

Effects of spruce bark beetle calamities on the faunistic biodiversity of mountain forests in the Alpine Berchtesgaden National Park

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Abstract

The European spruce bark beetle *Ips typographus* L. (Coleoptera, Scolytinae) is an important element of spruce forest ecosystems and one of the most destructive pests affecting Norway spruce (*Picea abies* (L.) Karst). Forest management has been aiming to eliminate natural disturbance dynamics in anthropogenically altered forest ecosystems over the last centuries. However, natural disturbances such as storm, fire and biotic impacts such as bark beetle calamities are important drivers for many ecosystem processes of European forests. Bark beetle calamities create spatial patterns in forests that alter microclimate and nutrient conditions within a short time. In addition large amounts of deadwood are produced. Changes in habitat structures are closely related to altered occurrence and abundance of forest species.

The Alpine National Park Berchtesgaden was founded in 1978. In contrast to managed forests where most often active control, salvage logging and regeneration measures are conducted during and following bark beetle calamities, no manipulation of natural forest dynamics takes place on approximately 6,000 ha of forest land in the core zone of the National Park. Although already in the early 1990s several bark beetle outbreaks occurred in the Parks forest following the storm *Wiebke* in 1990, spruce bark beetles caused a significant die-off of spruce stands not before the winter storm *Kyrill* in 2007.

To assess the impact of large-scale disturbances on unmanaged mountain forest ecosystems and their further development, a research project was started addressing the following questions:

- Which functional groups of species react (in terms of density and diversity) on the changed forest ecosystem following bark beetle outbreaks?
- Does the change of forest structure induced by the bark beetles lead to an increase of faunistic diversity in the mountain forests?
- Do the effects of spruce bark beetle calamities on the faunistic biodiversity of mountain forests already start to level off 20 years after the disturbance?

Over 50 study plots were established in three different stages of forest succession characterizing a chronosequence of unmanaged forest dynamics following spruce bark beetle attack. The three stages are: undisturbed spruce stands potentially susceptible to bark beetle infestation (*reference forest*), stands affected by bark beetles within the last five years (*early succession*) and those being infested in the early 1990th (*late succession*). Each category is represented on different altitudinal zones (montane - subalpine) on south- and north-facing sites with three replicates each. Arthropods were sampled during 2012 (May-September) using two pitfall traps and one flight interception trap per plot. Determination to species level was conducted for Coleoptera, Arachnida, Collembola, Aculeata and Heteroptera.

First preliminary results indicate significant differences in diversity between the three successional stages showing highest abundances on the early succession plots but highest species richness on the late succession sites when analyzing all investigated species groups commonly. Furthermore, advanced succession is characterized by the highest β -diversity. Light- and flower-demanding species and species depending on advanced wood decomposition were selected by an indicator analysis as species typically occurring on the late succession sites. On the landscape scale, the bark beetle induced spruce die-back leads to a mosaic of different forest structures modifying the faunistic species composition and initiating an overall increase in species diversity in the National Park. As a next step functional and phylogenetic diversity of arthropods will be analyzed with respect to possible successional pathways in the mountain forest.

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