Research Forest

Summary of Shelterwood Codominant Ten Year Response in 50% BA Removal Treatment

Research Project # 01-04

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Quick Sheet #17

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Objectives:

The uniform shelterwood at Gavin Lake on the Alex Fraser Research Forest is in a 115 year old Douglas-fir-lodgepole pine stand. The first harvest entry was in the summer of 1991. The objectives of this study were to analyze stem increment and wood allocation patterns in mature interior Douglas-fir codominant trees during the 10 years following the initial harvest entry. Earlier studies in 12m tall 45 year old Douglas-fir near 100 Mile House showed that following pre-commercial thinning, slenderness ratios declined due to a temporary reduction in height increment, an increase in stem radial increment and an increase in basal allocation of stem wood. The greatest reduction in slenderness was in trees with the highest initial slenderness. The greatest rate in downward adjustment occurred in the five years following thinning. Little further adjustment occurred after 10 years. Small trees are able to rapidly increase the ratio of crown:stem volume resulting in large relative increases in radial increment in a short period of time. This is not the case for larger trees. It was therefore expected that the period of slenderness adjustment would be longer, and that reduction slenderness would result principally from reduction in height increment and greater basal allocation.

Methods:

In February 2001, during the second harvest entry into the shelterwood trials, 6 codominant trees were sampled from the 50% removal treatment (Shelterwood Road - TU 4). An additional 6 codominant trees were sampled from the unharvested stand immediately east of the shelterwood. Disks were taken from the stem at 30cm (1%), 130cm (5%), 450cm (15%), 33%, 59%, 84% and 92% of current tree height. Annual height increments during the period from 1980 to 2000 were recorded. Ring increments in each cardinal direction (N, E, S, W) were measured to the nearest 0.001cm using a stereomicroscopic-mechanical scanner. Data was compiled and analyzed using SAS statistical software. The following variables were calculated for each year: height increment (HTinc), DBH increment inside bark (DBHinc), slenderness (HDR), average ring width over the bole (specific increment – RVI), ratio of ring volume in the lower stem to that in the upper stem (allocation - RV50), and the ratio of ring increment at each disk height to RVI (relative ring width - RRW).

Results:

The mean height of the sample trees was 28.8m. Mean DBH outside bark was 32cm (control) and 33cm (shelterwood). Mean slenderness is therefore approximately 90. The result for each of the response variables is shown in the attached figures. The error bars are +/- 1 standard error. Differences are significant ($p<0.05$) where the error bars do not overlap.

Height increment was significantly lower in the shelterwood codominants for all years after 1990 except 1998 (Figure 1). In 1993 it was only 41% of that in the control trees. Diameter increment (DBHinc) was similar to that of the control trees until 1994. In 1996 it was 73% higher than the controls (Figure 2). Slenderness (HDR) of the shelterwood trees began declining in 1993, and continues to decline during a period when that of the controls is constant. The rate of adjustment appears to have slowed in 2000, however it appears that

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several more years of downward adjustment would have occurred had the trees not been harvested (Figure 3). The total adjustment to date is -4%. The average ring width over the bole (RVI) indicates that the increase in DBH increment is not due to an increase in overall stem increment, but reflects downward allocation of wood (Figure 4). This is borne out by the trend in the allocation ratio (RV50) over time. The ratio continues to increase in the shelterwood trees up to and including the year 2000 (Figure 5). The relative ring width plots clearly show the increase in stem increment in the lower 15% of the stem is at the expense of stem increment in the upper half of the stem. Also interesting to note is the degree to which lower stem increment suffered compared to upper stem increment during the drought years of the late 1980's (Figures 6 and 7).

Conclusions:
Codominant trees within the shelterwood (50% BA removal treatment) have undergone a period of form adjustment over the 10 years following the initial entry. The adjustment is primarily due to a large reduction in height increment, and moderate increases in basal allocation. There is no apparent increase in overall stem increment. The absolute adjustment in slenderness is relatively small, and does not appear to have equilibrated prior to harvest, although the recovery in height increment and apparent inflection in the HDR curve suggests that the period of peak adjustment is over.

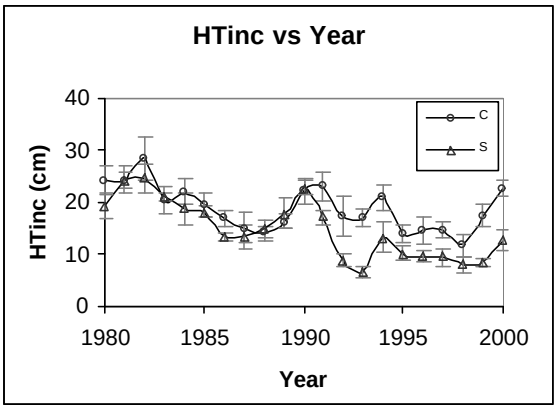

Figure 1

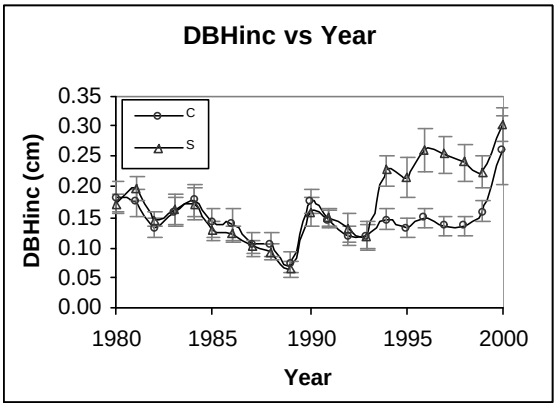

Figure 2

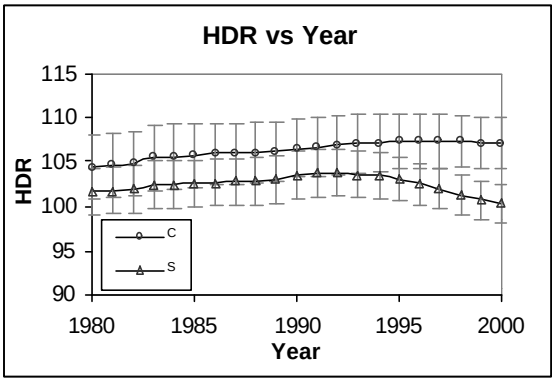

Figure 3

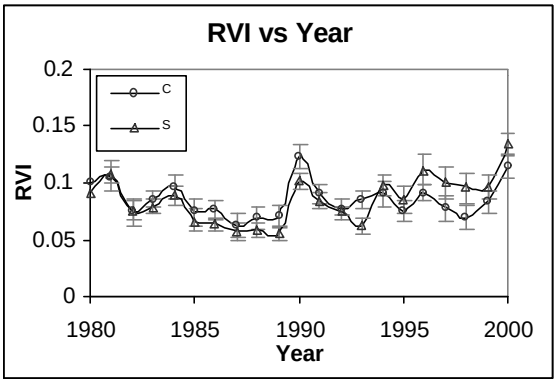

Figure 4

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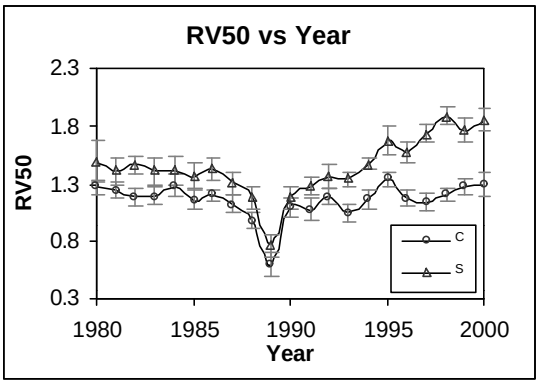

Figure 5

Figures 1-5. Mean height increment (HTinc), breast height diameter increment (DBHinc), slenderness (HDR), average ring width (RVI) and allocation ration (RV50) for control (C) and shelterwood (S) codominant trees before and after the initial harvest entry in 1991. Vertical bars are +/- 1 standard error.

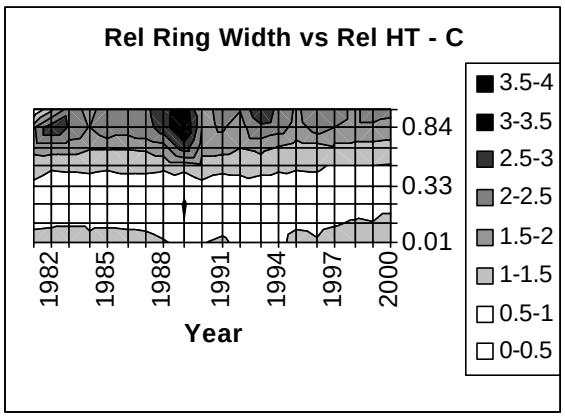

Figure 6

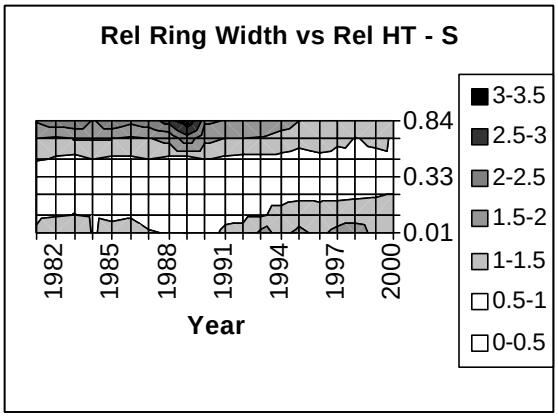

Figure 7

Figures 6-7. Contour plots of relative ring width (shading) at relative height in stem (vertical axis) by year (horizontal axis). Note – the vertical scale represents disk position in the stem and is non-linear.

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