

# Responses of Engelmann spruce and the *Ericaceous shrub* complex to manual cutting: A summary of 10 year PROBE results

## About the *Ericaceous shrub* complex

Ericaceous shrubs are often present under the ESSF forest canopy, and although they do not spread quickly, they may form the dominant plant community following logging. This is particularly true on sites where the community was well developed prior to harvest, such as in gaps associated with very old, high elevation ESSF forests. Ericaceous shrubs are negatively affected by disturbance to the forest floor, so this complex is most likely to thrive on winter-logged sites where stems have been protected by the snowpack. This community can seriously impede conifer seedling survival and early growth because the dense vegetation canopy reduces light availability at seedling height and prevents soils from warming above critical thresholds for uptake of water and nutrients. The springy stems of ericaceous shrubs can also cause physical damage to young seedlings. Competition from the *Ericaceous Shrub* complex is most problematic on cool, steep, north-facing slopes. ([Full complex description](#))

## Results

This section summarizes 10-year results from the fully replicated PROBE experiment that studies Engelmann spruce and vegetation responses to manual cutting in 0-2 year-old<sup>1</sup> plantations in the ESSF zone. Study sites were submesic to mesic, moderately sloping (25-45%), with variable aspect. Elevation ranged from 1450-1800 m, and total vegetation cover averaged 88% at the time of treatment. ([Full Methods description](#))

Table 1. A summary of 10-year Engelmann spruce responses

Was there a significant <sup>a</sup> improvement in conifer performance 10 years after treatment?	
Survival	No†
Basal stem diameter	No
Stem diameter increment	No
Height	No
Leader length	No
Height:diameter ratio	No

<sup>a</sup> Differences are significant where  $p \leq 0.05$  according to ANOVA.

† Indicates that although  $p > 0.05$ , there was a strong trend of improved performance in the cutting treatment.

<sup>1</sup> Seedling age refers to age since planting, so that “0 years-old” means seedlings were newly planted.

### Spruce responses 10 years after brushing

- **Survival** - Ten years after treatment, when Engelmann spruce were 10-12 years-old, survival had declined to 52% in the untreated control and 74% in the manual cutting treatment. Despite the large difference, the effect of manual cutting on survival was not statistically significant ( $p=0.1544$ ) because of high variability between sites.
- **Vigour** - As of year 10 after brushing, most surviving seedlings in both the treatment and control were of good or moderate vigour. Ten percent of control spruce and 13% of treated spruce were of poor vigour (Figure 1), which suggests there could be further small declines in survival.
- **Stem diameter** - Ten years after manual cutting, there were no difference in Engelmann spruce stem diameter as a result of manual cutting (Figure 2a). Diameter had increased significantly relative to the control in years 3 and 5 after treatment, but the effect had disappeared by year 10. This is probably because small, poor vigour trees in the control died between years 5 and 10. Diameter was increasing slowly in both the treatment and the control.
- **Height** - Height of Engelmann spruce did not significantly increase as a result of manual cutting within 10 years of treatment (Figure 2b). Spruce were less than 1 m tall when they were 10-12 years-old.
- **Height:diameter ratio** - Manual cutting had no significant effect on H:D ratio.

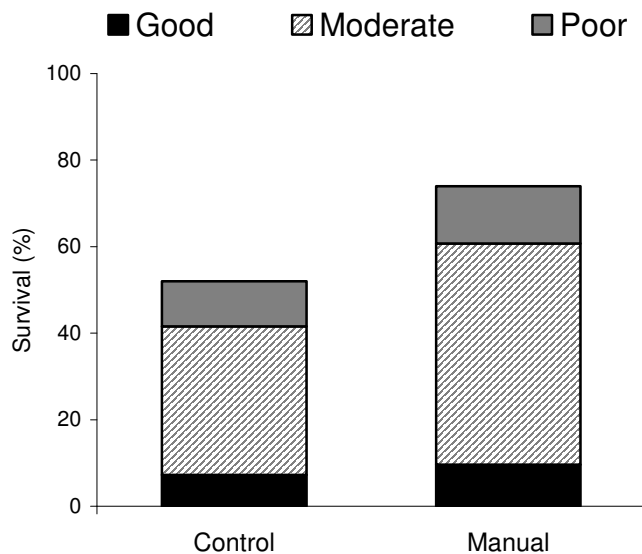


Figure 1. A comparison of Engelmann spruce survival and vigour in the control and treatment 10 years after manual cutting.

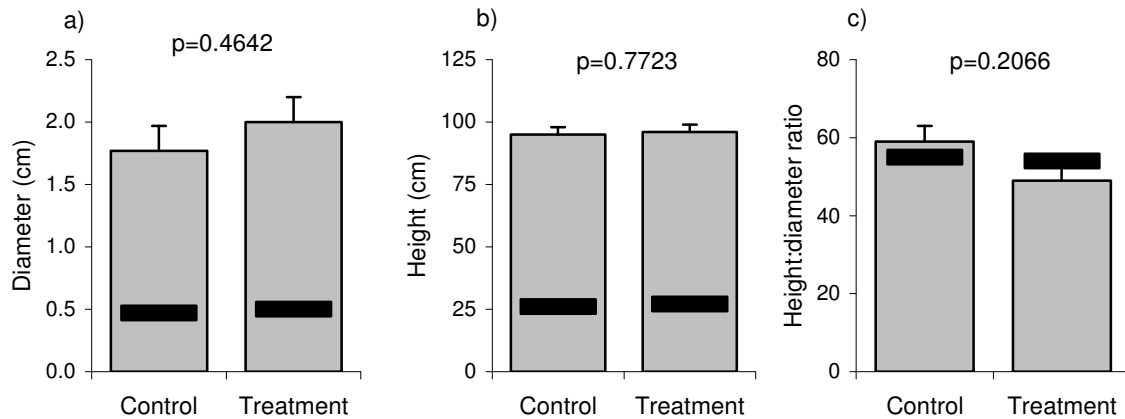


Figure 2. Comparisons of Engelmann spruce (a) basal stem diameter and (b) height in the control and treatment 10 years after manual cutting. Horizontal bands represent spruce size at the time of treatment. Error bars represent 1 standard error.

## Vegetation responses

Table 2. Duration of vegetation responses

Years of significant <sup>a</sup> effects on vegetation	
Shrub cover	> 10 years
Shrub height	>1 year and < 3 years
Herb cover	None
Herb height	None

<sup>a</sup> Differences are significant where  $p \leq 0.05$  according to ANOVA.

**Manual cutting** immediately reduced height and cover of shrubs, and these reductions were statistically significant at the time of the first year assessment. Shrub height recovered by year 3, but small differences in shrub cover persisted for at least 10 years. Despite the lack of significant difference in vegetation height, spruce in the manual cutting treatment had, on average, grown as tall as the vegetation canopy by the time they were 10-12 years-old, whereas those in the control were continued to be approximately 20 cm shorter than the height of the vegetation canopy (Figure 3).

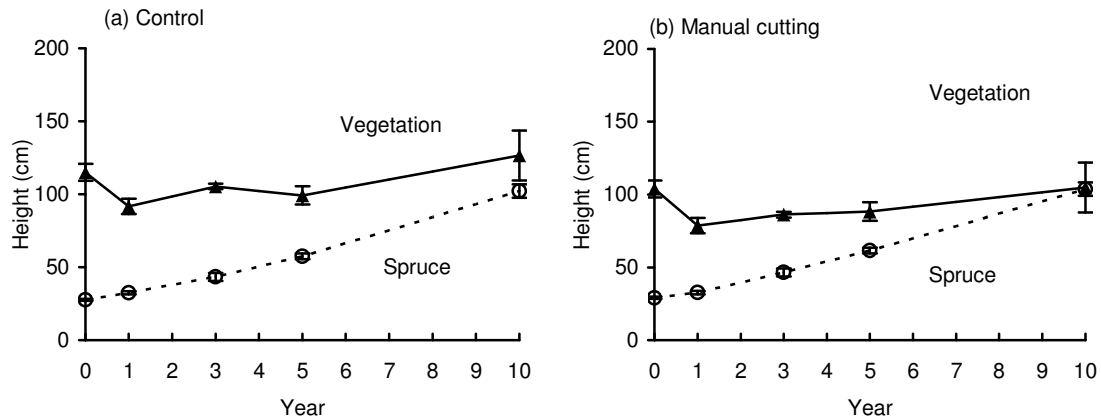


Figure 3. A comparison of average Engelmann spruce and vegetation height profiles in (a) the control and (b) the foliar glyphosate treatment.

### Management interpretations

**Survival** - Although spruce survival did not differ significantly between the manual cutting treatment and the control because of high variability between sites (52 versus 74%,  $p=0.1544$ ), the magnitude of the difference suggests that brushing has the potential to improve survival of spruce growing among the ESSF *Ericaceous Shrub* complex. On high elevation ESSF sites, low soil temperature and a short growing season are also important limitations to conifer performance, and the manual cutting treatment would not have relieved these factors.

**Conifer growth** - Spruce growth did not improve as a result of brushing, which suggests that either the treatment did not reduce vegetation abundance sufficiently to improve growth, or, other factors than vegetation competition were stronger limitations to spruce performance.

**Treatment efficacy** - Ericaceous shrubs were slow to recover from the manual cutting treatment, and significant differences in cover between the treatment and the control persisted for more than 10 years. However, the actual magnitude of the difference was small. Treatment radii varied from 0.5 to 2.0 m across the four sites. It is possible that a consistently larger treatment radius would have improved treatment efficacy and allowed significant survival and growth responses to emerge.

**Richness and diversity** - A single manual cutting treatment applied to the *Ericaceous Shrub* complex had no effect on richness of vascular plant species within 5 years of treatment. Species diversity (according to the Shannon-Weaver diversity index) briefly increased in the treatment relative to the control, but the effect had disappeared by year 5.

### 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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