

Title: The influence of wind on treeline position – the question of summit syndrome

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Abstract: Growing season temperatures drive treeline position on a global scale. However, environmental factors including wind action may critically modify the position of treeline ecotone on a regional or a local scale. The intensity of wind action increases with shortening of treeline-summit distance. High intensity of wind action may cause the presence of a summit syndrome. This results into the lowering of treeline below its potential limit given by temperature conditions. Alpine treeline ecotones occurring in 11 mountain ranges including the Harz Mts., the High Sudetes and the Carpathians represented the model areas for my research. These mountains are located at the 50th parallel and reflect an increase in the gradient of continentality. Moreover, the distance of treeline from the summit is highly variable among these mountains. These mountains are moreover characterized by differences in mass elevation effect and in the summit syndrome intensity. Treeline position in Central Europe is increasing its elevation about 94 m per 100 km towards the east, when reflecting rise of elevation isotherms due to increasing continentality. However, thermal conditions of the majority of these treelines do not differ significantly from each other as well as from similar positions in the Alps. Treelines in the Harz, Králický Sněžník, Hrubý Jeseník and Velká Fatra are, however, an exception. These mountains showed higher radial and apical growth when compared to the rest of investigated treelines. We found that temperature conditions were strongly correlated to radial growth, correlations were lesser for height growth below 2 m and there was no correlation with height growth above 2 m. Results of xylogenesis indicated a potential influence of wind action on wood formation in high-elevation tree stands. Anyway, the high wind speeds were reflected in higher occurrence of clonal tree islands and irregular tree crowns reflecting prevailing wind direction in winter. Wind was able to limit only apical growth of trees after they exceed the height of 2 m. The approximate rate of this limitation was 0.65 cm per 1 m.s⁻¹ of wind increment per year. Nevertheless, the overall wind-induced depression of highest treeline positions is probably low, even in windy mountain regions such as the mountainous regions of Central Europe, because even in the highest elevations, the wind-sheltered sites favourable for tree growth exist. Thus, overall effect of summit syndrome in mountains of Central Europe generally manifests in a difference in tree size between wind protected and wind affected sites. This might lead to slight treeline depression in mountain ranges such as the Králický Sněžník Mts. and Hrubý Jeseník Mts.

Keywords: treeline, summit syndrome, tree growth, wind influence, High Sudetes, Harz, Carpathians