

Abstract

Avalanche Effects on Endemic Pine Forests in the Pirin Mountains in Bulgaria [†]

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Abstract: The Pirin Mountains in Bulgaria are refuge of endemic *Pinus peuce* and *Pinus heldreichii* forests. Due to the steep and long slopes, the forests are affected by avalanches and many trees keep record of the past avalanche activity in their tree rings. In our study, we used a combination of dendrochronology, satellite images and historical aerophotos to study the effects of avalanches on forests in the Bunderitsa valley. Our findings show that avalanches are the main shaping factor for the structure of forests in the valley, followed by fires. Past avalanche activity is responsible for the opened long-lasting avalanche tracks in the forests. About 60% of the potential forests (i.e., territories below the treeline, outside of the avalanche couloirs, streams, rock formations and screes) are strongly affected by avalanches. Of them, almost 40% are in avalanche runout zones, 12% are in avalanche tracks in the forests and 48% are forests, which are periodically strongly affected by bigger avalanches. Comparisons of newer satellite images with older aerophotos showed that in the 1970s, there were larger openings in the forests due to the high frequency of avalanches in the very snowy 1950s and 1960s. Although, recently, the avalanche activity has decreased, there are still years with larger avalanches, which affect forests. In addition, tourist development in the vicinity has increased the risk for human health and life due to avalanche accidents, including in forests. Tree-ring analysis allowed for the reconstructing of past avalanches that affected certain areas. The big couloirs are affected by smaller avalanches almost annually, while bigger avalanches have hit the neighboring forests almost every decade. Our findings demonstrate that avalanches in the valley are of a high importance and require more attention from authorities both as a risk factor for human health and life and as a natural disturbance, shaping the structure and dynamics of the forest.

Keywords: tree-ring analysis; dendrochronology; avalanches; Pirin; *Pinus peuce*; *Pinus heldreichii*

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