over the period. No change in weather variability over time was observed. There was increased damage caused by two species on deciduous trees. The area of damage attributed to R buoliana decreased over the study period. There was no evidence of increased variability in damage. We conclude that species exhibiting a trend toward ontbreak-level damage over a greater geographical area may be positively affected by changes in weather conditions coinciding with important life stages. Strong associations between the geographical extent of severe damage and monthly temperature and precipitation are difficult to confirm, studying the life-history traits of species could help to increase understanding of responses to climate change.

Long-term data sets, covering several decades, could help to reveal the effects of

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Visser and Both 2006; Walther 2010). Species range expan sions and, to a lesser extent, retractions have been observed (Parmesan et al. 1999; Parmesan 2006) as well as changes in population dynamics in response to changing winter temperatures and snow cover (Ims and Fuglei 2005; Bale and Hayward 2010). Changes in outbreak patterns (Esper et al. 2007) and in outbreak range (Jepsen et al. 2008) have been attributed to climate warming. One example is the

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J Pest Sci DOI 10.1007/s10340-015-0694-7 ORIGINAL PAPER

Multi-decade patterns of gypsy moth fluctuations in the Carpathian Mountains and options for outbreak forecasting

Tomáš Hlásny^{1,2} · Jiří Trombik² · Jaroslav Holuša² · Karolina Lukášová² · Marian Grendár³ · Marek Turčáni² · Milan Zúbrik¹ · Mara Tabaković-Tošić⁴ · Anikó Hirka⁵ · Igor Buksha⁶ · Roman Modlinger⁷ · Magdalena Kacprzyk⁸ · György Csóka⁵

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Abstract The gypsy moth is the most important defoliator of broadleaved forests in the Northern Hemisphere. We explored the patterns in the moth's long-term dynamics and produced outbreak forecasts for seven countries located in central to southeastern Europe and extending into the Carpathian Mountains. We investigated how the outbreak periods and trends in the size of outbreak areas differ among the countries, the extent to which pest dynamics are synchronized, and how the observed patterns can be used to forecast outbreaks. We used long-term time series on outbreaks from about 1947 to 2013. The outbreak period ranged from 13 years in the northwest to 8 years in the southeast of the region; the periods were statistically significant in six of the seven countries ($\alpha = 0.05$). Two distinct patterns in outbreak size were observed, i.e. while outbreak areas in the northwest were increasing, excep tionally large outbreaks occasionally occurred in the

southeastern part of the region. Outbreak forecasts based on combined use of the Fourier Transform and ARFIMA approaches showed that outbreak predictability differs among the countries. An increase in outbreak areas, the control of which would require increased resources, was forecasted mainly in the central part of the region Although the forecasts can support the forest management there are limits to their use because of the complex relationships between the pest and the environment, which were not cantured by our empirical forecasting models.

Keywords Lymantria dispar · European temperate forests · Pest management · Outbreak cycles · Population synchrony

Key message

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Electronic supplementary material The online version of this article (doi:10.1007/s10340-015-0694-7) contains supplementary material, which is available to authorized users.

🖂 Jiří Trombik jiri.trombik@gmail.com

- Department of Forest and Landscane Ecology, National Forest Centre - Forest Research Institute Zvolen, 7 G. Masaryka 22, 960 92 Zvolen, Slovak Republic
- 2 Department of Forest Protection and Entomology, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 21 Prague 6, Czech Republic
- ³ Institute of Measurement Science of the Slovak Academy of Sciences, Dúbravská costa 9, 841 04 Bratislava, Slovak Republic

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We investigated the long-term dynamics of the gypsy moth in seven countries in the Carpathian Mountains The long-term pest dynamics significantly differed between the northern and southern regions.

Department of Forest Protection, Institute of Forestry elgrade, Kneza Višeslava 3, Belgrade 11030, Serbia

Department of Forest Protection, NARIC Forest Research Institute, Mátrafüred, Hegyalja u. 14 3232, Hungary

⁶ Ukrainian Research Institute of Forestry and Forest Melioration, Pushkinska str., 86, Kharkiv 61024, Ukraine

Forestry and Game Management Research Institute, Strnady 136, 252 02 Jiloviště, Czech Republic Department of Forest Protection. Entomology and Forest

Climatology, Faculty of Forestry, Institute of Forest Ecosystems Protection, Agricultural University in Krakow, Al. 29 Listopada 46, Kraków, Poland

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Vertical expansion of gypsy moth damage

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Yearly damage caused by gypsy moth (left) and its fully grown caterpillars killed by *Entomophaga maimaiga* (right)

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A few of the potential candidates to replace gypsy moth as dominant defoliator (if gypsy moth "retires")

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Pine decline after severe drought in the Mátra mountains caused by the endophytic fungus *Cenangium ferruginosum*

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Turkey oak

Beech

Biscogniauxia mediterranea

Maple decline

Ash dieback

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Yearly area of reported beech decline and the yearly values of PDI

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Beech splendour beetle (Agrilus viridis)

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Healthy looking beech crown

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Yearly mortality (%) and the PDI values in the Hungarian sessile oak (*Q. petraea*) stands between 1983 and 2012

Biotic stem damage on beech caused by "first generation human" (*Subhomo xyloscriptor*)

Almost all types of forest damage show an increasing trend in the last 50 years in Hungary, even in percentage of the actual forested area.

The health status of the Hungarian forests strongly depends on the weather conditions, but the forest management also have major effect.

The climate change scenarios (more frequent and more severe droughts, more frequent extreme meteorological events) therefore predict even further negative trends in forest health.

The "story" is not restricted to Hungary. Similar problems and trends are present in many European countries.

Managing forests for resilience

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In details:

More careful and higher resolution soil site/tree species choice

-The "old traditional knowledge" must often be reconsidered.

Increasing intraspecific diversity

-Natural regeneration is better than artificial.

-"Climate matching/assisted migrations": Introducing propagation material from more southern populations of beech, sessile oak, etc. Health risks should also be considered!

Increasing interspecific diversity

-Mixed stands instead of monocultures. -Supporting earlier neglected native tree and shrub species, even "weed trees".

Increasing the structural diversity

Small scale cutting areas.Increasing size and age diversity.Dead wood.

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Alternative forest management systems

-Continous cover forestry instead of clearcut systems should be considered where possible.

Proactive consideration of potential future health risks

- -Arising native and alien pests and pathogens.
- -Extreme weather events.
- -Forest fires.

Basic priorities should be reconsidered

Forest planning and legislation should be tuned accordingly

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Effects of topography and tree stand characteristics on susceptibility of forests to natural disturbances (ice and wind) in the Börzsöny Mountains (Hungary)

K. Kenderes¹, R. Aszalós², J. Ruff³, Zs. Barton³ and T. Standovár^{1,4}

¹Department of Plant Taxonomy and Ecology, L. Eötvös University, Pázmány sétány 1/c, H-1117 Budapest, Hungary

²Institute of Ecology and Botany, Hungarian Academy of Sciences, H-2163 Vácrátót, Hungary ³Királyrét Forest Directorate, Ipoly Erdő Inc., Királyrét 6, H-2624 Szokolya, Hungary ⁴Corresponding author. E-mail: standyčalikalens.elte.hu

Keywords: Beech, C&RT, Fagus sylvatica, Ice break, Quercus petraea, Sessile oak, Windthrow.

Abstract: We analysed the role of topography, tree stand characteristics and management on the susceptibility of forest stands to abiotic natural disturbances. In 1996, stands of Börzsöny Mts, Hungary were hit by a severe ice storm, then by strong winds three years later. Affected areas were mapped on aerial photos, and we built a GIS database containing variables describing topography and tree stand characteristics. The role of variables in predicting ice break and windfall was investigated by non-paremetric statistical tests and by a series of C&RT (Classification and Regression Tree) analyses. Elevation, aspect and slope proved to have strong statistical relationships with the distribution of both ice break and windfall, with misclassification error (MER) of 18% and 15%, respectively, if studied without stand descriptors. Mixing ratio and age of beech were the most important stand descriptors to explain the distribution of ice break (MER=15%), whereas that of windfall was best described by the age and height of the two dominant tree species (MER=115%). The explanatory power could be increased if all variables (topographic + stand descriptors) were considered, though the increase in explanatory power was higher in the case of ice break (MER decreased from 15% to 115%) than for windfall (MER decreased from 11% to 10%). Since management related stand variables (bech mixture ratio, age, height, amount of recently felled stock, slenderness) and susceptibility to disturbance events seemed to be related, our results suggest that the sensitivity of tree stands could be decreased by increasing compositional and structural heterogeneity.

Abbreviations: C&RT – Classification and Regression Tree, MER– Misclassification Error Rate, GIS – Geographic Information System, DEM – Digital Elevation Model, RelAgeSlen – Relative Age-specific Slenderness, fs – amount of felled stock, totut – total cut, planeut + planned cut.

Introduction

In temperate broadleaved forests of Europe and North America, the most common form of natural disturbance is fine scale gap dynamics driven by the deth of individual (or a few) canopy trees (Peterken 1996, Splechtna et al. 2005). Less frequent natural disturbances that affect larger areas are responsible for shaping the natural coarse pattern of forests. In Europe, this group of natural disturbances includes windthrow and ice break which, depending on their size and intensity, may result in the destruction and renewal of individual forest stands or entire woodlands (Pickett and White 1985, Peterken 1996, Ulanova 2000, Splechtna et al. 2005, Nagel and Diaci 2006). Unfortunately, there is limited quantitative information on the natural disturbance regimes of European forests, because unmanaged old-growth forests are scarce after a long history of intense forest use and exploitation (Glatzel 1999, Parviainen 2005). In Eastern Central Europe, where more remnants of natural forests survived, scientific traditions focused on describing forest stand structures and on distinguishing forest community types, hence much less emphasis has been put on studying processes (Standovár and Kenderes 2003).

Much more information is available on the natural disturbance regimes of North American forests (Van Dyke 1999, Bragg et al. 2003). Ice break and windthrow

PATTERNS AND CAUSES OF ICE BREAK IN A MANAGED FOREST LANDSCAPE (BÖRZSÖNY MTS., HUNGARY)

K. Kenderes¹, T. Standovár¹, J. Ruff² and R. Aszalós³

¹Department of Plant Taxonomy and Ecology, L. Eötvös University, Budapest, Hungary ²Királyrét Forest Directorate, Ipoly Erlő Ltd., Hungary ³Institute of Ecology and Botany, Hungarian Academy of Sciences, Hungary

ABSTRACT

Tree stands of the Börzsöny Mts, Hungary, were hit by severe ice storm and very strong wind several times in the past decade. In this work we analyse the spatial behaviour and background causes of ice breaks. Affected areas were mapped by marking the homogeneous disturbance patches in the airborne photos that were taken after the disturbance event, and then we estimated the intensity of the damage in each patch by field observation. The role of variables describing topography, stand characteristics and management were investigated. Beside topographic variables mixture ratio of beech, stand age and average slenderness had prominent role in the generation of ice break. Our results show that in addition to the natural processes forestry operations also increased the susceptibility of the affected areas. These forest stands dominated by beech woods, are almost pure and even-aged. The resulting stand structure promotes the growth of sensitive slender trees.

Keywords: natural disturbance, silvicultural system, CART, beech, Fagus sylvatica

INTRODUCTION

Forest management has changed both the composition and structure of the original forests. The direct effects of the widely used form of age-class forestry, i.e. uniform shelterwood system with large felling units (<u>Matthews 1991</u>) include altered age and tree stand structure as well as the lack of certain forest developmental phases (e.g. old decaying phases) and of several structural elements (e.g. large snags, logs, rootplates). The importance of most associate tree species and characteristic patch size of stand types have also been changed. In addition to these direct effects, there are less obvious consequences.

The potential change in susceptibility of trees to biotic and abiotic disturbances result in changed spatial patterns of affected areas as well as changes in the severity of disturbances. Several studies showed that the occurrence of severe disturbances in managed temperate forests can be related to the effects of forestry operations that changed the composition and structure of the tree stands (e.g. for wind disturbances Gardiner & Quine 2000, Gardiner et al. 2005). While studying the possible factors that contribute to the development of ice break several studies showed the effects of topographic position (Seischab et al. 1993, Warillow 1999, Mou & Warillow 2000, Rhoads et al. 2002, Millward & Kraft 2004), tree species (Lemon 1961, Melancon & Lechowicz 1987, Warillow 1999, Mou & Warillow 2000, Duguay et al. 2001, Rhoads et al. 2002, Millward & Kraft 2004) and stand age (Rhoads et al. 2002). The effects of tending were also studied (Morris & Ostrowski 2005, <u>Srage</u> et al. 2003). In this paper we study the effects of two events of ice brake that hit the same managed forest area within 5 years (in January 1996 and 2001). We study the effects of topography, tree species composition and management related stand characteristics on the development of ice brake.

Patterns and processes in forest landscapes. Consequences of human management R. Lafortezza and G. Sanesi (eds.) © 2006 Accademia Italiana di Scienze Forestali

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d Research

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Subject Areas ecology

Keywords associational resistance, biodiversity ecosystem functioning

Virginie Guyot^{1,3}, Bastien Castagneyrol³, Aude Vialatte^{1,2}, Marc Deconchat¹ and Hervé Jactel³

¹INRA, DYNAFGR, UMR 1201, 31326 Castaret-Falosan, France ²INPT-ENSAT, DYNAFOR, Université de Touleuse, UMR 1201, 31326 Castaret-Tolosan, France ³INRA, BIOGECO, Université de Bordeaux, 33610 Cestas, France (D) VG. 0000-0003-1766-1465

Tree diversity reduces pest damage

in mature forests across Europe

Forest pest damage is expected to increase with global change. Tree diversity could mitigate this impact, but unambiguous demonstration of the diversity-resistance relationship is lacking in semi-natural mature forests. We used a network of 208 forest plots sampled along two orthogonal gradi-ents of increasing tree species richness and latitudes to assess total tree defoliation in Europe. We found a positive relationship between tree species richness and resistance to insect herbivores: overall damage to broadleaved species significantly decreased with the number of tree species in mature rests. This pattern of associational resistance was frequently observed across tree species and countries, irrespective of their climate. These findconfirm the greater potential of mixed forests to face future biotic disturbances in a changing world.

1. Introduction

rees (2014) 28:777-79 DOI 10.1007/s00468-014-0991-4

ORIGINAL PAPER

European beech grows better and is less drought sensitive in mixed than in pure stands: tree neighbourhood effects on radial increment

Inga Mölder · Christoph Leuschner

Received: 10 July 2013/Revised: 9 January 2014/Accepted: 1 February 2014/Published online: 27 February 2014 © Springer-Verlag Berlin Heidelberg 2014

Abstract

Key message Tree neighbourhood can affect the radial increment of Fagus sylvatica and its sensitivity to environmental fluctuation, which partly depends on soil clay content and species identity of the neighbours.

Abstract In a temperate deciduous forest, we analysed the tree ring chronologies of 152 Fagus sylvatica L. target trees from tree neighbourhoods varying in species composition and tree diversity. We hypothesised that the species identity of the neighbour trees influences radial stem increment and envi ronmental sensitivity of growth of the target trees. Further, we postulated that the effect was stronger under low abiotic stress as expressed by soil clay content and that beech individuals could have a higher wood production in mixed than in monospecific stands. We measured radial increment and analysed the growth response to, and recovery from, selected stress events. Fagus trees in a neighbourhood with more than 30 % of the canopy's 'influence sphere' occupied by allospecific trees had a higher mean stem increment, a lower increment sensitivity to environmental fluctuation and a smaller growth depression after the 1976 drought than beech trees surrounded by conspecific trees. We found that the neighbours' identity can influence beech growth: positive effects on mean increment and a reduced sensitivity were found for Tilia, Fraxinus and Acer neighbourhoods, but not

Present Address. I Milder Energieagentur Region Göttingen e.V, Berliner Str. 4, 32073 Göttingen Germany I. Mölder · C. Leuschner (🖂) Plant Ecology and Ecosystems Research, Albrecht von Haller for Ouercus neighbourhoods. The growth-promoting effect was significant on clay-poorer soil, but not on clay-richer soil. Tree species diversity in the neighbourhood tended to correlate positively with mean stem growth and negatively with the sensitivity to environmental fluctuation. We conclude that the neighbourhood of a tree can influence its mean stem increment and growth sensitivity to environmental fluctuation in temperate mixed forests with the effect partly depending on the neighbours' species identity.

Keywords Dendrochronology · Fagus sylvatica · Interspecific competition - Intraspecific competition Negative pointer year · Tree diversity

Introduction

While plant-plant interactions have been studied in detail in a multitude of natural and synthetic herbaceous plant communities, much less is known about the mechanisms of tree-tree interactions and their consequences in mature forests. Since more than a century, foresters have conducted growth trials investigating density effects on the vield of monospecific plantations (e.g. von Seebach 1845; Bohdanecký 1926; Assmann 1970; Plauborg 2004). These studies have greatly improved our understanding of the nature of intraspecific competition among woody plants and its dependence on stem density, canopy structural properties, and nutrient and water availability (Piutti and Cescatti 1997; Chen et al. 2003; Gouveia and Freitas 2008). Interspecific interactions in mixed tree plantations have also received considerable attention with a focus on

in P. DPI and T in 118 Re 111 sp 📍 📍 🥊 🥊 🥊 Available online at www.afs-journal.org **Review** article The influences of forest stand management on biotic and abiotic risks of damage Hervé JACTEL^{1#}, Bruce C, NICOLL², Manuela BRANCO³, José Ramon GONZALEZ-OLABARRIA^{4,5}, Wojciech GRODZKI6, Bo LÂNGSTRÖM7, Francisco MOREIRA8, Sigrid NETHERER9, Christophe ORAZIO^{1,10,11}, Dominique PIOU¹², Helena SANTOS³, Mart Jan SCHELHAAS¹³,

Growth stability of beech trees under drought stress

in mixed compared to monoculture patches

ent Kint*, Quentin Ponette**, Bart Muvs

¹ INRA, UMR 1202. BioSpersity, Genes and Communities, Laboratory of Foreir Datamology and Biodevaring's 3060 Cestus, France ² Foreir Research, Northern Research, Station, Rodin, Mallothau, Scottan, UK E125 957, UK ² Centro Leenday, Foreira La Quanton, Liveranda E Textica de Laborat, Fraydu da Aydau, Ja 194-01 7 Labora, Peringal ⁴ Centra Decodysis Foreira da Constanya, Pupita da Sensitira in Tayanda Aydau, Ja 194-01 7 Labora, Peringal ⁴ Centra Decodysis Foreira da Constanya, Pupita da Sensitira in Tayanda Aydau, Ja 194-01 7 Labora, Peringal ⁴ Perent Research, Stationa Regional Ottor, Carlo Marcha, Carlo Marcha, Barton Marcha, Carlo Marcha, Barton Marcha, Barton Marcha, Pelanda ⁴ Parte Research, Carlo Marcha, Barton Regional Data Aydau, Pelanda ¹ Parts Research directori Marcha, Texture Tayana, Parabata, Stochem ¹ Parts Research directori Texture Research, Parama Tayana, Parabata, Andrea Chene, Texture Marcha, Parama Parabata, Andrea Chene, Texture Marcha, Parama Parabata, Parabata, Barton Research, Parabata, Andrea Chene, Andrea Chene, Andrea Chene, Andrea Chene, Andrea Chene, Parama Tayana, Parabata, Andrea Chene, Texture Andrea, Andrea Chene, Andrea Ch ¹⁷ De Swedin University of Agricultural Sciences, Department of Ecology, PO, Den 7044, 750 07 Uppsida, Sweden 4² Centro de Ecologia Agricalos "Print East Active", Intuitiva Spraeto de Agronom, Universidad Versico de Librico, Tabola da Juda, 1540, 1740 ¹¹ Centre for Ecosystem Studier, Atterna Wageningen UR, PO, Box 47, 6700 AA Wageningen, The Netherlands ¹⁴ Albert-Ludwigs-University Freiburg, Institute for Forest Growth, Tennenbucher Str. 4, 79106 Freiburg, Gemany

(Received 1 December 2008; accepted 4 April 2009)

Abstract

 This article synthesizes and reviews the available information on the effects of forestry practices on the occurrence of biotic and abiotic hazards, as well as on stand susceptibility to these damaging agents, concentrating on mammal herbivores, pest insects, pathogenic fungi, wind and fire. agents, concentrating on manuma networke, per interces, partogenes traig, wina ann ine. - The management operations examined are at solection, its preparation, stand composition, re-generation method, clearing and weed control, thirming and pruning, and harvesting. For each of these operations we have examined how they influence the occurrence of kiolic damaging agents, the susceptibility of European forests, and describe the ecological processes that may explain agents, the susceptibility of European forests, and describe the ecological processes that may explain three influence Overall, we find that the silvicultural operations that have the largest influence on both biotic and abiotic risks to European forest stands are closely related to species composition and the structure of the overstorey. Four main processes that drive the causal relationships between stand management and susceptibility have been identified: effect on local microclimate, provision of fuel and resources to biotic and abiotic hazards, enhancement of biological control by natural enemies and changes in adividual tree physiology and development. . The review demonstrates an opportunity to develop silvicultural methods that achieve forest mangement objectives at the same time as minimising biotic and abiotic risks.

Résumé - Influences de la sylviculture sur le risque de dégâts biotiques et abiotiques dans les neunlements forestiers.

Cette revue bibliographique s'intéresse aux effets de la sylviculture sur la sensibilité des peuple ments forestiers aux principaux agents de dégâts bioliques et abiotiques que sont les mammifère

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RESEARCH ARTICLE

Tree Diversity Limits the Impact of an Invasive Forest Pest

Virginie Guyot^{1,4}*, Bastien Castagneyrol^{3,4}, Aude Vialatte^{1,2}, Marc Deconchat¹, Federico Selvi⁵, Filippo Bussotti⁵, Hervé Jactel^{3,4}

1 INRA, DYNAFOR, UMR 1201, 31326 Castanet Tolosan, France, 2. Université de Toulouse, INPT-ENSAT, DYNAFOR, UMR 1201, 31326 Castanet Tolosan, France, 3. Université de Bordsaux, BIOGECO, UMR 1202, 33405 Takinoc, France, 4. INRA, BIOGECO, UMR 1233610 Cestas, France, 5. Università di Firenze, DISPAA, Laboratori di Botanica, 50144 Florence, Italy • virginie guvot @egsat.fr

Abstract

The impact of invasive herbivore species may be lower in more diverse plant communitie due to mechanisms of associational resistance. According to the "resource concentration hypothesis" the amount and accessibility of host plants is reduced in diverse plant commu nities, thus limiting the exploitation of resources by consumers. In addition, the "natural enemy hypothesis* suggests that richer plant assemblages provide natural enemies with Citation: Guyot V, Castagneyrol B, Vialate A, Deconchat M, Selvi F, Bussotti F, et al. (2015) Tree Diversity Limits the Impact of an Invasive Forest Pe more complementary resources and habitats, thus promoting top down regulation of herbiores. We tested these two hypotheses by comparing crown damage by the invasive Asiar chestnut gall wasp (Dryocosmus kuriphilus) on chestnut trees (Castanea sativa) in pure and nixed stands in Italy. We estimated the defoliation on 70 chestnut trees in 15 mature stands sampled in the same region along a gradient of tree species richness ranging from one spe Editor: Andrew Hector, University of Oxford, UNITED cies (chestnut monocultures) to four species (mixtures of chestnut and three broadleave species). Chestnut defoliation was significantly lower in stands with higher tree diversity. Damage on individual chestnut trees decreased with increasing height of neighboring, het erospecific trees. These results suggest that conservation biological control method based on tree species mixtures might help to reduce the impact of the Asian chestnut gall.

Introduction

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Plant diversity effects on insect herbivores and their natural enemies: current thinking, recent findings, and future directions

ScienceDirect

Xoaquín Moreira¹, Luis Abdala-Roberts², Sergio Rasmann³, Bastien Castagneyrol^{4,5} and Kailen A Moonev⁶

A rich body of theory has been developed to predict the effects of plant diversity on communities at higher trophic levels and the mechanisms underpinning such effects. However, there are currently a number of key gaps in knowledge that have hindered

the development of a predictive framework of plant diversity effects on consumers. For instance, we still know very little about how the magnitude of plant trait variation (e.g. intraspecific vs. inter-specific), as well as the identity and combined effects of plant, herbivore and natural enemy traits, mediate plant diversity effects on consumers. Moreover, the fine-scale hanisms (e.g. changes in consumer behav recruitment responses) underlying such diversity effects in many cases remain elusive or have been overlooked. In addition, most studies of plant diversity effects on associated

consumers have been developed under a static, unidirectional ottom-up) framework of effects on herbivores and predators without taking into account the potential for dynamic feedbacks across trophic levels. Here we seek to address these key gaps in knowledge as well as to capitalize on recent advances and emerging frameworks in plant biodiversity research. In doing so, we provide new insights as well as recommendations which will stimulate new research and advance this field of study.

Addresses ¹Biological Mission of Galicia (MBG-CSIC), Apdo. 28,

Biological Mission of Galica (Miss-U-SN), Apdo. 28, 3060 Pontwelaw, Galical, Spain ²Department of Tropical Ecology, Autonomous University of Yucatan, Apartado Postal 4-16, Istiman, 2000 Merida, Yucatan, Mexico ³Institute of Biology, Laboratory of Functional Ecology, University of Neuchtel, Rue Emie-Argand 11, 2000 Neuchtel, Switzerland *NPA, BioSecco, UMP1202, 69 Route d'Arcachon, F-33610 Cestas,

⁶ Univ. Bordeaux, BIOGECO, UMR 1202, F-33615 Pessac, France ⁶ Department of Ecology and Evolutionary Biology, University of California, 92697 Irvine, CA, USA

Corresponding author: Moreira, Xoaquin (xmoreira1@gmail.com)

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The consequences of plant intra-specific and inter-spe-cific diversity on associated faunas have been the focus of much research over the last decade (e.g. [1**.2-8,9**] Studies have found that plant diversity positively influ ences arthropod diversity and abundance [3,4,8,10], and alters plant-arthropod and arthropod-arthropod interactions [3,7,11,12]. These findings emphasize that conserv ing and manipulating plant diversity in natural and managed systems, respectively, is crucial for maintaining ecosystem function [13-15]. A rich body of theory has been developed to predict the effects of plant diversity on communities at higher trophic levels ([16–22], see Box 1). Despite this vast collection of

theory behind plant diversity effects on associated faunas and the large number of empirical studies conducted thus far, formal evaluations of the mechanisms behind the observed patterns have been developed in natural com munities (but see [20] for e.g. in agricultural systems). In addition, there are also a number of key gaps in knowl edge that have hindered the development of a predictive framework of plant diversity effects on higher trophic levels (Figure 1). For example, we generally ignore how the magnitude of variation in plant traits (e.g. interspecific vs. intra-specific diversity) or the identity (includ ing independent and interactive effects of multiple traits) of plant traits determines such effects. Similarly, many studies have lacked an explicit evaluation of the influence of herbivore traits such as diet breadth, mobility and feeding behaviour, and the underlying mechanisms for diversity effects on consumer abundance or behaviour remain elusive (e.g. effects of diversity on consumers via increased plant growth vs. increased habitat heterogene ity). Finally, most empirical studies of plant diversity effects on associated faunas have been developed under a static, unidirectional (bottom-up) framework of effects on herbivores and predators, ignoring the intrinsic dynamism in the form of feedbacks between the bottom-up effects of plant diversity and top-down effects by con-

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Thanks for your attention!

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