FSP Project no.: Y073024

Project Title: Long-term effects of vegetation management treatments on growth and yield and stand development.

Project team:
Jean Mather – Skyline Forestry Consultants Ltd, Kamloops, BC (Teamleader)
Dr. Donald Sachs – Forestry Research Consultant, Nelson, BC
Dr. Suzanne Simard – Professor, Faculty of Forestry, University of BC
Jean Heineman – J. Heineman Forestry Consulting, Vancouver, BC
Teresa Newsome – BC Ministry of Forests, Williams Lake, BC
Barbara Zimonick, Zimonick Enterprises, Kamloops, BC

Abstract:

PROBE is a broad-based project that has been investigating conifer and vegetation responses to vegetation management treatments in southern interior British Columbia. As a result of work conducted from 2005 to 2007 with FSP funding, we installed Permanent Measurement Plots (PMPs) and/or conducted re-measurements on 17 sites. The fieldwork component of the project focused on broadleaf and alder vegetation complexes. We also conducted analysis, produced three journal articles, and prepared or updated extension notes annually for posting on our website (address below).

Introduction:

Since 1991, the PROBE (Protocol for Operational Brushing Evaluations) project has studied the effects of operational brushing treatments on conifer seedlings and vegetation. The project has installations on 96 sites across the southern interior of BC, and includes a range of vegetation complexes, conifer species, and brushing treatments. FSP funding has contributed to two components of the PROBE project: (1) the addition of permanent measurement plots (PMPs) to assess the long-term effects of brushing treatments, (2) the remeasurement of sites that were part of the original experiment.

In the first component, PMPs were established on sites that, generally, have already yielded 10 years of information. The data that we collect in the PMPs will allow us to assess the long-term effects of brushing on conifer growth and yield, stand health, stand dynamics, and plant community development and diversity. Information about the relationship between forest health problems and the application of brushing treatments is expected to be of particular interest. Measurements will be taken at approximately 5 year intervals. In the past 3 years we have installed PMPs on a range of sites where the Mixed Broadleaf-Shrub, Aspen, and Dry Alder complexes are being studied. These complexes
were out highest priority because of the long period over which they interact with conifers.

In the second component, the effects of operational brushing treatments on conifer seedling performance (i.e., survival, growth, health, and free-growing status) and on the vegetation community (i.e., plant species abundance and condition) are assessed at intervals of 1, 3, 5, and 10 years after treatment. At present, 10-year data has been collected at some, but not all, of these sites. Plant community structure and diversity are also studied. The results are providing forest managers with valuable guidance regarding a) where brushing is and is not required, b) the selection of appropriate treatments, c) expected conifer and vegetation responses, d) the effects of treatment on forest health, and e) the effects of treatment on non-timber site values. Information regarding broadleaf complexes is particularly important because of the long time period during which conifers and broadleaves interact, because of the controversy that currently exists regarding appropriate levels of broadleaves that can be retained at free-growing, and because these complexes occur in some of the most productive ecosystems in BC.

The long-term objectives for Component 1 are:
1. To study the long-term effects of brushing on growth and yield and stand development (and provide an infrastructure for collection of this information at regular intervals).
2. To study the ongoing effects of brushing on plant community development and diversity.
3. To identify forest health problems (e.g. increases inn the spread of *Armillaria*) that may be occurring as a result of brushing treatments.

The long-term objectives of Component 2 are:
1. To quantify the effects of operational brushing treatments on: (a) conifer seedling survival, growth, health, and free-growing status, (b) plant species abundance, and (c) the structure, diversity, and condition of plant communities.
2. To identify, wherever possible, competition thresholds for conifer growth.
3. To discuss possible effects of brushing treatments on various ecosystem attributes.
4. To determine whether or not brushing treatments are meeting biological and economic management objectives.

The specific 2004/05 and 2005/06 objectives were listed in the year-end reports for these years.

The specific 2006/07 objectives for Component 1 were:
1. To install PMPs and collect baseline information on three sites where broadcast and variable retention manual cutting treatments were applied to release lodgepole pine or Douglas-fir growing among the *Aspen* complex.
2. To produce a report on summary statistics for baseline measurements.

The specific 2006/07 objectives for Component 2 were:
1. To re-measure four sites where broadcast and variable retention manual cutting treatments were applied to release lodgepole pine or Douglas-fir growing among the Aspen complex.
2. To conduct full analysis of the PROBE data set.
3. To prepare a journal article reporting PROBE results for the Aspen complex.
4. To prepare and post on our website an extension note reporting 10 year results for manual cutting of the Aspen complex on lodgepole pine and vegetation.
5. To report PROBE results at SISCO or another extension venue, as themes permit.

Methods

Component 1
PMPs are installed on PROBE sites that have already yielded approximately 10 years of conifer response and neighbourhood data. At each PROBE site where PMPs are being established, one circular plot of 11.52 or 17.84 m radius (depending on stem density) is laid out at the centre of each of the 0.9 ha PROBE treatment and control plots. All stems over 2 m tall are tagged, measured, and assessed for damage and disease. Soils are also described and stand conditions are photographed. The methods for PMP installation were adapted from Biring et al. (1997) and are described fully on the PROBE website (Heinemann 2007): (http://www.myquire.com/vegman/expertsyste/probewebpage/probe.html/).

Component 2
Each PROBE installation is approximately 1.6 ha in size, and consists of a treatment plot (treated operationally with the rest of the opening) and a control plot (area left untreated in the same opening) that have similar site history and ecosystem characteristics. Thirty-six crop tree-centred subplots are established on a grid within each of the treatment and control plots, within which conifer crop tree size, condition, damage, and degree of overtopping are assessed. For each dominant plant species and vegetation group (total vegetation, herbs, shrubs, and broadleaf trees), modal height and cover are also assessed within the 10 or 20 m\textsuperscript{2} subplots. These measurements are taken prior to brushing and 1, 3, 5, and 10 years after treatment.

Statistical analysis is carried out when a particular treatment cell (i.e., a particular combination of vegetation complex/conifer species/ecosystem/brushing treatment) has been replicated at least three times. Analysis of variance (ANOVA) is conducted separately for each measurement year for quantitative crop tree and vegetation variables, and summary statistics were produced for qualitative variables.

The methods for Component 2 (re-measurement of PROBE installations) are fully described in Simard (1993) and Mather (2007).

Results

Field measurements
During the 3 year term of the project we used FSP funds to re-measure 9 PROBE installations and to establish and measure 13 PMPs (see Table 1).

Table 1. List of field measurements completed for Project Y073024 (all 3 years)

<table>
<thead>
<tr>
<th>Year</th>
<th>Site</th>
<th>Type of measurement</th>
<th>Vegetation complex</th>
<th>Crop tree species</th>
<th>Brushing treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>51-Spahats Creek</td>
<td>PROBE yr 10</td>
<td>Mixed Broadleaf-Shrub</td>
<td>Fd</td>
<td>Manual cutting – variable retention</td>
</tr>
<tr>
<td>2004</td>
<td>130-Champion Creek</td>
<td>PROBE yr 3</td>
<td>Mixed Broadleaf-Shrub</td>
<td>Fd</td>
<td>Manual cutting – variable retention</td>
</tr>
<tr>
<td>2004</td>
<td>4-Buck Creek</td>
<td>PMP</td>
<td>Dry Alder</td>
<td>Pl</td>
<td>Manual cutting</td>
</tr>
<tr>
<td>2004</td>
<td>7-Larch Hills</td>
<td>PMP</td>
<td>Mixed Broadleaf-Shrub</td>
<td>Fd</td>
<td>Manual cutting</td>
</tr>
<tr>
<td>2004</td>
<td>15-Gordon Bay</td>
<td>PMP</td>
<td>Mixed Broadleaf-Shrub</td>
<td>Fd</td>
<td>Girdle</td>
</tr>
<tr>
<td>2004</td>
<td>46-Burnyeat Creek</td>
<td>PMP</td>
<td>Mixed Broadleaf-Shrub</td>
<td>Pl</td>
<td>Glyphosate spray</td>
</tr>
<tr>
<td>2004</td>
<td>51-Spahats Creek</td>
<td>PMP</td>
<td>Mixed Broadleaf-Shrub</td>
<td>Pl</td>
<td>Manual</td>
</tr>
<tr>
<td>2005</td>
<td>28-Mabel Creek</td>
<td>PMP</td>
<td>Aspen</td>
<td>Fd</td>
<td>Girdling</td>
</tr>
<tr>
<td>2005</td>
<td>31-Crown Bench</td>
<td>PMP</td>
<td>Dry Alder</td>
<td>Pl</td>
<td>Glyphosate spray</td>
</tr>
<tr>
<td>2005</td>
<td>55-Ross Lake</td>
<td>PMP and PROBE yr 11</td>
<td>Dry Alder</td>
<td>Pl</td>
<td>Manual cutting</td>
</tr>
<tr>
<td>2005</td>
<td>74-2km Road 1221</td>
<td>PMP</td>
<td>Aspen</td>
<td>Fd</td>
<td>Girdle</td>
</tr>
<tr>
<td>2005</td>
<td>87-Honeymoon Road</td>
<td>PROBE yr 5</td>
<td>Mixed Broadleaf-Shrub</td>
<td>Fd</td>
<td>Manual cutting – variable retention</td>
</tr>
<tr>
<td>2005</td>
<td>88-Pisima</td>
<td>PROBE yr 5</td>
<td>Mixed Broadleaf-Shrub</td>
<td>Fd</td>
<td>Manual cutting – variable retention</td>
</tr>
<tr>
<td>2006</td>
<td>80-Skimikin</td>
<td>PMP</td>
<td>Aspen</td>
<td>Pl</td>
<td>Manual cutting</td>
</tr>
<tr>
<td>2006</td>
<td>77-Boone Creek</td>
<td>PMP and PROBE yr 9</td>
<td>Aspen</td>
<td>Pl</td>
<td>Manual cutting – variable retention</td>
</tr>
<tr>
<td>2006</td>
<td>52-Chuck Creek</td>
<td>PMP and PROBE yr 12</td>
<td>Aspen</td>
<td>Fd</td>
<td>Manual</td>
</tr>
<tr>
<td>2006</td>
<td>58-Fowler Creek</td>
<td>PROBE yr 11</td>
<td>Aspen</td>
<td>Pl</td>
<td>Manual</td>
</tr>
</tbody>
</table>

**Deliverables and extension**

Extension has been crucial to the success of the PROBE project since its inception in 1991. PROBE is a well-known project, and the fact that it has survived and received funding from both government and industry for 15 years demonstrates that it has provided returns to its clients. Communicating our results to user groups was an important role in the 3 years for which FSP funding was received. Three journal articles and 10 extension notes were produced during this time. In earlier years, a Land
Management Report and other memos and extension notes have been produced, Presentations at silviculture meetings such as SISCO have also been an important venue to communicate PROBE results.

List of journal articles:


List of extension notes:


**Presentations at meetings**

Northern Interior Silviculture Committee Meeting - 2007 – Oral Presentation

Southern Interior Silviculture Committee Meeting - 2006 – Poster presentation

Southern Interior Silviculture Committee Meeting - 2005 – Poster presentation

**Website**

We improved the ability of operational users to easily access PROBE results when we launched our own website at the end of the 2004/05 fiscal year. ([http://www.myaquire.com/vegman/expertsystem/probewebpage/probehtml/](http://www.myaquire.com/vegman/expertsystem/probewebpage/probehtml/))

The website has provided a venue for us to post our extension notes (including the ones listed above), and allows users to easily find current PROBE results for a specific vegetation complex. We were stimulated to post extension materials electronically following communication from operational users that they continued to be interested in our results, but that they faced increasingly busy schedules that allowed them little time to read in-depth reports.

**Contribution of PROBE results to other projects**

PROBE is the main building block for the vegetation management component of the “Expert System for Site Preparation and Vegetation Management in Southern Interior BC” (Project Y073021), which is an innovative extension tool that aims to facilitate access and interpretation of research results for practicing foresters. New PROBE results have been included in the Expert System each year.

**Database management**

The PROBE project began in 1991, and it has gradually grown over the years to include 96 individual research sites. Measurements are conducted at regular intervals, and the amount of data we are now working with is enormous. The original data base and SAS
analysis programs were designed to include a maximum of about 40 sites that were analyzed using straight-forward ANOVA. We now have a larger number of sites that are measured at less regular intervals, and we are interested in a greater range of analysis techniques and site and vegetation complex groupings. The data base and data management programs became cumbersome, so in 2007 we undertook a review of notes and data sheets for each site, and compared the information with that entered into the database. In the past we were carrying out this reviewed on an “as-needed” basis, but with FSP funding we were able to clean up the data set in one operation.

Discussion and Conclusions

All of the money in the budget was spent. All activities and extension products that were planned were completed (to the point where they need to be reviewed). The extension notes should be peer reviewed and ready for posting at the end of May.

The Final Report has been posted on the MOFR website. The other extension products for 2006/07 are not posted because they are either awaiting publication in a journal, or are drafts that require review.

The 2006/07 extension products are:


Mather, W.J. 2007. Methods for measurement of PROBE installations. (draft completed, requires review)


Literature cited
