Relative Costs of Red Alder-to-Conifer Site Conversion
Project No. 2.06

Backlog coastal alluvial sites are among the most productive forest lands in the province, but they are also challenging and expensive to manage. FRDA Project 2.06 is a detailed, multidisciplinary study of nine conversion systems potentially useful for establishing conifers on alder-dominated sites. A minor component of the project being reported here, is to determine the relative costs of each system.

When reviewing the results that follow, two important points must be considered. First, no economic returns from the use of alder are included in the analysis. Should red alder gain economic value on the North Coast, the value of untreated red alder stands should be compared to the costs of conversion systems and the value of the conifer crop. Second, the costs reported in this memo do reflect silvicultural success, as the seedlings in the treated plots will not reach free-growing status for another 3-4 years.

LOCATION

The Selvus test site is an alluvial plain 60 km west of Terrace, B.C. It is a mixture of spruce and Devil’s club/fadly fern/oak fern ecosystems in the CWH on the north side of the Skeena River. The area was logged between 1962 and 1965, bladed scarified in 1971/72, and planted with bareroot Sitka spruce in the spring of 1972. The site preparation treatment favored establishment, by seed, of dense red alder stands, and the spruce plantations failed due to vegetative competition. By 1987, the 16-year-old red alder averaged 15.2 m tall and 10.0 cm dbh with a density of 2200 stems/ha. Under the alder was a dense, 1.5-2.0 m tall understory of thimbleberry, salmonberry, ferns, red elderberry, stink currant, and other herbaceous and woody species.

THE CONVERSION SYSTEMS

Each conversion system consisted of a sequence of treatments chosen in consultation with local silviculturists. Four of the systems involved the application of glyphosate (Roundup®) via backpack sprayer or hand and-squirt; the remaining five systems plus the control were non-chemical in nature. Prescribed fire plots were 1.0 ha (100 m x 100 m) in area. All other plots were 0.5 ha (70 m x 70 m) in size.

The majority of the site preparation treatments occurred in 1987, and the plots were planted in the spring of 1988. One brushing treatment occurred in 1989 and the balance are scheduled for 1990.

The costs associated with the treatment of small, replicated research plots are obviously greater than the costs of large scale, less critically detailed operational treatments. For this reason, the treatment costs and manpower/ha requirements should be compared on a relative, rather than an absolute, scale. This considered, the project is very informative. On a single, uniform site, the same field crew has implemented 10 different conversion systems using a wide range of equipment, and silvicultural strategies. Because the manner in which individual treatments were performed will strongly influence cost, each treatment is described in detail.

Determination of accurate costs and production rates from the small plots was a concern. To address this, the latter stages of each treatment were monitored when the crews were more familiar with the treatments and production was "up to speed". Straight wages were used in all cases because both contract and salaried employees were on the site. If a treatment did not resemble operational practice, a local cost estimate was substituted.

Blading Treatments

In the 0.5 ha mechanical plots, operational mechanical site preparation was not feasible given the experimental design; the researchers needed wide, open areas in which to work without the complications of windrows. Thus, a D-7 cat with 55 cm-wide pads and a brush blade, moved all material out of the plots. The cat had an average push distance of 17.5 m and a maximum push distance of 35 m. Blading cost $1351.00/ha with a labour requirement of 1.75 mandays/hectare (Table 1). This cost includes a swamer and saw, and reflects average production rates after the familiarization period. Lowboy costs for transporting the cat are not included.

More efficient operational patterns, such as windrowing along 40 metre centres or using irregular circular piles routinely cost $1000/ha, with an additional $100-150/ha to burn the piles.

Grass Seeding

Grass seeding was done with cyclone seeders. The seeders were calibrated to deliver 50 kg/ha using a 2.5 m swath. Flagged guide poles were erected at plot sides to ensure even coverage of the plots. The seed mixture used was 45% boreal creeping red fescue, 15% annual rye, 10% Chinook orchard grass, and 30% aurora Aisike clover. This mixture was obtained from Buckerfields of Vancouver at a cost of $1.87/kg.

Grass seeding of bladed plots was an extremely quick and efficient treatment. Once the cyclone seeders were calibrated, two men could treat a 0.5 ha bladed plot in 20 minutes. The treatment cost $121.82/ha, and required 0.17 mandays/ha labour (Table 1).
<table>
<thead>
<tr>
<th>System number</th>
<th>Treatment</th>
<th>Date</th>
<th>Rate of production (mandays/ha)</th>
<th>Treatment cost/ha</th>
<th>Total cost/ha</th>
<th>Relative cost/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control, plant¹</td>
<td>04/88</td>
<td>0.91</td>
<td>$00.00</td>
<td>$481.80</td>
<td>0.21</td>
</tr>
<tr>
<td>2</td>
<td>Blade², plant</td>
<td>07/87</td>
<td>1.75</td>
<td>1351.00</td>
<td>1832.60</td>
<td>0.79</td>
</tr>
<tr>
<td>3</td>
<td>Blade, plant, brush &amp; weed w/ glyphosate³</td>
<td>04/88</td>
<td>0.91</td>
<td>481.80</td>
<td>149.25</td>
<td>0.85</td>
</tr>
<tr>
<td>4</td>
<td>Blade, plant, brush &amp; weed manually⁴</td>
<td>06/90</td>
<td>5.00</td>
<td>500.00</td>
<td>2332.80</td>
<td>1.00</td>
</tr>
<tr>
<td>5</td>
<td>Blade, grass-seed⁵, plant</td>
<td>07/87</td>
<td>0.17</td>
<td>121.82</td>
<td>1954.62</td>
<td>0.84</td>
</tr>
<tr>
<td>6</td>
<td>Fell &amp; buck⁶, burn⁷, plant</td>
<td>04/88</td>
<td>0.91</td>
<td>481.80</td>
<td>1566.30</td>
<td>0.67</td>
</tr>
<tr>
<td>7</td>
<td>Fell &amp; buck, burn, plant, brush &amp; weed w/ glyphosate⁸</td>
<td>06/87</td>
<td>10.00</td>
<td>939.60</td>
<td>1741.04</td>
<td>0.75</td>
</tr>
<tr>
<td>8</td>
<td>Girdle alder⁹, plant</td>
<td>07/87</td>
<td>3.50</td>
<td>297.36</td>
<td>779.16</td>
<td>0.33</td>
</tr>
<tr>
<td>9</td>
<td>Ground spray⁹, blade, plant</td>
<td>07/87</td>
<td>0.75</td>
<td>149.25</td>
<td>1954.62</td>
<td>0.84</td>
</tr>
<tr>
<td>10</td>
<td>Hack-and-squirt¹⁰, Ground spray¹⁰, plant</td>
<td>07/87</td>
<td>0.75</td>
<td>149.25</td>
<td>1954.62</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Notes:
1. Based upon 1100 spf PSB 415 with a seedling cost of $0.238/seedling and a planting cost of $0.200/seedling. Estimate based on local, 1988 operational costs.
2. Based on a cost of $1169.00/ha for a D-7 with brush blade and operator ($83.50/hr), and $182.00/ha ($13.00/hr) for a swampor and saw. Lowboy costs are not included.
3. Based on a cost of $63.72/ha labour ($10.62/hr/man w/o wage loading) with a 2-man crew, and $85.53/ha glyphosate ($14.50/litre) using 2.1 kg a.i./ha.
4. Estimated from operational projects using Husqvarna 165R saws, $425/ha labour ($10.62/hr/man) and $75/ha fuel.
5. Based on a cost of $28.32/ha labour ($10.62/hr/man) and $93.50/ha seed. The seeding rate was extremely heavy in this experiment at 50 kg/ha.
6. Based on a cost of $849.60/ha labour ($10.62/hr/man) and $90.00/ha fuel.
7. Based on an August 10 cost of $144.90/ha for 17 ha. (Future costs can be reduced to $60.00/ha).
8. Based on a cost of $89.21/ha labour ($10.62/hr/man w/o wage loading) with a 2-man crew, and $85.53/ha glyphosate ($14.50/litre) using 2.1 kg a.i./ha.
9. Based on a labour cost of $10.62/hr/man.
10. Based on a labour cost of $233.64/ha ($10.62/hr/man) and $73.32/ha glyphosate ($14.50/litre) using 1.8 kg a.i./ha.
Felling and Bucking

In preparation for the prescribed burns, the fire plots were felled and bucked. Bucking was essential to lower and concentrate the fuels to achieve the desired intensity of burn. Trees were completely severed from stumps to ensure rapid drying, and they were bucked soon after they were felled. Early attempts to fell large areas, then return later to buck the felled trees, were unproductive due to the depth of the slash.

The treatment cost $939.60/ha, and required 10.0 man-days/ha labour. Although fire guards were used, they were unnecessary, and these costs are not included.

It is likely that future fell-and-burn treatments in alder stands will involve hand felling, drying stems for 4-6 weeks, followed by the use of a cat to crush stems and lower the fuel bed. This approach would eliminate bucking and dramatically lower treatment costs.

Prescribed Fire

On August 5, 1987, Kalum Forest District staff attempted to aerially ignite two plots using central ignition patterns. Conditions at the time included a temperature of 20.8°C, a relative humidity of 65%, a wind speed of 5 km/hr, a FFMOC of 84, a DMC of 11, and a DC of 275. The failure of the burns to cover the plots resulted in a decision to call off the operation.

A second attempt was made on August 10, 1987 when the air temperature was 24.6°C, the relative humidity was 49%, the wind speed was 1 km/hr, with an FFMOC of 88, a DMC of 19, and a DC of 308. On this occasion the remaining 4 plots were successfully burned as well as an adjacent 13 ha area in which a 1985 fell-and-burn had been unsuccessful. This older area was bladed in the spring of 1987 to align slash for ground spray operations in 1988. All August 10, 1987 burns were vigorous. The experience from these and earlier burns is summarized in FRDA Memo 032.

Burning costs totalled $144.90/ha during the second attempt as shown in Table 1. Ignition of future burns is expected to cost $50 to $60/ha with no mop-up required.

Hack-and-Squirt

The hack-and-squirt treatment of three, 0.5-hectare plots was performed 16 to 21 days prior to the ground-based broadcast spray of these plots. A 50% solution of Roundup® in water was applied at a rate of 1 ml per cut in a continuous frill at a height of 1.1 m above ground around the stems of standing alder and residual trees in the plots. Leaf necrosis on all treated trees was observed within 10 days after treatment, and by the time of the broadcast spray the canopy had opened, increasing the light levels within the stand. Fall inspection of these plots indicated nearly complete mortality and few missed trees. Costs amounted to $306.96/ha with a manpower requirement of 2.75 mandays/ha.

Broadcast Spray

Three series of ground broadcast sprays have been conducted to date. The first series (system 9) involved ground spraying the understory on July 8, 1989 with CO₂ powered sprayers equipped with flood nozzles on 3 m upright booms. Plots were treated with 2.1 kg a.i./ha glyphosate in 97 L of solution/ha. These plots were bladed four weeks after treatment, at which time understory species exhibited some chlorosis.

The second and third series of broadcast spray treatments (systems 10 and 7) occurred on July 29, 1987 and September 20, 1989, respectively. Equipment, rates, and techniques were identical to the first series.

The production rates given in Table 1 contain equal time for setup and spraying, as determined from the first and second treatments in 1987. Generally, two men could underspray one hectare in 90 minutes, but setup required an additional 90 minutes. In the burned plots, ground vegetation hid unburned alder trunks making footing treacherous; spray time increased to 125 minutes/ha, excluding setup time. For all three treatments, scaled up operations would reduce setup time considerably, and larger, better burns would yield cleaner plots and speed up ground spraying operations.

Girdling

Girdling was accomplished by a three-man crew between July 21-24, 1987. Tools consisted of the Vredenberg plier-type girdler (stems 6 to 15 cm diameter) and the chain-type girdler (larger stems).

Girdling was slower (3.50 mandays/ha) than the hack-and-squirt method (2.75 mandays/ha). Physically, girdling demanded more arm strength, and was more difficult to perform correctly. The main reason for this lower productivity was the variation in size and shape of the alder stems, requiring constant tool changes and careful work to ensure the cambium was completely severed. The cutting bits on the Vredenberg girdler were difficult to sharpen. When dull, the teeth tended to tear through the bark rather than cut cleanly. The chain girdler performed poorly in willow stems; the chain tended to jam in the fibrous bark.

Despite the limitations, girdling defoliated or killed most alder stems by the fall of 1989. Although scorps (i.e. wood gouges used to clean incomplete girdles) were not used, the incidence of cambial bridging was less than 5%. Costs and manpower requirements/ha are given in Table 1. Equipment rental was not included in the cost of $297.36/ha.

Planting

All plots were shovel planted on April 26-28, 1987 with 1+0 FSB 415 western hemlock, western redcedar, and Sitka spruce. The planting was extremely easy, as the site is completely level, and there were no restrictive soil horizons or coarse fragments in the deep, silty-loam regosol. Local estimates of cost and productivity were substituted because the experimental planting did not resemble operational practice.

COMPARING THE CONVERSION SYSTEMS

Total costs for each conversion system ranged from a low of $481.60 for system 1 (control, plant only), to a high of $2332.80 for system 4 (blade, plant and manually brush &
weed). As stated earlier, these costs are of limited use without some measure of silvicultural effectiveness and a "free-growing" silvicultural evaluation of the systems is several years in the future.

However, some interim observations can be made:

1. Girdling has resulted in a dramatic increase in vigour of the understory shrubs and herbs. It appears unlikely that any of the 3 coniferous species planted will become established. Therefore, the treatment appears to have failed despite a low cost of $779.16/ha.

2. Similar observations were made in the control where seedlings were simply planted beneath the alder without further treatment. Both the western hemlock and Sitka spruce are declining in vigour. The western redcedar appears to be growing slowly, but with good vigour. If this species can rise above the shrub layer, later control of all or a portion of the alder overstory could be achieved by girdling or hack-and-squirt treatments.

3. Systems involving a blading treatment and exposure of mineral soil promoted abundant reinvasion of alder. Grass-seeding appears to have reduced the rate of invasion for an additional cost of only $121.82/ha. Provided this treatment does not have detrimental effects on conifer seedlings, it may represent an excellent value.

4. Burning treatments, though expensive, provided moderate control of understory vegetation and prevented extensive reestablishment of alder by seed.

5. By May, 1990, most alder stems in the girdled and hack-and-squirt plots were broken off at the point of treatment. The resulting slash problem has made travel through these plots both difficult and dangerous, and some damage to seedlings is expected from slash press.

For more information on the relative costs of these silvicultural systems, contact:

John Pollack or: Phil LePage
Forest Science Officer Assistant Research
Nelson Forest Region Silviculturist
518 Lake Street Prince Rupert Forest Region
Nelson, B.C. V1L 4C8 Bag 5000,
(604) 354-6200 Smithers, B.C. V0J 2N0
(604) 847-7500