Foothills Forest

White Spruce Shelterwood Trial

Marlboro Working Circle

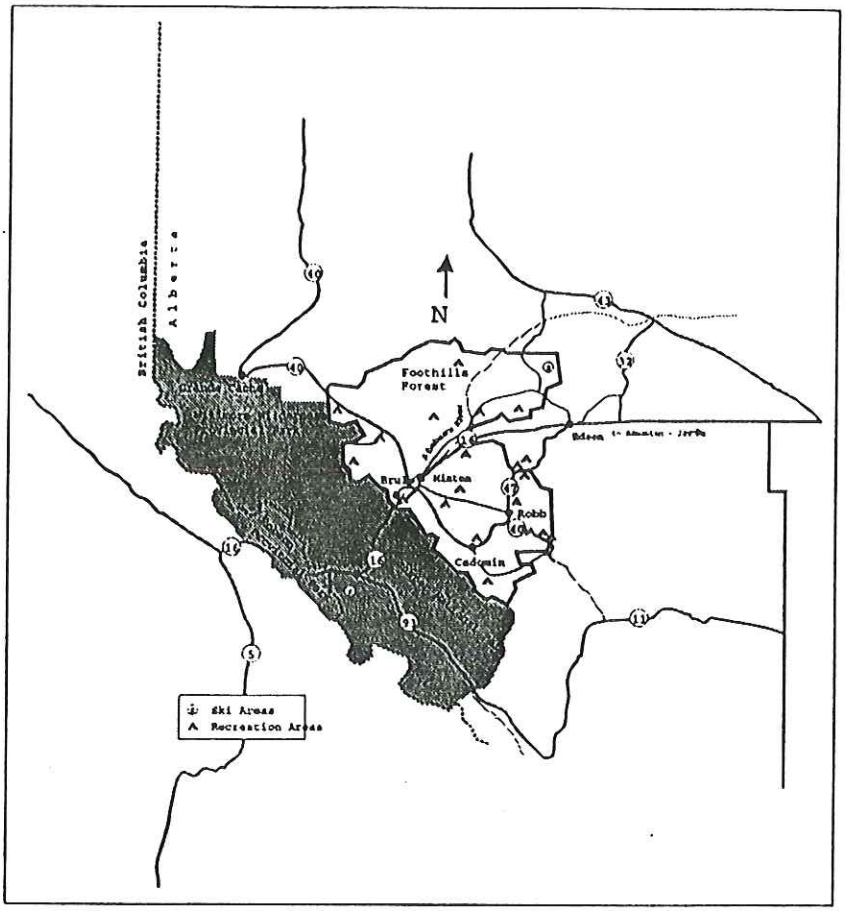
MODEL FOREST NETWORK
RÉSEAU DE FORÊTS MODÈLES

Alberta
ENVIRONMENTAL PROTECTION

Weldwood
Weldwood of Canada Limited
Hinton Division

Foothills Forest Overview

The Foothills Forest is a joint venture of Weldwood of Canada Limited (Hinton Division), Alberta's Forest Technology School, and Alberta's Department of Environmental Protection. The three sponsors share a common vision of sustainable development and integrated management of forest resources through conservation and cooperation.



The Foothills Forest contains 1,208,014 hectares of forested land in west central Alberta. The area itself is found in the foothills adjacent to Jasper National Park. The majority of the Forest is comprised of Weldwood's Forest Management Agreement area (just over 1 million hectares) that has been continuously and progressively managed for over 37 years.

The three sponsoring partners all have their own resource management mandates which remain unchanged even though the Foothills Forest overlies the forests under their areas of separate jurisdiction. It is hoped that the results of the many activities and research projects now underway in the Foothills Forest will be evaluated and, where appropriate, put into place by not only the sponsors but other resource management agencies in Alberta and Canada.

Major Initiatives

A five year program has been developed for the Foothills Forest which addresses our mission - "to develop and recommend an approach to sustainability and integrated resource management through research and technology developed by means of collaborative partnerships. This approach will achieve local, national and international recognition". This program is directed towards the following strategic initiatives including:

- integrated resource management and sustainability
- information, research and knowledge

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- partnerships
- communications

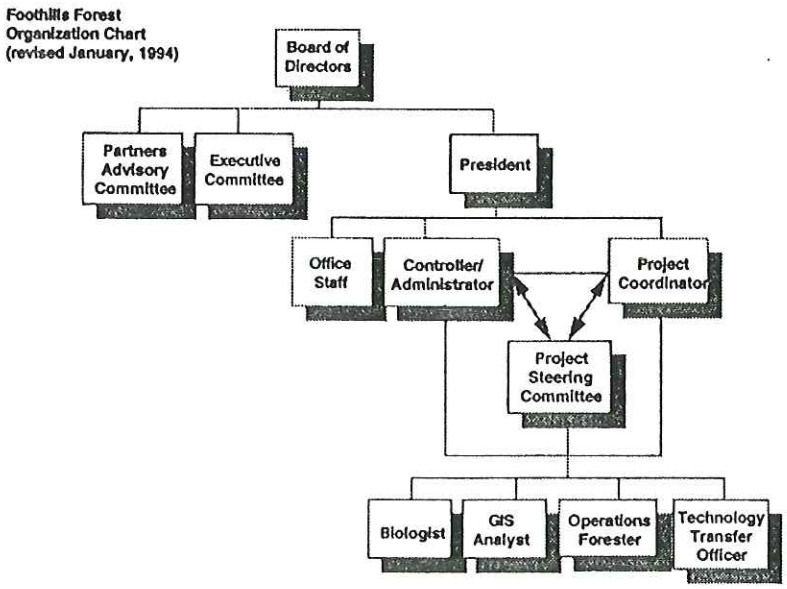
From these initiatives a series of projects and activities were developed including such things as resource inventories, ecosystem classification, decision support system development, integration of commercial and non-commercial forest uses, harvesting and silviculture, computerized planning/mapping and training tools, public information, and demonstration of integrated resource management.

In developing the proposal, a number of potential partners were contacted for either general or specific participation in the project. Over 70 different individuals, groups or organizations have confirmed their intent to participate.

The Foothills Forest is a non-profit corporation under Alberta law. Business is conducted through a Board of Directors which has 10 members: three from Weldwood of Hinton, two from the Forest Technology School, two from the Department of Environmental Protection, one from Jasper National Park, and two elected members from the various partner organizations.

The agreement between the Government of Canada and the Foothills Forest was finalized on March 1, 1993 and originally totalled $5 million over its five year term. That amount has since been reduced due to Green Plan cutbacks.

Foothills Forest Organization



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Adapting Shelterwood Practices to Enhance and Protect Natural White Spruce Regeneration in Deciduous/Coniferous Mixedwoods

Introduction/Purpose:

Almost 90 percent of the Foothills Forest is characterized by pure and mixed conifer stands of pine, spruce and subalpine fir within the Subalpine, Upper Boreal Cordillean and Lower Boreal Cordilleran Ecoregions. About 10 percent is mixedwoods with significant deciduous composition, in the Lower Boreal Cordilleran and Boreal Mixedwood Ecoregions. Historically, coniferous species have been utilized, and clearcutting has been the primary silvicultural system, applied mainly to coniferous stands.

Recent dramatic increases in demand for the deciduous component of mixedwood stands, characterized by aspen, poplar and white spruce - commonly as an understoryhas coincided with increased concern about alternatives to clearcutting and maintenance of the relatively diverse composition, structure and function of mixedwoods (biodiversity). Mixedwoods common to the Foothills Forest are ecologically suited to management by systems other than clearcutting, particularly shelterwood, which can beadapted to facilitate enhancing and protecting natural spruce regeneration. Such an approach addresses the well-known problem of maintaining the coniferous component within boreal mixedwoods throughout Canada. They tend to revert to deciduous stands when clearcut, making reintroduction of coniferous species like spruce costly and risky. The maintenance of conifers in the mixedwood is important from wildlife and aesthetics as well as timber production perspectives.

The application of shelterwood silviculture to white spruce management is not new in Western Canada. It has historically been researched and practiced most successfully in stands with a high coniferous content, prior to the introduction of modern mechanized harvesting equipment. However the adaptation of shelterwoodsilviculture to enhance and protect natural white spruce regeneration in mixedwoods with a high deciduous content, using modern mechanized harvesting equipment, is new, and merits both research and demonstration in support of innovative mixedwood management strategies with application within and well beyond the Foothills Forest.

End Results: Goals and Objectives:

The goal of this project is to adapt shelterwood silvicultural practices to deciduous/coniferous mixedwoods, composed of 60% or more deciduous species, in order to enhance and protect natural white spruce regeneration.

This project will provide data and demonstrations relevant to current mixedwood management issues including harvesting, site preparation and tending treatments which favour natural regeneration, mechanical harvesting impacts on established immature spruce, alternatives to clearcutting for spruce, which is one of the few species in the Foothills Forest ecologically suited to alternative systems, and maintenance of biodiversity in forest structure, function and composition.

Objectives within the above goal include:

1. Evaluate even-age shelterwood systems with two different levels of canopy removal and site preparation for enhancement of white spruce establishment in mixed predominately aspen stands;

2. Determine the response of shrubs, herbs and grasses to the seeding cuts of shelterwood systems and their interference with white spruce establishment;

3. Determine the quality (density and growth) of aspen regeneration under the conditions of the seeding cuts of shelterwood systems and relate these to light and temperature thresholds;

4. Determine light transmission levels through the canopy after the seeding cuts of shelterwood systems;

5. Demonstrate the adaption of modern mechanized harvesting systems to achieving protection of established immature spruce.

6. Monitor and demonstrate the incorporation of protected immature spruce into mixedwood stocking standards, and its role in future stand structure and growth and yield.

Methods and Activities:

There are a total of 3 treatments each replicated 4 times. Two replications were done in 1993/94 (Marlboro 14, block 89) and two willbe done in 1994/95 (Cache Percotte Forest - tentative).

The treatments for Shelterwood are:

1. Control (understory removed)

2. Light Reduction Canopy Removal
   - will leave residual trees of approximately 25 white spruce and 125 aspen.

3. Heavy Reduction Canopy Removal
   - will leave residual trees of approximately 25 white spruce and 25 aspen.

Pre-Harvest:

- A pre-harvest assessment for partial cutting will be done on selected stands. Density, basal area, age and height of merchantable trees of each species will be determined. Amount of understory (unmerchantable >1.3m in height and regeneration < 1.3m in height) was recorded.

- Low-level air photographs will be used to determine the spatial distribution of the canopy-sized spruce.

- Each treatment block will be 150m X 150m (2.25 ha). Within each block will be a 25m buffer leaving a 1 ha plot within the buffes. The entire 2.25 ha block will have appropriate treatment conducted on it but sampling will be within inner 1 ha..

- Trees to be left after the seeding cut will be marked in the 2.25 ha block.

- Each plot (including Control) will have the 1ha plot divided in thirds. Each third will be randomly selected for site preparation (one third to remain as a control). The site preparation will expose mineral soil.

- The four most important herbs and shrubs (two of each) will be identified and the aerial cover and height will be determined in 25 systematically located 1m x 1m quadrants in each plot in each location.

Harvest:

- Harvesting will be conducted in winter 1993/94 and winter 1994/95.

- Roads and landings will be designed to avoid the shelterwood treatment blocks.

- Skid trails will be pre-planned and pre-located andskidders will be confined to them.

- Protective rub stumps will be used.

Post-harvest:

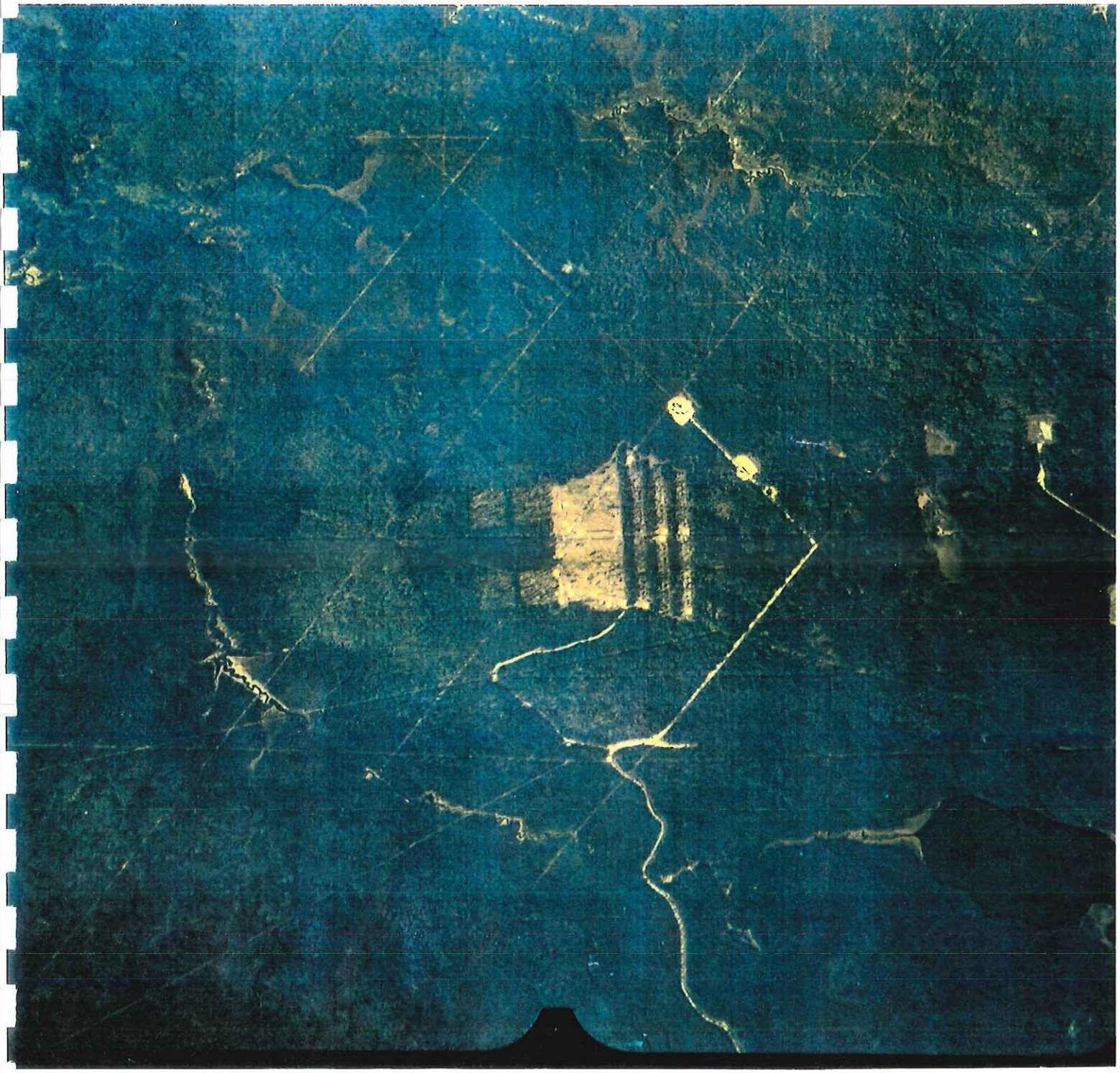
- Both the scarified (⅔) and unscarified (⅓) portions of each treatment will be staked out with 25 systematically located points. These will be the focal points for other measurements;

- adjacent to each stake, the transmitted light will be assessed on clear days, in mid-summer and near solar noon using a Decagon ceptometer.
- in late summer the cover and height of the four principal shrub and herb species, along with the number, height and origin of the aspen stems will be determined in 1m x 1m quadrants.
- the number of white spruce seedling will be counted in 0.5m x 0.5m quadrants.
- soil temperature will be assessed at 10 cm depth by installing a 5 copper-constant thermocouple in each of the sub-plots at each site. These will be measured using a millivolt meter and an icepoint junction, at least four times during the growing season.

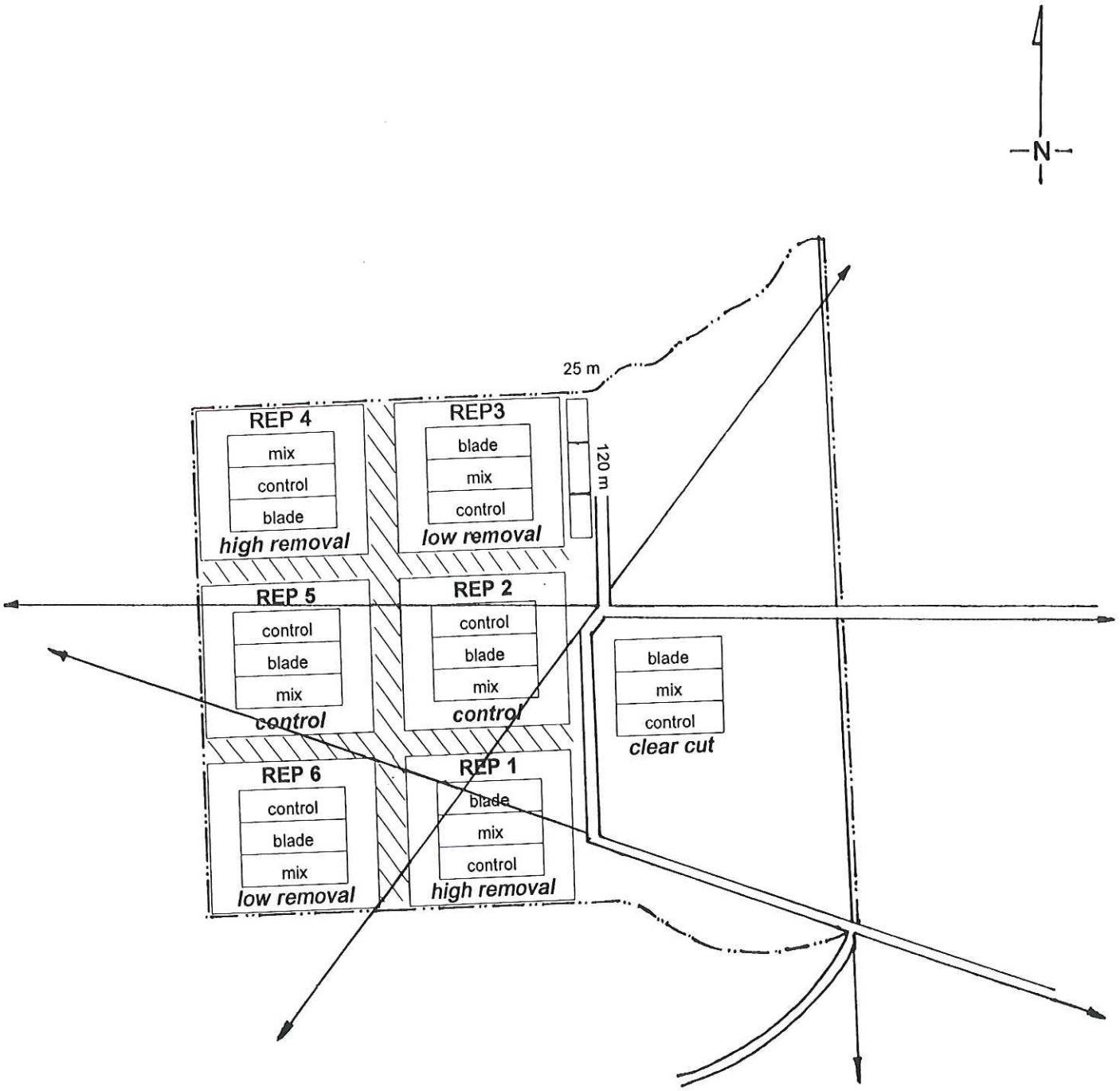
- The above measurements will be repeated each year of the study. Also, the height and basal diameter of the white spruce seedlings will be assessed in year three.

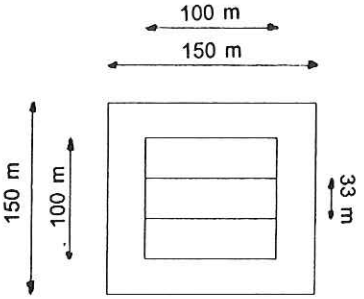
Layout and Design:

The air photo on the subsequent page was photographed following harvest, on May 8, 1994. The scale is 1:20000. Block layout For the shelterwood is amended following the air photo to provide a more detailed description of the area involved.



BLOCK LAYOUT - SHELTERWOOD





LEGEND

Compartment:	Marlboro 14
Block number:	89
Scale:	1:5000
wind buffer	
roads	
seismic lines	

Silvicultural Summary

Scarification Methods

In each replicate (150m x 150m) the inner 1 hectare was divided into thirds, one third remaining as a control, and the other two thirds being scarified. One of the two scarified portions was bladed, using a tilting blade mounted on a skid steer loader (Thomas 233 HD Tom-Cat). The remaining one third of the hectare was scarified using a mixing technique. The mixer used was a Meri Crusher (model MJ-1.4). This hydraulic unit front mounts onto the skid steer loader (see photo Meri Crusher and loader on a following page).

The small size of the loader (prime mover) was chosen specifically for the Shelterwood site, since it has a high manoeuvrability amongst the residual stand in the shelterwood treatments. This maximizes the ground coverage for site prep. The small size will also minimize damage to the residual trees, by being capable of avoiding them. Also, the small size and weight will minimize soil compaction.

Control:

Within the control itself, understory tree species less than 15 cm DBH were removed. This was facilitated in order to accurately monitor the light transmittance through the canopy (with no interference from the understory), and compare it to the light transmittance of the two canopy removal replicates.

Blade:

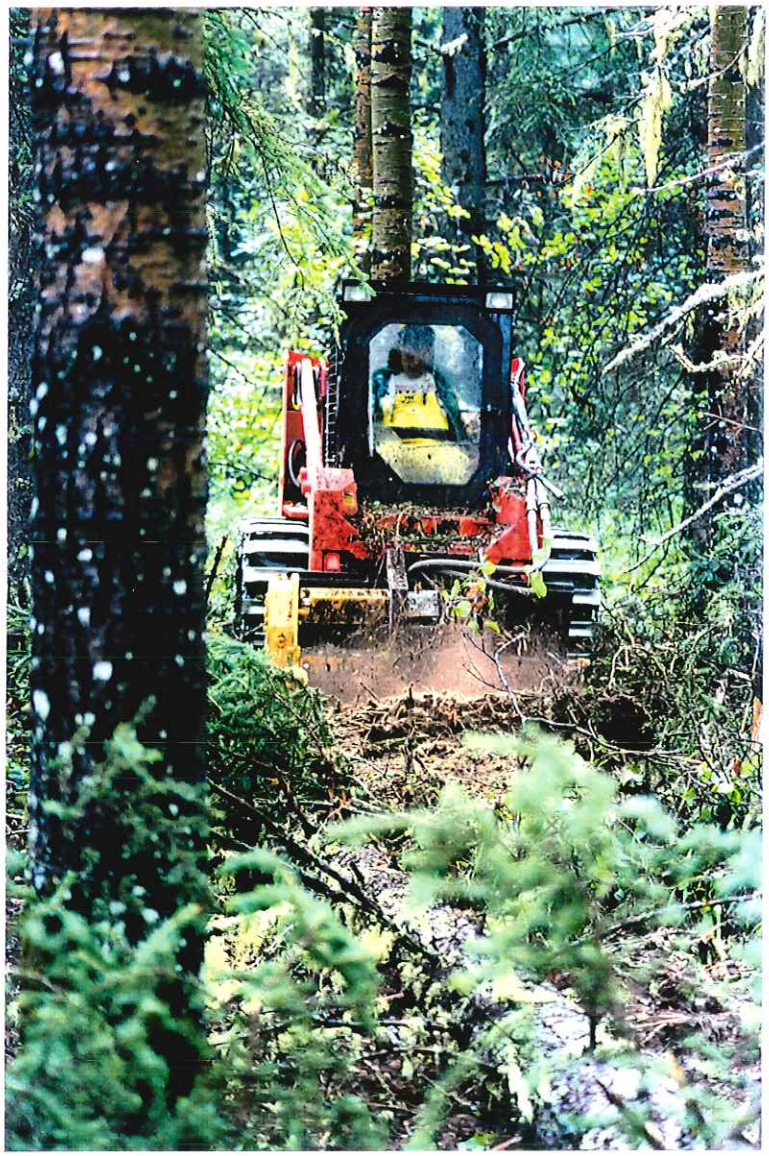
Problems arose during site preparation when using the blade. The prime mover (skid steer loader) was underpowered and undersized to move/remove some of the larger stumps and logs. Also Tracks were installed over the tires of the Cat to alleviate having any traction and mobility problems.

It was difficult to maintain a constant blade depth into the soil due to the instability of the loader. Light weight and a short wheel base caused the unit to bounce around, and vary the blade depth (and therefore exposure of mineral soil).

Mix :

The Meri Crusher was quite capable in mixing the duff layer with the mineral soil. But by choosing a small prime mover to mount it on, this compromised the efficacy of the Meri Crusher. The Meri was operating as approximately 38 horsepower. This is one third of the power the unit is able operate under. The unit was therefore unable to "crush " or "mix" larger stems and stumps into the soil and had to avoid large debris. This avoidance decreases the amount of exposed mineral soil.

The Meri Crusher was equipped with a floating mechanism whereby the unit would maintain a constant cutting depth (to a degree), and would rise over any uncuttable obstacles. But similarly to the blade treatment, the Meri was unable to maintain a constant cutting depth because of the instability of the skid steer loader over uneven ground.



Site preparation tool using the Meri Crusher, mounted on a Tom-Cat

Specifications	Model MJ-1.4	
working width	mm	1400
cutting depth max	mm	200
total width	mm	1600
weight	kg	550
primary shaft	in	1 3/8
mounting	cat	1+11
number of cutters	pcs	52
power demand	hp	30-110
cutting drum	mm	360

Harvest Data:

The following pages are the stand summaries of Pre and Post harvest assessments completed in the Shelterwood. The pre-harvest assessments are based upon 6 plots per replicate, using a BAF of 4. The post harvest assessments were obtained by evaluating all the residuals in the replicates.

Pre - Harvest Data

TREATMENT 1

SPECIES: Sw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	0.5	113	2.0	8.87
21-30	1.0	82	4.0	24.0
31-40	0	0	0.0	0.0
41-50	0	0	0.0	0.0
50+	0	0	0.0	0.0
TOTAL		195	6.0	33

SPECIES: Aw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	0.5	113	2.0	14.3
21-30	2.17	178	8.68	64.5
31-40	3.33	140	13.32	107.9
41-50	0.17	4	.67	5.5
50+	0.17	3	.67	19.4
TOTAL		435	25	212

TREATMENT 2

SPECIES: Sw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	0.33	75	1.32	5.85
21-30	0.83	68	3.32	14.72
31-40	0.17	7	0.67	296
41-50	0.0	0	0.00	0.00
50+	0.67	13	2.68	11.88
TOTAL		150	7.99	35.41

SPECIES: Aw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	0.17	38	0.67	4.8
21-30	1.17	96	4.67	34.7
31-40	2.50	105	10.0	81
41-50	0.50	13	2.0	16.5
50+	0.00	0	0.0	0.0
TOTAL		251	17	137

TREATMENT 3

SPECIES: Sw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	1.5	339	6.0	26.6
21-30	0.33	27	1.3	7.92
31-40	0.0	0	0	0
41-50	0.0	0	0	0
50+	0.0	0	0	0
TOTAL		366	7.32	34.61

SPECIES: Aw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	0.17	38	0.67	4.78
21-30	1.0	82	4.0	29.7
31-40	4.33	182	17.33	140.4
41-50	0.67	17	2.67	22.0
50+	0.00	0	0	0
TOTAL		318	25	197

TREATMENT 4

SPECIES: Sw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	1.83	414	7.33	32.51
21-30	3.83	314	15.33	92.0
31-40	0.17	7	0.67	4.0
41-50	0.0	0	0.0	0.0
50+	0.17	3	.68	6.84
TOTAL		736	24.01	135.4

SPECIES: Aw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	0.0	0	0.0	0.0
21-30	0.33	27	1.33	9.9
31-40	1.33	56	5.33	43.19
41-50	1.17	29	4.67	38.58
50+	0.0	0	0.0	0.0
TOTAL		112	11	92

TREATMENT 5

SPECIES: Sw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	1.17	264	4.67	20.7
21-30	1.17	96	4.67	28.0
31-40	0.33	14	1.33	8.0
41-50	0.17	4	0.67	6.0
50+	0.00	0	0.0	0.0
TOTAL		378	11	63

SPECIES: Aw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	0.17	38	0.67	4.78
21-30	1.83	150	7.3	54.5
31-40	2.33	98	9.3	75.6
41-50	1.0	25	4.0	33.1
50+	0	0	0.0	0.0
TOTAL		311	21	168

TREATMENT 6

SPECIES: Sw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	2.67	603	10.67	47.3
21-30	1.33	109	5.33	32.0
31-40	0.5	21	2.00	12.0
41-50	0.17	4	0.67	6.0
50+	0.00	0	0.00	0
TOTAL		737	19	97

SPECIES: Aw

dbh class	trees/ plot	trees/ ha	BA/Ha	Vol./ Ha
10-20	1.67	377	6.67	47.8
21-30	2.0	164	8.0	59.5
31-40	1.33	56	5.33	43.2
41-50	0.5	13	2.0	16.5
50+	0.0	0	0	0.0
TOTAL		609	22	167

Post Harvest Data

Diameter Distribution: Rep 1 High Removal

	Sw	Aw	Pb	Sb	Pl
<10.9	46	4	3	0	0
11-15.9	13	0	1	0	0
16-20.9	3	5	1	0	0
21-25.9	2	7	1	0	0
26-30.9	3	17	1	0	0
31-35.9	2	25	0	0	2
36-40.9	0	21	0	0	1
41-45.9	2	7	0	0	0
46-50.9	1	0	0	0	0
<51	4	0	0	0	0
Count	76	86	7	0	3

Basal Area					
sum	2.713	7.043	0.152	0	0.297
avg	0.036	0.082	0.021	0	0.099
std	0.082	0.036	0.023	0	0.005

TOTAL BA 10.199

Diameter Distribution: Rep 4 high removal

	Sw	Aw	Pb	Sb	Pl
<10.9	44	0	2	0	0
11-15.9	9	0	7	0	0
16-20.9	4	2	6	0	0
21-25.9	2	4	7	0	0
26-30.9	9	14	1	1	0
31-35.9	3	30	5	0	0
36-40.9	4	23	4	0	0
41-45.9	0	17	2	0	0
46-50.9	0	6	0	0	0
<51	7	1	0	0	0
Sum	82	97	34	1	0

Basal Area					
sum	4.85	10.36	1.85	0.05	0
avg	0.06	0.11	0.05	0.05	0
std	12	0.04	0.04	0	0

TOTAL BA 17.113

Diameter Distribution: Rep 2 Control

	Sw	Aw	Pb	Sb	Pl
<10.9	13	0	7	1	0
11-15.9	53	0	2	2	0
16-20.9	69	4	9	3	0
21-25.9	29	20	5	1	2
26-30.9	11	60	4	0	3
31-35.9	4	48	1	4	4
36-40.9	1	33	1	0	8
41-45.9	3	18	2	0	12
46-50.9	2	2	2	0	10
<51	15	2	0	0	4
Sum	200	187	33	11	43

Basal Area					
sum	10.11	16.37	1.64	0.49	6.04
avg	0.05	0.09	0.05	0.04	0.14
std	0.07	0.04	0.05	0.03	0.05

TOTAL BA 34.65

Diameter Distribution: Rep 5 Control

	Sw	Aw	Pb	Sb	Pl
<10.9	11	0	0	0	0
11-15.9	77	3	0	1	0
16-20.9	168	23	0	4	0
21-25.9	82	67	0	0	1
26-30.9	34	84	0	0	2
31-35.9	8	54	0	0	6
36-40.9	4	26	0	0	8
41-45.9	1	13	0	0	19
46-50.9	0	5	0	0	9
<51	8	1	0	0	5
Sum	393	276	0	5	50

Basal Area					
sum	14.946	19.6	0	0.131	7.31
avg	0.038	0.071	0	0.026	0.146
std	0.042	0.036	0	0.004	0.047

TOTAL BA 41.989

Diameter Distribution: Rep 3 Low Removal

	Sw	Aw	Pb	Sb	Pl
<10.9	79	0	1	0	0
11-15.9	16	0	3	0	0
16-20.9	7	0	8	0	0
21-25.9	4	19	9	0	0
26-30.9	3	59	9	0	0
31-35.9	2	67	10	0	0
36-40.9	1	40	6	0	0
41-45.9	1	11	0	0	0
46-50.9	1	4	1	0	0
<51	5	1	0	0	0
Sum	119	201	47	0	0

Basal Area					
sum	3.18	17.67	2.91	0	0
avg	0.03	0.09	0.06	0	0
std	0.07	0.03	0.03	0	0

TOTAL BA 24.083

Diameter Distribution: Rep 6 Low Removal

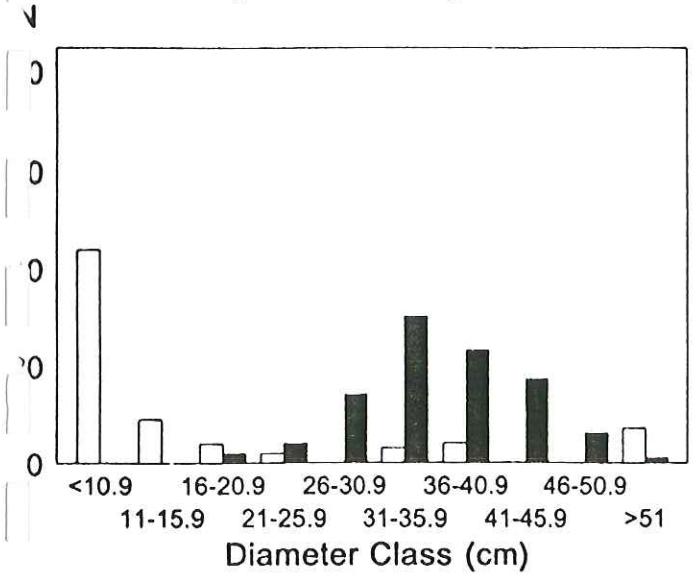
	Sw	Aw	Pb	Sb	Pl
<10.9	118	0	4	0	0
11-15.9	19	2	4	0	0
16-20.9	3	24	4	0	0
21-25.9	12	26	17	0	0
26-30.9	6	51	15	0	0
31-35.9	3	50	6	0	1
36-40.9	2	33	8	0	0
41-45.9	0	12	2	0	1
46-50.9	1	2	2	0	0
<51	4	0	0	0	0
Sum	168	200	62	0	2

Basal Area					
sum	4.046	15.42	3.955	0	0.159
avg	0.024	0.077	0.064	0	0.159
std	0.064	0.034	0.04	0	0

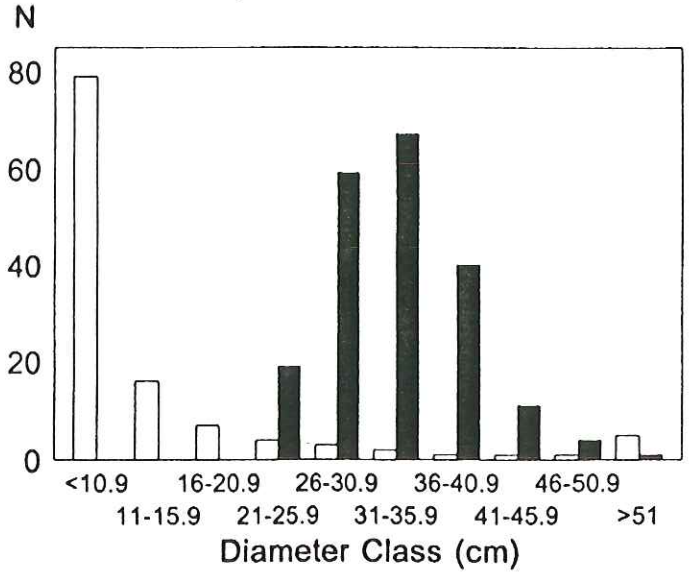
TOTAL BA 23.582

Diameter Distribution by Species of Aspen and Spruce

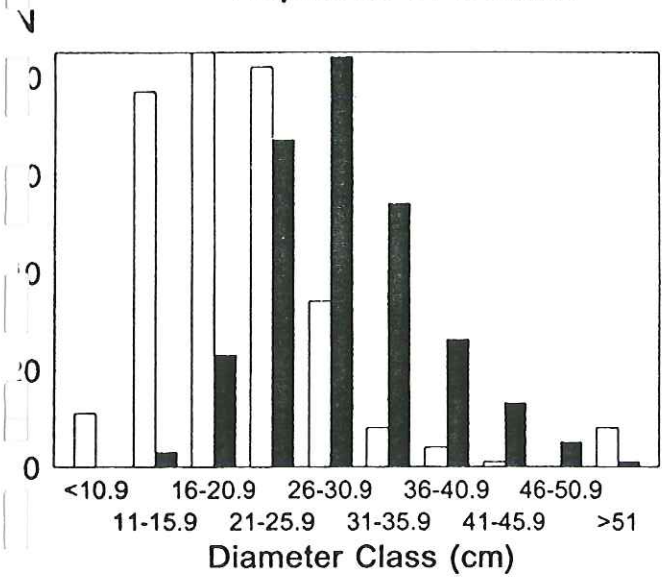
Replicate 4: High Removal



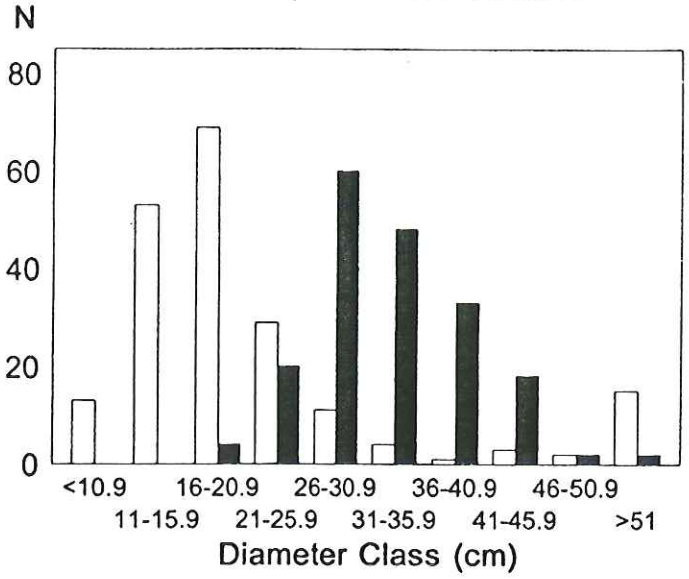
Replicate 3: Low Removal



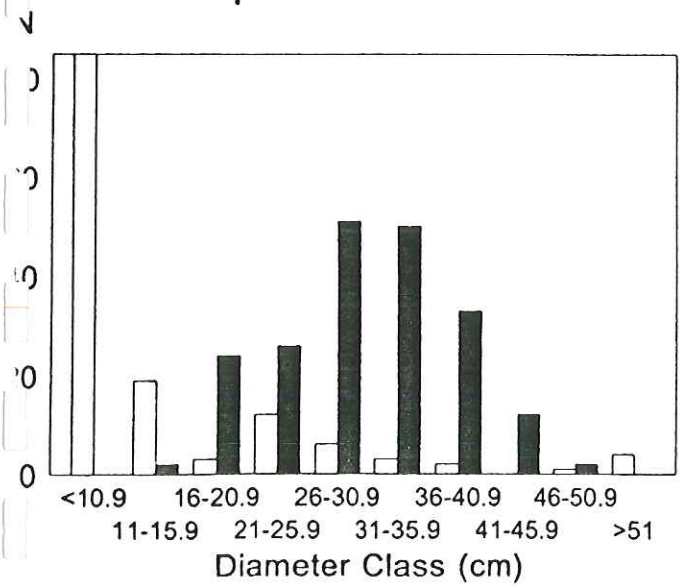
Replicate 5: Control



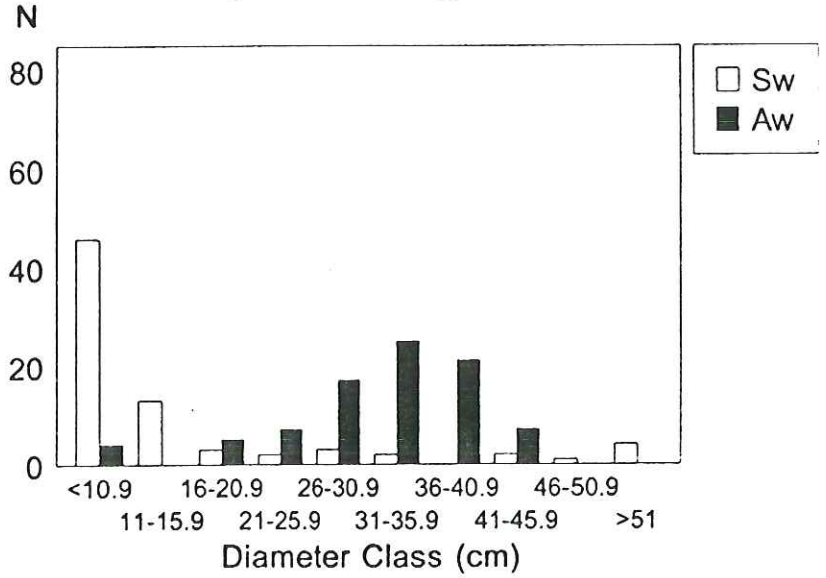
Replicate 2: Control



Replicate 6: Low Removal



Replicate 1: High Removal



Environmental Considerations:

- This proposal addresses outstanding boreal forest resource management issues including alternatives to clearcutting where ecologically appropriate, and maintenance of mixedwood biodiversity.
- All operations undertaken will be subject to provincial guidelines.
- Treatments will encourage natural regeneration of both coniferous and deciduous tree species, and enhance conifer productivity through the release of immature coniferous stock from overstory competition.
- Treatments will maintain mixedwood ecosystem biodiversity.
- The proposed treatments address public concerns regarding clearcutting.
- The treatments are designed to maintain the mixedwood land base which is an important consideration in landscape aesthetics.

Status:

Air and ground reconnaissance was done in June/July 1993 to select an appropriate block.

Partial cut pre-harvest assessments were done to select most suitable location for the shelterwood study research component.

The replicates were laid out in August 1993, with tree selection done in January 1994. The area was harvested February/March 1994. Hand-falling and line skidding was used.

Site preparation was completed in June 1994.

Air and soil temperature data collection stations were set up in June/July 1994.

Basal area data was collected in the shelterwood site and analyzed in August/September 1994.

A new area has been selected for the second replicate (Cache Percotte Forest). The site location is under review by the Forest Technology School Forest Management Committee. Replicates were laid out in July 1994. Pre-harvest assessments will be done in September 1994.

Project Sponsors:

Weldwood of Canada Limited, Hinton Division

Canadian Forest Service, Department of Natural Resources

Foothills Forest

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