

>> SYNTHESIZE MOUNTAINS OF KNOWLEDGE <<

Submitted Abstract

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Abstract

Treelines are predicted to move upward and poleward globally due to increasing temperatures under the ongoing climate change. The establishment of new tree populations above the current treeline depends on the up-slope transport of viable tree seeds, their successful germination and the long-term survival of seedlings. In the framework of the Global Treeline Range Expansion Experiment (G-TREE), we conducted a multifactorial long-term field experiment to quantify biotic and abiotic recruitment drivers in an alpine treeline ecotone in the Swiss Alps. In 2013, two experimental sites - at and above the current treeline - were established. At each site, we applied a combination of vegetation removal and seeding treatments with low and high elevation provenances of *Picea abies* L. Karst (Norway spruce) and *Larix decidua* MILL. (European larch) in two consecutive years. Seedling survival and growth were monitored annually since then. Over the whole study period, natural recruitment only rarely occurred in the study plots. Only 21% of the totally 1'715 emerged seedlings survived the first winter. Thereafter, the number of surviving seedlings continuously decreased to 4% in 2021. Vegetation removal had a positive effect on seedling survival, especially in the first years, while this influence became slightly less important in the longer-term. Above treeline, only *L. decidua* seedlings survived, while at treeline equal numbers of both species survived. Average seedling heights at and above treeline were similar except for the last two years of the study, when seedling growth above treeline even exceeded growth at the lower elevation site. Our results demonstrate that tree seedlings can establish several hundred meters above the current treeline when viable seeds and suitable microsites are available. After passing the bottleneck of first winter survival, some seedlings survived for at least seven years. Enhanced seedling survival in the presence of open ground in the immediate surrounding indicates a positive effect of light availability and higher soil temperatures. Our findings also show an advantage for the pioneer species *L. decidua*, which had higher survival rates. The strong seed source limitation in the alpine treeline ecotone suggests that individual survivors may become stepping stones for treeline advance.