Southern Interior Forest Region

St. Mary River Single Tree Selection Study in the Rocky Mountain Trench

Background

In 1993, the Forest Sciences staff from the former Nelson Forest Region established the St. Mary River research trial in the Rocky Mountain Forest District to demonstrate the operational feasibility of the single tree selection silvicultural system in mixed Douglas-fir, western larch, and lodgepole pine stands in the Interior Douglas-fir biogeoclimatic zone (Pollack and Crampton 1994). This silvicultural system could be used to address a range of forest management objectives and applied in sensitive areas. The trial was set up to measure growth and yield, and regeneration response to different levels of residual basal area retention. The target residual basal areas were 24 m²/ha (heavy), 16 m²/ha (medium), and 8 m²/ha (low) (for trees >17.5 cm diameter at breast height [dbh]). A no-harvest treatment was also included in the study. Growth and yield plots were installed before harvest in 1994 and remeasured immediately post-harvest in 1995. Interest in this trial was renewed in 2006 because of the potential for immediate application of results (year 15) to similar stands where mountain pine beetle and salvage logging are selectively removing the pine component.

Project Objectives

- To evaluate the growth and yield implications based on residual overstorey and understorey regeneration.
- To evaluate the impact of various levels of basal area retention on the survival and performance of natural regeneration.
- To investigate the effects of understorey light, as created by various residual basal areas, on understorey vegetation, and on the abundance, survival, and growth of natural regeneration.
To evaluate deviation from potential and uneven-aged stocking survey methods used in partially harvested stands.

To measure ungulate, snow, and forage response to the residual basal area treatments, which will contribute to developing silvicultural systems appropriate for winter range.

To demonstrate the operational feasibility of variable retention silvicultural systems.

**Study Area**

The trial site is located between km 11 and 14 on the St. Mary River Forest Service Road, about 25 km northwest of Cranbrook in the Kootenay variant of the Interior Douglas-fir dry, mild biogeoclimatic subzone (IDFdm1) (Figure 1). Soil moisture and frost are major limitations to regeneration and growth in this subzone (Braumandl and Curran 1992). Fine sandy loam to silty clay loam soils predominate upper horizons; carbonates exist at 33+ cm depth. Soil compaction hazard and forest floor displacement hazard are very high. The study blocks are generally flat but each contains some microtopography such as short gullies and small knolls.

A stand-replacing fire occurred 120 years ago, followed by a number of light ground fires, resulting in an uneven-aged structure with at least four distinct age classes. Pre-harvest, Douglas-fir, western larch, and lodgepole pine were the most common species in the overstorey, and total basal area was 37 m²/ha (live trees >4 cm dbh) (Table 1). Douglas-fir is the most common species in the regeneration layer.

**Study Design and Layout**

Before harvest in 1993, sixteen 1.0-ha (100 × 100 m) treatment units were established. The four harvesting treatments (no-harvest, 8 m²/ha, 16 m²/ha, and 24 m²/ha) were replicated four times and each was randomly assigned to a 1.0-ha treatment unit for a total of 16 treatment units in a completely randomized design. The treatment units are physically grouped into three areas: west, centre, and east (Figure 2). In each 1.0-ha unit, one hundred 10 × 10 m plots were delineated. Of the 100 plots, 16 of the inner 64 plots were randomly selected for growth and yield, regeneration, and vegetation sampling.

<table>
<thead>
<tr>
<th>Species</th>
<th>Basal area &gt;4 cm (m²/ha)</th>
<th>Basal area &gt;12 cm (m²/ha)</th>
<th>Density &gt;4 cm (stems/ha)</th>
<th>Density &gt;12 cm (stems/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas-fir</td>
<td>12.8</td>
<td>9.2</td>
<td>2144</td>
<td>311</td>
</tr>
<tr>
<td>Western larch</td>
<td>12.2</td>
<td>11.2</td>
<td>805</td>
<td>361</td>
</tr>
<tr>
<td>Lodgepole pine</td>
<td>11.9</td>
<td>9.2</td>
<td>1259</td>
<td>614</td>
</tr>
</tbody>
</table>

Figure 1 View of the St. Mary River valley from the trial site.

Table 1 Pre-harvest basal area (outside bark) and stem density of live trees (at >4 cm and >12 cm dbh) across the study area.
Harvesting

Harvesting was completed between November and December 1994. The residual trees over 17.5 cm dbh in each treatment unit were marked to leave to meet the target basal area. Trees were selected to leave based on order of species preference (Douglas-fir > larch >> lodgepole pine), largest diameters, and best form and vigour. Lodgepole pine was targeted for removal as it was at high risk to mountain pine beetle attack. Logging crews were instructed to protect trees less than 17.5 cm dbh for future crop trees.

Four-metre-wide skid trails were laid out before harvest. Trees were hand felled then skidded using either a 1987 Komatsu 37E crawler tractor or 1993 John Deere 540E rubber tire skidder (Figure 3). Skidding was restricted to designated trails to protect regeneration; however, in some circumstances, off-trail random skidding was allowed to minimize damage to overstorey residual stems.

Growth and Yield

Growth and yield data will provide valuable insight into stand development and estimates on timber growth in these treatments, as well as data for modelling programs such as TASS and PrognosisBC. In 1993, sixteen 0.01-ha plots were established in each treatment unit, all live trees over 4 cm dbh were tagged, and data were collected on species, dbh, height, and defects. In 1995, trees remaining after harvest were recorded and assessed for damage. In 2007, plot corners were re-established and permanently marked, plot centres were installed, and all remaining live trees were retagged in preparation for data collection in 2008 (Figure 4). Data will be collected according to the Resources Inventory Standards Committee (2003) standards.
Natural Regeneration and Understorey Vegetation

A 3.99-m radius regeneration/vegetation subplot will be established in the centre of each 10 × 10 m growth and yield plot. Natural tree regeneration density will be recorded for all species by layer class (15 cm to 1.3 m tall; >1.3 m tall to 3.9 cm dbh). Also, up to four trees of each species will be selected in each size class for growth assessments. Vegetation will be assessed in every second plot.

Measurements will include percent cover and modal height for all vegetation species over 0.5% cover and for each layer (moss/lichen, herb, low shrub [<2 m tall], and high shrub [>2 m tall]). Figure 5 illustrates the understorey development in the light retention treatment in 2007.

Understorey Light and Microclimate

Data will be collected to document effects of residual basal area treatments on regeneration performance. Light will be measured at each regeneration plot centre using three different methods: a densiometer, a fisheye-lens camera, and an LAI 2000 plant canopy analyzer. In addition light will be assessed with the LAI-2000 at three heights: ground level, 1.3 m, and above the regeneration layer (defined as trees <4 cm dbh). Light will also be assessed at the individual trees that have been tagged and related to the assessed growth variables. Sensors will be installed to monitor soil moisture, soil temperature, air temperature, and light (photosynthetic photon flux density [PPFD]) in one selected plot for each of the four levels of overstorey retention: untreated, 24 m²/ha, 16 m²/ha, and 8 m²/ha.

Site Occupancy

Measures of tree site occupancy between treatments will be compared using Reinecke’s Stand Density Index (SDI) (Long 1985) and two common survey methods: the deviation from potential survey (Martin et al. 2005) and the uneven-aged stocking survey (B.C. Ministry of Forests 1992). As well, relationships between measures of growing-space occupancy or site utilization, such as light, basal area, relative density, or SDI, as they affect tree growth will be explored.

Ungulate Winter Range Use and Snow Interception Capacity

The trial site is located on ungulate winter range. The types of prescriptions tested could be used to create desired conditions for management of winter habitat (Ungulate...
Winter Range Technical Advisory Committee (2005). This trial provides the opportunity to measure the snow interception capacity and understorey shrub production, which could help in developing appropriate silvicultural systems for winter range in low-elevation Douglas-fir forests in the Rocky Mountain Trench.

Forty measurements of snow depth in each treatment unit were taken in 2007 and 2008 in early February at peak snowpack; this will be repeated in 2009. In addition, 40 measurements of open snow depth will be taken at several large cleared areas adjacent to the treatment units to calculate percent apparent snow interception (ASI). Analysis of variance will be used to test for significant differences among the treatments for ASI. Track transects (200 m in each treatment unit) will be conducted while snow is measured to compare ungulate use of the treatments.

Summary

This trial will provide valuable insight into how complex stands develop, and provide estimates of initial growth of retained trees. The trial will also be used to explore methods that estimate the level of site utilization, and to refine silvicultural methods and standards for complex stands. There is also an opportunity to contribute to development of better management practices on deer and elk winter range.
References


