PRESCRIBED FIRE RESEARCH IN THE PRINCE RUPERT FOREST REGION

by

Anne Macadam and Rick Trowbridge

RR84010-PR

R·E·S·E·A·R·C·H REPORT

Internal Reports of the Ministry of Forests Research Program

Province of British Columbia
Ministry of Forests

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November, 1984

Province of British Columbia
Ministry of Forests

This publication is RR84010-PR

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Citation:

Macadam, A. and R. Trowbridge. 1984. Prescribed fire research in the Prince Rupert Forest Region. B.C. Min. For. Research Report RR84010-PR.

FOREWORD

A request by the Research Branch Director at a March 1984 Regional Research Advisory Committee meeting in Smithers initiated this report. It is a compilation of previous work, revised and condensed, which summarizes the objectives of the current prescribed fire research and details experimental designs and sampling procedures. Future plans are briefly discussed.

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1.0 BACKGROUND

From November 1980 to a concluding symposium in March 1982, a committee with representation from the regional Research, Protection, and Silviculture sections held meetings to examine the use of prescribed fire in the Prince Rupert Forest Region. Two of the objectives of this Prescribed Fire - Forest Soils Committee were:

1. to define and identify priorities for this Region in the field of prescribed fire-forest soils research; and
2. to promote better understanding of fire-soil relationships among forest managers.

During this time, an interim report was prepared by Macadam on the effects of prescribed fire on forest soils[1], as well as a draft of a working plan for operational trials. These reports were reviewed and formed the basis for discussion in the initial prescribed fire research in the Prince Rupert region.

The concern for quantifying the impacts of prescribed fire on forest productivity was identified as the first priority for research. A final working plan was approved in the spring of 1982 and became Experimental Project (E.P.) 953[2]. Following this initial work, E.P. 953 was expanded to include similar, cooperative work with the University of British Columbia (UBC)[3], and vegetative succession studies were initiated on Macadam's and UBC's research plots.

In addition to this work, A. Waters (previous staff member in the Research section) introduced E.P. 885 in 1979, which formed the basis for vegetation management research on coastal alluvial sites. In 1983 work was begun on E.P. 885.03 in the use of prescribed fire on specific sites for rehabilitation[4].

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1 A.M. Macadam. 1981. Effects of prescribed fire on forest soils in the Prince Rupert Forest Region. An interim report. B.C. Min. For., Research Section, Smithers, B.C. Unpublished manuscript.

2 ____________ 1982. Working plan for operational broadcast burning-site productivity trials. B.C. Min. For., Research Section, Smithers, B.C. Unpublished report.

3 S.W. Taylor. 1983. A study of the effects of slashburning on soil nutrients and initial tree growth in the Sub-boreal Spruce Biogeoclimatic Zone. B.C. Min. For., Smithers, B.C. Unpublished report.

4 J. Pollack. 1983. Trials of prescribed fire for vegetation management - The rehabilitation of coastal alluvial sites in the Prince Rupert Forest Region. B.C. Min. For., Research Section, Smithers, B.C. Unpublished report.

2.0 OVERVIEW OF CURRENT WORK

2.1 Prescribed Fire Ecology Studies (E.P. 953)

Prescribed fire is used extensively in the Prince Rupert Forest Region for wildfire hazard abatement and as a tool for site preparation following clearcut logging. Up to 1982 there had been little documentation of the short- and long-term effects of burning on the productivity of forest ecosystems within the range of conditions encountered in the Prince Rupert Region. This information is needed to support the development of guidelines for prescribed fire and to ensure that fire use is consistent with the maintenance or enhancement of forest site productivity.

During the past two years a series of experimental trials has been installed within the Prince Rupert Forest Region to address this need.

2.1.1 Impacts on fuels, soils, and seedling performance (E.P. 953.01)

This project involves the examination of soil properties before and after burning, the measurement of ectorganic layer and slash loading and consumption, and the long-term monitoring of tree growth on operationally burned and planted clearcuts. To date, a total of seven trials have been established in the SBSe, ESSFk, ICHg, and CWHg subzones. The objectives of E.P. 953.01 are:

1. to monitor short- and long-term changes in important soil properties and the growth of planted seedlings following operational broadcast burning;
2. to examine the resulting data for trends and relationships and present results within the context of ecological classification; and
3. to develop an efficient procedure for the evaluation and documentation of prescribed fire impacts that is adaptable to operational use by Ministry of Forests or industry personnel.

2.1.2 Vegetative succession (E.P. 953.02) (provided by A. Banner)

To date, the ecological classification program in the Prince Rupert Forest Region has concentrated on the description and interpretation of climax ecosystems. However, many disciplines (silviculture, protection, range and wildlife management) are concerned with managing seral ecosystems and require a knowledge of successional stages and pathways for ecosystem associations and biogeoclimatic subzones.

After discussions with Regional Protection we developed a research proposal to investigate plant succession following prescribed fire on the E.P. 953 research plots, and to examine the use of prescribed fire in "vegetation management". The objectives of E.P. 953 were thus broadened to include post-fire vegetative succession in addition to prescribed fire-soil relationships and seedling performance. A. Banner and J. Pojar[4] were requested to implement this sub-project.

2.1.3 University of British Columbia cooperative study (E.P. 953.03)

With the cooperation of M. Feller (Faculty of Forestry, UBC), S. Taylor has been recruited as a Master's student to supplement the operational trials with a more intensively monitored experimental trial in the SBSe subzone.

Plots have been established in two ecosystem types (mesic/mesotrophic and subhygric/permesotrophic) within one clearcut. The project includes replicated medium and low intensity burning treatments and unburned controls for each ecosystem type.

2.2 Rehabilitation of Coastal Alluvial Sites (E.P. 885.03)

Certain ecosystems in the productive coastal valley bottoms present major reforestation problems if the sites revert to brush. One category of brush field that can develop on these alluvial landforms is dense stands of red alder (Alnus rubra). The question remains as to whether dense, continuous stands of red alder can be rehabilitated with existing site preparation techniques.

E.P. 885.03 is expected to produce important basic information about the response of valley bottom ecosystems to prescribed fire. The

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[4] Research ecologists, B.C. Ministry of Forests, Smithers, B.C.

objectives of E.P. 885.03 are:

1. to monitor short- and long-term changes in important soil properties following slash-and-burn treatment of red alder stands on coastal alluvial landforms;
2. to develop techniques for the assessment of fuel and biomass loading prior to and following the treatment of such sites;
3. to determine the rates of growth and invasion of plant species following slash-and-burn treatment of red alder stands on coastal alluvial landforms;
4. to determine the growth and survival of Sitka spruce plantations following slash-and-burn treatment of such sites; and
5. to determine the applicability of slash-and-burn techniques (e.g., cost per established seedling and ease of application) on such sites.

3.0 EXPERIMENTAL DESIGN AND SAMPLING PROCEDURES

3.1 E.P. 953

3.1.1 E.P. 953.01

Each operational trial site consists of a cutblock scheduled for broadcast burning. Sites are selected with the assistance of district forest service and/or industry personnel and must be representative, in terms of terrain, soils, and vegetation characteristics, of site types commonly logged and burned within the subzone.

Within each trial three 30 x 30 m sample plots are established (Figure 1). Plots are selected subjectively to satisfy the following criteria:

1. Within the 900-m^2 area, soils, surface shape, and fuel loading and distribution are as nearly uniform as possible.
2. Areas in which soils have been severely disturbed by logging are avoided.
3. Soil parent materials, development, and properties, and moisture and nutrient regimes indicated by soil and vegetation characteristics are representative of those associated with the zonal ecosystem association.

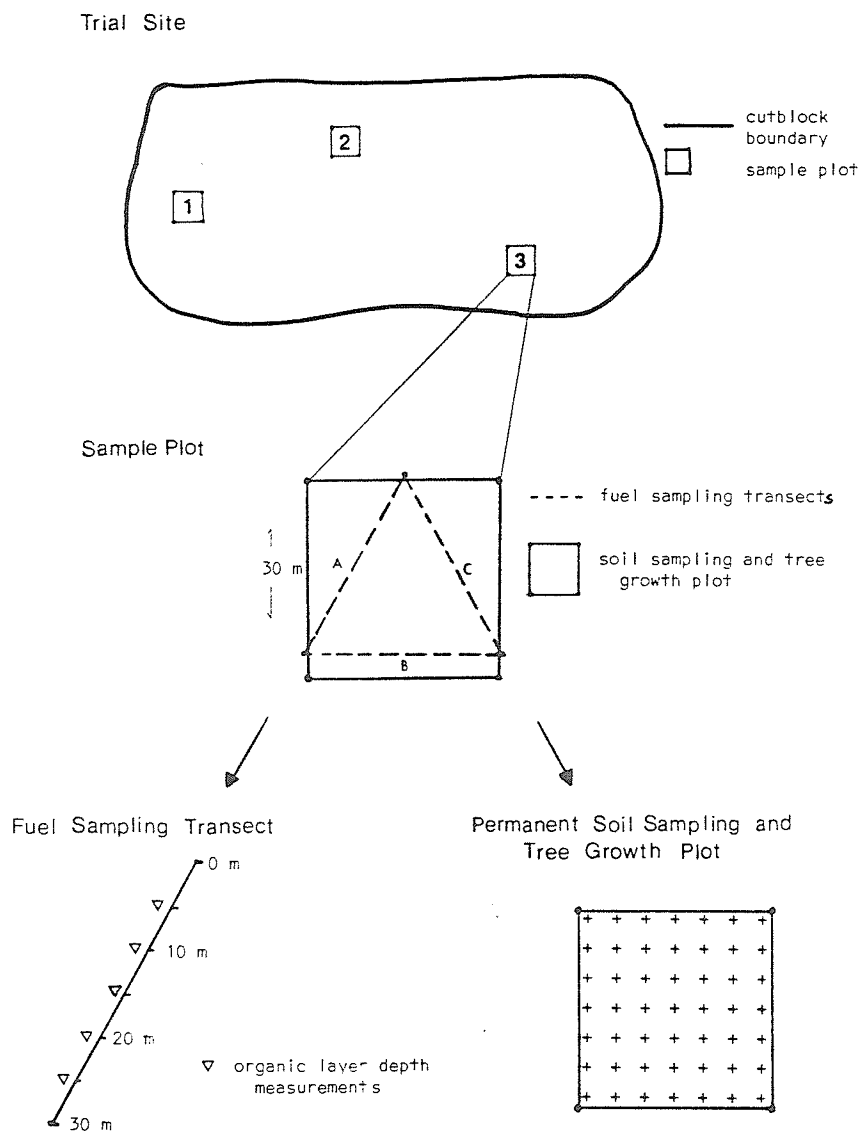

FIGURE 1. E.P. 953.01 Operational trial layout.

Prior to burning the following information and samples are collected from each plot:

1. site and soil profile characteristics are described,
2. soil samples are taken for chemical and physical analysis;
3. slash loading is estimated using a line intersect sampling method; and
4. ectorganic layer depth is measured.

Site characteristics are recorded for each plot on the form in Figure 2. Information from all three plots is summarized on the form in Figure 3.

Adjacent to each plot a soil pit is dug, the soil profile is described, and samples are taken from each horizon for chemical and particle size analysis. Soils are sampled for chemical analysis at a minimum of 15 permanently located points within each plot at a minimum of two depth ranges: the ectorganic layer and the 0-15 cm mineral layer. The 15-30 cm depth range is sampled within at least one plot per trial.

Where average ectorganic layer depths exceed 15 cm the organic sample is taken with a peat auger and divided by horizon type into two or more parts.

All 15 samples from each depth range are individually analyzed for at least one plot per trial to provide an estimate of soil chemical variability. The following analyses are performed:

pH ($CaCl_2$), pH (H_2O)
carbon (total)
nitrogen (total, mineralizable)
phosphorus (total, Bray P-1)
sulfur (total, soluble sulfate)
exchangeable calcium, magnesium and potassium
cation exchange capacity, base saturation

Bulk density and coarse fragment content are determined for each depth range at four points per plot prior to burning. Only ectorganic layer bulk density is determined in conjunction with subsequent post-fire sampling.

SITE DESCRIPTION FORM

Proj. ID ____________ Plot No. ____________ Date (Y/M/D) ____________

Location ____________

Aspect ______ ° Slope ______ percent Elevation ______ ± metres

Site position macro
a. apex
b. face
c. upper slope
d. middle slope
e. lower slope
f. valley floor
g. plain

Site position meso
a. crest
b. upper slope
c. middle slope
d. lower slope
e. toe
f. depression
g. level

Site surface shape
a. concave
b. convex
c. straight

Microtopography
a. smooth
b. micro mounded
c. slightly mounded
d. moderately mounded
e. strongly mounded
f. severely mounded
g. extremely mounded
h. ultra mounded

Site position diagram

photo roll no. ____
photo no. ____

Direction

scale ______ 1 = ______

Zone/Subzone ____________

association ____________

Notes on Veg.

Ecological Moisture Regime
a. very xeric
b. xeric
c. subxeric
d. submesic
e. mesic
f. subhygric
g. hygric
h. subhydric
i. hydric

Nutrient Regime
a. oligotrophic
b. submesotrophic
c. mesotrophic
d. permesotrophic
e. eutrophic
f. hypereutrophic

Soil Temperature Class
a. extremely cold
b. very cold
c. cold
d. cool
e. mild

Soil Moisture Subclass
a. xeric
b. arid
c. subarid
d. semiarid
e. subhumid
f. humid
g. perhumid
h. subaquic
i. aquic
j. peraquic

Depth to (cm)
a. water table ______
b. rooting (effective) ______
c. root restricting layer ______
d. frozen layer ______
e. bedrock ______

Bedrock type ____________
Terrain classification ____________
Soil Classif. ____________
Humus Form Class. ____________
Family P.S. ____________

Soil drainage
a. rapidly
b. well
c. mod. well
d. imperfectly
e. poorly
f. very poorly

Perviousness
a. rapidly
b. moderately
c. slowly

Free Water
a. present
b. absent

Flood hazard
a. frequent and irregular
b. frequent
c. may be expected
d. rare
e. no hazard

Notes on Site Description ____________

FIGURE 2. EP 953.01 Site description form. (An abbreviated version of the EP 822 site description form).

EP 953.01 OPERATIONAL TRIAL DESCRIPTION

Name ____________ Location ______________________________ Subzone_____

Date of establishment ______________ Sampling Crew ________________

Map Ref. ____________ C.P. ___________ Blk. _______ Blk. size _____ha

Block Diagram (indicate location of sample plots) Licensee _____________

Pre-cut Stand: Forest Type ______________ Height ______________

Age class ___________ Site class ___________

Stocking ___________

Date of logging __________________ Method ____________________

Site disturbance ____

Purpose and objectives of burn _________________________________

Soils ____________________________________ Family P.S. __________

Ave. Slope __________% Aspect __________ Terrain Class. __________

Ecosystem associations ____

Notes on Veg. ____

Notes on Slash ____

WEATHER CONDITIONS AND DAILY PREDICTOR READINGS ON DAY BURN IGNITED

DATE OF IGNITION	FINE FUEL MOISTURE CODE	DUFF MOISTURE CODE	DROUGHT CODE	IGNITION RANK	SPREAD RANK	CONTROL RANK	IMPACT RANK

FIGURE 3. E.P. 953.01 Operational trial site description form.

Fuel sampling procedures are modelled on the line intersect method developed and described by Van Wagner (1968, 1982*a*, 1982*b*) and McRae *et al*. (1979). Each sample plot consists of three 30-m transects forming the sides of a triangle. End points are staked with metal rods to permit their relocation for post-fire sampling.

Along each transect the number of intersecting slash pieces smaller than 7 cm is tallied by size class as follows:

Size class	Length sampled per transect
0 - 1 cm[5]	10 m
1 - 3 cm	15 m
3 - 5 cm	20 m
5 - 7 cm	25 m

Species composition of the fine slash is estimated for each transect. Over the entire 30 m, pieces larger than 7 cm in diameter are measured with calipers and their species and diameters are recorded. Samples of each species and size class of slash are collected for specific gravity determination.

Organic layer depth is measured at a minimum of 5 points per transect. Adjacent to each point of measurement a depth-of-burn pin is inserted, the crossbar level with the surface of the organic layer.

Figure 4 contains the field form used to collect slash loading and organic layer depth data.

On the day of burning, ignition pattern, current weather conditions, and fire weather codes and indices are recorded.

Following burning, using the same transects sampled pre-fire, slash loading is re-assessed and depth of burn is measured. Pre- and post-fire slash and organic layer data, slash specific gravity, and organic layer bulk density data are entered into an IBM BASIC computer program for conversion into fuel loading and consumption estimates.

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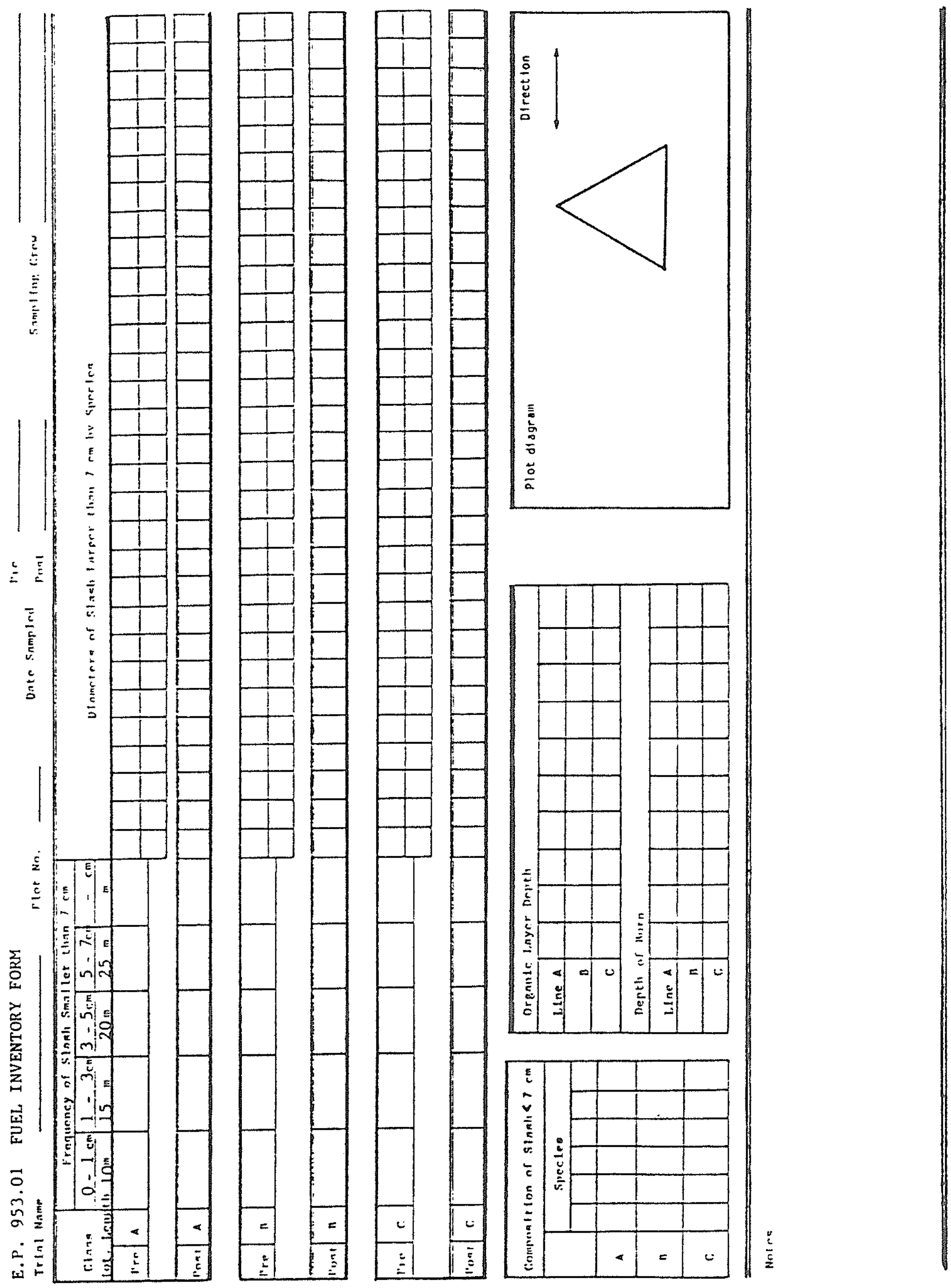
5 Where large amounts of fine slash (less than 1 cm in diameter) and foliage are present it may be preferable to sample these destructively. The feasibility of this approach will be investigated in conjunction with future sampling.



E.P. 953.01 FUEL INVENTORY FORM

Trial Name ______ Plot No. ______ Date Sampled Pre ______ Post ______ Sampling Crew ______

Class		Frequency of Slash Smaller than 7 cm					Diameters of Slash Larger than 7 cm by Species
		0 - 1 cm	1 - 3 cm	3 - 5 cm	5 - 7 cm	- cm	
Tot. Length		10 m	15 m	20 m	25 m	m	
Pre	A						
Post	A						
Pre	B						
Post	B						
Pre	C						
Post	C						

Composition of Slash < 7 cm

	Species					
A						
B						
C						

Organic Layer Depth										
Line A										
B										
C										
Depth of Burn										
Line A										
B										
C										

Plot diagram

Direction

Notes

FIGURE 4. E.P. 953.01 Fuel inventory form.

Seedlings are planted in each sample plot in conjunction with the operational planting of the cutblock. At the time of planting sample seedlings are staked and tagged and height measurements and condition are recorded. Seedling height, increment and condition are recorded following the first, second, third, and fifth growing seasons and at five year intervals thereafter for the life of the project. Foliage will be sampled for chemical analysis following the fifth and tenth growing seasons.

Soils are sampled again for chemical analysis in the spring following burning, usually just after the site is planted. One plot per trial is sampled again in the second spring following burning, and all three plots are sampled in the fifth, tenth, and fifteenth springs following burning.

35 mm color slides are taken at every sampling interval from fixed points in each plot.

3.1.2 E.P. 953.02 (provided by A. Banner)

Permanent vegetation sampling plot transects 5 x 25 m were established in the three soil and fuel sample plots of each operational trial. Transects were located to encompass the maximum microsite variability within each plot. The 25-m transects are divided into five 5 x 5 m plots and each of these contains three sizes of nested plots (5 x 5 m, 3 x 3 m, and 1 x 1 m; see Figure 5). Tree strata and total cover of all strata are sampled within the 5 x 5-m plots; tall and low shrubs within the 3 x 3-m plots; and herbs, bryophytes, lichens, and seedlings within the smallest 1 x 1-m plots. Percent cover (visual estimate) and distribution (9-point distribution scale from Walmsley et al. 1980) are recorded for each species. The sampling method used in this study was modified from Stickney (1980).

Transects are sampled annually in the fall for at least 15 years, at which time sampling frequency may be reduced to every second or third year depending on the rate of vegetation change.

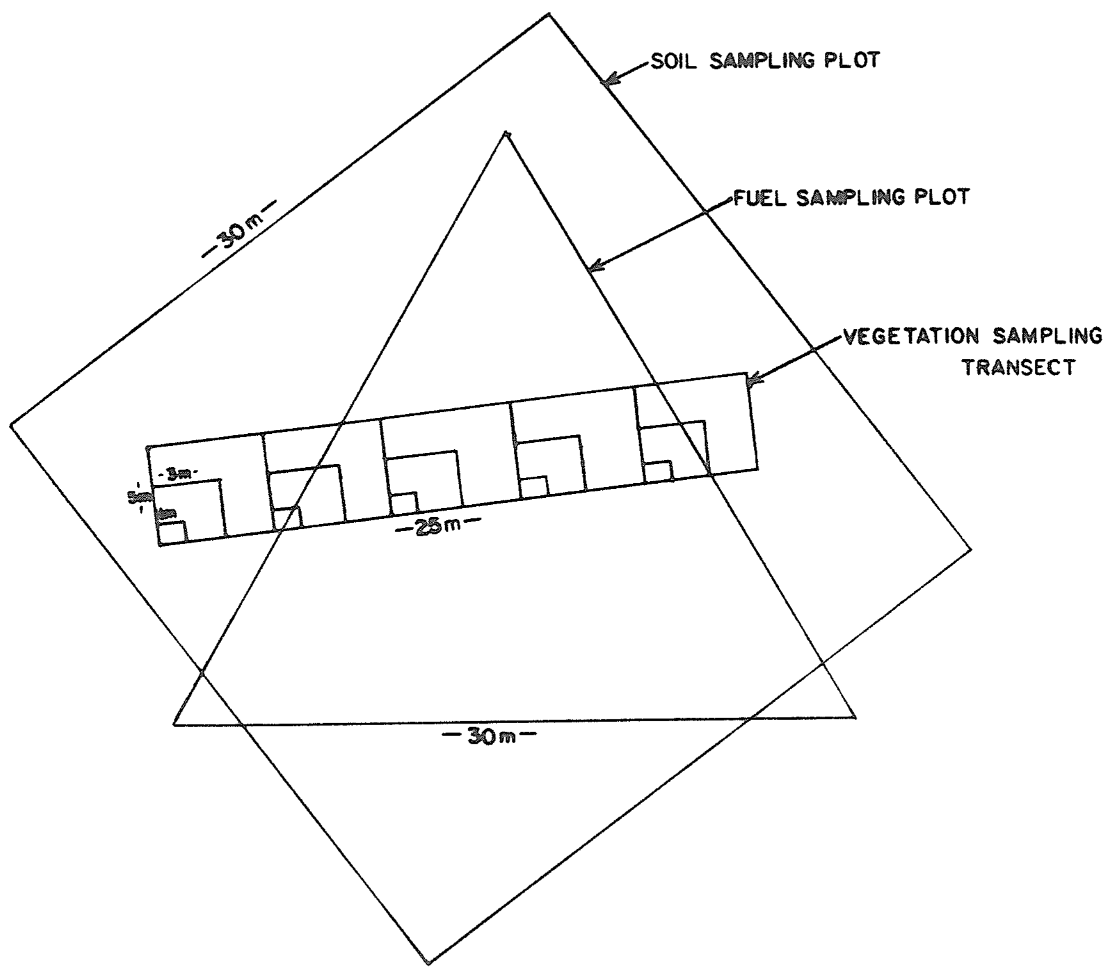


FIGURE 5. Sample plot layout showing location of vegetation sampling transect with respect to soil sampling plot and fuel sampling transects. Three such sample plots are established in each operational trial.

3.1.3 E.P. 953.03

The original research proposal was a 2x4x3 factorial experiment: two ecosystem types (mesic/mesotrophic and subhygric/permeosotrophic) and four treatments (control, low, medium, and high fuel consumption) replicated three times. The ecosystem types closely correspond to the concept of treatment units used by Klinka et al. (1980). Fuel consumption was assumed to be an indication of fire intensity levels and subsequent impact levels.

Twenty-four 400-m^2 plots were located in four areas of one cutblock thought to be suited to the achievement of the desired treatments (Figure 6). A road located in the cutblock was expected to serve as a firebreak behind which the control plots were established. An increase in fuel moisture, using irrigation, was desired to provide low fuel consumption plots, therefore those plots were located within pumping distance of a stream adjacent to the cutblock. The high fuel consumption plots were located in the center of the planned ignition pattern and close to primary fuel sources (landings). The medium fuel consumption plots were located in areas expected to have moderate fuel consumption.

Loading of slash greater than 1 cm in diameter was estimated using a line intersect technique modified from McRae et al. (1979). Six diameter classes of slash pieces (1.1-2.0, 2.1-3.0, 3.1-5.0, 5.1-8.0, 8.1-13.0, and greater than 13.1 cm) were measured on nine 10-m long transects forming three equilateral triangles which are superimposed on each 400-m^2 plot. Species composition of these six classes was estimated. The loading of slash less than 1.0 cm in diameter was determined in 12 randomly located 0.5-m^2 subplots within each plot using a destructive sampling procedure. Following the burn, these procedures were repeated in order to estimate slash fuel consumption.

Slash samples were collected by species and by diameter classes for nutrient concentration and specific gravity determination. Following the burn, samples of less than 1.0 cm slash were collected for post-treatment nutrient concentration. Slash samples will be analyzed for total N, P, S, K, Ca, and Mg.

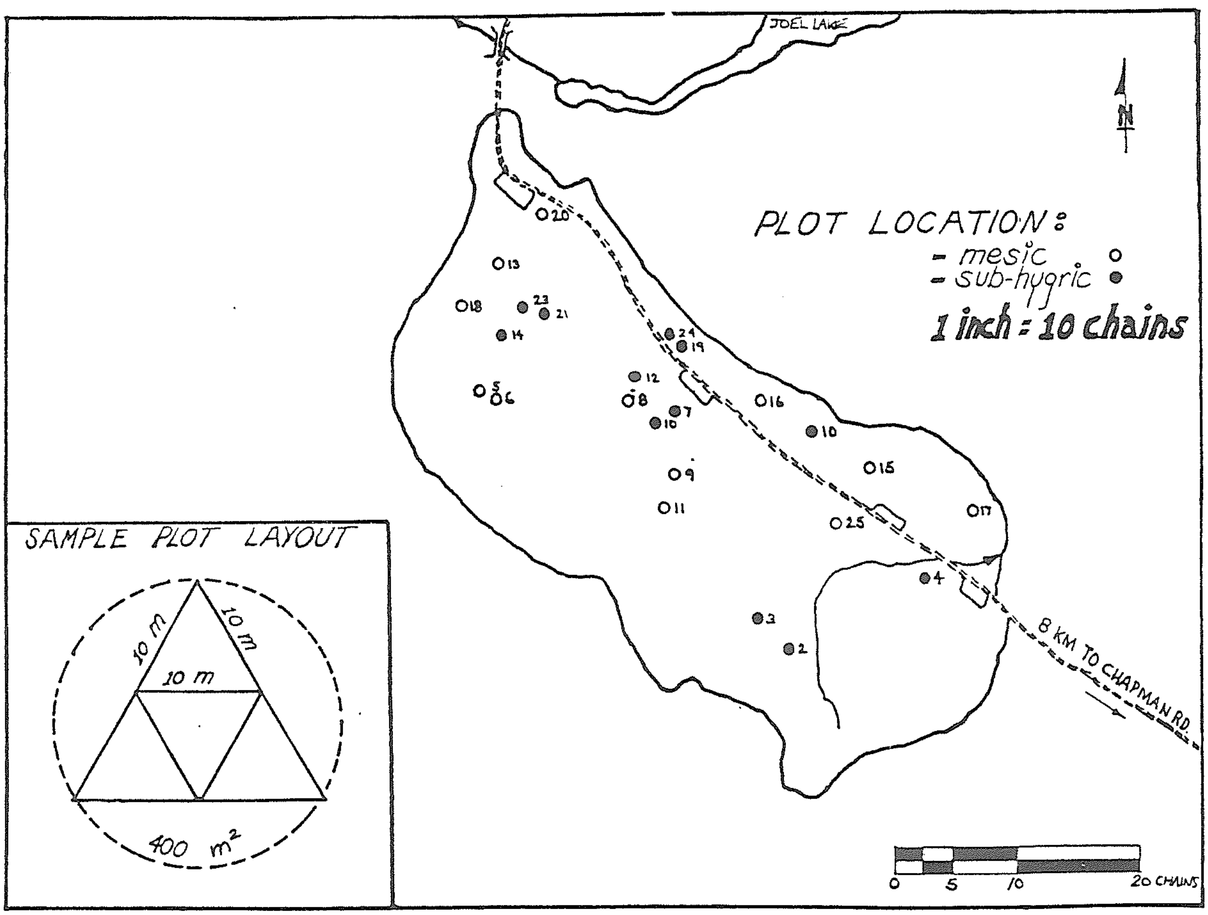


FIGURE 6. E.P. 953.03 Plot layout.

It was found that forest floor depth could be estimated within 10% precision at the 0.90 level based on an average of four measurements from 20 sample squares. Thus, twenty 20 x 20-cm forest floor samples were randomly taken from each plot before burning. These were bulked into four composites to reduce analytical times and costs. Dry weight was determined on the bulked samples. Forest floor depth reduction was estimated from 18 systematically located reduction-pins in each plot.

Twenty forest floor and mineral soil samples from the 0-15 cm layer were taken in each plot and bulked into four composites for chemical analysis. Four mineral soil samples were taken in each plot for physical analysis. These procedures were used for pre- and post-treatment sampling. Mineral and forest floor samples will be analyzed for bulk density, total nitrogen, mineralizable nitrogen, extractable nitrate and ammonium, extractable phosphorus, exchangeable potassium, magnesium and calcium, cation exchange capacity, total organic carbon, and pH. Forest floor samples will also be analyzed for total S, P, Mg, Ca, and K,; texture and coarse fragment content will be determined in the pre-treatment mineral samples.

A preliminary study of soil chemical variability in a mesic ecosystem was carried out in the spring of 1983. At 20 randomly located points forest floor (ectorganic layer) and mineral soil samples from the 0-15 cm depth range were taken. The results are presented in Table 1. A very large number of samples would be necessary to estimate the true mean for all properties of interest within 10% at the 0.95 level of confidence in both the forest floor and mineral soil. With 20 sampling points, total N and pH can be estimated with at least 10% precision at the 0.95 level, while other more variable properties (exchangeable cations) can be estimated with close to 20% precision at the 0.90 level.

A more intensive study of soil chemical variability is being carried out. Twenty forest floor and twenty 0-15 cm mineral soil samples from four sample plots (two mesic, two subhygric) will be individually analyzed for a wider range of chemical properties.

TABLE 1. Preliminary estimates of the number of samples needed to estimate the true mean of some soil chemical properties in mesic SBSe ecosystems within x% at the y level of confidence. Means and standard deviations are based on 20 samples.

				No. of samples needed			
				x: 10%		20%	
	Mean	S.D.	C.V.	y:0.95	0.90	0.95	0.90
Forest floor properties							
Total N(%)	1.150	0.170	14	11	8	5	4
Mineralizable N (ppm)	221.2	70.16	32	42	29	12	9
Extractable P (ppm)	141.4	46.09	32	44	31	13	9
CEC (meq/100g)	84.93	14.00	16	13	10	6	4
Exchangeable K (meq/1000g)	4.008	1.186	30	36	26	11	8
" Ca "	18.56	6.661	36	52	37	15	11
" Mg "	4.084	1.566	38	59	49	17	12
Mineral soil (0-15 cm depth) properties							
Total N (%)	0.0815	0.0303	37	56	39	16	11
Mineralizable N (ppm)	8.289	10.406	126	600	430	155	110
Extractable P (ppm)	66.00	29.79	45	80	50	22	16
CEC (meq/100g)	15.46	4.97	32	42	29	12	9
Exchangeable K (meq/100g)	0.251	0.101	40	65	46	18	13
" Ca "	2.116	1.930	91	320	230	80	58
" Mg "	0.624	0.632	101	400	280	105	75
Total C (%)	2.11	0.994	47	80	62	24	17

A weather station was installed in a block adjacent to the study area in mid-July and daily weather observations were taken until mid-September. Fuel moisture sticks were weighed prior to ignition.

The experimental block was ignited with a helicopter drip torch in a center-fired ignition pattern. The fire was extensively photographed.

The low intensity treatment area was irrigated in mid-September but burning was delayed until late September due to wet weather conditions and by this time all areas had a uniformly high forest-floor moisture content (low DMC, BUI). Burning under these conditions resulted in a uniformly low impact in terms of forest floor reduction and a moderate impact on woody fuels across the blocks with apparently only minor variation in impacts between treatment areas. Four of the control plots were burned due to a small escape, and four of the burned-treatment plots were only partially burned due to poor spread at the ends of the block. These plots have been eliminated from post-burn sampling and analysis, and new controls have been established.

The plots were planted with 81 2-0 spruce, 49 of which are permanent sample trees. The height and condition of seedlings and planting spots were measured and observed at the time of planting. At the end of each growing season in the first three years, total height, increment, and condition of sample trees will be measured. These measurements will be taken every three years thereafter. In addition, samples of foliage will be taken for the determination of nutrient concentration in the first year and every additional third growing season.

3.2 E.P. 885.03

The purpose of this project is to investigate the applicability and impacts of using slash-and-burn techniques for the conversion of red alder stands to Sitka spruce plantations on coastal alluvial landforms.

In 1983 an initial attempt was made to install this project on a site adjacent to the Skeena River in the CWHf subzone. The trial site was dominated by 15-year old red alder with an estimated stand density of 2700 sph and a mean height of 12 m.

Pre-treatment vegetation assessments and soil sampling were completed as described in the working plan[6]. Due to operational difficulties, slashing was not accomplished according to plan and the burning treatment did not proceed in 1983.

In 1984 the working plan was revised to include the assessment of fuel and biomass loading and consumption[7]. A new 8-ha trial area was chosen adjacent to the 1983 site. Pre-treatment sampling and slashing were completed according to plan, however exceptionally poor weather and resulting high fuel moisture contents prevented burning and the completion of the experiment this year. A mid-summer burn is planned for 1985.

A 6 x 8 sample grid of steel stakes has been established, with an interstake distance of 12 m. Each stake marks the center of a circular plot in which vegetation, soils, and fuels are sampled.

Prior to slashing, the following assessments were made of the vegetation:

1. at all 48 points, within 20-m^2 plots, percent cover of the five major understory species (using the quadrat method) and percent cover and maximum height of all brush species;
2. at 8 points, within 20-m^2 plots, percent cover of all species; and
3. at all 48 points, within 25-m^2 plots, the number of red alder stems and the height, dbhob, and canopy position for a single dominant or co-dominant red alder.

Total biomass and fuel loading was estimated prior to slashing based on:

1. fifteen 15-m line transects for the sampling of downed woody material;

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6 J. Pollack. 1983. Trials of prescribed fire for vegetation management - The rehabilitation of coastal alluvial sites in the Prince Rupert Forest Region. B.C. Min. For., Research Section, Smithers, B.C. Unpublished report.

7 J. Pollack, A. Macadam, and R. Trowbridge. 1984. Draft working plan for E.P. 885.03, Trials of prescribed fire for vegetation management - conversion of early seral coastal alluvial sites to Sitka spruce plantations in the Prince Rupert Forest Region. B.C. Min. For.

2. eight 25-m^2 circular plots in which dbh and height of all trees were determined; and
3. the destructive sampling of shrubs, herbs, and mosses and litter from within 1-m^2 hoops at 15 points.

Published volume equations (Kozak and Marshall, 1983) will be used to estimate total stem volume for the experimental area. Experimentally determined stem wood to total biomass relationships (Smith, 1977) will be used to estimate total biomass for the standing alder.

A modal soil profile description and sampling by horizon for physical and chemical analysis was undertaken for descriptive and classification purposes. At 15 points, soils were sampled for chemical analysis within two depth ranges: the 0-15 and 15-30 cm mineral layers. Soils are analyzed for pH, total carbon, available phosphorus, soluble sulfate, exchangeable calcium, magnesium and potassium content, cation exchange capacity, and base saturation. Bulk density is determined for both depth ranges at four points.

Following slashing and burning, fuel loading is reassessed and soils are sampled for chemical analysis.

At the time of planting, soils are again sampled for chemical analysis, mineral soil exposure is estimated, and total height of the two planted seedlings closest to each of the 48 sample points is measured.

One, two, three, and five years after the fire, dominant understory species, brush species, and full species tallies are repeated and the total height and current leader increment of the two planted seedlings closest to plot center are recorded.

In the fifth year following planting, foliage from planted seedlings will be analyzed for N, P, K, S, Ca, and Mg.

Data from each site will be subjected to graphical, multiple regression, and multiple discriminant methods of analysis. The following will be presented graphically:

1. percent cover of the major brush species and average survival of plantation conifers versus time; and
2. height of the major brush species and plantation conifers versus time.

Multiple regression analysis with stepwise inclusion of all variables will be used to predict the periodic mean annual height increment and the current height increment of the plantation conifers.

Two separate discriminant analyses are possible. The first analysis will determine those variables which best separate plots with 0, 1 and 2 surviving conifers after five years. The second analysis will determine differences in species presence/absence between plots before treatment and plots after treatment.

4.0 FUTURE PLANS

4.1 E.P. 953.01

The original plan was to install four to six trials per year until each silviculturally productive zone had three to four trials established. Despite constraints of manpower and dollars available it is hoped that two trials each in the ESSF, ICH, SBS, and CWH zones can be established.

During the 1984 field season, soil and fuel sampling procedures were re-examined with the aim of improving efficiency and testing the consistency and reliability of our methods. The results of these investigations will be applied in the near future to the development of standard procedures for the routine monitoring of fire impacts.

4.2 E.P. 953.02

This sub-project will follow the development of E.P. 953.01.

4.3 E.P. 953.03

While Mr. Taylor's work should be complete by the spring of 1985, Feller and Trowbridge have had discussions to continue cooperative work in the ecologic impacts of prescribed fire. Topics have included expansion of work similar to Taylor's into other zones (particularly high elevation sites such as the ESSF and MH zones).

4.4 E.P. 885.03

A research proposal for the rehabilitation of coastal brushfields to conifer plantations has been submitted to our Ministry's Research Branch. Prescribed fire treatments will be evaluated as to the ecologic impacts on the vegetation, site, and consequent conifer productivity.

4.5 Fire Impacts on Soil Climate

It has been our plan since as early as 1979 to research the impacts of site preparation on soil climate. Several proposals have been made and presented to the Regional Research Advisory Committee. The most recent development was a proposal written by M. Goldstein (Soilcon Laboratories Ltd.) under a contract let by the Ministry of Forests. Mr. Goldstein was asked to design experimentation to quantify the impacts of the prescribed fire on the soil moisture and temperature regimes in E.P. 953.03. Unfortunately funding for the project was not allocated. However, this type of work will be the next priority in further developments of E.P. 953.

5.0 SUMMARY

Ecologic research into the impacts of prescribed fire for forest management has begun in the Prince Rupert Forest Region. Studies to date include quantification and/or qualification of impacts on fuel, soil chemical and physical properties, vegetative succession and management, and seedling performance. As soon as resources become available, impacts of prescribed fire on soil climate will be included.

The current research has always aimed at involving cooperative efforts not only of the regional researchers (of the B.C. Ministry of Forests), but also of the other sections and branches of the Ministry, as well as the public and private agencies and the Faculty of Forestry at UBC. It is hoped that this report will help to continue and promote that approach.

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