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Biodiversity on avalanche tracks, a case study in the national park "Gesäuse" (Styria, Austria)

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Summary

Because there is a conflict between protection of natural processes on the one hand and protection against natural hazards on the other hand, the nature-conservation value of active avalanche tracks was assessed. For this purpose 16 plant stands on three different avalanche tracks in the national park "Gesäuse" (Styria, Austria) were examined.

On the investigated avalanche tracks the soils are very shallow, stony, nutrient-poor, base-rich rendzinas that developed over limestone debris. The sites are steep and mainly east-facing slopes located in the montane belt. Under these conditions, the plant stands are characterized by a high species density. The average number of vascular plant species within a plot size of 20 m^2 is 71, and the number of bryophyte species is 5. The species-rich plant stands, colourful when in bloom, are dominated by herbs, resulting in a high aesthetic value and an increased diversity of butterflies. The avalanche tracks investigated have a high nature-conservation value because natural ecological processes still happens, leading to near-natural, species-rich ecosystems.

Keywords

species richness, natural disturbance, butterflies, nature-conservation value

Introduction

The protection of natural ecological processes is the basis for a long-term conservation of natural and near-natural ecosystems. In a national park highest priority for nature conservation is therefore protection of natural processes (SCHERZINGER 1990).

Avalanches are not only a natural process and a natural factor of disturbance, but they can also endanger people and cause heavy damage to buildings and infrastructure. From an anthropocentric point of view, protective measures in the form of avalanche barriers are necessary. Avalanche barriers are able to prevent avalanches, leading also to a permanent suppression of the natural dynamics. Hence, there is a conflict between nature conservation on the one hand and protection against natural hazards on the other hand.

For the management in a national park the nature-conservation value of active avalanche tracks has to be assessed. Consequently, the aims of this study were:

recording, documentation, analysis and evaluation of the species composition and species richness of plant stands on active avalanche tracks and

analysis of the importance of natural disturbances by avalanches for biodiversity.

The national park "Gesäuse" is an appropriate study area because of numerous avalanche tracks and frequent avalanche events due to suitable topographical and climatic conditions. Parts of the results, presented in this conference volume, have been developed in the frame of the INTERREG III B project MONITOR.

Methods

Two avalanche tracks on the SE side of the mountain Tamischbachturm near Hieflau (Northern Limestone Alps, Styria, Austria) were investigated. These tracks were selected as study sites because they are two of the largest and most remarkable avalanche tracks in the national park "Gesäuse". In total, 15 permanent plots were established along two altitudinal gradients ranging from 523 to 960 m a.s.l. The tracks are surrounded by mixed spruce-fir-beech forests. An additional permanent plot on a third avalanche track, located on the SE side of the mountain Zinödl, was installed at an altitude of 1451 m a.s.l. The avalanche tracks investigated are devoid of

large trees and tall shrubs. There are no avalanche barriers and there is no agricultural land use such as mowing or grazing. All permanent plots have the same plot size of 20 m². At each plot relevès have been done according to the method of Braun-Blanquet. The installation of the plots took place immediately after snow-melting, therefore species richness has not influenced the selection. At the two avalanche tracks on the SE side of the mountain Tamischbachturm also butterfly species and numbers were recorded. Frequency and magnitude of avalanche events are unknown.

Results and Discussion

On the investigated avalanche tracks the soils are very shallow, stony, nutrient-poor, base-rich rendzinas that developed over limestone debris. Soil pH (in a $CaCl_2$-solution) is ranging from 6.2 to 7.3. The sites are steep and mainly east-facing slopes located in the montane belt (523 to 1451 m a.s.l.). Soil water regime is periodically dry (BOHNER et al., 2009).

The plant stands investigated belong mainly to *Origano-Calamagrostietum variae*; one stand is classified as *Seslerio-Caricetum sempervirentis*. Both phytocenosis represent near-natural disclimax communities. Range of vegetation cover is between 40 and 90 %.

On the investigated avalanche tracks the plant stands are dominated by CSR strategists, stress-tolerant competitors and competitors; all other life strategy types are insignificant. Moderate stress due to periodically dry, nutrient-poor soils with an excess of Calcium and low intensity of disturbance by avalanches determine species composition. Because of their appearance outside the vegetation period, avalanches damage mainly large trees and tall shrubs. Thus, light-demanding species will benefit from the improved light conditions. The vegetation is characterized by a high species density and evenness value (figure 1 and 2). The average number of vascular plant species within a plot size of 20 m² is 71 (minimum: 58, maximum: 77), and the number of bryophyte species is 5. The plant stands investigated harbour species from different vegetation types and elevation zones, leading to the observed high species richness. In Europe, following HOBOHM (2005), plant communities can be viewed as very species-rich, if more than 50 different species of vascular plants, bryophyte species and lichens within an area of 100 m² can be recorded. The plant stands investigated have, on average, a similar species density to semi-natural grasslands dominated by *Narcissus radiiflorus* or *Bromus erectus* in Upper Styria (70 respectively 68 vascular plant species within a plot size of 50 m²). Only plant stands from extensively managed alpine pastures can achieve even higher species densities. On the other hand, in deciduous and coniferous forests plant species density is comparatively lower (figure 1). The species-rich plant stands, colourful when in bloom, are dominated by herbs, resulting in a high aesthetic value and an increased diversity of butterflies. Diversity and abundance of butterflies are much higher than in the surrounding forests. Since 2005, on the two avalanche tracks studied, 501 butterfly species have been recorded. During one night a maximum value of 228 different species was observed.

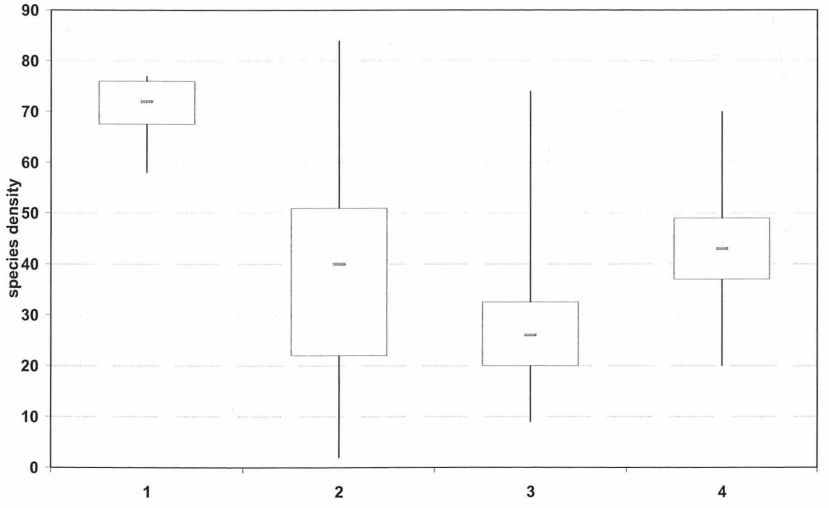

Figure 1: Plant species density (minimum, maximum, median, upper and lower quartile)

1 = plant species density on avalanche tracks (total number of vascular plant species within a plot size of 20 m², 16 relevés); 2 = non-forest areas in the Gesäuse National Park (plot size of 20 m², 145 relevés); 3 = deciduous and coniferous forests adjacent to the Gesäuse National Park (plot size of 300 to 500 m², 123 relevés); 4 = selected grassland communities (extensively and intensively managed grasslands) in Upper Styria, Austria (plot size: 5-100 m², 14 plant communities). See BOHNER et al. (2009) for further details.

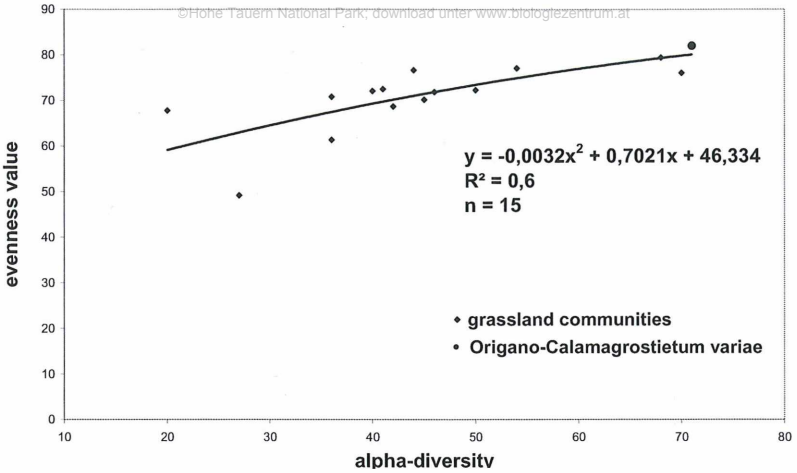

Figure 2: Relationships between alpha-diversity and evenness values of selected grassland communities (extensively and intensively managed grasslands) in Upper Styria plus *Origano-Calamagrostietum variae* (plant stands on avalanche tracks)

Conclusions

Avalanches can be assessed both positive and negative. Seen from a bio-centric point of view, avalanches keep habitates open and species rich in the montane and subalpine belt. The avalanche tracks investigated are most valuable ecosystems from a nature conservation point of view. Disturbances by periodic or occasional avalanche events are the precondition for the existence of these near-natural ecosystems. Hence, the establishment of buildings and infrastructure below these avalanche tracks should be prevented in order to avoid a need for protective measures in the form of avalanche barriers. In the case of permanent suppression of avalanches, natural succession would result in reforestation of the sites, leading to a decrease in biodiversity. Avalanche galleries could be an alternative, because they ensure a protection against avalanches without suppressing natural ecological processes.

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