# SX 7801 Q
# Coast and Interior Girdling Trial
# Final Report



Province of British Columbia
Ministry of Forests

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# Coast and Interior Girdling Trial
# Final Report

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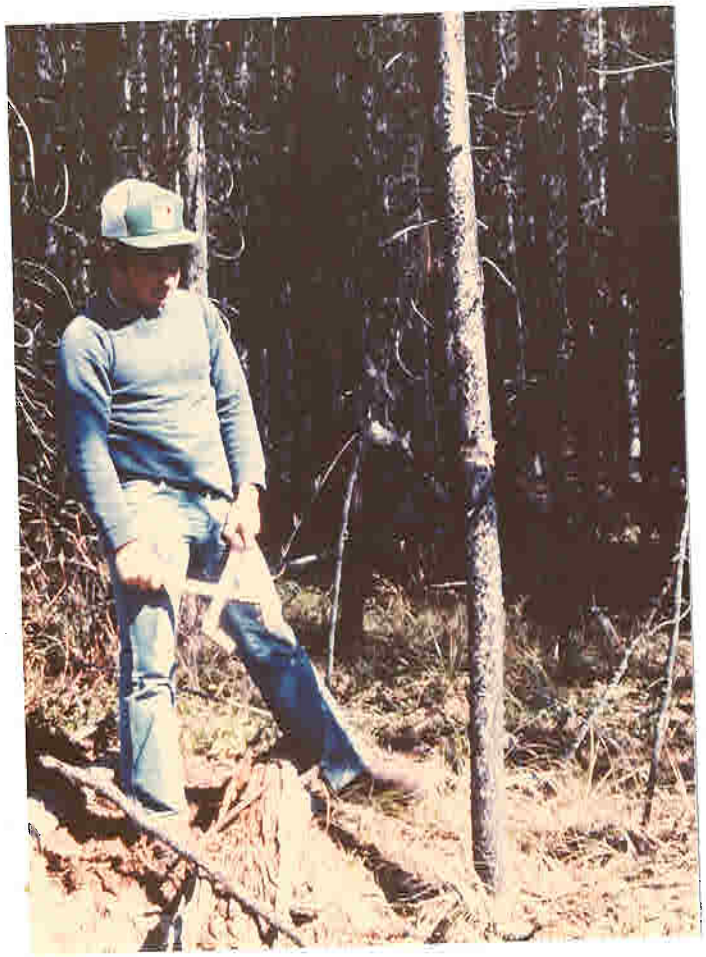
## INTRODUCTION

Most juvenile spacing in British Columbia is done by chain saw. Rising costs of equipment, including fuel and maintenance, and concern for operator safety have led to investigation of alternate spacing methods. Vredenburg North Star Products (Box 135, Fortine, Montana) has recently introduced a girdling tool of Russian design, (Figure 1). The tool is clamped onto the tree stem and manually rotated in a back and forth motion. With adequate pressure, the girdling teeth cut completely through the bark and cambium, interrupting downward translocation of nutrients and growth substances which ultimately results in death of the tree (1).

Figure 1. Vredenburg North Star Tree Girdling Tool



Based on preliminary results of a test conducted by the U.S. Forest Service in Montana (2), the manufacturer claims that:

- production equalling chain saw spacing is possible at one-tenth the cost*;
- safe and foolproof operation is possible afer minimal operator training;
- standing girdled trees retain some snow and wind interception capability, and;
- no slash buildup during treatment reduces fire hazard and obstructions to wildlife.

SX 7801 Q was initiated in 1978 to assess the potential of the North Star Tree Girdler for spacing Coastal and Interior stands in British Columbia. A total of 2120 coastal Douglas-fir and 2000 Interior Lodgepole pine were treated in groups of (approximately) 200 at various times between June 1978 and January 1979. Mortality of treated stems was assessed in the fall of 1979, 1980 and 1981; an attempt to relate mortality to crown class was made in the last two assessments. Final results of this trial are evaluated in this report.

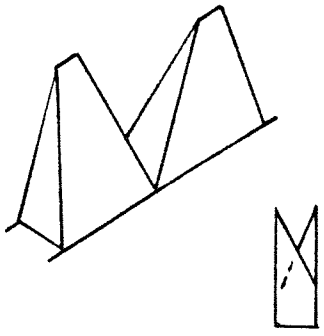
Several associated girdling trials including time and cost studies and girdling of other species (Alnus, Larix) are also discussed.

## METHODS

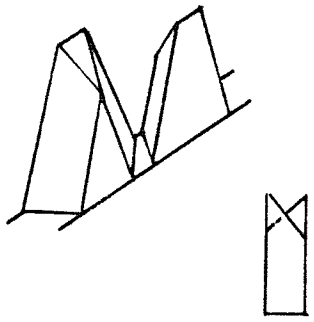
### EFFICACY

A total of 2120 Douglas-fir and Western hemlock (avg. 10 cm dbh) in a 40 year old stand in the Goldstream watershed (Vancouver Island), 2000 Lodgepole Pine (avg. 12.5 cm dbh) and 76 Larch in a 35 year old stand in the Gold Fire area (near Cranbrook) were girdled between June 1978 and January 1979 using the two available models (Fig. 2) of North Star Tree Girdler. (Table 1).

Figure 2: Tooth Design of Girdling Tools Tested



(a) Siberian Beaver Mk I, a single cut tooth design



(b) Siberian Beaver Mk II, a double cut tooth design

*Note: This claim is not conclusively demonstrated by the USFS study.

TABLE 1: Number of stems treated, by tool design and month of treatment.

(a) COAST (Douglas fir)

| | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. |
|---|---|---|---|---|---|---|---|---|
| S.B. Mk. I | 0 | 0 | 0 | 200 | 200 | 0 | 0 | 200 |
| S.B. Mk. II | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |

(b) INTERIOR (Lodgepole pine)

| | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. |
|---|---|---|---|---|---|---|---|---|
| S.B. Mk. I | 0 | 0 | 200 | 200 | 200 | 200 | 0 | 0 |
| S.B. Mk. II | 200 | 200 | 200 | 200 | 200 | 200 | 0 | 0 |

(Larch)

| | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|
| Mark II | 4 | 10 | 14 | 15 | 17 | 16 |

Twelve hundred (1200) Douglas-fir in the Coastal area and 400 pine in the Interior were marked as untreated control stems and monitored to enable estimation of natural mortality for comparison to mortality within treatments.

Assessments of mortality based on needle discolouration were undertaken in all treatments and controls in the fall of 1979, 1980 and 1981, (Table 2). The last two assessments break down total mortality into mortality by crown class (Dominant, Co-dominant, Intermediate and Suppressed).

TABLE 2: Assessment Dates

| | 1st Assessment | 2nd Assessment | 3rd Assessment |
|---|---|---|---|
| Coast | October 1-3, 1979 | September 9, 1980 | October 20-1, 1981 |
| Interior | September 21-3, 1979 | August 30-31, 1980 | September 26, 1981 |

PRODUCTION

Time trials were undertaken in the August, September, and October treatments of Interior Lodgepole pine. Time required to girdle 50 stems was recorded and used to provide a very rough estimate of expected production.

## RESULTS

### EFFICACY

(a) COASTAL DOUGLAS FIR (Table 3).

Mortality of treated stems after 3 years ranged between 89.8% and 98.4%. Variation in mortality after 3 years associated with month of treatment or tool design tested is not large.

While mortality of suppressed stems approached 100% two years after treatment, mortality above 80% in intermediates and 45% in dominant or co-dominant stems was rare until the third year when satisfactory results were observed for all crown classes.

(b) INTERIOR LODGEPOLE PINE (Table 4).

Mortality of treated stems after three years ranged from 85.5% to 90.5%. There is considerable variation in mortality within crown classes after 2 years, but acceptable levels are reached in all classes after 3 years. The general trend to lower mortality in dominant and codominant stems (compared to suppressed and intermediate stems) is not as pronounced as that observed in the Coastal trial; in fact, particularly good results were achieved with treatment of dominant stems (89.1-100% mortality after 3 years).

(c) INTERIOR LARCH (Table 5).

High mortality rates were observed after 2 years (88.9%-100%). Only 2 treated stems remained alive after 3 years, both of which were 50% brown and expected to succumb to treatment soon.

### PRODUCTION

Frequent cleaning of sap and bark from tools during Spring treatments (June and July) slowed production somewhat in both areas; this was not a major problem in later treatments. Interior trials were terminated in November, as girdling of stems became extremely difficult after ambient air temperature dropped and remained below the freezing point.

An average of 205 stems girdled/man hour (range 129-303) was obtained by extrapolation from data obtained by treatment of 4 replicates of 50 trees each, in each of three months (Aug.-Oct., 1978) in the interior test block.

Table 3: Summary of Mortality Assessments of Coastal Girdling Trial (Douglas Fir and Hemlock)

| TREATMENT | % MORTALITY (TOTAL) | | | | % MORTALITY BY CROWN CLASS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | DOMINANT | | | CODOMINANT | | | INTERMEDIATE | | | SUPPRESSED | | |
| | No. Stems | 1979 | 1980 | 1981 | No. Stems | 1980 | 1981 | No. Stems | 1980 | 1981 | No. Stems | 1980 | 1981 | No. Stems | 1980 | 1981 |
| SIBERIAN BEAVER MARK II | | | | | | | | | | | | | | | | |
| JUNE 1978 | *186* | 48 | 73 | 89.8 | *15* | 43.8 | 66.7 | *40* | 33.3 | 76.9 | *46* | 69.4 | 95.7 | *85* | 98.9 | 96.4 |
| JULY | *191* | 40 | 77.5 | 96.3 | *23* | 45.8 | 95.7 | *42* | 46.5 | 85.7 | *37* | 78.9 | 100 | *89* | 100 | 100 |
| AUG. | *193* | 45.5 | 79 | 94.3 | *14* | 23.1 | 81.8 | *35* | 47.1 | 81.3 | *38* | 72.2 | 96.7 | *106* | 99.0 | 97.6 |
| SEPT. | *182* | 26 | 68.5 | 98.4 | *27* | 27.6 | 100 | *38* | 36.6 | 92.1 | *50* | 75.5 | 100 | *67* | 98.6 | 100 |
| OCT. | *194* | 18 | 62.5 | 92.2 | *25* | 28.0 | 69.2 | *44* | 31.8 | 84.1 | *45* | 55.6 | 95.0 | *80* | 93.8 | 100 |
| NOV. | *198* | 38.5 | 77.5 | 98.4 | *13* | 15.4 | 92.3 | *35* | 40.0 | 97.1 | *50* | 76.0 | 98.0 | *99* | 100 | 100 |
| DEC. | *192* | 46 | 80.5 | 96.9 | *8* | 50.0 | 87.5 | *39* | 38.5 | 89.7 | *59* | 83.1 | 98.3 | *86* | 100 | 100 |
| JAN. 1979 | *195* | 27 | 56.5 | 94.4 | *16* | 0 | 75.0 | *54* | 24.4 | 90.7 | *57* | 59.6 | 96.5 | *68* | 100 | 100 |
| SIBERIAN BEAVER MARK I | | | | | | | | | | | | | | | | |
| SEPT.1978 | *194* | 38.5 | 72 | 93.8 | *26* | 32.0 | 80.8 | *40* | 46.2 | 90.0 | *38* | 64.9 | 92.1 | *90* | 97.7 | 100 |
| OCT. | *198* | 38.5 | 74 | 95.4 | *30* | 41.4 | 90.0 | *43* | 45.2 | 86.4 | *47* | 77.8 | 100 | *78* | 100 | 100 |
| JAN. 1979 | *197* | 31.0 | 63.5 | 94.9 | *19* | 5.5 | 73.7 | *49* | 16.7 | 89.6 | *47* | 65.9 | 100 | *82* | 98.7 | 100 |
| CONTROL | | | | | | | | | | | | | | | | |
| AVERAGE | *2200* | | | 1.85 | *295* | | 0 | *498* | | 0 | *480* | | 1.32 | *927* | | 3.45 |

Table 4: Summary of Mortality Assessments of Interior Girdling Trial (lodgepole pine)

| TREATMENT | % MORTALITY (TOTAL) | | | | % MORTALITY BY CROWN CLASS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | DOMINANT | | | CODOMINANT | | | INTERMEDIATE | | | SUPPRESSED | | |
| | No. Stems | 1979 | 1980 | 1981 | No. Stems | 1980 | 1981 | No. Stems | 1980 | 1981 | No. Stems | 1980 | 1981 | No. Stems | 1980 | 1981 |
| SIBERIAN BEAVER MARK II | | | | | | | | | | | | | | | | |
| JUNE 1978 | 200 | 33.5 | 85.5 | 89 | 18 | 72.0 | 94.4 | 62 | 83.8 | 80.6 | 90 | 87.9 | 90.0 | 30 | 90.0 | 100 |
| JULY | 200 | 10.5 | 78 | 85.5 | 36 | 68.6 | 100 | 76 | 73.3 | 83.0 | 75 | 84.9 | 78.5 | 13 | 92.3 | 100 |
| AUG. | 200 | 4 | 78.5 | 89.5 | 80 | 78.6 | 97.5 | 63 | 68.3 | 74.6 | 42 | 90.5 | 90.5 | 15 | 86.7 | 100 |
| SEPT. | 200 | 0 | 62 | 90 | 77 | 50.6 | 96.1 | 60 | 65.0 | 76.7 | 34 | 58.8 | 91.2 | 29 | 89.7 | 100 |
| OCT. | 200 | 1 | 29.5 | 85.5 | 30 | 30.0 | 100 | 80 | 27.5 | 82.8 | 58 | 12.1 | 72.4 | 32 | 65.6 | 100 |
| NOV. | 200 | 4 | 42 | 90.5 | 18 | 10.9 | 89.1 | 71 | 25.4 | 60.5 | 64 | 39.3 | 95.3 | 47 | 78.4 | 100 |
| SIBERIAN BEAVER MARK I | | | | | | | | | | | | | | | | |
| AUG. 1978 | 200 | 4.5 | 80.5 | 89.0 | 41 | 82.9 | 100 | 69 | 77.5 | 74.6 | 19 | 78.3 | 95.7 | 22 | 94.7 | 94.7 |
| SEPT. | 200 | 3.0 | 64.4 | 86.5 | 70 | 56.8 | 95.9 | 72 | 56.6 | 75.1 | 42 | 75.2 | 85.4 | 16 | 100 | 100 |
| OCT. | 200 | 1.5 | 39.5 | 90.0 | 84 | 38.1 | 98.5 | 71 | 31.0 | 70.2 | 31 | 54.8 | 75.0 | 14 | 64.3 | 100 |
| NOV. | 200 | 3.5 | 42.5 | 86.5 | 81 | 34.6 | 100 | 53 | 34.0 | 69.1 | 56 | 60.7 | 79.3 | 10 | 50.0 | 100 |
| CONTROL | | | | | | | | | | | | | | | | |
| CONTROL | 200 | 0.5 | 0.5 | 0.5 | 119 | 0 | 0 | 60 | 0.98 | 0.98 | 20 | 0 | 0 | 1 | 0 | 0 |

Table 5: Summary of Mortality Assessments of Interior Girdling Trial (Larch)

| TREATMENT | No. Stems | % MORTALITY 1979 | 1980 | 1981 |
|---|---|---|---|---|
| June 1978 | *4* | 100 | 100 | 100 |
| July 1978 | *10* | 100 | 100 | 100 |
| Aug. 1978 | *14* | 7.1 | 92.3 | 100 |
| Sept. 1978 | *15* | 26.7 | 93.3 | 93.3 |
| Oct. 1978 | *17* | 29.4 | 88.9 | 100 |
| Nov. 1978 | *16* | 37.5 | 93.8 | 93.8 |

## DISCUSSION

### EFFICACY

Results noted in the third year after treatment (Tables 3, 4 & 5) suggest that girdling will result in acceptable mortality in all crown classes of all species treated (Douglas fir, western hemlock, lodgepole pine and larch). Assessment of mortality was based on needle discolouration only; treatment was not judged satisfactory until 100% browning of tree crown was observed. It is probable that mortality preceeded observation of this condition. An average of 87.5% mortality was reported one year after treatment of 400 Red Alder (Alnus rubra) by a Forest Service crew at Gold River (3). It seems reasonable at least to hypothesize that competition for soil moisture and nutrients is reduced soon after girdling, as uptake and new growth by root tissues is, in part, dependant on the availability of photosynthate normally transported down the stem in phloem tissues (5, 6). Crown needles may remain green for longer periods if the cambium is not scored deeply enough to prevent upward translocation of water in the xylem (1).

### PRODUCTION

Production estimates are difficult to interpret generally; production is dependant on stand density and species composition, dbh and branchiness of individual stems, terrain, season, and weather. Very dense stands restrict operator mobility and make proper rotation of the tool difficult. Optimum stem size for treatment with this tool is 5-11 cm dbh; smaller stems lack the necessary rigidity and girth while larger stems require excessive time and energy expenditure. Girdling must be performed below the lowest live branch, or lower branches must be removed, to ensure success. Spring treatments (during maximum sap flow) were slowed by buildup of sap and bark in the girdling teeth which necessitated frequent cleaning, while winter treatments in the interior, under freezing conditions, were judged too difficult to be practical. Optimum time of treatment in the interior, from a production stand point, is August to October. General quantitative estimates of operational costs are not possible at present; cost of treatment is highly dependant on the above conditions and treatment prescription.

Although the manufacturer claims production rates of 300-500 stems/manhour, rough production estimates undertaken in the interior test block do not support this claim (avg. 205 stems girdled/manhour; range 129-303 stems/manhour). Operational trials undertaken by the US Forest Service on a 2 ha larch, Douglas fir and lodgepole pine stand (avg. 4.4 cm dbh) in Montana (2) thinned to 4900 stems/ha from 14,650 stems/ha resulted in 100-120 stems girdled per manhour (84.8 manhours/ha). A very small area ( .2 ha) near Kettle Valley Ranger Station in a 40 year old lodgepole pine-larch stand was thinned to 1000 stems/ha from 11,800 stems/ha by a BC Forest Service Crew in 1978 using a two pass system; stems under 6 cm dbh were removed by Sandvik prior to girdling of larger stems (4). Production rates were extrapolated to 32.8 manhours (total time)/ha; sandvik - 21.0 manhours/ha, girdling - 11.8 manhours/ha. This may prove to be the most economical way of treating very dense stands with many small stems.

In a time and cost comparison between hack and squirt (9.6 ha) and girdling (1.4 ha) of alder for conifer release near Gold River, reported by Vancouver Region in 1980, girdling required 26.4 manhours/ha while hack and squirt treatment required 33.3 manhours/hectare (3). When cost of chemical required for hack and squirt treatment is considered in conjunction with labour costs, girdling would appear to represent a substantial saving.

GENERAL

Girdling offers several advantages worthy of consideration from cost, safety, and environmental viewpoints:

- initial cost of equipment is relatively low;
- equipment maintenance requirement is low;
- no fossil fuels or chemicals are required;
- safe operation of the tool requires minimal operator training;
- treated trees left standing may reduce fire hazard and provide some protection to leave trees from wind and snow damage in the short term. The method is suited mainly to trees past optimal spacing age (eg. 35 year old lodgepole pine);
- cattle and wildlife access is not impeded;
- treatment of some environmentally sensitive areas is possible (eg. areas of high recreation or grazing value which preclude saw spacing or areas bounding water where chemical spacing is not advised);
- girdle marks are visible from all sides and may be used to provide control within chemical treatment areas (rather than string, flagging or paint) without sacrificing productive time.

Some operator preference for chain saws over the girdling tool was expressed in all trials. It is likely that this reflects a natural preference for power tools over manual tools; evidently a high degree of physical effort is required to maintain optimum production over extended periods with the muscle powered girdling tool. Girdling may provide less job satisfaction to crews used to saw spacing as immediate results are not as dramatic. Emphasis placed on environmental and safety advantages may outweigh this factor.

In view of the low safety hazard and simple operation of the girdling tool, it may prove feasible to utilize local labour for conifer release or spacing of appropriate sites in connection with government job creation programs.

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