University Research Forests Extension Note Series

Quicksheet #22

13-Year Results of an Interior Douglas-fir Precommercial Thinning Experiment

Research Project 88-11

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Stands of uneven-aged interior Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco) form an important portion of the harvest in the central and southern interior of British Columbia. This forest type is structurally complex due to a history of disturbances from partial cutting, insects, and fire. In addition to being important from a timber perspective, many interior Douglas-fir stands provide important winter habitat for mule deer (*Odocoileus hemionus hemionus* Raf.), which has been the subject of many studies in the region[1].

Large trees are essential to good mule deer winter range. Recruitment of sapling-sized trees to larger diameters is necessary to replace large trees that die from various causes or that are harvested. Recruitment is especially necessary in areas that meet other criteria for good winter range, but presently lack sufficient numbers of large trees, often because of diameter-limit logging in the past. Removal of some portion of the smaller trees in dense patches (precommercial thinning, sometimes called juvenile spacing) is one possibility for increasing the growth rate of individual trees. If successful, this treatment will be beneficial from both a timber and a mule deer winter range perspective.

This note summarizes the results to date of a precommercial thinning experiment carried out in the Knife Creek Block of the Alex Fraser Research Forest, near Williams Lake, BC. Funding for remeasurements in 2004 was provided by the FIA Forest Science Program.

Key Words:

- precommercial thinning
- clumpy spacing
- mule deer habitat
- growth and yield

An example of 5 m Clumpy Spacing

[1] Armleder, H.M., M.J. Waterhouse, R. Dawson and K. Iverson. 1998. Mule deer response to low-volume partial cutting on winter ranges in Central Interor British Columbia. B.C. Min. For., Victoria B.C., Research Report 16.

Experimental Layout

Three 40 ha blocks were divided into quarters, three of which received different spacing treatments, and the fourth was a control. A slight elevational and accompanying moisture gradient exists, from lower and drier in the western part of the Knife Creek block (Block B) to higher and moister in the eastern part (Block D). The areas were logged in the 1950s and 1960s to some diameter limit (possibly 25.4 cm), so many but not all of the larger trees were removed at that time. This disturbance caused a flush in natural regeneration and a release of existing advance regeneration.

In 1989-90 two 0.05 ha plots were established in each of the quarters resulting in 8 plots per block and 24 plots for the study. The plots were situated in locations most likely to show the largest measurable response to spacing regimes, i.e., the densest areas. Trees >1.3 m in height within the plot boundaries were tallied by diameter and species before thinning to provide a record of pre-treatment conditions.

The precommercial thinning treatments applied were: the 1991 standard prescription for these types of stands (S) and two clumped designs (C1 and C2). The focus of the **standard prescription (S)** was to leave most larger trees (≥12.5 cm dbh) uncut, and for smaller trees allow an average spacing of 2.5 m for Douglas-fir or spruce (*Picea engelmanni* x *glauca*) and 2.8 m for lodgepole pine (*Pinus contorta* var *latifolia*). The object of the clumped designs was to leave trees in clumps according to height class. Classes were: 1 - 3 m, 3 - 7 m, 7 - 15 m, and > 15 m. A clump was defined as 3 to 9 trees in the same height class within a 3-m radius circle. Spacing within a clump could vary between 0.5 m and 2.5 m. Trees < 25 cm dbh in the same or lower height classes were to be removed within either 3 m (**3 m Clumped – C1**) or 5 m (**5 m Clumped – C2**) of each clump. Controls were **unspaced (U)**.

Clumpy spaced trees are showing greater volume growth.

The spacing treatments were applied in the late fall and early winter of 1990-91. The plots were re-established in early 1993. At this time, all trees >1.3 m in height within the confines of the plot and those trees >10 cm dbh within a 5 m distance of the plot boundary were permanently tagged. The species of each tagged tree was recorded, along with measures of dbh, total tree height, height to the base of the live crown (for each of four quadrants around the tree), crown width (in two directions), and vigour. The locations of all tagged trees were also mapped.

The plots were remeasured in the spring/summer of 1997 and 2004. Diameters of all living trees were measured in the spring; other measurements did not include current year foliage, so the measurements were inclusive of the 1996 and the 2003 growing seasons, respectively.

Results

The period from 1997-2003 saw some significant mortality in lodgepole pine due to mountain pine beetle attack in some of the plots. Since lodgepole pine was not distributed evenly among the plots and treatments, and because the attack varied in severity among plots, the growth response to the various treatments was confounded by this mortality. A considerable range of growth among plots within a treatment resulted. For example, the seven-year periodic volume growth based on the six plots within treatment C2 varied from a loss of almost 36 m^3/ha to a gain of almost 58 m^3/ha.

In order to adjust for the uneven impact of logdepole pine mortality, the dead trees were added back into the plot totals and the growth rates were recalculated. Table 1 lists the growth response since the last measurement in 1997, after adjusting for lodgepole pine mortality. Table 2 compares the 13-year average yearly net growth rates by treatment and growth period after adjusting for lodgepole pine mortality.

Summary of the Impacts of Thinning After 13 Years

- The thinned plots averaged higher levels of ingrowth, considerably less mortality, greater basal area per ha growth, larger changes in

Table 1. Seven-year growth (1997 to 2003 growing seasons) adjusted to offset the impact of lodgepole pine mortality.

Block	Treatment	Plot	Periodic Change					
			Ingrowth (St./Ha)	Mort. (St./Ha)	BA/ha (m^2/ha)	Volume (m^3/ha) [1]	QMD (cm)	RD
B	C1	1	0	0	5.78	43.8	1.3	1.2
	C1	2	0	40	4.21	34.4	1.1	0.8
C	C1	21	60	280	3.57	68.7	1.4	0.5
	C1	22	300	360	5.41	71.1	1.2	1.1
D	C1	11	0	100	4.83	61.3	1.0	0.9
	C1	12	0	40	5.46	58.5	1.3	1.1
Avg.	**Period**		**60**	**137**	**4.88**	**56.3**	**1.22**	**0.95**
Avg.	**Year**		**9**	**20**	**0.70**	**8.0**	**0.17**	**0.14**
B	C2	5	0	80	3.83	26.2	1.2	0.7
	C2	6	0	0	3.94	40.4	1.1	0.7
C	C2	17	100	20	5.09	49.4	1.3	1.1
	C2	18	140	60	5.43	52.1	1.4	1.2
D	C2	13	40	60	5.29	49.2	1.7	1.0
	C2	14	40	80	4.60	57.6	1.7	0.8
Avg.	**Period**		**53**	**50**	**4.70**	**45.8**	**1.40**	**0.92**
Avg.	**Year**		**8**	**7**	**0.67**	**6.5**	**0.20**	**0.13**
B	S	7	0	60	4.74	40.2	1.3	0.9
	S	8	0	60	4.42	37.5	1.4	0.8
C	S	23	200	80	4.40	49.8	0.5	1.0
	S	24	0	20	5.07	48.0	1.6	0.9
D	S	9	40	380	3.74	38.9	1.8	0.4
	S	10	20	80	5.17	45.8	1.5	1.0
Avg.	**Period**		**43**	**113**	**4.59**	**43.4**	**1.35**	**0.83**
Avg.	**Year**		**6**	**16**	**0.66**	**6.2**	**0.19**	**0.12**
B	U	3	20	1420	3.69	36.5	1.0	0.3
	U	4	0	840	4.75	41.8	1.0	0.7
C	U	19	20	500	4.70	54.5	1.0	0.9
	U	20	0	580	4.80	62.1	1.2	0.7
D	U	15	0	420	4.10	56.5	0.9	0.7
	U	16	60	840	1.07	37.1	1.4	-0.3
Avg.	**Period**		**17**	**750**	**3.85**	**48.1**	**1.08**	**0.52**
Avg.	**Year**		**2**	**107**	**0.55**	**6.9**	**0.15**	**0.07**

[1] Total volume – i.e. volume of the whole bole, including stump and top segments, for living trees only.

Table 2. Comparison of the average yearly growth rates by treatment and growth period (after adjusting for lodgepole pine mortality).

Growth Period	Treatment	Average Yearly Change					
		Ingrowth (St./Ha)	Mort. (St./Ha)	BA/ha (m^2/ha)	Volume (m^3/ha)	QMD (cm)	RD
1993-1996	C1	10.0	19.2	0.88	6.72	0.22	0.19
1997-2003		8.6	19.6	0.70	8.04	0.17	0.14
Average[a]		**9.1**	**19.5**	**0.77**	**7.56**	**0.19**	**0.16**
1993-1996	C2	11.8	5.8	0.83	5.25	0.25	0.18
1997-2003		7.6	7.1	0.67	6.54	0.20	0.13
Average		**9.1**	**6.6**	**0.73**	**6.07**	**0.22**	**0.15**
1993-1996	S	12.5	15.0	0.90	5.80	0.23	0.19
1997-2003		6.1	16.1	0.66	6.20	0.19	0.12
Average		**8.4**	**15.7**	**0.75**	**6.05**	**0.20**	**0.15**
1993-1996	U	5.0	78.2	0.59	5.08	0.12	0.12
1997-2003		2.4	107.1	0.55	6.87	0.15	0.07
Average		**3.3**	**96.6**	**0.56**	**6.22**	**0.14**	**0.09**

[a] The average is weighted by the number of years in each of the growth periods.

Quadratic Mean Diameter and higher increases in Relative Density than did the control plots. Average total volume per ha growth was similar between the control plots and treatments C2 and S. Note, however, that a much larger proportion of the volume growth in the control has accumulated on trees that will not become merchantable.

- Volume per ha growth was consistently the highest (by more than 1m^3/ha/year) in plots that received treatment C1.
- The growth responses to the three thinning designs were similar to one another, with the exception of volume per ha growth. However, as expected the heaviest thinning (treatment C2) had the least mortality, the largest increase in QMD, and slightly lower basal area per ha growth than the other two thinning treatments.

Measurements will continue in future.

Related Reports

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