

What controls growth of Norway spruce saplings in Swiss subalpine forests? Does snow duration and spring climate matter?

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Snow protects saplings from early exposure to capricious weather in late winter. However, late-lying snow reduces growth by limiting light availability, increasing the presence of snow mold, and preserving cold soils late into spring. To identify primary drivers of sapling growth in relation to snow duration we conducted a field observation study (H1), a planting experiment (H2), and a modeling case study (H3).

In H1 we measured annual growth of saplings, local site conditions, biological disturbances, snow duration, air temperature, and light. In H2 we eliminated local site variability and observed sapling growth response to controlled treatments of snow duration, ungulate browsing, snow mold, and plant competition. In H3 we used the Alpine 3D model to enhance mathematical growth models derived in H1 with parameters for soil temperature/moisture and total net radiation below the canopy on each site (25m resolution). For H1 we produced a dataset of sapling growth, light availability, local site conditions, and snow environment for 524 trees. For H2 we treated 661 three year old, genetically identical saplings for 1 of 8 biological treatments in 2003 and 1 of 3 snow duration treatments in 2004. For H3 we used observed field data (H1) and daily climate data from local SLF/Meteo Swiss stations for 2003 (applied 3D interpolation routine) to simulate environmental parameters not measured on sampling sites. Global climate change scenarios applied to Alpine 3D are expected to produce altered snow conditions for subalpine forests that when fit to derived statistical growth models should predict the influence of anticipated climate change on sapling growth.

The success of this research relies on a good understanding of snow dynamics and plant science with an emphasis in regeneration ecology in subalpine forests. Given that winter climate patterns are changing in subalpine ecosystems and forest succession models do not yet account for snow conditions in predicting sapling growth, this study contributes to the current literature on snow ecology in mountain forests.