

## Is it possible and necessary to control European spruce bark beetle *Ips typographus* (L.) outbreak in the Białowieża Forest?

Jacek Hilszczański<sup>1\*</sup>, Jerzy R. Starzyk<sup>2</sup>

<sup>1</sup>Forest Research Institute, Sękocin Stary, ul. Braci Leśnej 3, 05–090 Raszyn, Poland; <sup>2</sup>University of Agriculture in Kraków, Faculty of Forestry, Institute of Forest Ecosystem Protection, Department of Forest Protection, Entomology and Forest Climatology (Phytoclimatic Research Station in Krynica), Al. 29 Listopada 46, 31–425 Kraków, Poland

\*Tel. +48 22 7150603, e-mail: [J.Hilszczanski@ibles.waw.pl](mailto:J.Hilszczanski@ibles.waw.pl)

**Abstract.** In response to the information published in ‘*Forest Research Papers*’ (vol. 77(4), 2016), regarding the problem of the European spruce bark beetle *Ips typographus* (L.) in the Białowieża Forest, we present our viewpoint on this issue. The role of the European spruce bark beetle in the Białowieża Forest is discussed based on the experience gained in Europe’s forests. We present the effects of *I. typographus* outbreaks on forest biodiversity as well as outbreak mitigation in the context of the processes taking place in semi-natural forests.

**Keywords:** forest protection, nature conservation, sanitation cutting, biodiversity

In the anticipant release of the ‘*Forestry Research Papers*’ (vol. 77(4), 2016), a review article entitled ‘Managing bark beetle outbreak (*Ips typographus*, *Dendroctonus* spp.) in the conservation areas in the 21<sup>st</sup> century’ by Dominik Kulakowski. As some of the information and statements regarding the outbreak of the bark beetles were false, it has been considered to evaluate it and to provide the appropriate interpretation using published data as well as personal research.

Author states that the article has been written and analysed in accordance with the selected publications indexed by ISI (International Scientific Indexing), alas the list of the cited literature is very limited and it does not contain the most accurate publications when it comes to the issues of biology, ecology and the population dynamics of the *I. typographus* in Europe. Therefore, the reader may feel that the choice of the cited publications was not objective. As the species of the bark beetles belongs to one of the most researched and the best-known species of the Forest insects, the number of the publications in this field is overwhelming and encompasses both comprehensive review and monographic papers (e.g. Zumr 1985,1995; Wermelnger 2004; Skuhravy 2002; Lieutier et al 2004; Grodzki 2013; Fettig and Hilszczański 2015). Hence, it is deemed, when discuss-

ing the issue of the bark beetles outbreak in Europe, to focus and rely on the immense knowledge regarding the bark beetle species, which is, without any doubt, one, if not, of the most essential biotic factor responsible for the rapid decay of the spruce trees and tree stands. The conditions, process and especially the special size of the *I. typographus* species outbreak in Europe and the outbreak of the bark beetle *Dendroctonus* sp. in America are beyond comparable; therefore, attempts to explain the outbreak processes in Europe basing on the American researches are very dubious at best.

Title of the mentioned study in both Polish (‘Kontrolowanie gradacji korników...’) and English (‘Managing bark beetle outbreaks...’) confuses the reader as the study is directly why and how to control bark beetles. ‘Management’ in this context has a different meaning and has very little to do with the Polish word ‘Kontrolowanie’ which is more about monitoring than excising of the oversized bark beetle populations. Moreover, in English, the term ‘management’ is much more than just control. It is an array of activities and actions that aims to limit the development of insects and thus focuses on the reduction of its effects.

Author of the article cites inter alia publication of Ministry of Environment from 2016 on the signing of the project

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‘Białowieża Primeval Forests as the UNESCO cultural and natural heritage’, writing that: ‘Outbreak become the reason of the common unrest about the health status of the Forests and that’s why it is more often implied to remove the trees in tree stands inflicted by the outbreak or deemed susceptible to such threats’, even though there are no references to the clearance of either trees or tree stands whatsoever. It is also worth mentioning that the goal of sanitary cuttings of the trees infested by the bark beetle is to remove the trees that are a hatchery for the bark beetle and cutting them prevents the next generation of beetles. It is a method that has been developed for a long time (Kolk, Grodzki 2013).

Amongst some adherents of the passive protection of the Primeval Forest, you can find opinions that the outbreak of the bark beetle is caused by the forest management in the given area. Suggestion of the anthropogenic sources that have impact on the scale of the bark beetle outbreak in the Primeval Forest has no scientific explanation. Outbreaks in both artificial monocultures as well as natural forest exist with the same intensity and are even more stronger in the natural forest of North America (Aukema et al. 2006). Other example given by Kulakowski (2016), which has no scientific explanation, is an opinion that removing the trees infested by the bark beetle was not effective especially in the areas encompassed by the active protection (Fahse, Heurich 2011). Forestry exercise and science shows unequivocally that limitation of the unfavourable natural and economic results of outbreak when it comes to huge areas in strongly fragmented European Forests is justifiable and accurate with the right amount of time for the particular activities and possession of adequate resources (Fettig, Hilszczański 2015; Stadelmann et al. 2013). One of the common methods regarding forest monitoring and limitation of the excessive population of the bark beetle during its outbreak is the usage of the artificial pheromone traps (Starzyk 1996, Grodzki 2007) apart from removal of the infested spruce trees (removal of the deadwood). They are also used in the economic forests that are a part of the Introductory Forest Compound ‘Primeval Forest of Białowieża’ (forest district of Browsk and Hajnówka); unfortunately the author did not include in his article.

Some researchers contest the meaning for reduction of the population of bark beetle, admitting that: surveillance of the vast outbreaks is possible in theory but it would require treating each and every infected tree (Hughes, Drever 2001), which would lead to more trees being cut from the very same outbreak (Tempereli et al. 2014). Practically every infested tree is removed which does not imply that the higher number of trees is removed than it is needed as the cutting is unitary and apply only for the trees which have beetles developing under the bark (Stadelmann et al. 2013). It is also admitted by Kulakowski (2016) who by citing Wermelinger (2012) claims

that the tree clearance is effective if it is conducted before the beetles hatch. Therefore, it is redundant to ‘smile in sympathy’ (Szwagrzyk 2016) but rather precisely exercise the protective treatments accordingly to the forestry art even when it is ‘difficult’. Their effectiveness is based on the accuracy and, above all, time keeping. Removal of the trees that had been already a hatchery to the beetles is obsolete in terms of the expected treatment result. Bark beetle does not only attack and kill the trees but also weakens them as Kulakowski writes (2016). Thus there is no possibility to mend the conditions of inhabitation for many other competitive saproxylic organisms (Raffa et al. 1998) because saproxylic organisms, which benefit from its infestation, do not compete with the bark beetle – it is rather a microsuccession of saproxylobionts on the trees killed by the bark beetle. Debarking (Thorn et al. 2016) cannot be considered as an alternative for the tree clearance because no one debarks the standing trees – they have to be cut first in order to remove the bark. What happens later with the wood of the debarked trees is redundant in terms of constraining the population of the bark beetle. Concerns on the excessive hampering of the saproxylobiont populations are in this context unreasonable as the trees will be left in forest after they have been debarked. Though, it is necessary to maintain certain balance between the needs of active protection and the demand of leaving deadwood or fragments of deadwood in forests (Kausrud et al. 2012).

Matter of leaving deadwood in the forest is vital from the point of view of biodiversity protection in the Białowieża Primeval Forest. Even a dozen or so years ago, it was commonly believed that remaining as much ‘deadwood’ as possible in the forest (to be more precise deadwood and its fragments) would solve the issues of protection of the saproxylic organisms. Today, the majority of the ecologists who examine the meaning of the deadwood know well that much more important than the parenchyma left in the woods is its quality measured by the temperature resulting from intensity of sunlight, humidity and, lastly, its location and the species (Gossner et al. 2013). A very essential variable for healthy preservation of saproxylic organism’s populations lies in the continuity of distribution of the deadwood in the forest areas with its appropriate quality (Sverdrup-Thygeson et al. 2014). Therefore, a broad outbreak of bark beetle that occurs on the big but limited territory because of the deadwood availability leads only to further increase of the deadwood, which might disturb the continuity of availability of such trees in the future (Werner et al. 2006).

Whilst the presence of hives of the bark beetles impacts the diversity of the tree stand and creates better development conditions for many organisms, the broad outbreaks of bark beetle we are witnessing in the Primeval Forests of Białowieża may lead to negative results in the longer time period

because of the drastic changes in the environment. From 2012 to 2016, more than 1 million cubic metre of the spruce deadwood has been recorded in the area of the Forest districts of Browsk, Białowieża and Hajnówka, which was led to by the activity of the bark beetle. Decline in old Spruce trees is also particularly dangerous for the species involved with such trees as well as for the bioindicator species susceptible to the environmental changes. To such species belongs inter alia a beetle *Pytho kolwensis* present in the annexes of the ‘Habitat Directive’ which develops and hides in thick, down spruces trees but its population continuity is seriously threatened because of the bark beetle outbreaks. Additionally, surplus of the spruce deadwood does not favour the preservation or increase of the biodiversity. Such trees are not preferred by the insect species seen as indicatory for the good conservation of the deadwood environment such as *Cucujus cinnaberinus* (Scop.), *C. haematodes* Er. or *Boros schneideri* (Panz.). It has been proved, thanks to the results of the environmental inventory conducted by the Forest Research Institute on for General Directory of State Forests in the Primeval Forest of Białowieża; these species prefer the deadwood of trees in following order: aspen, alder and pine tree (Hilszczański, unpubl.). It is considerable to keep in mind the process of compensation of the local scarcity of deadwood because of the increase in temperature caused by the climate changes, which enhance its value as a substrate and habitat, and should be accounted into the overall balance of the deadwood (Muller et al. 2015).

Every protected area must have precisely defined aims of protection and their accomplishment should be assured by the subordinate protection methods. Resolution on putting certain area into protection zone and under specific protection rules should be based on root analysis for conducting given protection form basing on adequate criteria. It is reasonable to apply the strict protection rules with simultaneous approval of any consequences resulting from such decision including the complete decay of tree stands infested by the bark beetle outbreak if the goal of protection is to track the dynamics of the natural ecosystem development. On the other hand, if the aim of protection is to keep particular merits such as preservation of old spruce stands or spruces and anything else connected to this species, it is expected to provide an active form of protection (Michalski et al. 2004) that will lower the number of the infested tree stands and lead to the steady formation of both structure and species composition for the future forest generation (Grodzki et al. 2013).

We do not propose to introduce the proactive treatment of forests from the activity of bark beetle in areas that by virtue of the ruling law are excluded from such protection. Therefore, any clearance of tree stands is unthinkable in the preserved areas (Grodzki 2016) as it is suggest by (Kulakowski 2016). There are still broad forest areas in Białowieża Primeval Forest,

which are infested by the bark beetle outbreak and, at the same time, are not tended to (at least officially) to any restrictions in this aspect. A proactive treatment should be reintroduced into those areas (not tree stand clearance) according to the rules of the forest protection management. Unfortunately, there are many forms of nature protection in Primeval Forest that make rational and integral decision establishment impossible.

Classification of the Białowieża Primeval Forest to the natural heritage of UNESCO has been accomplished without thorough analysis of the consequences of such decision. According to the UNESCO’s protocol – criterion IX, ‘Protection of natural processes’ – any treatment is forbidden to be conducted within the most of the Primeval Forest including proactive protection of both species and habitats. The first step in introducing certain area into the protective zone where natural processes would be observed is to ask a question: What would be the minimal area for such zone? This kind of analysis has not been conducted. The minimal area of the facility that protects the natural processes should constantly provide an internal recolonisation sources for the population of every natural elements existing in the given area. Such space should guarantee the functionality for the factors that shape the environment (disturbances) in both space and time line, providing development conditions for habitats and species (Leroux et al. 2007). For instance, in the boreal zone of Canada, the minimal area that is not prone to any risk of the biodiversity loss and where you can observe and protect natural processes is about 2 million hectares. Such opinion has been stated by the experts of the IUCN who evaluated ‘Pimachiowin Aki’ reserve of around 3.3 million hectares included to the UNESCO programme based on the criterion IX in Istanbul (IUCN World Heritage Evaluations 2016). Climate zone of the Primeval Forest of Białowieża suggests that the minimal area should also be any less than 2 million hectares. Whole area – even with the Belarus part of the Primeval Forest (around 160,000 ha) – is definitely not enough to fulfil the requirements in the protocol regarding protection measures without the risk of losing biodiversity. Space severity of the Białowieża Primeval Forest in context to the natural processes protection can be observed through the decline of the species and slow disappearance of habitats. It is especially vivid in case of tree stands that are characterised by the big amount of light such as open pine or xerothermic oak tree stands. Regression of insect species, such as *Cerambyx cerdo* L., *Lucanus cervus* (L.) and *Euphydryas aurinia* (Rott.), as well as plants, such as *Pulsatilla patens* (L.) Mill. or *Cypripedium calceolus* L., characteristic for these forests stands in Białowieża Primeval Forest is so far the most extraordinary. These kinds of processes of disappearance and renewal had probably occurred very often in the past. Today, unlike in the past, the renewal process is usually impossible especially in

the areas under strict protection favourable for natural succession with strong fragmentation loss of continuity and lack of essential disturbances, for example, fires. In this particular situation the only solution for survival for many species and habitats in Europe is to reintroduce the active conservation methods (Bernes et al. 2015; Sebek et al. 2015).

Spruce amounts to about 22 percent in the Białowieża National Park in comparison to the managed forest districts, which is 33 percent (LIFE+ ForBioSensing 2016). This discrepancy results from various responses to the bark beetle outbreak. Treatment has been given only to area of forest districts of the Primeval Forest and not in the part of forest covered by the strict protection. Regardless, the role of the spruce in the Primeval Forest is very vital, nonetheless – weather for creating spruce tree stands or mixed stands with spruce. Outbreak of bark beetle in the context of their relevance for the dynamics of Primeval Forest ecosystems are no longer seen as beneficial because they eliminate almost entirely specific environments – predominantly old spruce forests. In this situation, there are two possible ways: either to accept the irrevocable impoverishment of Białowieża Primeval Forest or to commence actions allowing prohibition of the destructive effects of bark beetle outbreak. It is not only achievable but also necessary.

## Conflict of interests

Authors do not declare any potential conflicts.

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### Authors' contribution

J.H., J.R.S. – concept and review.