

A SURVEY OF NATURAL REGENERATION OF NORWAY SPRUCE ON SCARIFIED CLEAR-CUTS

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In Norway, the use of natural regeneration for reforestation of spruce stands has increased in recent years, but the practical results have been little studied [1]. We carried out a survey of natural regeneration in 99 clear-cut stands of medium site index (G14) within a 35 000 ha forest estate in southeast Norway (Romedal and Stange Commons). The stands were scarified during 2001-2006, usually one or two years post harvest, and the inventory was carried out during June-October 2008. Seedlings were counted in 15 plots per stand, the plot area depending on species and cohort (1 m² for one- or two-year old spruce seedlings, and 16 m² for pine, broadleaves and spruce older than two years). Here, we focus predominantly on the establishment of spruce seedlings, of which the majority emerged in 2007, following a rich seed year in 2006, i.e. two years prior to the inventory. The influence of site factors was assessed using a generalized linear mixed model approach, which allows accounting for random plot and stand effects.

The time elapsed between scarification and the main seed year in 2006, as well as the vegetation type and location of plots in relation to potential seed bearing trees in adjacent stands were the most important factors affecting spruce seedling establishment (Fig. 1, $p < 0.0001$ for all factors). Overall, the density of spruce seedlings was acceptable in stands scarified in 2006, immediately before the rich seed fall. Among stands scarified during 2003-2005, the regeneration result was highly variable. The poorest results were found in stands scarified in 2001 or 2002, where seedling densities of spruce were mostly very low. This can be attributed to the establishment of competing vegetation in the scarified spots, leaving the older ones to be of little value as a germination substrate at the time of seed fall in 2007.

The dominating vegetation types in the inventoried stands were cowberry woodland (n=29), bilberry woodland (n=52), or small fern woodland (n=18). The small fern type contained the highest densities of spruce seedlings, while there was no difference between the other two vegetation types. The difference between vegetation types depended on the year of scarification however, being largest in stands scarified most recently ($p < 0.05$ for the interaction).

About twice as many seedlings were present at 10 m distance from a stand edge with potential seed-bearing trees, compared with plots located at 40 m distance from the edge. This illustrates the need to consider also the configuration of the clear-cuts when aiming at natural regeneration of spruce after clear-cutting.

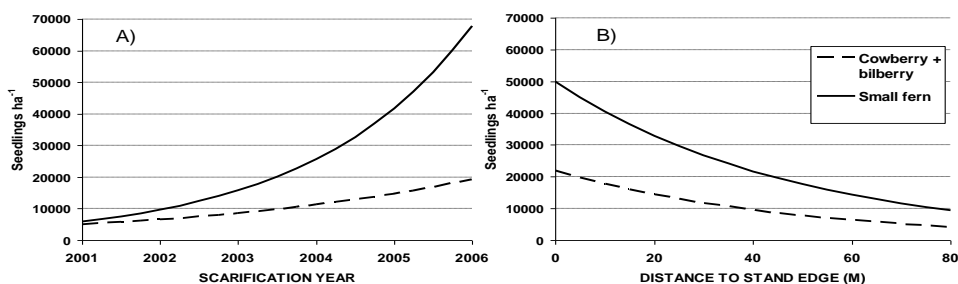


Figure 1. General linear mixed model showing the number of two-year-old spruce seedlings in 2008 as a function of the time elapsed since scarification (A), distance from the sample plot to the nearest stand edge with potential seed-bearing trees (B) and vegetation type (A, B). There were no significant differences between the cowberry and bilberry vegetation types.

Older spruce seedlings contributed only modestly to the regeneration result, regardless of stand age (median 530 seedlings ha⁻¹). A lack of good seed years during the years 1999 – 2005 may explain this, and a large proportion of the older spruce seedlings had probably established as advance growth. In stands that contained scattered retention trees of Scots pine, establishment of pine contributed significantly to overall seedling densities. However, potential seed trees of pine were often lacking or only present at rather low densities in the harvested stands, so this contribution was usually not sufficient to secure adequate regeneration.

Considering that the main objective in these stands was to obtain a spruce dominated regeneration, the overall regeneration result can only be regarded as satisfactory in the stands that were scarified immediately prior to the 2007 seed fall. A prerequisite for this condition was that the configuration of the clear-cut did not compromise seed supply.

1 Granhus, A. & Fløistad, I.S. 2010. Natural regeneration after scarification on medium site index (G14). *Forskning fra Skog og landskap* 01/2010. 23 p.