Responses of Engelmann spruce and the *Wet Alder* complex to manual cutting: A summary of 5 year PROBE results

About the *Wet Alder* complex

This community can be problematic with regard to conifer establishment because it develops relatively quickly following harvest. The rich, moist conditions where alder thrives are also conducive to abundant herb growth, particularly in areas that are not fully occupied by shrubs. Where abundant, the *Wet Alder* complex can negatively affect seedling performance by competing for light and soil resources, by inhibiting soil and air warming, and by causing physical damage through vegetation- and snow-press. However, this complex often develops on sites where poor seedling performance is related primarily to the effects of cold, wet, fine-textured soils on seedling root development, rather than to vegetation competition. The presence of some alder can benefit seedlings by increasing the availability of nitrogen and by improving long-term site productivity. (Full complex description)

Results

This section summarizes 5-year results from the fully replicated PROBE experiment that studies Engelmann spruce and vegetation responses to manual cutting of the *Wet Alder* complex in 4-6 year-old plantations in the ESSF and ICH zones. Study sites were mesic to subhygric, moderately sloping (35-45%), with variable aspect. Alder cover averaged 32% at the time of treatment. (Full Methods description)

Table 1. A summary of 5-year Engelmann spruce responses

Was there a significant[a] improvement in conifer performance 5 years after treatment?	
Survival	No
Basal stem diameter	No
Stem diameter increment	No
Height	No
Leader length	No
Height:diameter ratio	Yes

a Differences are significant where $p \leq 0.05$ according to ANOVA.

Engelmann spruce responses 5 years after brushing

- ***Survival*** **-** Fifth year survival of Engelmann spruce did not differ significantly between the treatment (82%) and the control (97%) (Figure 1). Mortality in the treatment was due mainly to treatment damage
- ***Vigour*** - Proportions of good, moderate, and poor vigour Engelmann spruce were similar in the treatment and control in year 5 after manual cutting (Figure 1). This suggests further mortality is likely to occur equally in the control and the treatment.
- ***Stem diameter*** - Engelmann spruce stem diameter did not differ significantly between the treatment and the control 5 years after manual cutting (Figure 2a). However, diameters were,

on average, 36% larger among treated than untreated spruce, which contributed to the development of significant differences in the height:diameter ratio.

- ***Height*** - There were no differences in Engelmann spruce height between the treatment and the control 5 years after manual cutting (Figure 2b).
- ***Height:diameter ratio*** - Engelmann spruce in the manual cutting treatment had a significantly lower height:diameter ratio than those in the untreated control after 5 years (Figure 2c). This is due to a trend of increasing stem diameter among treated seedlings.

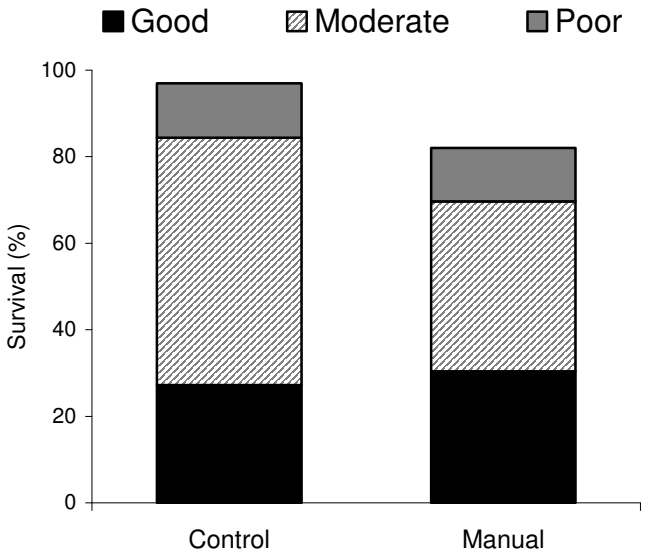

Figure 1. A comparison of Engelmann spruce survival and vigour in the control and treatment 5 years after manual cutting.

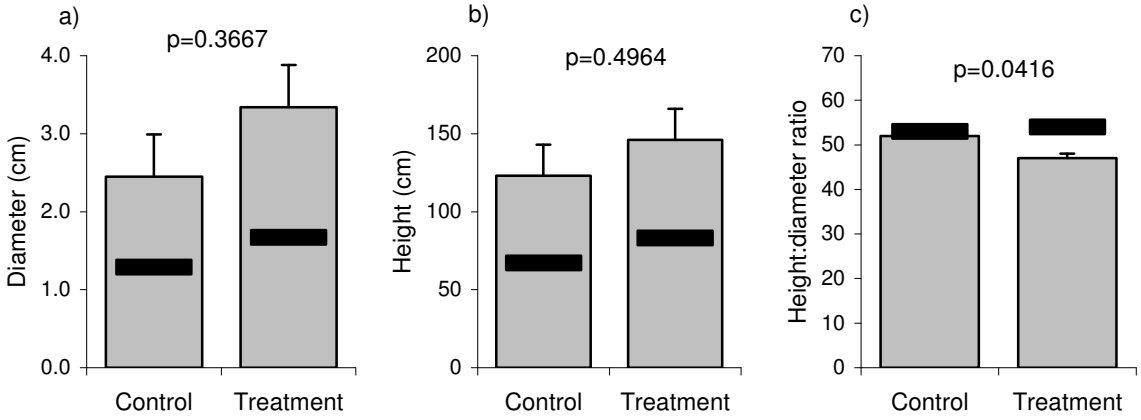

Figure 2. Comparisons of Engelmann spruce (a) basal stem diameter, (b) height, and (c) height:diameter ratio in the control and treatment 5 years after manual cutting. Horizontal bands represent lodgepole pine size at the time of treatment. Error bars represent 1 standard error.

Vegetation responses

Table 2. Duration of vegetation responses

Years of significant[a] vegetation reduction	
Alder cover	> 5 years
Alder height	> 5 years
Herb cover	None
Herb height	None

a Differences are significant where p≤0.05 according to ANOVA.

Manual cutting significantly reduced alder cover and height for at least 5 years. Five years after cutting, 81% of cut alder stumps had an average of five sprouts each, and they averaged 119 cm tall. However, spruce were small and slow-growing, and were again overtopped by alder within one year of brushing (Figure 3). There were no significant treatment effects on herb height and cover during the 5 years following manual cutting. Neither were richness and diversity of vascular plant species affected by the treatment.

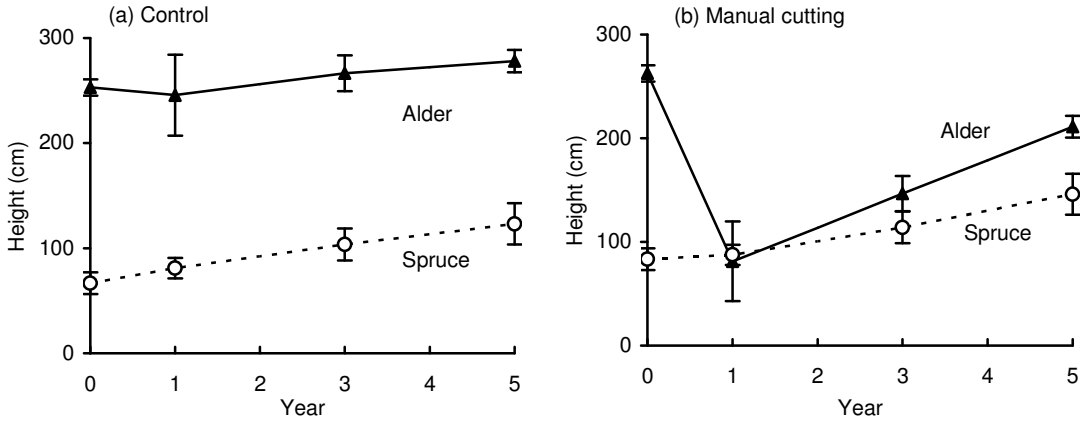

Figure 3. A comparison of average Engelmann spruce and alder height profiles in (a) the control and (b) the manual cutting treatment.

Management interpretations

Survival - Our results suggest that on mesic-subhygric sites in the ESSF and upper ICH, manual cutting of the *Wet Alder* complex does not improve Engelmann spruce survival. Survival averaged 90% regardless of whether brushing was done. However, spruce were 4-6 years-old when manual cutting was done, and initial surveys suggest that considerable mortality had occurred prior to treatment. Earlier treatment application may have affected survival.

Conifer growth - Manual cutting of the *Wet Alder* complex had very little effect on spruce growth. Only height:diameter ratio improved significantly. The lack of growth response may be due to one or more of the following factors: (1) Other growth-limiting factors may have been more limiting to seedling performance than vegetation competition. On sites where the *Wet Alder* complex develops, cold soils and excessive soil moisture in seepage patches are important limiting factors. (2) Conifers were slow to respond because the brushing treatments were not applied early enough. Treatments were applied when spruce were 4-6 years-old. (3) The cutting treatment did not reduce alder abundance enough to release seedlings. In spite of significant reductions in alder height following treatment, sprouts easily overtook the slow-growing spruce.

Treatment efficacy – A single manual cutting treatment significantly reduced alder cover and height for more than 5 years, but the treatment was not severe enough to reduce alder height below that of spruce. Full results are described in LMH 48 (Simard et al. 2001).

Richness and diversity - A single manual cutting treatment applied to the *Wet Alder* complex had no effect on richness or diversity of vascular plant species or vegetation structural groups.

References

Simard, S.W., J.L. Heineman, W.J. Mather, D.L. Sachs, and A. Vyse. 2001. Effects of operational brushing on conifers and plant communities in the southern interior of British Columbia: Results from PROBE 1991-2000. Res. Br., Min. For., Victoria, B.C. Land Manage. Handb. No. 48.

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