FORESTS´ FUTURE 2021

Consequences of Bark Beetle Calamity for the Future of Forestry in Central Europe

Two days on-line conference March 23rd – 24th

MINUTES

Central European forests face an unprecedented bark beetle infestation, which may change the future of our forests and forestry as well as that of the whole forest-based sector. The calamity perception by general public has partly decreased due to COVID-19 pandemic, while the forest deterioration is persistently developing and all associated topics of clear-cuts ecology, forest regeneration or forest economy are of increasing importance. The FORESTS´ FUTURE 2021 on-line conference aimed on presentation and discussion of the current and foreseen calamity consequences for forestry sector on the base of experiences from individual countries and institutions. The conference was divided into four sessions dealing with topics of forest protection, environmental issues, forest regeneration and forest economy and policy. More than 170 scientists, researchers, forest owners, government/administration officers, students and other participants from 29 countries took part during the two days meeting.

Session 1: CURRENT AND FORESEEN BARK BEETLE INFESTATION IN EUROPEAN COUNTRIES

Session 1 consisted of 12 oral presentations introducing the audience into the bark beetle situation in selected countries of Europe with significant amount of spruce stands and with remarkable difficult situation with outbreak of spruce bark beetles in recent years. The participating countries with presentation were: Poland, Slovakia, Austria, Bavaria, Saxony, Czechia, Switzerland, Sweden, Latvia, Romania, Slovenia and Croatia. Also participants from other countries were registered and joined the meeting, all together about 120 fellows. In their short presentations the speakers addressed the following questions:

1. How and when the bark beetle calamity in particular countries start,
2. What is the current situation (including the most recent general data of infestation volume and sanitary cutting), volume of sanitary cuttings of bark beetle infested spruce wood, reasons of possible calamity decline),
3. A map showing the present spreading of bark beetle in the particular countries (if available series of maps showing the development during last five-six years),
4. Participating bark beetle species,
5. How do the different forest owners fight this problem (protection methods applied and their effectiveness, government response, factors hindering effective management of the outbreak), and
6. How does it look like for the coming few years. By these means we got more or less comparable data.

In most central European countries, the recent bark beetle outbreak started after a very dry and warm period in 2015 or later. There was no influence of major storm or snow/ice breakage (except Slovenia and Croatia), unlike in most previous cases. The main spruce bark beetle species were *Ips typographus, Ips duplicatus, Pityogenes chalcographus, Polygraphus poligraphus*, partly also *Ips amitinus*.

The situation in particular countries was illustrated by series of maps showing the development of infestation, together with graphs showing the amount of damage and/or sanitary cuttings in the period of several decades. Besides extreme weather conditions other – human mediated – reasons for bark beetle outbreak development were mentioned in several countries, such as lack of qualified workforce, inactivity of a number of forest owners, inflexible system of public procurement, and mainly late and insufficient processing of infested trees. Methods like early detection of infested trees and removal of infested trees out of the forest to sufficient distance (500 m minimally) were presented as the most effective measures.

In some countries chemical treatment (spraying, packaging the stocks, covering by insecticide coated net, etc.) is used while such kind of treatment is not widely used and questioned by certificating authorities, or even forbidden in others. Problems with forest protection in cases where high numbers of "small" forest owners were affected were also mentioned.

It can be concluded, that the situation is rather non comparable between the regions with highly influenced or changed forest constitution with extensive spruce monocultures and countries with more nature close forests. In the latter case, even when a bark beetle calamity develops just minimal if any influence is recognized at the landscape level, since infested spruces are intermixed with other tree species and the existence of the mature forest is not endangered.

In addition to bark beetle outbreaks and problems in spruce stands problematic situations in pine stands were frequently mentioned. The reasons for this were again unsuitable weather conditions: dry and warm periods since 2015. Main species causing the damages are *Ips acuminatus, Ips sexdentatus, Orthotomicus* spp., *Tomicus* spp. and the buprestid *Phaenops cyanea*. Some reports also mentioned the additional, weakening effect of fungal infections and mistletoes.

In the end of the Session, most of speakers expressed some hope - even though it is difficult and somehow impossible to predict the situation - that in the following year, 2021, a similar or slightly better situation than in 2020 could be expected. But due to unpredictable weather and because there is still high stock of „living" spruce wood, the situation can easily become worse as well. Only in the countries with more close to natural stands were more optimistic.

Session 2: ECOLOGY OF CLEAR-CUTS AND ENVIRONMENTAL RISKS

Session 2 comprises five talks covering the topics of carbon sequestration, nutrient pools, changes in biodiversity and the potential threat of spreading fungal pathogens associated with bark beetle populations. The session was attended by more than 100 participants.

The bark beetle outbreak significantly affects carbon sequestration. Timber harvesting and wood increment are the major parts of the carbon balance with high levels of harvest having a negative impact on the balance. According to the study by Barka and Priwitzer, harvest of spruce wood in 2019 in Slovak forests was 4.36 mil. m^3 and exceeded the increment by 25 %. They also modelled carbon sequestration by spruce forests with and without influence of bark beetle outbreaks. The results of the simulations show the significant impact of sanitary logging on the age structure of forests, the reduction of sequestered carbon in spruce stands, as well as the increase of greenhouse gas emissions. However, the study did not take it into account the structure of harvested wood products, which is important in the carbon balance evaluation in forestry sector.

Wind and bark beetle disturbances turn spruce forests from a carbon sink into a carbon source through the increased soil respiration and reduced photosynthetic assimilation. The team of P. Fleischer analyses carbon balance of 15-year-old windthrow sites (managed and unmanaged) and bark beetle clearing in natural Norway spruce forests in the Tatra Mts. in Slovakia using chamber method and eddy covariance method for carbon fluxes. Mature Norway spruce forest, which was carbon neutral, turned into a carbon source just one year after the disturbance. After 15 years the windthrow sites acted as carbon sinks, whilst managed sites

sequestered more carbon than unmanaged ones. In contrast, forest stands strongly infested by bark beetle regenerated much slowly. The amount of sequestered carbon in studied sites was driven by the extent of fast-growing successional vegetation cover.

The impact of bark beetle calamity processing on carbon and nutrient pools in upper organic soil layer strongly depends on soil properties, climatic conditions and used harvest technology, V. Šrámek pointed out in his talk. After tree death and tree felling, increase in soil temperature (resulting from intensified insolation) and soil water availability (through reduced transpiration and canopy interception) may stimulate microbial activity and thus nutrient cycling. In the same time higher carbon losses may occur through respiratory processes. Higher temperature in the litter layer together with the increased rainfall infiltration may accelerate leaching of dissolved organic carbon, nitrate and other elements to the deeper soil horizons. Leaching of nutrients on wide clear-cuts can potentially contribute to further soil degradation as well as to lowered quality of stream water. The risk of heavy metal release - especially in previously heavy polluted areas - from the soil organic matter increases.

As E. Brockerhoff showed in his presentation that the bark beetle calamity is expected to have a rather positive effect on biodiversity, both in the case of clear cutting and subsequent artificial planting of new forest stand of different tree species composition, and in the case of leaving the habitat to natural succession. In both cases there will be a pronounced change in forest structure and tree species composition. New forest stands could host more living species than spruce monocultures due to increased richness of habitats, but on the other hand spruce connected species may be lost. If dead trees are not removed, the increase in deadwood volume is likely to promote species richness of saproxylic insects and deadwood fungi. Woodpeckers and other insectivorous birds may also benefit and have a temporary increase in their populations. Plant and insect species that are adapted to open habitats will profit. Mixture of forest and open areas increases diversity at the landscape scale. An adverse effect on biodiversity can be expected if very large clear-cuts remain without forest cover.

The fungal communities associated with bark beetle population have been studied in the UK using the DNA metabarcoding method. In her talk A. Ceballos-Escalera emphasized that it is necessary to understand which factors mediate in beetle-fungi interactions. The beetle species, life stage of the beetle, life cycle and forest type play a major role to influence fungal community composition and abundance. Altogether 18 potentially invasive fungi were determined in studied communities.

Session 3: FOREST REGENERATION – REPRODUCTIVE MATERIAL AND SILVICULTURE APPROACHES

Session 3 consisted of 7 oral presentations focused on silvicultural measures and needs on calamity clearcuts. The first part of the session brought information on the state of knowledge and the possibility of covering supplies of reproductive material for forest regeneration after calamity. On the base of example from Saxony, the broad catalogue of methods of tree breeding was presented which can be used to procure forest reproductive material for afforestation and reforestation. Several examples showed the work to evaluate provenances, progenies and clones with phenotypical traits as well as to identify alternative tree species on different geographical levels. Since the objective is to create scopes for action for foresters and land users, the broader application for forest regeneration meets with several obstacles (knowledge gaps, legal constraints, volatile market for reproductive material among others).

High importance of forest trees genetic resources preservation ex situ was presented through the introduction of National Forest Tree Seed Bank. It is a lesson from history, as illustrated by an example from the Czech Republic, we failed to catch some populations of Norway spruce in areas of incipient calamity (northern Moravia), but to the contrary, a number of populations from areas of ongoing disaster are already stored in the seed bank.

The extent of the calamity has led to more attention being paid to previously less-used or economically neglected woody plants such as birch or poplars. Therefore, procedures to ensure a sufficient amount of high-quality forest reproductive material resources started with an emphasis on these species with a pioneering growth strategy. The best quality gene resources could be the basis for establishment of a seed orchard.

Scientific findings and practical experiences of forest regeneration on clearcuts were the topics of the second part of session. An example from Poland (Western Beskidy Mountains) brought experiences from natural regeneration of clearcuts due to bark-beetle calamity at the beginning of the 21st century. Pioneer species (birch, rowan) together with Norway spruce now occupy these localities. An important advantage of natural regeneration is the prevention of the development of weed growth on the soil surface and the creation of conditions suitable for the planting and maintenance of target trees species, mainly European beech and silver fir. Successful development of the newly formed stands is conditioned by appropriate silvicultural management (promotion of target tree species, shaping the spatial structure of regeneration, building the resistance of trees to damaging agents, etc.).

Situation from the mountains has been expanded by the concept of reforestation of salvage clear cuts in the Czech Republic, where current bark-beetle calamity impacted chiefly lower and middle elevations. Combination of several principal approaches to solve the renewal issues on calamity clear-cut sites are recommended (direct planting of tree species mixtures according to desired species composition, gradual planting (two-phase renewal) of intolerant, well-performing species in open conditions and/or two-phase renewal when first phase consists mainly of artificial or mainly in natural regeneration. Above mentioned successive management of young newly established stands will be also of great importance in the next decade. Dissemination of new knowledge and experiences is of the utmost importance, because neglected thinning of young stands would lead to loss of stability, loss of some species admixed, lower quality and overall malfunction of the ecosystems.

As a measure to reduce long-term damage and risks in spruce stands, adaptive forest management in Slovenian forests was presented with some key-study examples. The strategy is based on maintaining the balance between growth potential and site productivity, preference of admixture with other autochthonous tree species, stabilization through appropriate thinning regimes, shorter rotation periods and promotion of natural regeneration. Considering future scenarios and increased risks, a gradual replacement of spruce on sites below 700 m a. s. l. (due to low annual precipitation and increased extreme weather events) is recommended using close-to-nature silvicultural approach with gradual conversion of anthropogenic spruce monocultures on unsuitable sites, which has already proven successful. At the end of the session, international (AT-CZ) project focused on cross-border risk management in forestry in consequence of bark beetle calamity was introduced. Participants were invited to cooperate on the project in the process of identification of common problems and synthesis of good-practice examples in current forestry.

In the frame of final discussion, use of domestic, non-native species and hybrids for forest regeneration was commented by representatives from the participating countries. It was concluded, that restoration of forests after calamities will continue to be affected by its further spread, but also by climate change and society's demands for the provision of ecosystem services.

Session 4: ECONOMIC AND POLITICAL CONSEQUENCES

Four talks were given in the last Session of the FORESTS´ FUTURE conference. Presentations and discussion was followed by 80 participants from 13 countries. Economic impact of bark beetle calamity on private forest owners was presented by Stanislav Janský who represents the Association of Municipal and Private Forest Owners in the Czech Republic. The calamity has strongly influenced forest sector in all its traditional pillars – Ecological, Economic as well as Social functions.

Salvage cuttings represents 95 % of total timber harvest in 2019. Total amount of logging overreached the annual average increment (7.1 $m^3.ha^{-1}$) – in the most damaged region of Vysočina the average intensity of logging was 43.7 $m^3.ha^{-1}$ in 2019. The surplus of timber on the market has led to significant decrease of conifer timber price since 2017. While the average sale cost for timber was 1.108 CZK (42.6 €) in 2017, it has dropped to only 423 CZK (16.2 €) in the end of 2020 and is deeply below the sustainability limit (estimated to 38 €) which would secure providing forest services not only to owners but also to the society as a whole.

The sustainability of the Czech forestry currently directly depends on state contributions to mitigate the effects of bark beetle calamity and contributions to provide forest management which reached 5.5 bilion CZK (211 mil €) for 2019.

Norbert Weber in his talk stated that unprecedented, large-scale bark beetle outbreaks, in combination with concomitant disturbances, cause mainly negative impacts on ecosystem services. He, however, pointed out different perceptions of calamity by the public, which range from strongly negative (destroying of forests and landscape) to positive (change towards higher heterogeneity and biodiversity). The general trust to foresters' competency is also broadly diverse with increasing attitudes of "critical trust", "distrust" up to "cynism". The need of proper communication based on criteria of comprehensibility, fairness and respect was stressed. For management of large scale damaged areas the triad approach was proposed which would include i) multifunctional forestry, ii) non-intervention management as well as iii) intensive timber production in an appropriate share.

Eduard Hochbichler also see the calamity as a trigger of change in the Central European forestry paradigm. Up to recently Norway spruce was highly productive species with the gain of ca 50.000 €.ha^{-1} considerably exceeding production of e.g. European beech or oak. Now the considerable risk should be incorporated in calculation. He present the possibilities of change forest owners attitudes by subsidies.

Jens Haertl introduced the potential benefits of collaboration under the Forest Europe (Ministerial Conference on the Protection of Forests in Europe) which will adopt a resolution "Adapting pan European forests to climate change" at its 8th conference in Bratislava in April 2021.

During following discussion the complex role of forest and forestry was discussed thoroughly as well as its perception by different groups of stakeholders, professionals and general public. Bark beetle calamity, global change as well as increasing importance of "green" issues change general attitude to forestry which is mirroring also in forest policy. The intensive communication and education is a necessary way to strengthen the role of European forestry in the socio – economic system.

The PDF versions of all presentations are available on web page of the conference
https://www.vulhm.cz/en/list-of-presentations/

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