



Forest health in a changing World

György Csóka

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Water in Forests

International Conference of KASZÓ-LIFE project
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FUN TIMES 30 May 2018

LIFE conference in Kaszó

The Canadians have entered the race to win a multibillion-pound project to build up to six nuclear reactors in Britain. The Times has learnt that SNC-Lavalin, Canada's largest engineering group, has teamed up with Japan's Hitachi to bid for the Horizon joint venture, which owns two vacant reactor sites in Anglesey and Gloucestershire.

E.ON and RWE, the German energy groups, pulled out of the venture in March after politicians in Berlin decided to scrap domestic nuclear power in the wake of last year's Fukushima nuclear disaster in Japan. Final bids were due in yesterday and within the next three weeks, according to industry sources.

Hitachi has put forward its advanced Boiling Water Reactor design, which SNC-Lavalin would build and operate on the two sites. However, it faces stiff competition from two Chinese state-backed companies: Toshiba Westinghouse, the Japan



Forestry

Latest News

A Geneva-based hedge fund manager has been fined £900,000 for manipulating the price of shares during the financial crisis (Alex Spence writes). Stefan Chaigne failed in an appeal yesterday to overturn a fine and ban by the Financial Services Authority. The Upper Tribunal found that he had committed serious market abuse in an effort to make his fund more attractive to investors.

The FSA tried to increase the fine to £1.25 million, but the tribunal said that Mr Chaigne's conduct was not "outrageous" and rejected the move. The tribunal banned Mr Chaigne from working in financial services in Britain. Patrick Seaton, a former broker at Cramer Fitzgerald, was fined £100,000 for executing trades for Mr Chaigne.

Thai beer on tap

Carlsberg has become the largest European brewer in the world, beating growth-based markets (Claire, Wales writes). Natural Corporation will launch a new line of beer, "The Natural", in 2018.

0,000
... could create

Everything is changing...



1987



1990



1995



2000



2005



2010



2015



2018

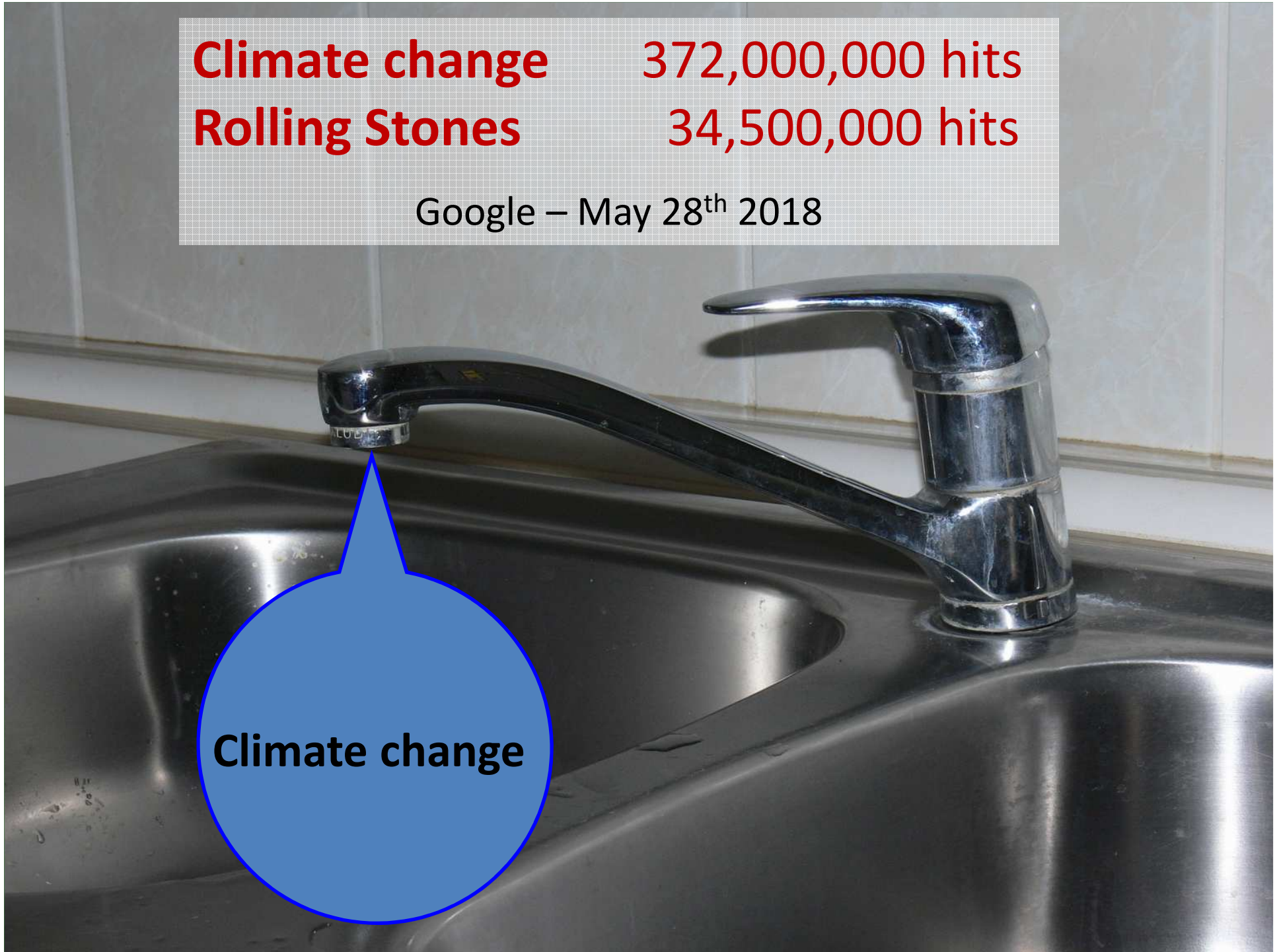
Long term changes in colour and density of my hair

Climate change
Rolling Stones

372,000,000 hits
34,500,000 hits

Google – May 28th 2018

Climate change



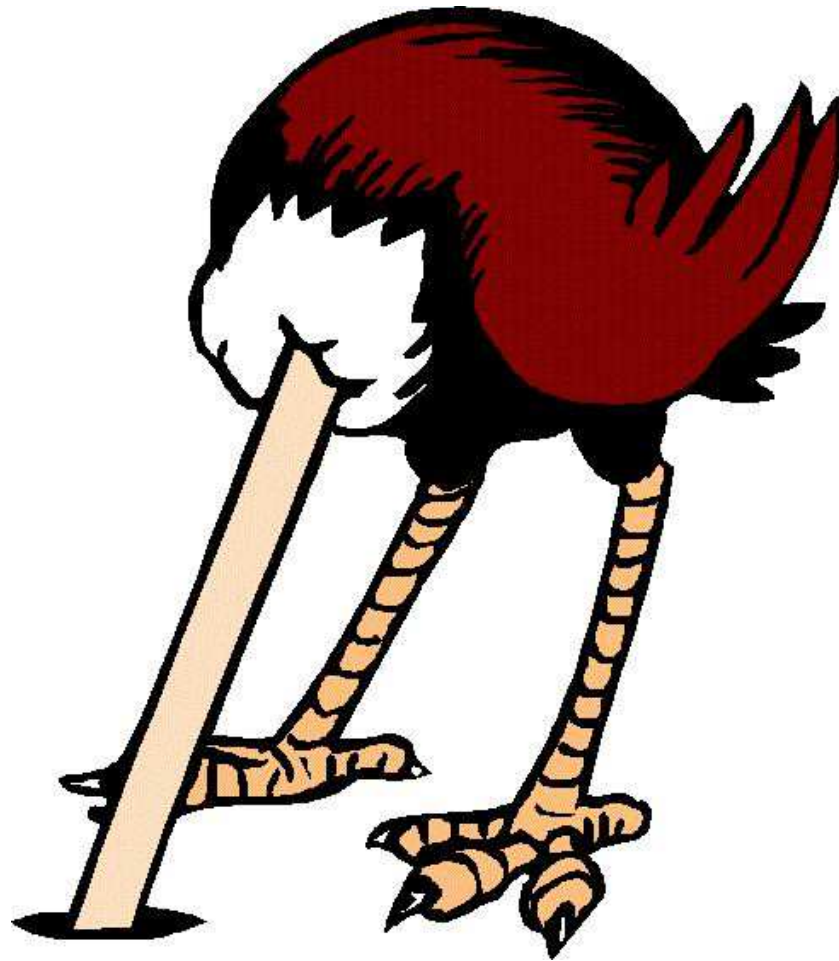
**“THE CONCEPT OF
GLOBAL WARMING
WAS CREATED BY
AND FOR THE CHINESE
IN ORDER TO MAKE
U.S. MANUFACTURING
NON-COMPETITIVE.”**

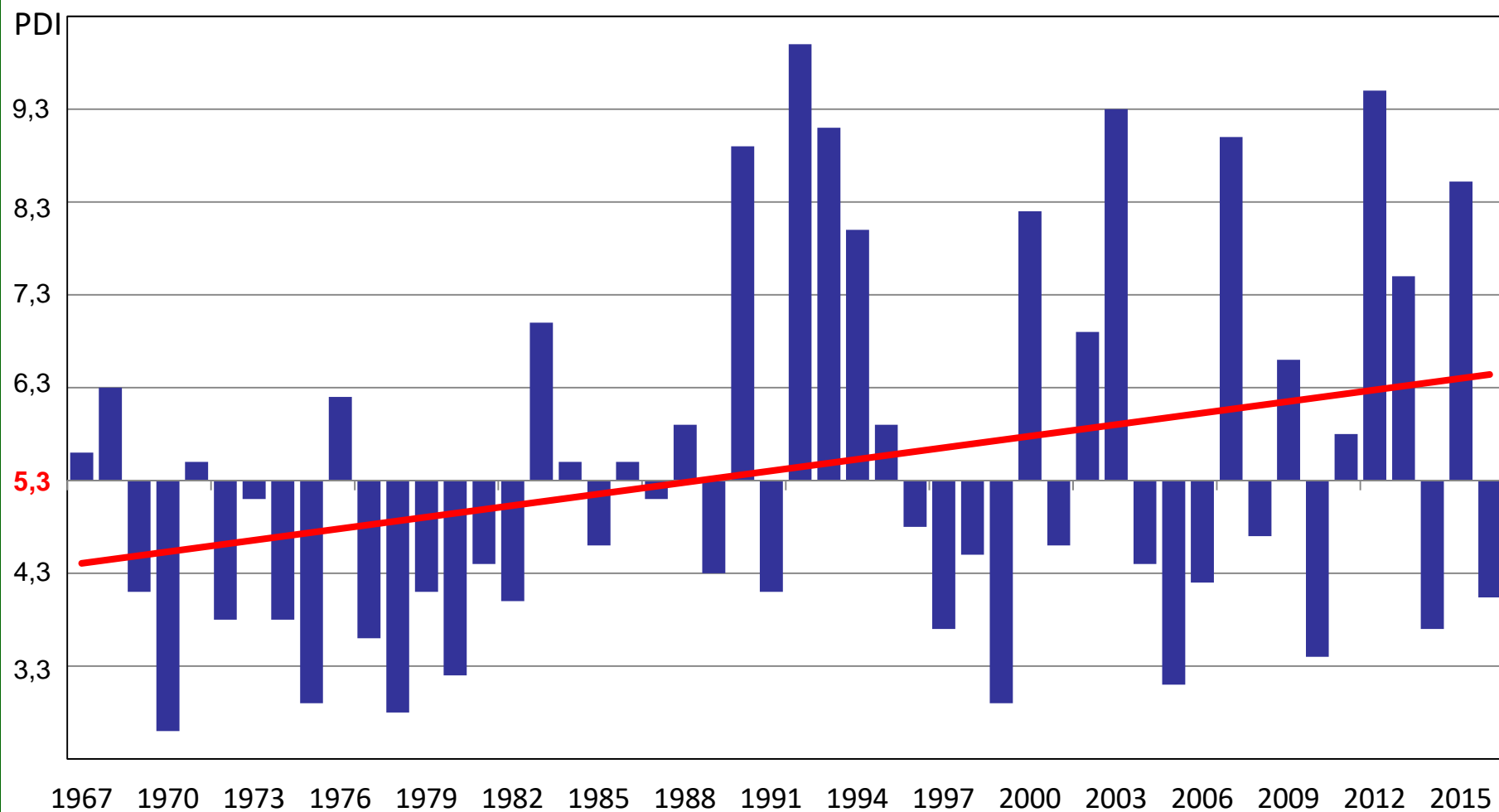
**“IT’S FREEZING
AND SNOWING IN
NEW YORK –
WE NEED GLOBAL
WARMING!”**

**“MY IQ IS
ONE OF THE HIGHEST-
AND YOU ALL KNOW IT!”**

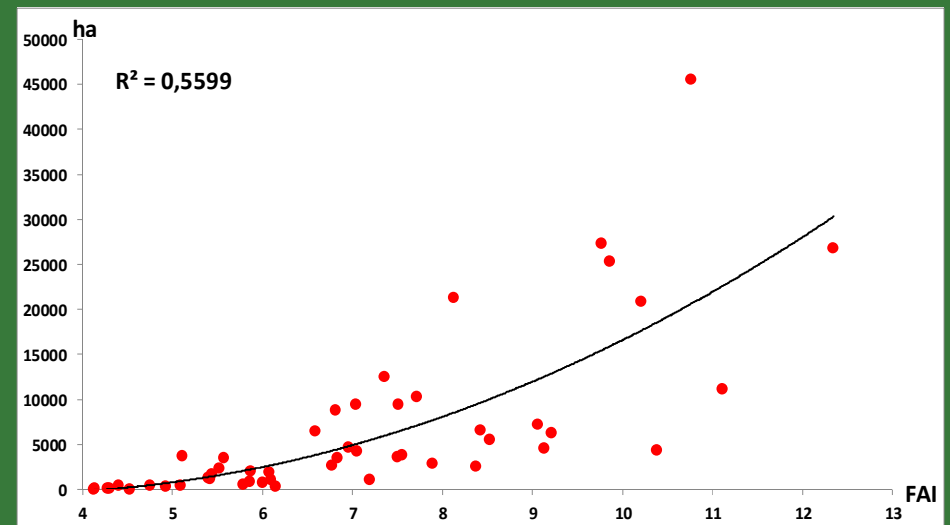
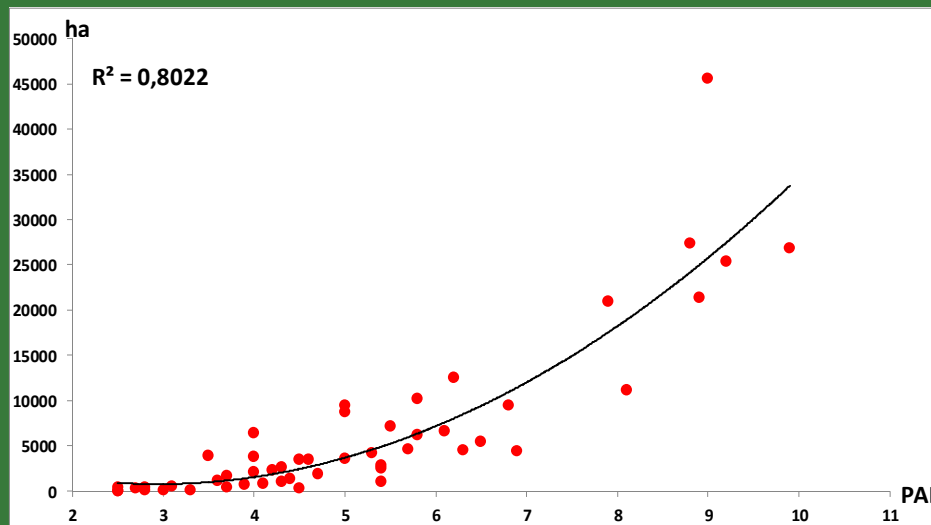
Quotations from US president Donald Trump

Is he right? Or is it ostrich policy?

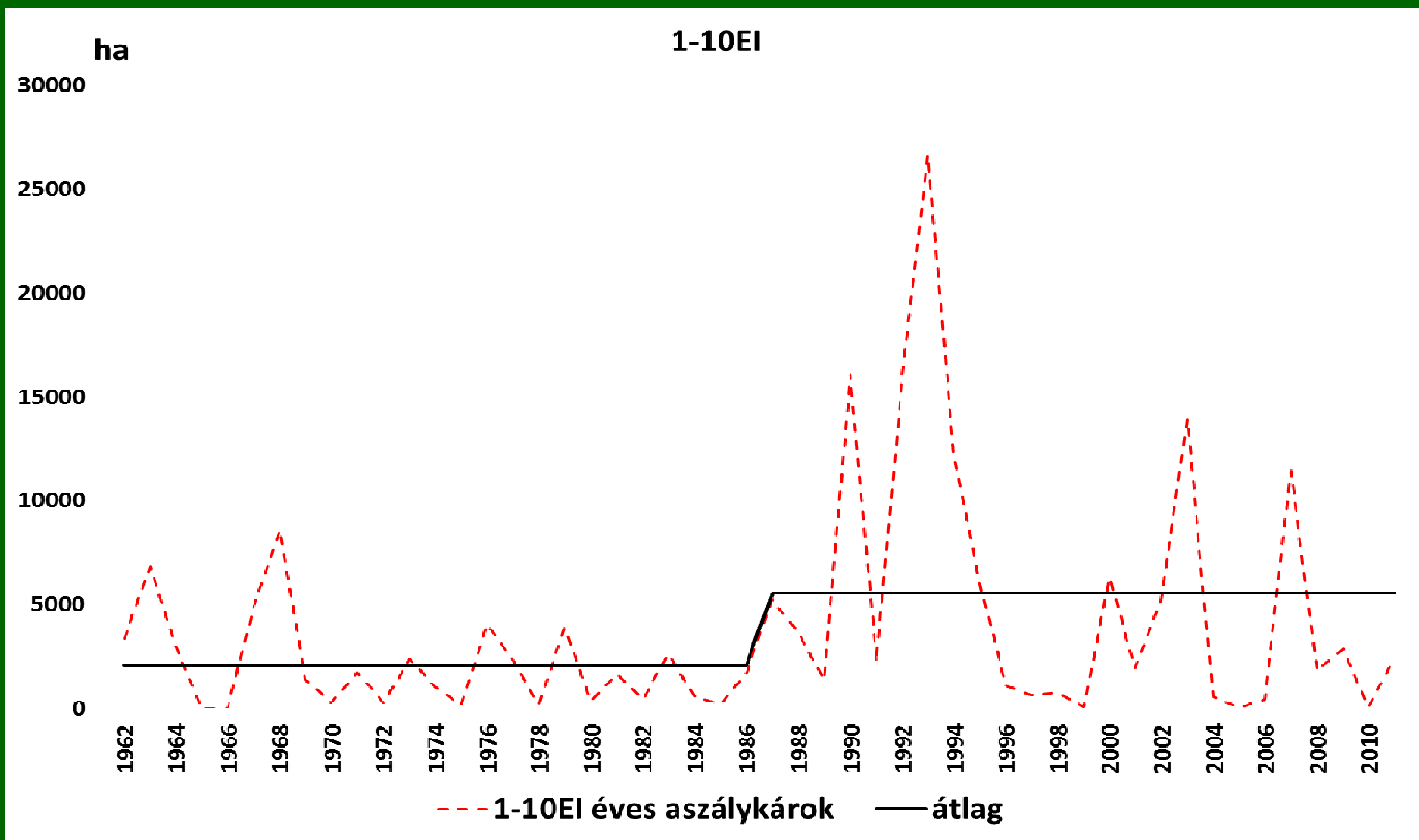




**Yearly deviations of the a Pálfi-Drought-Index from the 50 years
(1967-2016) average (5.3)**



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

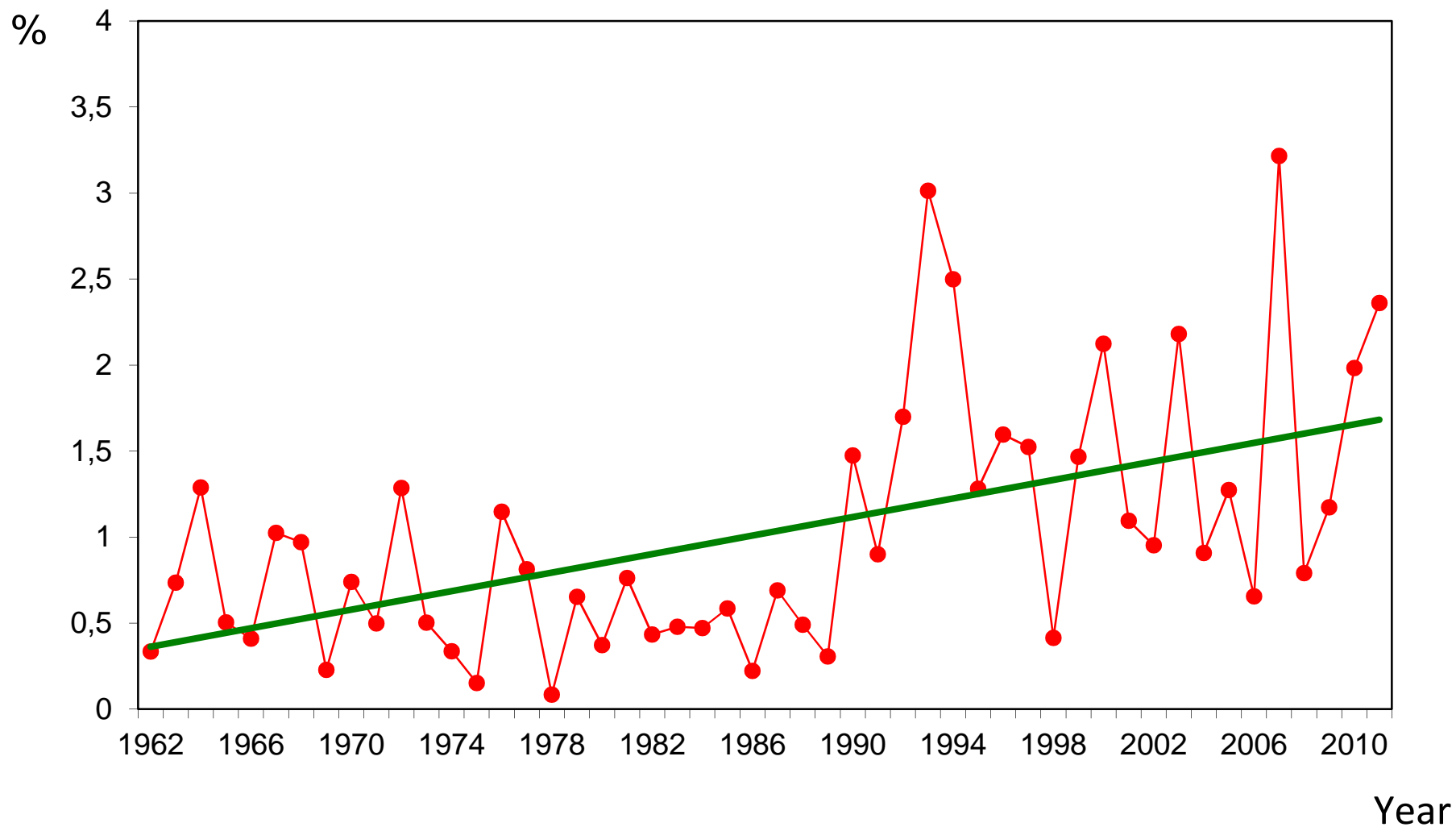


Breakpoint analysis of the yearly forest drought damage in Hungary

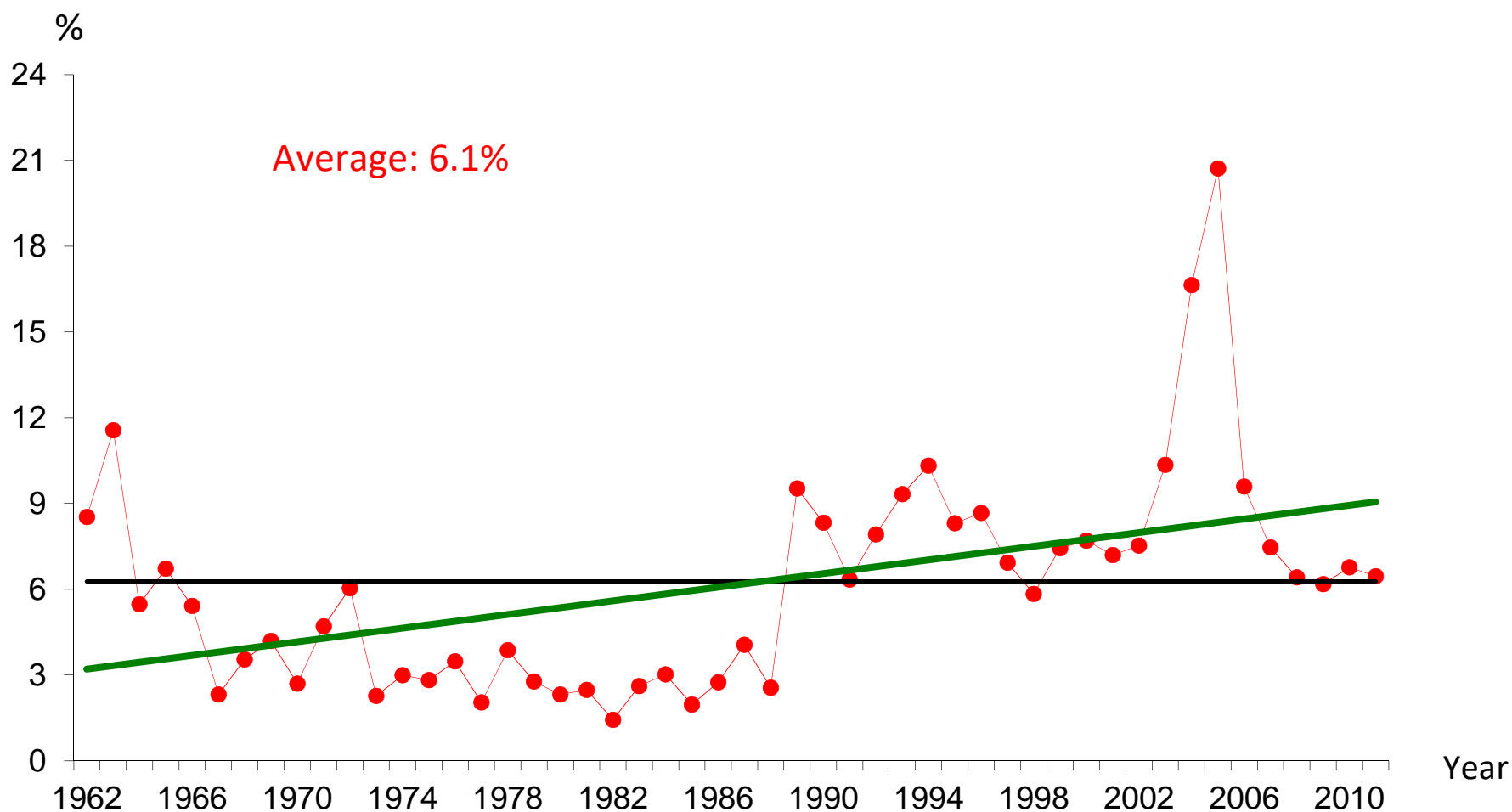


Early leaf abscission of beech in late July due to severe drought

(at ca. 650 meters above sea level)



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



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



Late April snow (2017) in the Börzsöny Mountains

(© László Nagy)

Extensive frost damage in the Mátra Mountains

(May 2017)



Hurricane in the Mátra Mountains

May 2017

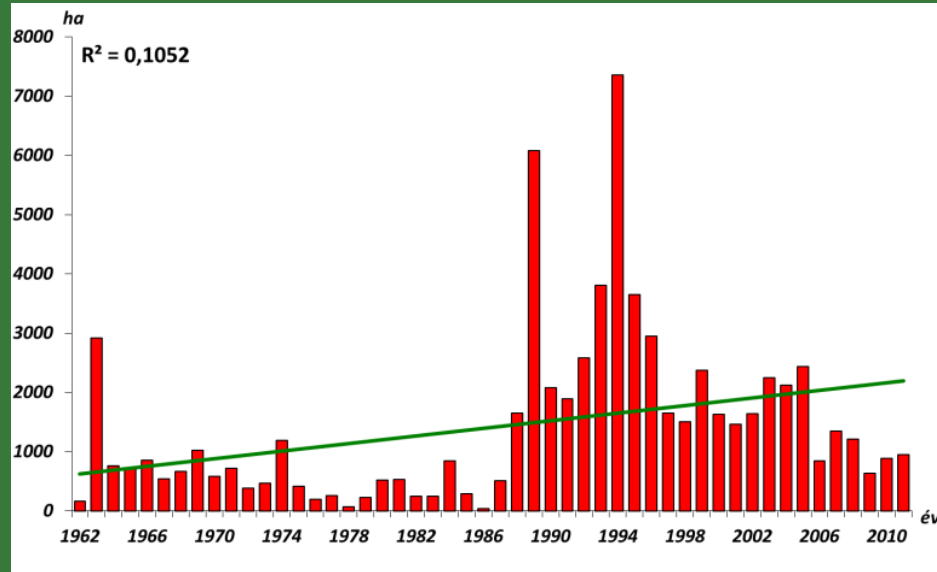


November 19th 2004. 150-170 km/hour windstorm affecting 12,000 hectares of forest in the Tatra Mountains damaging 2.5 million m³ timber. The pure and even-aged older spruce stands suffered the most severe damage.

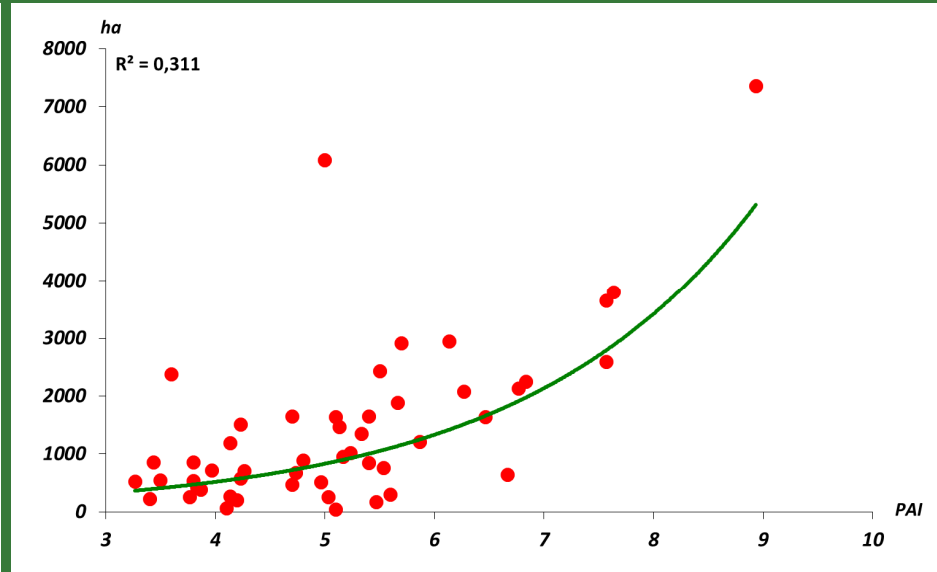


Foto: Milan Zubrik



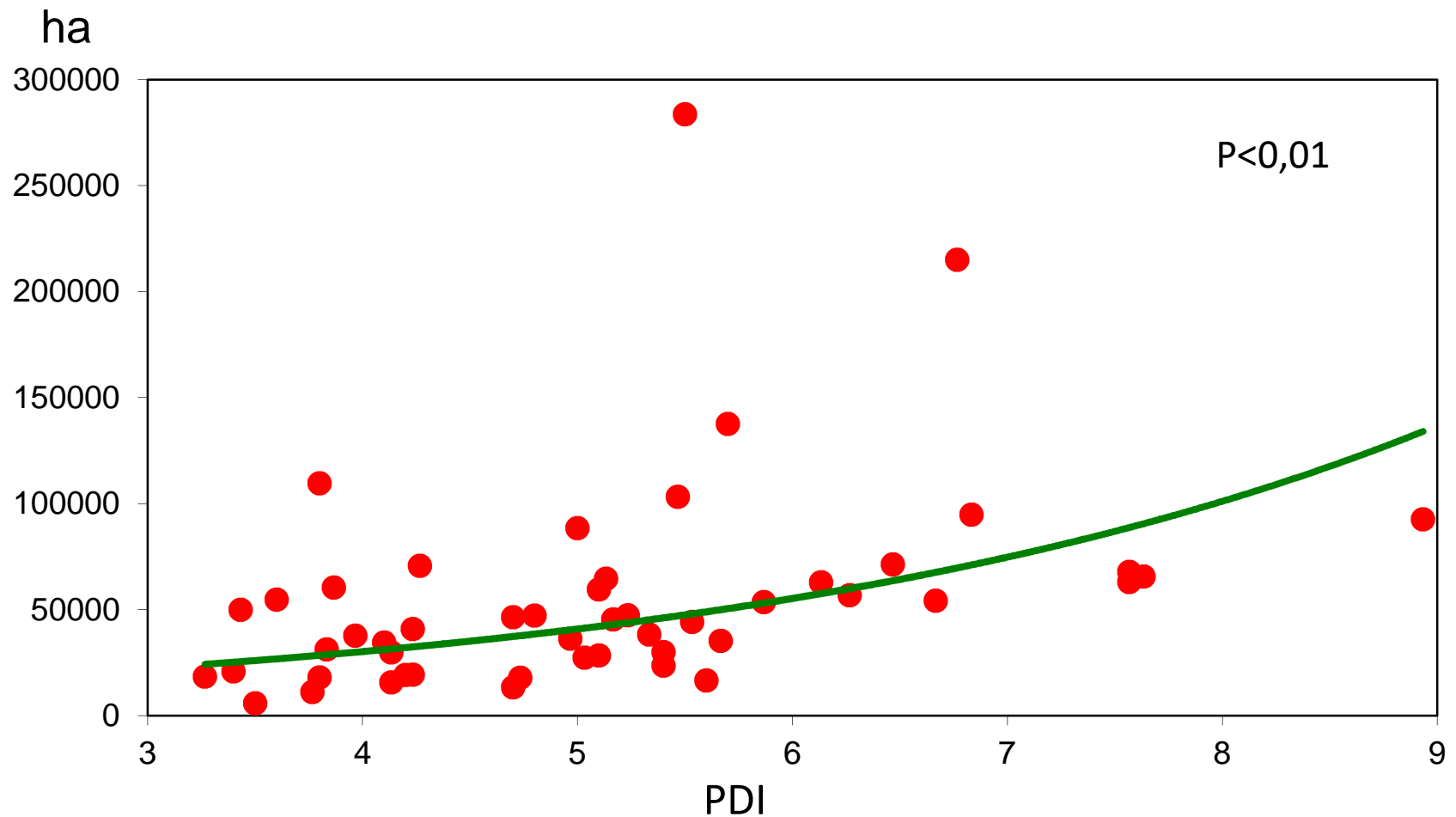


Yearly values and trend of the bark beetle damage

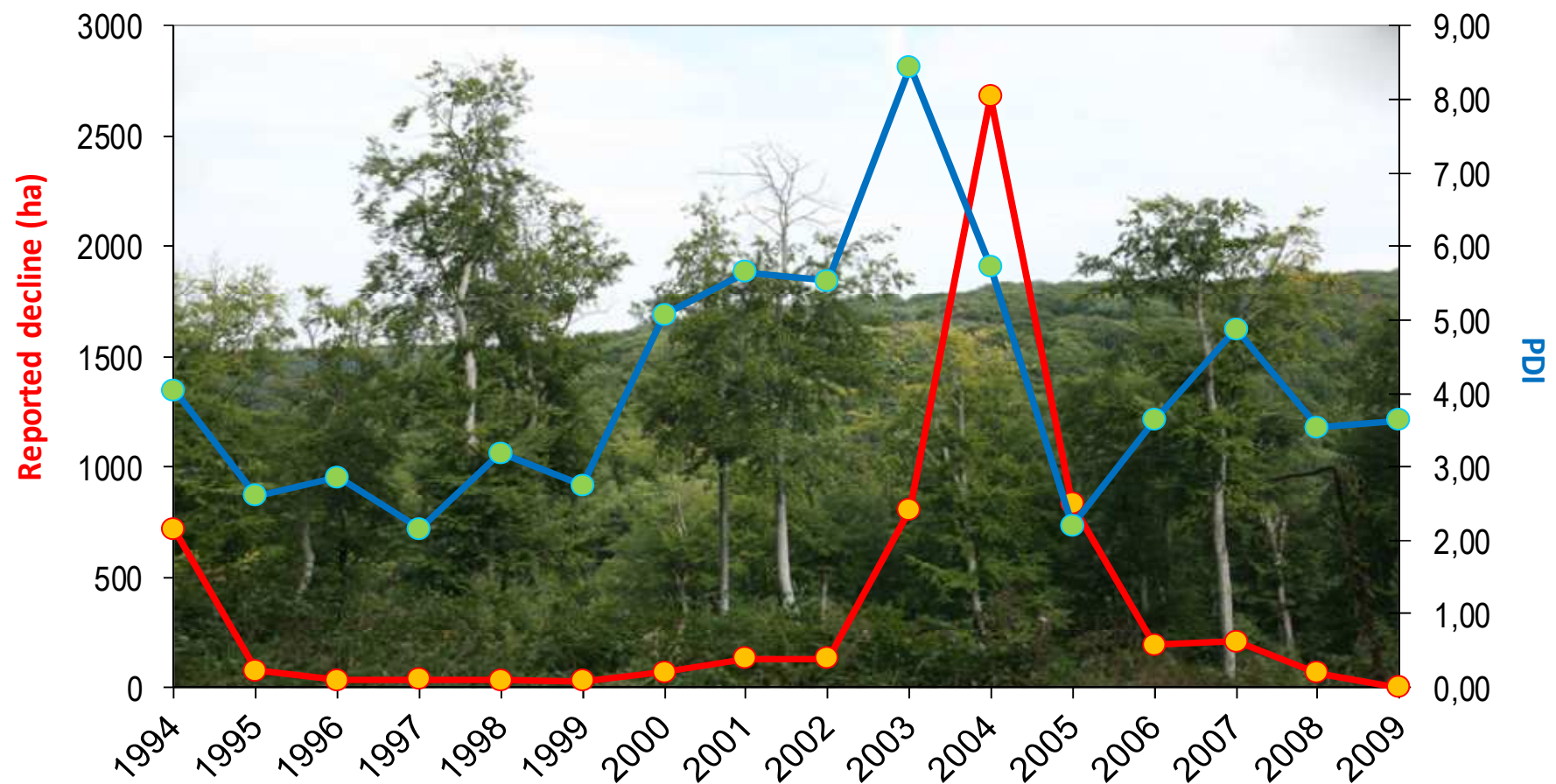


Yearly values of the Pálfaí-Drought-Index and the bark beetle damage between 1962 and 2011





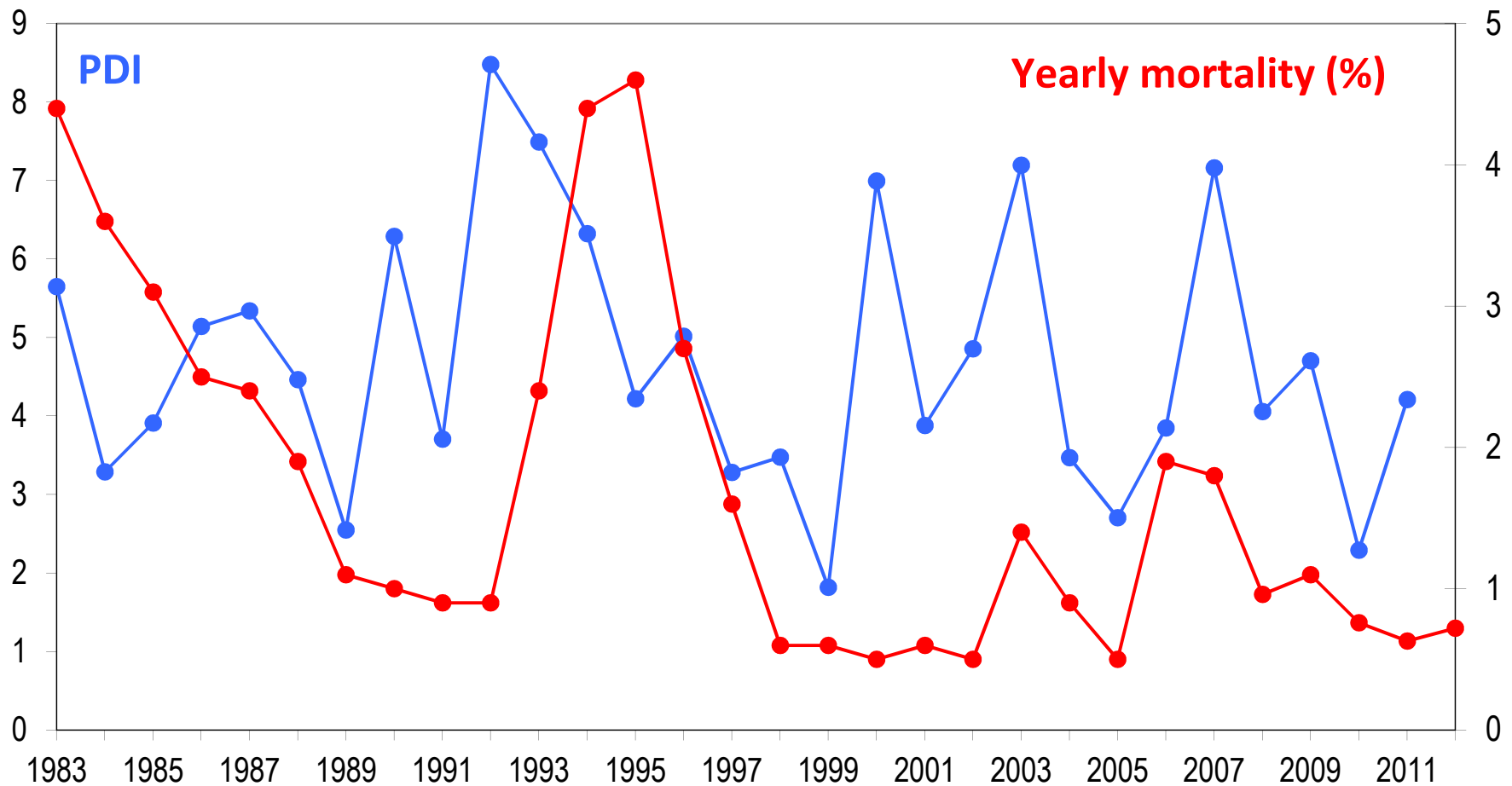
Yearly damage caused by forest insects and 3 years moving averages of Páljai Drought Index



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



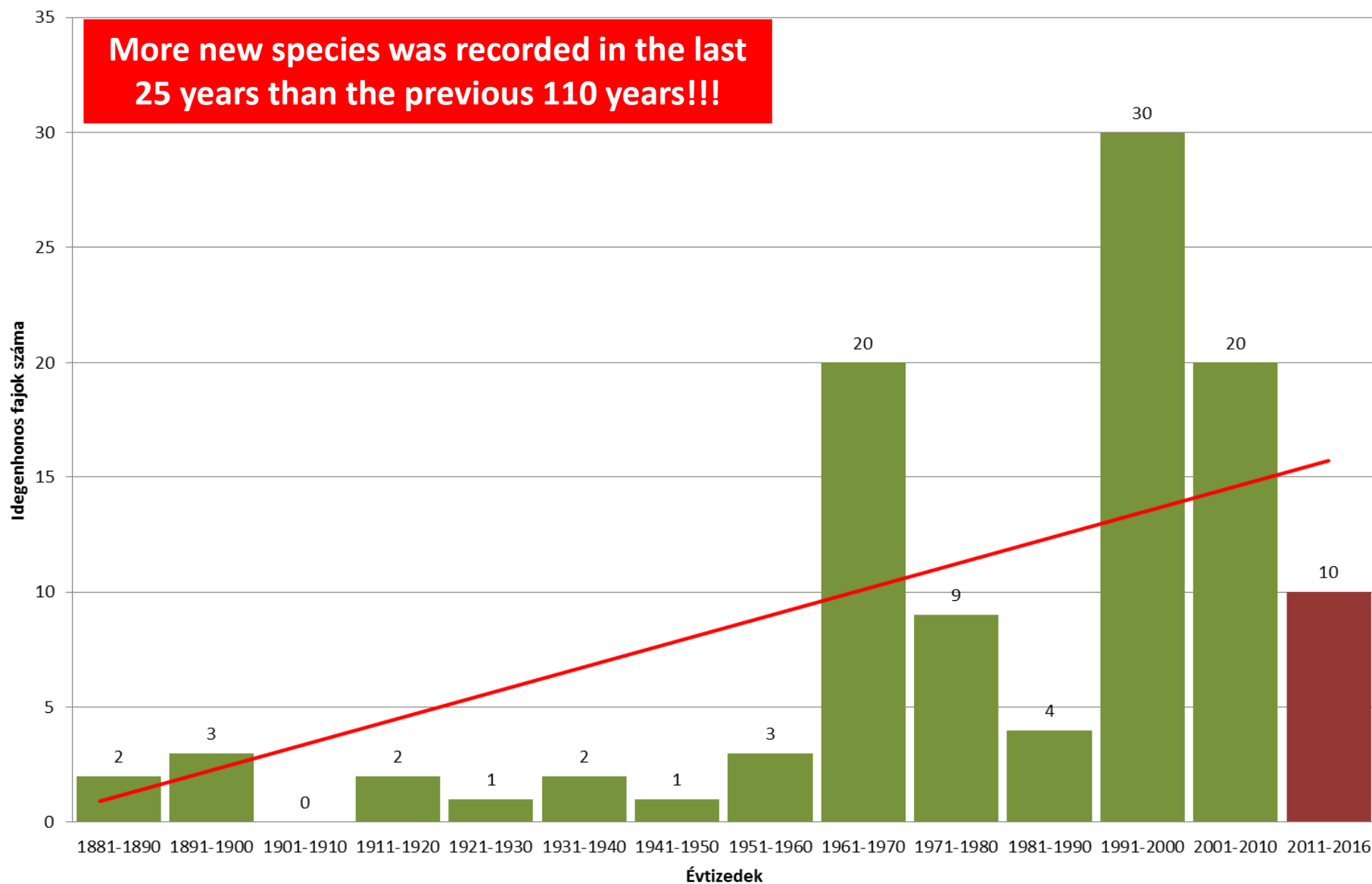
Beech splendour beetle (*Agrilus viridis*)



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

Mass mortality of pines caused by the endophytic fungus *Cenangium ferruginosum* after severe drought in the Mátra mountains





Non-native forest insects recorded by decades in Hungary since 1881



Tölgy csipkésposloska (*Corythucha arcuata*)

Known European country records







Emerald ash borer
(*Agrilus planipennis*)



June 6th 2006



June 15th 2009

Emerald ash borer (*Agrilus planipennis*) damage on an ash alley

Photo: Dan Herms (Ohio State University)



Hymenoscyphus pseudoalbidus + bark beetles

**No „magic pill” can be prescribed
for these problems!**

**Many „smart pills” should
be invented!**

**Forests should also be managed for
resistance/resilience**

**The natural ecosystem functions and
processes are becoming more and
more important!!!**



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

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Keywords: Beech, CART, *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-parametric statistical tests and by a series of CART (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=11%). 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 11%) than for windfall (MER decreased from 11% to 10%). Since management related stand variables (beech 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: CART – Classification and Regression Tree, MER – Misclassification Error Rate, GIS – Geographic Information System, DEM – Digital Elevation Model, RelAgeSpEn – Relative Age-specific Slenderness, f – amount of felled stock, totcut – total cut, plancut – 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 death of individual (or a few) canopy trees (Peterson 1996, Spelachna 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, Peterson 1996, Ulanova 2006, Spelachna et al. 2005, Nagel and Dieck 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, Bogg et al. 2003). Ice break and windthrow

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

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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 (Matthews 1993) 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, Warilow 1999, Mou & Warilow 2000, Rhoads et al. 2002, Millward & Kraft 2004), tree species (Lemon 1961, Melanson & Lechowicz 1997, Warilow 1999, Mou & Warilow 2000, Daguey 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, Bruge et al. 2003). In this paper we study the effects of two events of ice break 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 break.

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



A 2014. DECEMBERI JÉGKÁR OKAI ÉS KÖVETKEZMÉNYEI A PILISI PARKERDŐ ZRT. ÁLTAL KEZELT ERDŐÁLLOMÁNYOKRA

Csepányi Péter, Magassy Erik, Kontor Csilla, Szabó Csilla, Szentpéteri Sándor, Németh Rita, Némény Zoltán, Müller Szabolcs, Szabó Miklós, Kovács András, Szenthe Gábor, Limp Gábor, Ocsvai Zoltán, Brandhuber Ádám, Farkas Viktor és Petrik János

Pilisi Parkerdő Zrt.

Kivonat

Jelen tanulmány a 2014. december 1-3 között énos eső okozta jégkár okait és hatását vizsgálja a Pilisi Parkerdő Zrt. Visegrádi, Pilismaróti, Szentendrei és Pilisszentkereszti Erdészeti területein. A vizsgálat arra kereste a választ, hogy mely állományok károsodtak leginkább, és melyek azok a tényezők, amelyek a kár mértékét befolyásolhatják. Az elemzésekhez a kár mértékéről készült erdővizslet szövegi becsülés adatokat, valamint faegyed szintű saját mérései eredményeket használtuk fel. A vizsgálatok során kiderült, hogy jég, szél, hó okozta károkat okoztak a vegyeskorú, a vastag, idősebb fák jelenléte nagyobb mértékben járul hozzá az állományok jobb ellenállóképességéhez, mint az elegyesség. Az egykori állományok vizsgálata alapján megállapítható, hogy a faegyedek méretei kapcsolatban állnak a kár mértékével.

Kulcsszavak: jégkár, kár mérték, állományterkezet, elegyarány, korszerkezet, faegyed méretek.

REASONS AND CONSEQUENCES OF ICE DAMAGE OF THE FOREST STANDS AT THE PILIS PARK FORESTRY COMPANY

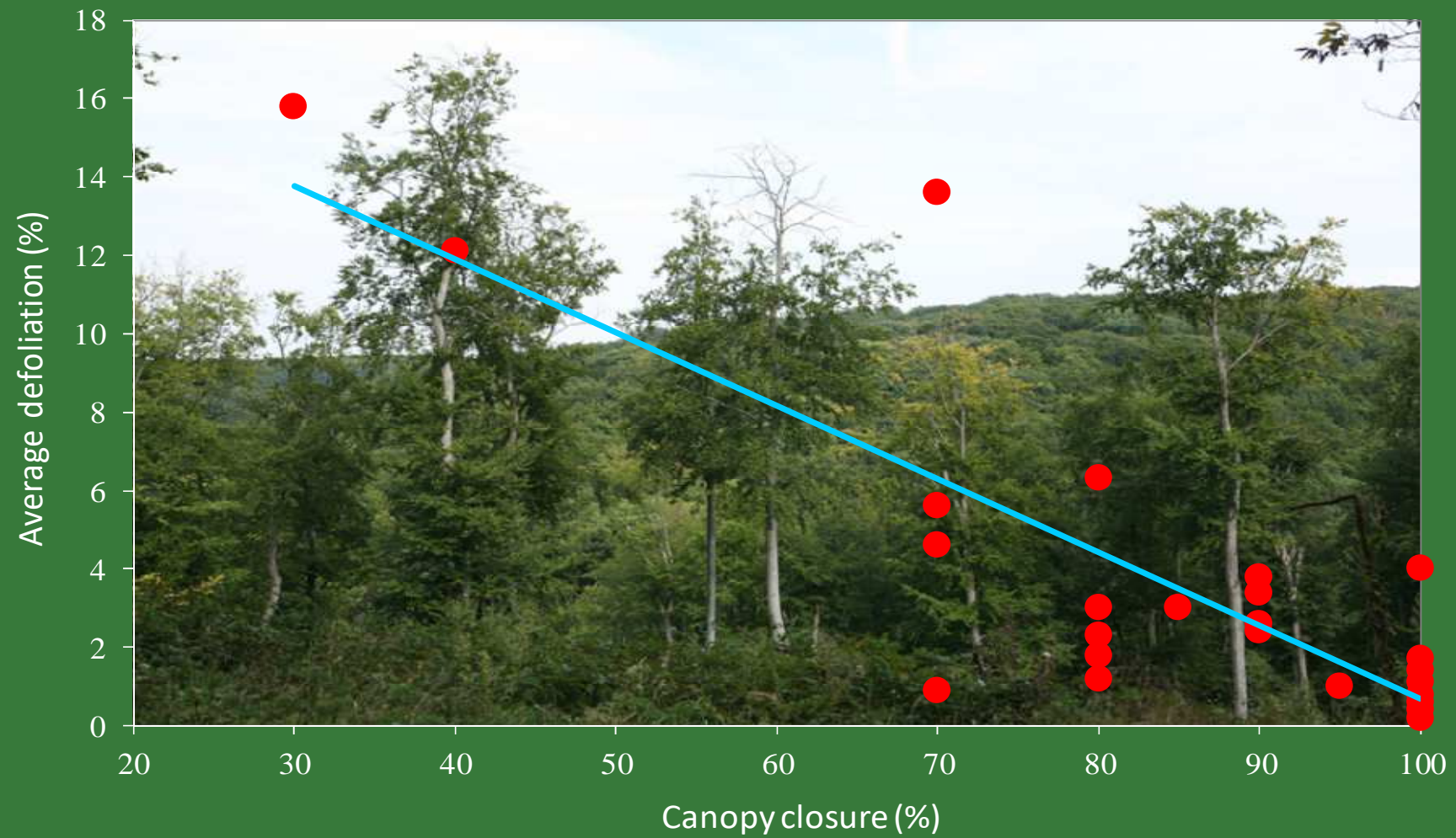
Abstract

This paper discusses the reasons and consequences of freezing rain of 1st - 3rd December 2014 on the territory of Szentendrei, Visegrád, Pilismaróti, Pilisszentkereszti Forestry Units of the Pilis Park Forestry Company. During the assessment the answer was looked for which stands are damaged most and which factors contributed principally to the size of the damage. For the analysis, the assessed data of the damaged forest subcompartments and the data of self-measured tree individuals were used. As a result it became clear that uneven-aged structure, containing the thick older trees contributed more to the resistance of the stands against ice, rime and snow damage than mixture ratio of tree species. In even-aged stands tree dimensions are in connection with the size of the damage.

Keywords: ice damage, damage rate, stand structure, mixture proportion, age structure, tree dimensions.

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Hungarian publications on stand structure characteristics and risk of abiotic damage



Canopy closure and health status of old beech stands

BIOLOGY LETTERS

rsbl.royalsocietypublishing.org



Oste this article: Guyot V, Castagneyrol B, Vialatte A, Deconchot M, Jactel H. 2016 Tree diversity reduces pest damage in mature forests across Europe. *Biol. Lett.* 12: 20151037. <http://dx.doi.org/10.1098/rsbl.2015.1037>

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Accepted: 4 April 2016

Subject Areas:
ecology

Keywords:
associational resistance, biodiversity,
ecosystem functioning

Community ecology

Tree diversity reduces pest damage in mature forests across Europe

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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 gradients 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 forests. This pattern of associational resistance was frequently observed across tree species and countries, irrespective of their climate. These findings confirm the greater potential of mixed forests to face future biotic disturbances in a changing world.

1. Introduction

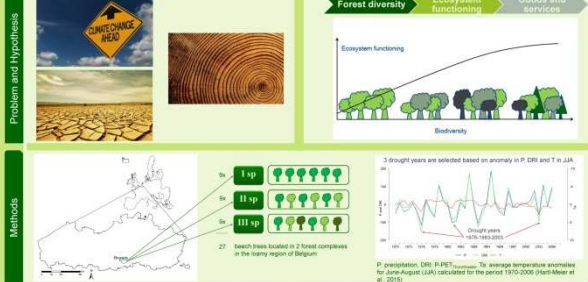
Biodiversity is widely acknowledged to support many forest ecosystem functions



Growth stability of beech trees under drought stress in mixed compared to monoculture patches

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¹Forest Ecology Research Unit, Ghent University, Coupure links 653, 9000 Ghent, Belgium
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Problem and hypothesis: Forest diversity 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 gradients 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 forests. This pattern of associational resistance was frequently observed across tree species and countries, irrespective of their climate. These findings confirm the greater potential of mixed forests to face future biotic disturbances in a changing world.

Methods: We used a network of 208 forest plots sampled along two orthogonal gradients 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 forests. This pattern of associational resistance was frequently observed across tree species and countries, irrespective of their climate. These findings confirm the greater potential of mixed forests to face future biotic disturbances in a changing world.

Keywords: associational resistance, biodiversity, ecosystem functioning

Trees (2014) 28:777–792
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

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© 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 environmental 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 allo-specific 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

for *Quercus* neighbourhoods. The growth-promoting effect was significant on clay-poorer soil, but not on clay-rich 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 · 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 yield of monospecific plantations (e.g. von Seebach 1915; Boldaković 1926; Assmann 1970; Plabonig 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 (Putti and Cesatti 1997; Chen et al. 2003; Gouveia and Freitas 2008). Specific interactions in mixed tree plantations have also received considerable attention with a focus on

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Plant Ecology and Ecosystem Research, Albrecht von Haller

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The influences of forest stand management on biotic and abiotic risks of damage

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Keywords:
silviculture /
stand /
occurrence /
susceptibility /
pest /
pathogen /
wind /
fire

Mots-clés:
sylviculture /
peuplement /
occurrence /
pest /
pathogen /
vent /
feu

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. The management operations examined are site selection, site preparation, stand composition, regeneration method, clearing and weed control, thinning and pruning, and harvesting. For each of these operations we have examined how they influence the occurrence of biotic and abiotic damaging agents, the susceptibility of European forests, and describe the ecological processes that may explain these influences. 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 canopy. 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 individual tree physiology and development. The review demonstrates an opportunity to develop silvicultural methods that achieve forest management objectives at the same time as minimizing biotic and abiotic risks.

Résumé – Influences de la sylviculture sur le risque de dégâts biotiques et abiotiques dans les peuplements forestiers. Cet article synthétise et résume les informations disponibles sur la sensibilité des peuplements forestiers aux principaux agents de dégâts biotiques et abiotiques que sont les mammifères herbivores, les insectes ravageurs, les champignons pathogènes, le vent et le feu.



RESEARCH ARTICLE

Tree Diversity Limits the Impact of an Invasive Forest Pest

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Abstract

The impact of invasive herbivorous species may be lower in more diverse plant communities due to mechanisms of associational resistance. According to the 'resource concentration hypothesis' the amount and accessibility of host plants is reduced in diverse plant communities, thus limiting the exploitation of resources by consumers. In addition, the 'natural enemy hypothesis' suggests that richer plant assemblages provide natural enemies with more complementary resources and habitats, thus promoting top-down regulation of herbivores. We tested these two hypotheses by comparing crown damage by the invasive Asian chestnut gall wasp (*Dryocosmus kuriphilus*) on chestnut trees (*Castanea sativa*) in pure and mixed 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 species (chestnut monocultures) to four species (mixtures of chestnut and three broadleaved species). Chestnut defoliation was significantly lower in stands with higher tree diversity. Damage on individual chestnut trees decreased with increasing height of neighboring, heterospecific 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.



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Current Opinion in
Insect Science

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

Xoaquin Moreira¹, Luis Abdala-Roberts², Sergio Rasmann³, Bastien Castagneyrol^{4,5} and Kailen A Mooney⁶

A rich body of theory has been developed to predict the effects of plant diversity on communities at higher trophic levels and the mechanisms underlying 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. intra-specific 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 mechanisms (e.g. changes in consumer behaviour or 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, undirectional (bottom-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.

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Publications on diversity and forest health



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Effects of forest heterogeneity on the efficiency of caterpillar control service provided by birds in temperate oak forests



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ABSTRACT

Controlling herbivore insects by insectivorous birds is a major ecosystem service, nevertheless little is known about how local habitat features and forest management influence the efficiency of this service and about how the pest control service birds provide can be maintained and improved. We conducted an experiment in temperate oak forests in the Mátra Mountains, northern Hungary to measure bird predation rate of artificial caterpillars resembling winter moth (*Operophtera brumata* L.) larvae, to evaluate the relationships among insectivorous bird communities, caterpillar populations and leaf damage caused by caterpillars and to assess the effect of forest heterogeneity on these processes. We found, that structurally heterogeneous forests maintained a significantly higher abundance of insectivorous birds. Especially the tree size heterogeneity increased bird abundance. The rate of bird predation was positively related to the abundance of insectivorous birds as well as to caterpillar abundance, which indicates that birds were able to respond to caterpillar density. We were not able to demonstrate a direct negative effect of bird predation on caterpillar abundance and a positive effect of caterpillar abundance on leaf damage. Structurally heterogeneous forests, however, suffered from less leaf damage than did homogeneous for-

More details (just to mention a few):

Wiser and higher resolution soil site/tree species choice

Increasing intraspecific diversity

- Natural regeneration is better than artificial
- „Climate matching/assisted migrations”

Increasing interspecific diversity

- Mixed stands instead of monocultures
- Supporting earlier neglected native tree and shrub species, even the presecuted „weed trees”

Increasing the structural diversity

- Small scale cutting areas
- Increasing size and age diversity
- Leaving dead wood in the foress

Alternative forest management systems

Water retention where possible

Proactive (preventive) instead of reactive forest protection



Water retention in the vicinity of Gyula



Water in Forests

A brief summary

- Almost all damage types show an increasing trend in the last 50 years in Hungary, even in percentage of the actual forested area.
- Health status of our forests strongly depends on the weather conditions, but the forest management practices also have major effect on it.
- The climate change scenarios (more frequent and more severe droughts, and extreme meteorological events) therefore predict even further negative trends in forest health.
- The „story” is not restricted to Hungary. Similar problems and trends are known worldwide.

Making our forests more resistant/resilient is extremely important and unavoidable!

**We need mor knowledge,
we need more research!**



Thanks for your attention!



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