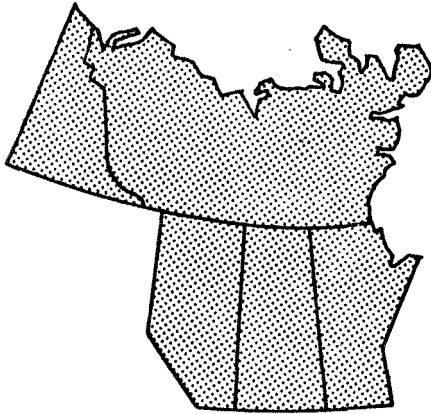


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NORTHERN FOREST RESEARCH CENTRE
EDMONTON, ALBERTA
MAY 1972



Environment
Canada

Environnement
Canada

Forestry
Service

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**CANADA
DEPARTMENT OF THE ENVIRONMENT**

**STUDY REVIEW STATEMENTS
NORTHERN FOREST RESEARCH CENTRE
1971-72**

**CANADIAN FORESTRY SERVICE
EDMONTON, ALBERTA
MAY 1972**

REDUCTION OF LOSSES BY IMPROVED FIRE SUPPRESSION METHODS

Suppression of wild fires and losses accruing from them is a major expense of forest management agencies. Nearly 10 million dollars was spent on suppression alone during this past year in this region.

Objectives of this project are improved utilization of existing airtankers, to develop a more efficient mix of airtanker types to take advantage of the special qualities of different retardants, to obtain more precise information on airtanker performance, retardant performance, drop patterns, airtanker-retardant-distance from base -- cost and effectiveness relations. Improved and upgraded detection systems utilizing modern sensing and communications techniques. Promotion of results to user agencies of results from both suppression and detection studies.

Benefits accruing from this project are reduction of costs and increase of effectiveness in operations of fire detection and suppression agencies.

Goals during the next year are continuation of studies relating to retardants, airtankers, detection and communications system. Intensive promotion of research results.

PROJECT REVIEW STATEMENT

Fiscal Year: 1971-72

1. Establishment: Prairies Region. Date Prepared: March 4, 1971.
2. Title: Fire retardant and airtanker tests and application.
3. Investigators: J. E. Grigel, R. Lieskovsky.
4. Year of Commencement: 1968.
5. Estimated Year of Completion: Original 1970
Revision I 1972
Revision II 1974
6. Key Words not in Title: Chemicals, airtankers, drop-patterns, aerial-suppression, fire control, retardants.
7. Discipline: Fire.
8. Project: Reduction of losses by improved fire suppression methods.
9. Establishment Project No.: NOR 037 Service Project No.: NOR 037
10. Status at Time of Statement Preparation: Active.
11. Estimated Total Man-Months Utilized to Date: Prof: 61 Other: 71
12. Man-Months Utilized in Fiscal Year Under Review: Prof: 10 Other: 10
13. Man-Month Requirements in Next Fiscal Year: Prof: 10 Other: 10
14. Locations of Work: Throughout region.
15. Background Statement:
 - a. Project proposed by: Regional forest services, Canadian Forest Service.
 - b. Objectives:
 1. To measure the drop patterns of various airtanker/fire retardant combinations, including helicopters.
 2. To evaluate fire retardants and determine the rates of application required to slow and/or stop fires burning in different fuels under varying burning conditions.

3. To observe and evaluate the effectiveness of airtankers and helitankers using retardants during fire suppression operations.

4. To develop new retardant mixing systems and evaluate these on wildfire operations.

5. To maintain close liaison with government and private organizations involved in forest fire control.

c. Need for project: Both land- and water-based fire-bombing aircraft play an important role in the suppression of wildfires. The use of these aircraft for quickly striking at small fires and supporting ground crews in the suppression of large fires is now well established. The cost of the airtankers and the retardant materials they release is high, thus their efficient utilization is necessary.

It is essential that a knowledge of the drop patterns formed by various airtanker/retardant combinations be available to aid operational fire control personnel in applying these suppression agents. This, in conjunction with information on the amounts of various retardants required to slow or stop fires of varying intensity burning in different fuel types, aids in the selection of the airtanker/retardant combination(s) best suited for a particular region. The development of new retardant mixing systems and the increased interest in the use of helicopters to drop both water and retardant necessitates gathering information on the effectiveness of different helicopters and buckets in fire suppression. Data on the drop patterns of helicopter/bucket combinations using different retardant thicknesses will permit a comparison with present airtankers. Further analysis will permit the use of the optimum fire suppression tool(s) for various wildfire situations.

d. Co-operating agencies: Regional forest services, Airspray (67) Ltd., Edmonton, Alberta; Chemonics Industries Ltd., Kamloops, B. C.; Monsanto Canada Ltd., Edmonton; Okanagan Helicopters, Vancouver, B. C.

16. Accomplishments to Beginning of Fiscal

Year Under Review: Preliminary field investigations were conducted in 1967. Procedures for carrying out air drop tests in open areas and forest stands were modified and/or developed. A series of air-drop tests with the Snow Commander airtanker and GELGARD F short-term retardant was conducted to provide background information for this project. At the same time an injector mixing system for GELGARD was field tested and fire-bombing activities on wildfire operations observed.

In 1968 air drop tests were made with the Snow and Thrush Commander airtankers and Fire-Trol 100 and Phox-Chek 205 long-term retardants. Drop tests with the PBY Canso water-bomber using water and GELGARD M retardant were also made. The nitrogen injection system for mixing GELGARD retardant in the PBY Canso was also evaluated. TX-350, a potential fire retardant, was evaluated and field tested.

The data for the 1968 air drop tests were analyzed, and the results of both the 1967 and 1968 tests prepared for publication. Aerial fire suppression operations were observed throughout the fire season. Liaison activities with various organizations were expanded. A procedure for determining the effective rates of retardant application for fires burning in different fuel types was developed. The modified nitrogen-injection system for mixing GELGARD retardant in the PBY Canso water-bomber was evaluated. Phos-Chek 259 long-term retardant for ground application was operationally tested. Air drop characteristics of the B-26 airtanker were evaluated in a limited drop test series and recommendations for modification to the tank system forwarded to the private contractor.

Air drop tests with the B-26 airtanker and Fire-Trol 100 retardant were carried out and completed in 1970. Results of these and the 1968 air drop tests were forwarded to operational agencies. Evaluation of liquid concentrate (LC) long-term retardant was initiated; this included a trip with operational fire control personnel to evaluate LC operations in the northwestern United States. Tests with different long-term retardants to determine the application rates required to stop fire burning in different fuels were also initiated. Liaison activities with fire control operations agencies in the region were continued or initiated. Preparation of guidelines for the use of various airtankers and retardants, using results of studies conducted to date, was initiated.

17. Goals set for fiscal year under review:

- a. Evaluate Twin Otter-Membrane Tank drop system.
- b. Evaluate Tracker airtanker.
- c. Air drop tests with B-26 and liquid concentrate (LC) retardant.
- d. Initiate evaluation of the helicopter's role as a retardant carrier (helitanker).
- e. Determine application rates for different long-term retardants applied onto standard fuel beds.

18. Accomplishments during fiscal year under review:

The modified nitrogen injection system for mixing retardant in the PBY Canso waterbomber was calibrated for Tenogum short-term retardant in three Canso aircraft working under contract to the Alberta Forest Service. The Twin Otter-Membrane Tank drop system was evaluated in co-operation with the Alberta Forest

Service. Also, a preliminary evaluation of the Tracker airtanker was made in Alberta.

An assessment of the role of helicopters in fire control was initiated in the Yukon Territory in co-operation with the Yukon Forest Service. A mobile retardant mixing system for use at or near a fire location was developed using the Bell 206 Jet Ranger, Sikorsky S58T, and Bell 205A helicopters. The system was evaluated on several going fires. Air drop tests with the Sikorsky S58T and Phos-Chek fire retardant were made to assess the effectiveness of this combination and to determine optimum helicopter drop heights and speeds and retardant viscosity. The study, which was carried out in Vancouver, B.C., was a co-operative venture with CFS, Northern Forest Research Centre, Okanagan Helicopters Ltd. and Monsanto Canada Ltd.

The following reports were prepared for publication:

1. Lieskovsky, R.J. 1971. Drop pattern for Twin Otter Membrane Tank System. Canadian Forestry Service, Department of the Environment, Internal Report NOR-2.
2. Grigel, J.E. 1971. Air drop tests with Fire-Trol 100 and Phos-Chek 205 fire retardants. Canadian Forestry Service, Department of the Environment, Information Report NOR-X-8.
3. Grigel, J.E., W.C. Taylor and J.B. Klassen. 1971. Mobile long-term retardant operation with helicopters in the Yukon Territory. Canadian Forestry Service, Department of the Environment, Information Report NOR-X-5.
4. (i) Portable helitanker retardant system for Yukon.
(ii) Liquid concentrate air drop tests with B-26 airtanker.
(iii) PBY-Canso air drop tests with GELGARD retardant.
(iv) Modification of chemical injection system in PBY Canso airtanker.
(v) Sikorsky S-58T helicopter drop tests with Phos-Chek retardant.

IN Forestry Report. 1972. Northern Forest Research Centre, Canadian Forestry Service, Department of the Environment. Volume 2, No.7.

19. Goals for next fiscal year:

(Note: J.E. Grigel resigned from CFS, February 11, 1972. Pending replacement, this study will be under the direction of R.J. Lieskovsky.)

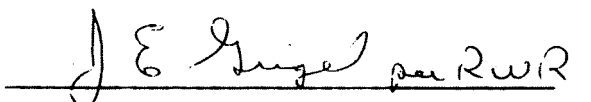
- a. Evaluate Tracker airtanker.
- b. Determine rates of application required for different retardants in regional fuel types.
- c. Conduct Bell 204B helicopter /Alberta Forest Service monsoon bucket drop tests with Phos-Chek retardant.
- d. Evaluate Monsanto's Phos-Chek eductor mixing system on (i) air drop tests, and (ii) wildfire operations.
- e. Observation and evaluation of airtanker and helitanker operations on wildfires in Northwest Territories.
- f. Reports to be published:
 - (i) PBY Canso air drop tests with GELGARD retardant.
 - (ii) Modification of chemical injection system in PBY Canso airtanker.
 - (iii) Liquid concentrate air drop tests with B-26 airtanker.
 - (iv) Sikorsky S-58T helicopter drop tests with Phos-Chek retardant.
 - (v) Drop patterns with Alberta Forest Service modified monsoon bucket.
 - (vi) Evaluation of Monsanto's Phos-Chek eductor mixing system.

20. Signatures:



March, 1972.

R.J. Lieskovsky,
Investigator.



J.E. Grigel,
Investigator.

REDUCTION OF LOSSES BY IMPROVED FIRE DANGER FORECASTING
AND ASSESSMENT METHODS

Near 30 million dollars is the average loss due to forest fires in this region counting suppression costs, costs of maintaining suppression agencies and losses to forest estate. There are near one dozen major types of forest fuels and each burns differently. The hazard build-up in each type varies in different weather patterns. Prescribed burning for hazard removal requires grid lines to permit protection and forestry staff engaged in burning to operate with confidence and effectiveness.

Objectives of this project are to provide fire protection agencies with guide lines in the form of hazard prediction indices, fire behaviour characteristics in different fuels, i.e. rates of spreads and fire intensity during different weather patterns for application to both wild fire and prescribed burning situations.

Benefits accruing from this project are reduced loss of forest estate from wild fires, reduced suppression costs, increased safety to fire personnel, utilization of prescribed fire as a management tool undertaken safely and effectively.

Goals during the next year are to record behaviour of fire in prescribed burns in several fuel types in standing timber. Draw up guide lines for operational use. Improve for regional use current fire weather index.

STUDY REVIEW STATEMENT

Fiscal Year 1971-72

1. Establishment: Prairies Region. Date Prepared: March, 1972.
2. Title: Development and use of fire behavior rating systems in the Prairies Region.
3. Investigators: A. D. Kiil.
4. Year of Commencement: 1963.
5. Estimated Year of Completion: Original 1968, Revision I, 1972. Revision II: Continuous.
6. Key Words not in Title: Fire danger, fire weather, fire reports, fuels, burning tables.
7. Discipline: Fire.
8. Project: Special Resource Protection.
9. Est. Study No.: NOR 035 Service Study No.: NOR 035
10. Status at time of statement preparation: Active.
11. Estimated total man-months utilized to date: Prof.: 21 Other: 22
12. Man-months utilized in fiscal year under review: Prof.: 2 Other: 2
13. Man-month requirements in next fiscal year: Prof.: Other:
14. Location of Work: Prairies Region.
15. Background Statement:
 - a. Project Proposed by: Fire control agencies in Prairies Region.
 - b. Objectives: To assist fire control agencies in promoting the use of the new Canadian Fire Behavior Rating System in support of pre-suppression and suppression activities, to assess the reliability of the new System in terms of its ability to reflect burning potential and to develop concepts, methods and procedures for refining the fire behavior rating system in the Prairies Region.

c. Need for Study: Forest fire behavior rating and forecasting are fundamental to planning and execution of fire prevention, detection, pre-suppression and suppression procedures at the headquarters and field levels. The ever-increasing sophistication and cost of such operations requires at least a corresponding improvement in fire behavior rating. In the Prairies Region alone, annual fire control costs and damage exceed 30 million dollars. A 0.1% reduction in yearly fire control costs and damage is roughly equivalent to maintaining a fire researcher and supporting staff.

During the past 10 years, all fire control agencies in the Prairies Region have used the now old Canadian Forest Fire Danger Rating System. Between 1966 and 1970 the Alberta Forest Service also used a version of the U.S. Danger Rating System. In 1970, the new Canadian Fire Behavior Rating System was introduced to all fire control agencies in the Prairies Region for field trial and/or full-scale use at all stations. The implementation of the new System in support of fire control planning and operations requires extensive training of headquarters and field staff, an assessment of the ability of the System to indicate fire potential, and developing of approaches and procedures for refining the System to satisfy specific needs of individual fire control agencies.

d. Co-operating Agencies: Forest fire control agencies in Alberta, Manitoba, Saskatchewan, Yukon, Northwest Territories and western National Parks. The type and extent of co-operation will vary between agencies and with time but it will entail establishment and maintenance of effective working relationships with officials of these agencies to ensure that their needs for fire behavior rating are identified and resolved.

16. Accomplishments to beginning of fiscal year under review: Over 3000 forest fire reports, covering the seven-year period from 1957 to 1963 were made available for analysis by the Alberta Forest Service. Individual fire reports were examined and the following information was extracted: fire location, time of year, fire size in acres, predominant fuel type, danger index, rate of spread in acres per hour, and length of fireguard built or held in feet. For the three-year period from 1961 to 1963, fire weather data from over 100 Alberta Forest Service weather stations were compiled and analyzed to determine what per cent of the days are classed as falling into a particular danger class.

The extracted information was analyzed by Forest or Division, fire cause, year, season and danger class. Preliminary results of the analysis were included in a report entitled "A problem analysis of forest fire research in Alberta (1964)". The new Canadian Fire Behavior Rating System has been introduced to all six fire control agencies in Region and is in operational use.

Publications:

1. Kiil, A. D. and D. Quintilio 1968. Forest fires and fire danger rating in Alberta, 1957-1963. Information Report A-X-25.

2. Kiil, A. D. and J. E. Grigel. 1969. The May 1968 forest conflagrations in central Alberta. A review of fire weather, fuels and fire behavior. Inf. Rpt. A-X-24.
3. Kiil, A. D. 1970. Forest-habitat inventory requirements for fire danger rating (Paper presented at the Workshop Symposium on Forest-land inventory for Management, Edmonton, Feb. 12-13).
4. Kiil, A. D. 1970. Distribution of moisture in spruce-fir duff and its relevance to fire danger rating. Canadian Forestry Service, Int. Rpt. A-34.

17. Goals set for fiscal year
under review:

1. To assist fire control personnel in familiarizing themselves with the workings of the new Fire Behavior Rating System and to help them determine the optimum use of fire danger indices to achieve fire control objectives.
2. Complete analysis of fire weather data from 40 Alberta Forest Service fire weather stations to facilitate comparison to U.S. and new Canadian Systems in terms of fire business.
3. Participate in developing a detailed approach to facilitate preparation of Burning Tables for selected major cover types in Prairies Region. The approach will consist of a combination of field experiments, observations and measurement of wildfires and simulation techniques.

18. Accomplishments during fiscal
year under review:

1. Computer programs are available to facilitate calculation of the various indices of the U.S. and the new Canadian Fire Behavior Rating Systems. Over 40 fire weather stations in Alberta have been selected to serve as a basis for comparing the reliability of the two Systems in terms of fire business. Precipitation data for these stations have been extracted from Monthly Weather Summaries. Computer analyses completed to determine frequency distribution for various indices and weather variables.
2. Participation in several lectures and training sessions to familiarize personnel of fire control agencies with the structure and application of new Fire Behavior Rating System.

19. Prepare a field guide for use of new Canadian fire behavior rating system in Region. To include comparison of old U.S. and new Canadian systems, analysis of fire weather in Region and calibration of indices.

Terminate project - future work to be part of study on fire behavior rating, including burning tables (Chrosciewicz).

20. Signatures:

A. D. Kiil

A. D. Kiil

April 13/72

Date

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

1. Establishment: Northern Forest Research Centre. Date Prepared: March, 1972.
2. Title: Fire intensity and rate of spread in lodgepole pine slash.
3. Investigator: D. Quintilio.
4. Year of Commencement: 1968.
5. Estimated Year of Completion: Original, 1970.
Revision I, 1971.
6. Key Words not in Title: Prescribed burning, fire danger rating, slash hazard, fire behaviour, Pinus contorta, var. latifolia, SAI.
7. Discipline: Fire.
8. Project: Reduction of losses by improved fire danger forecasting and assessment methods.
9. Estab. Study No. NOR 036. Service Study No. NOR 036.
10. Status at time of statement preparation: Completed.
11. Estimated total man-months utilized to date: Prof.: 27 Other: 71
12. Man-months utilized in fiscal year under review: Prof.: 4 Other: 8
13. Man-month requirements in next fiscal year: Prof.: Nil Other: Nil
14. Location of Work: Kananaskis Research Forest.
15. Background Statement:
 - a - Study proposed by: Alberta Forest Service.
 - b - Objectives:
 1. To study accomplishment of fire, i.e. fuel consumption, duff removal, fire residence, etc., and relate this to available fuel and important weather variables for silvicultural purposes.

2. To compile a burning table expressing fire hazard of lodgepole pine slash in terms of rate-of-fire-spread for danger rating purposes.

3. To determine important fire behaviour characteristics necessary for the development of guidelines for operational prescribed burning.

c - Need for study: In Alberta 50,000 acres of forest cover are clearcut annually. This constitutes an immediate depletion of merchantable and unmerchantable trees, and adds a heavy volume of slash to the site. Resource managers are hence faced with two problems: (1) regeneration of a desirable species and (2) reduction of the increased fire hazard.

Properly prescribed fire can effectively reduce fuel quantity, and prepare a seedbed by reducing competition and improving the nutrient regime. It is, then, a potential management tool following the clearcut logging method. However, before fire can be used with predictable results and at a level of risk acceptable to management, burning guidelines are required. With proper guidelines the operational use of fire can cost as little as \$4/acre.

Major fuel types must be rated in terms of fire behaviour, i.e. rate-of-spread, for the range of weather conditions experienced during a fire season. Logging slash is a unique fuel type and fire protection administrators require an objective measure of its state of hazard at any given time. Experimental burns will provide a conclusive means of objectively predicting fire behaviour by fuel type and weather conditions. These results can hence be incorporated into pre-suppression and suppression plans at the management level. Should this provide for more efficient use of, or reduce, a small percentage of the annual 2.5 million dollar provincial wildfire bill, the cost of the project will be easily repaid.

d - Co-operating agencies: Alberta Forest Service. The Forest Service agrees to provide pre-suppression forces and mop-up aid for each prescribed burn as well as field consultation.

16. Accomplishments to beginning of fiscal year under review:

Sixteen experimental one-acre plots were established at K.F.E.S. and all relevant stand and site information obtained. All fire lines were constructed and documentation of fuel characteristics completed during the summer of 1968. A single test burn was also undertaken to assure that the fire plan for the experiment was satisfactory. During 1969 eleven plots were burned over a range of hazard conditions with the following

distribution: Extreme - 4
 High - 3
 Moderate - 2
 Low - 2

The five remaining plots have been designated as control units for F. Endean's accompanying silvi-cultural study.

Post-fire inventories on burned areas were completed and data is analyzed. All fire characteristics have been related to important weather variables as a basis for operational burning guidelines.

Twenty additional acres of the lodgepole pine type were clearcut during January of 1970. All relevant stand and site information was obtained and firelines were constructed for 13 one-acre plots.

All plots were inventoried during spring of 1970 according to detailed work plan. Four research fires and four operational fires were conducted before the forest was closed due to extreme fire danger. Post-fire inventories are complete and data is analyzed. Two reports have been issued:

Quintilio, D. 1970. Preliminary guidelines for prescribed burning in lodgepole pine slash. Internal Report A-30, Can.For.Serv., Dept. of Fish. and Forestry.

Quintilio, D., R. Ponto and I.B. Frew. 1971. Sprinkler system designed for prescribed burning. Inf.Report AX-41, Can.For.Serv., Dept. Fish. & Forestry.

17. Goals set for fiscal year under review:

Burn the remaining plots, as weather permits, for the purpose of measuring fuel consumption, fire residence, and rate of spread. Post-inventory the burned areas and compile data for analysis and publication.

18. Accomplishments during fiscal year under review:

Six plots were burned under selected weather conditions and all post-inventories are complete. Data from 1969, 1970, and 1971 were grouped for analysis and presented as an M.Sc. thesis at the University of Montana:

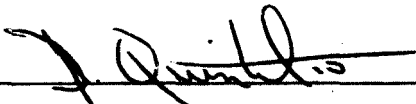
Quintilio, D. 1972. Fire spread and impact in lodgepole pine slash. Unpublished M.Sc. thesis, University of Montana.

The data was further pooled with Ontario results and a jack pine-lodgepole pine burning index is

in press. The index is to be inserted as supplement number one of the Canadian Fire Weather Index in both the Ontario and Prairies Region. The background information and method of analysis will be published in a suitable journal.

19. Goals for next fiscal year: None, project is terminated.

20. Signatures:



D. Quintilio,
Investigator.

March, 1972.

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

- | | | | |
|---|------------------------------------|---|----------------|
| 1. Establishment: | Northern Forest
Research Centre | Date Prepared: | February, 1972 |
| 2. Title: | | Burning indexes for major fuel
types in Prairies Region. | |
| 3. Investigators: | | D. Quintilio, G. Chrosciewicz. | |
| 4. Year of Commencement: | | 1970 | |
| 5. Estimated Year of Completion: | | Original 1973.
Revision I, 1975. | |
| 6. Key Words not in Title: | | Canadian Forest Fire Weather
Index, danger rating, fire
behavior, "B". | |
| 7. Discipline: | | Fire. | |
| 8. Project: | | Reduction of losses by improved fire
danger forecasting and assessment
methods. | |
| 9. Estab. Study No. NOR 086 | | Service Study No. NOR 086 | |
| 10. Status at time of statement
preparation: | | Active. | |
| 11. Estimated total man-months
utilized to date: | | Prof.: 4 Other: 4 | |
| 12. Man-months utilized in fiscal year
under review: | | Prof.: 7 Other: 3 | |
| 13. Man-month requirements in next
fiscal year: | | Prof.: 2 Other: 2 | |
| 14. Location of Work: | | Federal Fire Research Reserve,
Slave Lake, Alberta | |
| 15. Background Statement: | | | |
- a. Study proposed by: Regional forest services, Canadian Forestry Service.
- b. Objectives:
1. To determine the behaviour of surface fires within major fuel types by monitoring experimental fires over a selected distribution of weather conditions.

2. To determine the behaviour of crowning fires within major fuel types by observing and analyzing wildfire phenomena.

3. To develop fire spread and intensity tables which will regionally supplement the new Canadian Fire Weather Index.

c - Need for project: The provinces of Canada annually disburse an average of six million dollars for actual fire fighting costs and forfeit another thirteen million dollars through damage (equated only to wood fibre) caused by forest fires.¹ The Prairies Region accounts for 42% of the actual fire fighting costs and 30% of the loss through damage.

Suppression costs are continually increasing as are the implied and real values of our forest resources. We require, then, sophisticated tools for protecting this resource.

Intensive fire control management requires a means of predicting or forecasting the potential fire danger of specific fuel types for a range of weather conditions. Although such a tool would not prevent fires from occurring, it would, with proper pre-suppression planning, aid in the strategic preparation of initial attack crews, air patrols, etc.

A considerable step toward the creation of such a tool was the development of the Canadian Fire Weather Index by the fire research group of the Canadian Forestry Service. The Index is designed to summarize and rate the important weather variables that affect the ignition and spread of forest fires, and as such is a means of uniformly rating daily fire hazard across the country. As it is primarily a weather dependent scale the effect of fuel type on fire behaviour is not yet categorized.

The second step, then, is the regional development of burning tables for important major fuel types. Experimental fires can provide data necessary to relate surface fire behaviour to the Index for each selected fuel type. Additional data, including crownfire activity, must be studied separately on going wildfires. The completed burning tables will relate surface and crown fire behaviour in specific regional fuels to the national Fire Weather Index, providing a more precise prediction tool for fire control use.

¹ McLean, D.L. and M.R. Lockman. 1967. Forest fire losses in Canada, 1960. Dept. For. Rural Dev., Forest Fire Research Institute, Ottawa.

16. Accomplishments to beginning of fiscal year under review: Both aerial and ground reconnaissance surveys were made of the following types:

- (1) Pure aspen
- (2) White spruce-aspen
- (3) Pure jack pine
- (4) Pure black spruce

Study areas were chosen for the first three types and plot boundaries were surveyed for sixteen $\frac{1}{4}$ -acre plots in each type. Access roads, waterholes and firelines have been constructed at all three sites. The co-operating agency is assisting in locating field headquarters and weather station sites.

17. Goals for fiscal year under review: Inventory all established plots to determine fuel loading and distribution. Conduct pilot fires as weather permits and re-inventory to assess fire characteristics. Establish new plots for continuation of study as required.

18. Accomplishments during fiscal year under review:

A detailed stand description was obtained for the forty-eight established plots. A permanent weather station site was selected and wind, temperature, relative humidity, and precipitation were continuously monitored during the fire season. A pilot burn was conducted in the aspen type with the co-operation of the A.F.S., Slave Lake District. Following the test burn co-operative criteria were firmly established with the Slave Lake District in preparation for a full summer's burning in the forthcoming fiscal year. A reconnaissance was made of suitable sites for field headquarters with assistance from the A.F.S., Special Leases Branch. A final recommendation to expand the existing Hondo facilities was submitted, detailing equipment required and estimated costs.

19. Goals for next fiscal year: A general reassignment of duties to adjust for the resignation of the suppression project leader moves Mr. Quintilio to suppression research and Mr. Chrosiewicz to fire behavior research. In this regard Mr. Quintilio will phase out of this study following a one-month burning period in the aspen type in the spring of this fiscal year. Mr. Chrosiewicz, following a summer of reconnaissance and familiarization, will continue the study.

20. Signatures:

D. Quintilio
D. Quintilio
Investigator

Apr. 13 / 72
Date

G. Chrosiewicz
G. Chrosiewicz
Investigator

Apr. 13 / 72
Date

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

1. Establishment: Prairies Region. Date Prepared: March, 1972.
2. Title: The effect of stand composition on forest-floor fuels in Alberta.
3. Investigator: A. D. Kiil.
4. Year of Commencement: 1968.
5. Estimated Year of Completion: Original 1971. Revision I, 1972.
6. Key Words not in Title: Classification, pine, spruce, aspen, weight, heat of combustion.
7. Discipline: Fire.
8. Project: Special Resource Protection.
9. Estab. Study No.: NOR 091 Service Study No.: NOR 091
10. Status at time of statement preparation: Active.
11. Estimated total man-months utilized to date: Prof.: 6 Other: 21
12. Man-months utilized in fiscal year under review: Prof.: 0 Other: 2
13. Man-month requirements in next fiscal year: Prof.: 3 Other: 3
14. Location of Work: Alberta.
15. Background Statement:
 - a. Project proposed by: Canadian Forestry Service, Associate Committee on Forest Fire Protection.
 - b. Objectives:
 1. To determine the physical and heat yield characteristics of forest floor fuels in Alberta.
 2. To investigate the relationship between stand characteristics and forest floor fuels in Alberta forests.

3. To develop efficient and effective fuel sampling methods and techniques.

c. Need for project: Every forest fire danger rating system used in North America incorporates one or more measures of moisture of selected forest fuels. The selection of specific fuels to represent drying and wetting trends in different fuel complexes has been arbitrary and does not provide a quantitative measure of the amount or importance of each fuel factor. Our knowledge about fuels in forest stands is therefore incomplete and relative in the sense that the observers' estimates of the fuel complex are not necessarily related to fire behaviour. It is therefore important to determine the physical characteristics of the forest-floor universe as a basis for determining fuel-moisture relationships and classification of the forest fuel complex for the refinement of fire danger rating systems.

The most promising practical approach to identifying and classifying the important forest-fuel components appears to be in terms of the growth of the forest, for the kinds and quantities of fuels are controlled by the development of the forest. It is recognized that natural growth trends are often interrupted by artificial (logging) and natural (fire, insects, disease) disturbances which often greatly modify the fuel complex. Owing to the effects of such disturbances, the primary objective of this study is not a statistically exact description of the fuel-stand relationships involved but rather a general quantification of forest-floor fuels in the commercially important stands of the Prairies Region.

d. Co-operating Agencies: Alberta Forest Service. Participation consists of making available PSP photo and stand data.

16. Accomplishment to beginning of fiscal year under review: Sampling units were selected on the basis of Alberta Forest Service permanent sample plot (PSP) data. Stand characteristics, including age, basal area, site, total cubic foot volume and map cover type class, were used to stratify stands for sampling.

A total of 41 lodgepole pine and 20 white spruce stands have been located and twelve one-square foot forest-floor fuel samples taken in each sampling unit. The samples were taken to a field laboratory, measured for depth, separated into L, F and H layers, oven-dried and weighed. Computer analysis was carried out to calculate depth, weight and bulk density of the L, F, H, L & F, F & H and L & F & H layers.

17. Goals set for fiscal year under review:

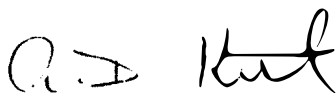
1. Collect an additional five one-square-foot samples from each of the four cover types.
2. Complete data analysis and prepare manuscript for publication.
3. Terminate project.

18. Goals for next fiscal year:
prepare manuscript for publication.

1. Complete data analysis and

2. Terminate project.

20. Signatures:



A. D. Kiil., Investigator.

March, 1972.

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

1. Establishment: Prairies Region. Date Prepared: March, 1972.
2. Title: Prescribed fire following clear-cutting of overmature spruce-fir in the Foothills Section of Alberta.
3. Investigator: A. D. Kiil.
4. Year of Commencement: 1967.
5. Estimated Year of Completion: Original 1971.
6. Key words not in Title: Fire intensity, fuels, Picea glauca, Abies lasiocarpa.
7. Discipline: Fire.
8. Project: Special Resource Protection.
9. Estab. Study No.: NOR 092 Service Study No.: NOR 092.
10. Status at time of statement preparation: Completed.
11. Estimated total man-months utilized to date: Prof.: 19 Other: 49
12. Man-months utilized in fiscal year under review: Prof.: 1 Other: 3
13. Man-month requirements in next fiscal year: Prof.: 1 Other: 2
14. Location of Work: Hinton, Alberta.
15. Background Statement:
 - a. Project proposed by: Requested by North Western Pulp and Power Ltd.
 - b. Objectives:
 1. Investigate the techniques and logistics of prescribed fire use in the overmature spruce-fire slash-fuel type.
 2. Evaluate the effects of prescribed burning in terms of slash hazard, fuel moisture, burning indices and fire intensity.

3. Determine the relationship between the U.S. Buildup Index and the moisture content of the L, F and H layers in spruce-fir stands and in clearcut areas.

c. Need for project: A significant portion of the pulp-wood harvest of North Western Pulp and Power Ltd. is from overmature stands of spruce-fir (Picea glauca (Moench) Voss, Abies lasiocarpa (Hook) Nutt.). Natural regeneration is generally inadequate following clearcutting of this type mainly because of irregular natural seed supply and unfavourable seedbed. Cultural treatments probably in combination with artificial regeneration are considered necessary if the Company is to fulfill its obligation to regenerate the cut-over forest adequately and promptly.

In the overmature spruce-fir stands, one of the problem site types for regeneration is characterized by a surface layer of moss and unincorporated organic material 6 to 24 inches deep, depending on moisture. It is probable that site deterioration is active and will continue with increasing accumulation of organic material and colder, wetter soils than at present if the process is not interrupted. A primary requirement for successful regeneration is a seedbed in which dry litter and thick humus barriers are removed or reduced and some moist topsoil is exposed or mixed with humus. Scarification can effect improvement in the seedbed but because of wet soils and excessively deep organic layers on the sites, satisfactory mineral soil exposure is not obtainable by normal blade and/or drag operations. The recognition by forest management and research agencies that scarification is not a panacea and a renewed interest in the potential of prescribed burning resulted in the initiation of this project. The experience and research findings from this large-scale prescribed burning experiment will be used as a basis for recommending further research and to provide guidelines for operational burning.

d. Co-operating Agencies: Alberta Forest Service- planning and execution; North Western Pulp and Power Ltd., - planning and execution.

16. Accomplishments to beginning of fiscal year under review: In 1966-67, four 15- to 25-acre blocks were selected on each of two site conditions, shallow organic and deep organic. At each site, three blocks were prepared for burning in 1967 and one block was set aside as a permanent control. An intensive site and stand inventory was carried out on each block in late fall of 1966, prior to clearcutting in winter of 1966-67. Following clearcutting, the weight-and-size distribution of slash, lesser vegetation, moss and humus were determined for each burning block. Twenty-four sampling points were established in each block to facilitate assessment of fuel consumption and depth of burn.

A standard weather station, consisting of a recording hygrothermograph, rain gauge and wind measuring system, was erected and maintained at each of the two sites to provide data for calculating daily spread and drought indices and to aid in fire weather forecasting. Shortly before each burn, pilot balloons and a theodolite were used to obtain information about wind speed and direction in the lower 5,000 feet of the atmosphere.

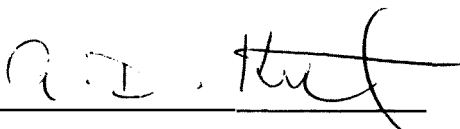
On all burns, the Edson Forest of the Alberta Forest Service provided a standby suppression crew and equipment, carried out pre-burn preparation such as wetting the fuels outside the firelines to reduce the probability of firebrands igniting in these fuels and assumed responsibility for possible suppression and mopup operations. Canadian Forestry Service personnel assumed responsibility for ignition and all aspects of research. Fire prescriptions and solutions to other problems related to this co-operative project were arrived at through a series of special meetings involving representatives of the Alberta Forest Service, North Western Pulp and Power Ltd., and the Canadian Forestry Service. One four-acre test plot and one 15-acre experimental block were burned in 1967. In 1968, all three shallow-duff blocks were burned according to the fire prescription. The deep duff blocks were burned in 1969. Compilation and analysis of data is complete and final report is available for distribution.

Publications:

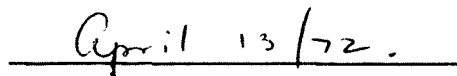
Kiil, A. D. 1969. Basic considerations in the planning and use of prescribed fire. Canada Dept. of Fisheries and Forestry, Inf. Rpt. A-X-21.

Kiil, A. D. 1969. Fuel consumption by a prescribed burn in spruce-fir logging slash in Alberta. The Forestry Chronicle, Vol. 45, No. 2.

17. Goals set for fiscal year under review: Publication of final report.
18. Accomplishments during fiscal year under review: Publications:
1. Prescribed burning in spruce-fir slash in Alberta. A 16-mm. color movie with sound track.
 2. "Prescribed fire effects in Subalpine spruce-fir slash in Alberta". Inf. Rpt. NOR-X-3.
 3. Kiil, A. D. and Z. Chrosciewicz. 1970. Prescribed fire - its place in reforestation. The Forestry Chronicle Vol. 46, No. 6.
 4. Termination of project.
19. Goals for next fiscal year: Study completed.
20. Signatures:



A. D. Kiil



Date

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

1. Establishment: Northern Forest Research Centre Date Prepared: March, 1972
2. Title: Evaluation of the fuel complex at different stages of vegetative succession.
3. Investigator: A. D. Kiil
4. Year of Commencement: 1971
5. Estimated Year of Completion: 1973
6. Key Words not in Title: weight, distribution, energy, lodgepole pine, white spruce, fir, classification.
7. Discipline: Fire
8. Project: Reduction of losses by improved fire danger forecasting and assessment methods.
9. Estab. Study No.: Service Study No.: NOR 124
10. Status at time of statement preparation: Active
11. Estimated total man-months utilized to date: Prof.: 1 Other: 4
12. Man-months utilized in fiscal year under review: Prof.: 1 Other: 4
13. Man-month requirements in fiscal year: Prof.: 1 Other: 5
14. Location of Work: Banff and Kootenay National Parks
15. Background Statement:
- a - Project proposed by: National and Historic Parks Branch, University of Alberta, Canadian Forestry Service.
- b - Objectives:
1. To determine amount and distribution of major fuel components in 3, 60, 150 and 300-year-old stands on similar sites.
 2. To determine the moisture content and distribution of moisture in duff layers in these vegetation types after selected intervals since last rain.

3. To establish a sound foundation for a long-term study of vegetation in the area.

c - Need for Study: There is at present no standard procedure for evaluating fire potential behavior and impact in different vegetative associations. It is therefore important to obtain quantitative information about forest fuels and to interpret existing fire behavior rating schemes in the light of new evidence. This information will serve as the basis for developing guidelines for rating and mapping fuel types according to fire behavior.

d - Co-operating Agencies: National Parks Service,
Universities of Alberta and Calgary.

16. Accomplishments to beginning of fiscal year under review: Study plan.

A detailed field reconnaissance and interpretation of aerial photographs of the Vermillion Pass area carried out. Following selection of study sites, field description and measurements of vegetation and fuel parameters made. Within each vegetation type, sub-samples will be taken to determine moisture content of duff layers after different amounts of rain. Results will provide description of fuel loading and distribution in the 4 vegetative types.

17. Goals set for fiscal year under review:

Complete field work and initiate data compilation and analysis procedures.

18. Accomplishments during fiscal year under review:

Plots were selected, established, and measured in all four vegetation types. Data analysis is underway.

19. Goals for next fiscal year:

Sample all four vegetation types to determine moisture content of duff after different amounts and durations of rain. Complete data analysis and prepare final report.

A. D. Kiil

A. D. Kiil
Investigator

Apr 12 6/72

Date

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

1. Establishment: Northern Forest Research Centre. Date Prepared: March 1972
2. Title: Artificial and natural regeneration of a cut-over and burned sub-alpine lodgepole pine site.
3. Investigator: F. Endean.
4. Year of Commencement: 1969.
5. Estimated Year of Completion: Original 1974.
6. Key Words not in Title: Planting, tubed stock, seeding, Pinus contorta, sub-alpine (Rowe, J. S. Bull 123).
7. Discipline: Silviculture.
8. Project: Improved regeneration methods for commercial forest species.
9. Estab. Study No. A-272, A-024. Serv. Proj. No.: NOR 001
10. Status at time of statement preparation: Active.
11. Estimated total man-months utilized to date: Prof.: 3 Other: 12
12. Man-months utilized in fiscal year under review: Prof.: 1 Other: 2
13. Man-month requirements in next fiscal year: Prof.: 2 Other: 2
14. Location of Work: ~~Kananaskis Forest Experimental Station.~~
15. Background Statement:
 - a. Study proposed by: Canadian Forestry Service.

b. Objectives: 1. To compare on the basis of survival, healthy development and rate of growth, the relative efficiencies of the following methods of regeneration on burnt and unburnt cut-over areas:

planting - open rooted stock
 planting - 12-16 week old container stock
 broadcast seeding
 spot seeding with spot scarification
 no seeding or planting

2. To observe the effects of different intensities of fire on seed trees left after logging, as to physical damage and in terms of degree of cone openings and seed yield.

3. To record cone survival in the slash and seed and seedling yields in burnt and unburnt plots.

c. Need for Study: The prolific regeneration of lodgepole pine following chance fire has long been recognized and the advantages of controlled burning to forest management in the form of reduction of fire hazard, exposure of mineral soil and removal of competing vegetation are well known and accepted. In the case of lodgepole pine, fire produces an additional benefit in hastening seed release from the resin sealed cones. Although a moderate amount of work has been done on the artificial and natural regeneration of lodgepole pine, most of that done in the sub-alpine regions has been in connection with scarification and seeding.

It is likely that the east slopes sub-alpine forests will come under heavy exploitation in the future. It is also likely that this cutting will be highly mechanised on large clear-cuts leaving no standing residual seed source for adequate natural seeding. The likelihood of such a situation makes it necessary to test the efficiency of the techniques of natural and artificial regeneration now available.

The experimental site exemplifies the more difficult sub alpine site for regeneration; techniques which prove suitable here will certainly have wide applicability in the rest of the forest type.

d. Co-operating Agencies: None. The burned areas to be used in this project will result from replicated slash burning trials to be carried out by D. Quintilio under another project.

16. Accomplishments to beginning of fiscal year under review:

Plots laid out, seed trees selected and assessed, cone counts carried out, seed traps set out, burning treatments applied. All after burn assessments of cones, seed trees and mineral soil exposure, done. Regeneration treatments applied.

17. Goals set for fiscal year under review:

Assess and measure seedling survival and growth, amount of regeneration from artificial and natural seeding, complete demarcation and plot numbering.

18. Accomplishments during fiscal year under review:

All goals set out above.

*Doesn't say
much.*

19. Goals for next fiscal year:

of previous year.

Repeat assessments and measurements

20. Signature:

F. Endean

F. Endean
Investigator

March 1972

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

1. Establishment: Northern Forest Research Centre. Date Prepared: March 1972.
2. Title: Prescribed burning following cutting of spruce/fir in the foothills section of Alberta.
3. Investigator: F. Endean.
4. Year of Commencement: 1967 (delayed until 1968).
5. Estimated Year of Completion: Original - 1973.
6. Key Words not in Title: Regeneration, planting, container stock, sowing, soil temperature, Boreal Region B19C (Rowe, J.S., Bull 123).
7. Discipline: Silviculture.
8. Project: Improved regeneration methods for commercial forest species.
9. Estab. Study No.: A 006 Serv. Study No. NOR 003
10. Status at time of statement preparation: Active.
11. Estimated total man-months utilized to date: Prof.: 9 Other: 20
12. Man-months utilized in fiscal year under review: Prof.: 3 Other: 6
13. Man-month requirements in next fiscal year: Prof.: 2 Other: 6
- 13A.
14. Location of Work: Hinton, Alberta
15. Background Statement:
- a. Project proposed by: Canadian Forestry Service, Alberta Forest Service, North Western Pulp & Power Co.
- b. Objectives: 1. To describe the effects of prescribed burning at a range of intensities on the following site factors which are regarded as of major importance to the establishment and growth of regeneration; nature of seed bed and root environment in

terms of depth of moss, L, F and H layers; ground vegetation regarded as possible competitor with seedlings, soil temperature in the seedling rooting zone, soil moisture.

2. To evaluate the effect and permanency of these changes in terms of growth and survival of artificially established seedlings of lodgepole pine and white spruce, reversal of site deterioration.

3. From these facts, to decide whether prescribed burning has any silvicultural value on these and similar sites and to suggest necessary further investigation on techniques for general use.

c. Need for project: A significant portion of the current and proposed pulpwood harvest of N.W.P.P. and the growing stock in the foothills generally comprises overmature stands of spruce/fir. These stands have persisted for 3-4 centuries without interruption by wild fire at high elevation in a cool climate. Apart from the present moribund condition of the growing stock, the main features of these sites are surface layers of unincorporated organic matter 6 - 24" deep, low summer soil temperatures and soil moisture levels varying from fresh to saturated. It is almost certain that in terms of productive capacity, these sites are deteriorating as organic matter continues to accumulate, causing even colder and wetter soil conditions and that radical treatments are required to reverse the process.

Natural regeneration is usually inadequate on clearcuts of this forest type, chiefly due to the combination of soil factors described. Mechanical scarification, followed by seeding has not been successful because the equipment is unable to disturb the organic layer and debris sufficiently to expose the mineral soil and produce conditions necessary for seedling establishment and growth. For the same reasons, little confidence is placed in the planting of open rooted or tubed stock on these sites.

It is this double problem of site deterioration and difficulty of regeneration which has simulated this project and which will assume more widespread proportions as exploitation of this type proceeds.

Burning is a treatment worth testing since it has been widely used in North America and Northern Europe to correct such conditions and carries with it other important benefits such as reduction of fire hazard and improved surface conditions for seeding and planting. With the exception of work done by Ackerman (1961) it has not been critically tested in the spruce/fir type in Alberta. The use of fire in these areas is being approached through careful research because of their hydrological importance and the dry summer climate. Furthermore Swedish work has suggested a reduction of growth potential on burnt sites plus serious damage from the fire associated fungus Rhizina inflata and burning has been widely rejected there for these reasons.

d. Co-operating Agencies: Department of Fisheries and Forestry Canadian Forestry Service, Fire Section - fire behaviour, Alberta Department of Lands and Forests - Fire Protection Section - fire control and authority to burn. Northwestern Pulp and Power Company - research areas and construction of fire lines.

16. Accomplishments to beginning of fiscal year under review:

Four 15-25 acre blocks were selected and demarcated on each of two different sites, one with shallow and one with deep duff. A reference grid of metal pins at 40L x 40L was laid out. A soil survey was done to describe soil types and variation within the treatment plots, 4,000 ground level measurements were made to detect changes due to burning, vegetation was recorded on random quadrats and photographed.

A soil temperature measuring system of thermocouples was set out to measure changes in soil temperature as a result of burning in terms of mean monthly temperatures.

Burning treatments were eventually applied in 1968 and 1969 and post burning assessments and measurements and regeneration treatments carried out.

First year survival and growth measurements on planted and seeded stock were done in 1970, soil temperature measurements were continued.

17. Goals set for fiscal year under review:

To remeasure growth and survival of planted and seeded stock and to maintain soil temperature measurements.

18. Accomplishments during fiscal year under review:

All above goals accomplished.

19. Goals for next fiscal year:

To enumerate recolonising vegetation, repeat measurements of growth and survival, take all necessary steps to complete project preparatory to it being placed on a maintenance basis.

20. Signature:

F. Endean

F. Endean
Investigator

March 1972

Why not indicate what is happening?

Any progress reports?

In how long?

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

1. Establishment: Northern Forest Research Centre. Date Prepared: March, 1972.
2. Title: Effects of prescribed fire on peaty humic gleysol and on gray wooded soils under spruce-fir forests.
3. Investigator: G.L. Lesko.
4. Year of Commencement: 1967.
5. Estimated Year of Completion: Original, 1970.
Revision I, 1972.
Revision II, 1980.
6. Key Words not in Title: Soil temperature, soil moisture, nutrients, Picea glauca, Abies lasiocarpa.
7. Discipline: Soils.
8. Project: Improved regeneration methods for commercial forest species.
9. Estab. Study No. A 295. Service Study No. NOR 004.
10. Status at time of statement preparation: Active.
11. Estimated total man-months utilized to date: Prof.: 4 Other: 19
12. Man-months utilized in fiscal year under review: Prof.: 0.5 Other: 3
13. Man-month requirements in next fiscal year: Prof.: 0.5 Other: 3
14. Location of Work: Hinton, Alberta.
15. Background Statement:
 - a - Project proposed by: Northwestern Pulp & Power Ltd.
 - b - Objective: The objective of this soil study is the evaluation of fire effects on the following physical

- and chemical soil properties:
1. Soil temperature
 2. Soil moisture
 3. Soil reaction
 4. Essential macro nutrients
 5. Organic carbon content
 6. Cation exchange capacity

c - Need for study: Regeneration of overmature spruce-fir (Picea glauca (Moench) Voss., Abies lasiocarpa (Hook Nutt.) stands after clear cutting is a recognized problem in the Northwestern Pulp & Power Ltd. lease area at Hinton. The main cause of regeneration failures in these forest types is the thick layer of unincorporated organic material and a dense moss cover over the mineral soil.

Successful regeneration of these forest types may be achieved by the partial removal of the surface organic horizon and by the exposure of the mineral soil. Removal of the organic layer with mechanical scarification is either ineffective or uneconomic. An alternative to mechanical scarification is the prescribed burning of logging slash after clear cutting.

The evaluation of fire effects on soil properties is necessary in order to detect and avoid excessive soil deterioration due to loss of nutrients or loss of water holding capacity in the top soil.

d - Co-operating agencies: Northwestern Pulp & Power Ltd., Alberta Department of Lands and Forests.

16. Accomplishments to beginning of fiscal year under review:

Two series of Colman soil moisture units with thermistors were installed in each of four blocks following prescribed burning, in a control block, and in the adjacent forest stand. Measurements of soil moisture and temperature were conducted for three growing seasons, and humus samples were collected for chemical analyses before burning, and after burning for two consecutive years. Chemical changes in the humus layer and one growing season soil temperature results were evaluated.

17. Goals set for fiscal year under review:

1. Continuation of data collection from all installed instruments.
2. Chemical analyses of humus samples collected in the last one-year period.
3. Reporting on the immediate effect of the 1968 prescribed fire.

18. Accomplishments during the fiscal year under review:

Field measurements were carried out according to plans. Analyses of the collected humus samples were only partially accomplished.

Early effect of the 1968 prescribed fire were evaluated and an internal report on the subject was completed.

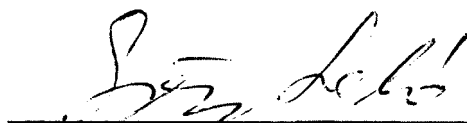
Paper published:

Lesko, G.L. 1971. Some early effects of a prescribed fire in spruce-fir slash on soil properties. Forest Research Laboratory, Calgary, Alberta. Internal Report.

19. Goals for next fiscal year:

Field measurements will be continued as in past year, and chemical analysis of the 1970 samples will be completed.

20. Signature:



March, 1972.

G.L. Lesko,
Investigator.

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

- 1. Establishment: Northern Forest Research Centre. Date Prepared: March, 1972.
- 2. Title: The role of fire in the ecology of jack pine: formerly, Microclimate, vegetation and soils.
 - Study a. Ecological effects of burning.
 - Study b. The effect of depth to water table on tree seedling growth.
- 3. Investigator: H. P. Sims.
- 4. Year of Commencement: 1960
- 5. Anticipated Year of Completion: 1973
- 6. Key Words not in Title: Pinus banksiana, root, growth, competition, nutrients, burn, mammals, Picea mariana, Picea glauca, Pinus resinosa.
- 7. Discipline: Tree Biology.
- 8. Project: Improved regeneration methods for commercial forest species.
- 9. Estab. Proj. No.: MS-218, 225, 243 MS 009 Serv. Proj. No.: NOR 047
- 10. Status at time of statement preparation: Active
- 11. Estimated total man-months utilized to date: Prof.: 42 Other: 56
- 12. Man-months utilized in fiscal year under review: Prof.: 8.0 Other: 8.0
- 13. Man-month requirements in next fiscal year: Prof.: 4 Other: 3
- 13a. Man-month requirements to complete project: Prof.: 4 Other: 3
- 14. Location of Work: Sandilands Provincial Forest and Winnipeg, Manitoba.
- 15. Background Statement:
 - a. Project proposed by: Canadian Forestry Service.

b. Objectives: Study (a). To determine the effects of fire on the environment growth and development of jack pine.

Study (b). To test the hypothesis that in sandy soils, depth to water table is the most significant edaphic factor influencing forest growth and species distribution.

c. Need for project: Study (a). In our northern forests fire is an important factor in the life cycle of jack pine, a pioneer species particularly well adapted to succession following wild fire. However, regeneration following harvest of this valuable timber species is often a problem and efficient methods of seedbed and site preparation are being sought. By investigation of the role of fire in the life cycle of jack pine and by determination of specific fire effects on the environment and on the establishment and early growth of this species it is hoped that prescribed fire can be eventually utilized as an efficient, effective regeneration method.

Study (b). Observations and plot studies in southeastern Manitoba suggested that in sandy soils the most significant edaphic factor influencing forest growth and distribution is depth to water table. Mean 50-year site indices for jack pine (Pinus banksiana) varied from 40 on dry sands without water table influence to 54 on moist sands with late-season water table depths of 4 to 5 feet. Vigorous black spruce (Picea mariana) understorey frequently occurred in moist sandy soils and was absent in dry sandy soils.

For the purpose of testing this hypothesis a greenhouse experiment was initiated in March 1961 to study the response of tree seedlings to a gradient of depth to water table on an artificial slope. Although behaviour of mature trees is not necessarily borne out by the behaviour of seedlings, it was assumed that if variations in depth to water table produce variations in growth response of seedlings, a relatively similar pattern may be exhibited by mature trees. Moreover, seedling survival determines, to a large extent, mature forest distribution patterns. The results find application in ecological classification of the land for management and silviculture.

The use of tree seedlings is also of immediate practical application. In reforestation, knowledge regarding seedling growth and survival is of extreme importance in directing the more costly practices to those sites that promise to yield maximum returns. For this reason the two other regionally important conifer species, red pine (Pinus resinosa) and white spruce (Picea glauca) were also included in the experiment. Both species are rare as stand components of present mature stands in south-eastern Manitoba, but are of immediate importance for planting.

d. Co-operating agencies: Manitoba Department of Mines and Natural Resources.

16. Accomplishments to beginning of fiscal year under review:

Study (a). In 1964 a combined fire research program was initiated in south-eastern Manitoba to study the use of fire for seedbed and planting site preparation (MS 245), fire behaviour (MS 603) and ecological effects of prescribed burning (MS 243). Prior to 1964 some ecological studies had been carried out on wildfire areas.

From 1961 to 1969 root and stem growth characteristics of jack pine seedlings in the age class one-to-ten years were studied on four burned over sites.

From 1964 to 1970 ecological effects of prescribed burning were studied on five areas. Effects on lesser vegetation, physical and chemical soil characteristics, and rodent populations were studied.

Progress reports were prepared annually to 1968 for each of the two studies combined under this project. In 1964 a paper was published on the root growth of jack pine on a burned over dry site. In February 1970 a paper was published on the recovery of vegetation after a light burn on a mixed pine-hardwood cover. In 1970 a manuscript was prepared on re-invasion of rodents on burned areas.

Study (b). Seedlings of four tree species were grown in two soil-filled tanks each containing soil from a different site. A continuously renewed water table was adjusted to six inches at the bottom of each tank.

Tanks were watered to stimulate summer showers. At the end of the experiment all seedlings were removed and height, diameter, and ramification of tops were measured. Root systems were measured and seedlings were oven-dried and weighed. Soil texture, pH, permanent wilting percentage, field capacity, organic matter content, and total exchange capacity were measured. The experiment was repeated except that three grasses were grown in the tanks to provide competition.

Four reports have been published and the study terminated.

17. Goals for fiscal year under review: Post burn sampling of soils of 1968 and 1969 burns were to be carried out.


Soils were to be analyzed, data processed, and a first draft of dissertation started. One publication was to be completed.

18. Accomplishments during fiscal year under review:

As above (17) except manuscript being revised.

19. Goals set for next fiscal year: Completion of dissertation;
check of vegetation establishment on burns; resubmission of manuscript.

20. Signature:



H. P. Sims,
Investigator.

March, 1972.

STUDY REVIEW STATEMENT

Fiscal Year 1971-72

- | | | | |
|--|------------------|---|---------------------|
| 1. Establishment: | Prairies Region. | Date Prepared: | March, 1972 |
| 2. Title: | | Ecological characteristics of seedbeds created by a middle-buster plow. | |
| 3. Investigator: | | H. P. Sims. | |
| 4. Year of Commencement: | | 1962. | |
| 5. Estimated Year of Completion: | | Original - indefinite.
Revision I - 1972.
Revision II - 1973. | |
| 6. Key Words not in Title: | | <u>Pinus banksiana</u> , microclimate, strip cut, growth, germination, B, mortality. | |
| 7. Discipline: | | Silviculture. | |
| 8. Project Group: | | Regeneration methods for commercial forest species. | |
| 9. Estab. Proj. No.: | MS-222 MS-012 | Serv. Proj. No.: | NOR 048 |
| 10. Status at time of statement preparation: | | Active | |
| 11. Estimated total man-months utilized to date: | | Prof.: | 19 Other: 18 |
| 12. Man-months utilized in fiscal year under review: | | Prof.: | 1.0 Other: 2.0 |
| 13. Man-month requirements in next fiscal year: | | Prof.: | 1.0 Other: 2.0 |
| 14. Location of Work: | | Sandilands Provincial Forest,
Manitoba. | |
| 15. Background Statement: | | | |
| a. Project proposed by: | | Canadian Forestry Service. | |
| b. Objectives: | | To assess the germination and growth potential of jack pine seedlings on 5 seedbeds and to determine some of the more important biotic and microclimatic factors causing mortality. | |

c. Need for project: It is now generally accepted that scarification is necessary in order to obtain acceptable restocking of jack pine cutovers. The method of scarification being studied in this project, commonly used in southeastern Manitoba, creates five seedbed types. Determination of the relative capacities of the seedbeds created for germination, survival and growth, will assure that maximum benefit can be obtained from investment in this treatment.

d. Co-operating agencies: Manitoba Department of Mines and Natural Resources.

16. Accomplishments to beginning of fiscal year under review:

In 1962, 1963 and 1964 the study was carried out on three strip-cut sites scarified with a middlebuster plow. Seed spotting and planting was done on five seedbeds created by the plow and measurements of germination, mortality and height growth were related to soil temperature and moisture measurements.

In 1964, 1965 and 1966 the study was carried out more intensively on a dry site.

A progress report has been prepared annually to 1969 for this study.

A manuscript covering the first three years' work on the three sites has been published.

17. Goals set for fiscal year under review: Preparation of data for publication.


18. Accomplishments during fiscal year under review:

Walker, N. R., H. P. Sims and R. F. DeBoo 1971. Deer browsing in jack pine plantations in southeastern Manitoba. Can. For. Serv. Information Report A-X-43.

Sims, H. P. Survival and height growth of planted jack pine on prepared seedbeds, southeastern Manitoba. Submitted for publication as an Information Report.

19. Goals for next fiscal year: Preparation of data for publication.

20. Signature:


 H. P. Sims,
 Investigator. March, 1972.

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

1. Establishment: Northern Forest Research Centre. Date Prepared: March, 1972.
2. Title: The use of prescribed burning in jack pine management in southeastern Manitoba.
3. Investigator: H. P. Sims.
4. Year of Commencement: 1967.
5. Estimated Year of Completion: Original, 1968.
Revision I, 1975.
6. Key Words not in Title: Regeneration, Pinus banksiana, planting, seeding, barrel, scarification, site preparation.
7. Discipline: Silviculture.
8. Project: Improved regeneration methods for commercial forest species.
9. Estab. study No. MS-245 Service study No. NOR 049
10. Status at time of statement preparation: Active.
11. Estimated total man-months utilized to date: Prof.: 6.5 Other: 14.5
12. Man-months utilized in fiscal year under review: Prof.: 0.0 Other: 1.0
13. Man-month requirements in next fiscal year: Prof.: 0.0 Other: 1.0
14. Location of Work: Sandilands Provincial Forest, Manitoba.
15. Background Statement:
 - a - Study proposed by: Canadian Forestry Service.
 - b - Objectives:
 1. To determine the effect of post-burn intervals before planting and seeding.

2. To compare the success of seeding and planting on areas burned, burned and scarified, and scarified.

c - Need for study: By sheer persistence, jack pine cutovers in Manitoba and some in Saskatchewan are being restocked. Essentially, an area is scarified, planted with nursery stock, and replanted as necessary. Federal research, most notably on site preparation methods, has contributed to current regeneration successes.

However, there is in this procedure considerable room for refinement and cost reduction. This has been made especially so by the recent availability of improved methods of site preparation (e.g. barrel scarification and prescribed burning) and by the promises of new regeneration techniques such as the use of "assisted (container) seedlings". Moreover, direct seeding has not been adequately investigated as an economic alternative to planting.

d - Co-operating agencies: Manitoba Department of Mines and Natural Resources.

16. Accomplishments to beginning of fiscal year under review:

The results of spring and fall seeding and planting are being studied on areas burned, scarified, and burned and scarified in 1967.

First, second and third year spring and fall seeding and planting have been completed.

First and second year examinations of the results of the first and second spring and fall seeding and planting have been completed.

17. Goals set for fiscal year under review:

The second year examination of the results of the second and third spring and fall seeding and planting will be completed.

18. Accomplishments during fiscal year under review:

As planned in (17) except second year examination of the third fall planting was not completed.

19. Goals set for next fiscal year:

The second year examination (now third year) of the third year fall planting will be completed.

The fifth year examination of the first spring and fall seeding and planting will be completed.

no data collected

20. Signature:

A handwritten signature in cursive script, appearing to read "H. P. Sims", written over a horizontal line.

March, 1972.

H. P. Sims,
Investigator.

STUDY REVIEW STATEMENT

Fiscal Year: 1971-72

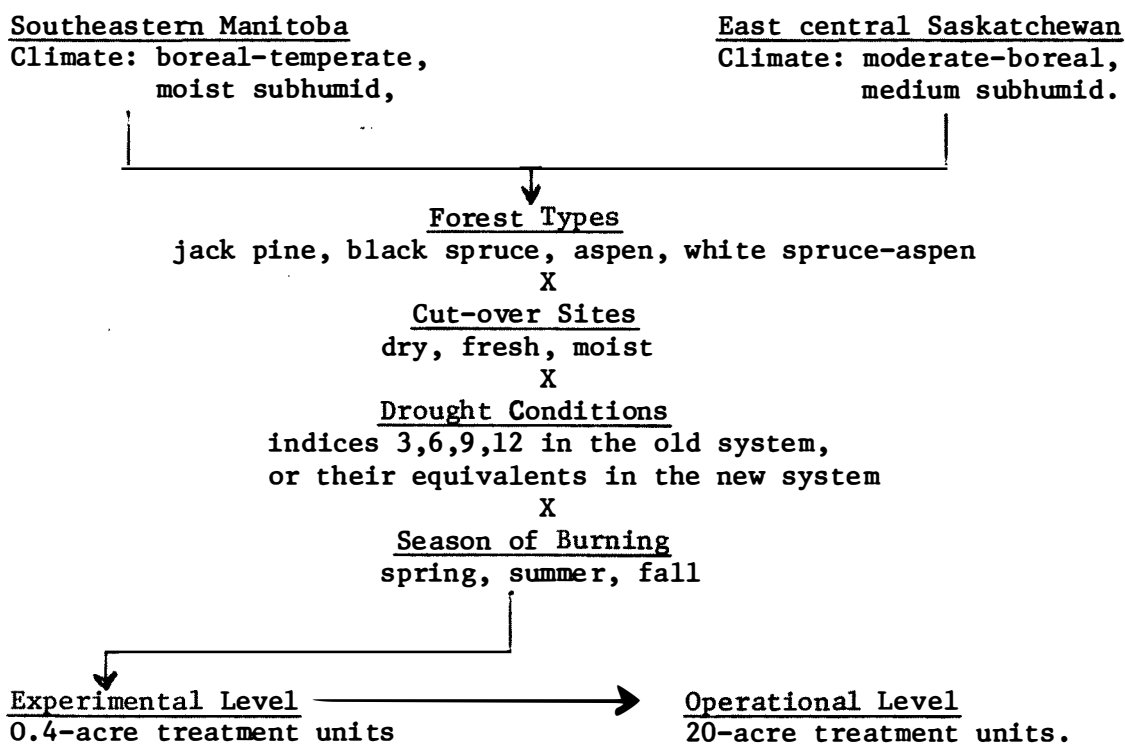
1. Establishment: Northern Forest Research Centre. Date Prepared: March, 1972.
2. Title: Controlled burning in forest management.
3. Investigator: Z. Chrosciewicz.
4. Year of commencement: 1969.
5. Estimated year of completion: Original, 1983.
Revision I, 1973.
6. Key words not in title: Pinus banksiana Climates
Picea mariana Sites
Picea glauca Fuels
Populus tremuloides Drought
7. Discipline: Fire.
8. Project: Regeneration methods for commercial forest species.
9. Estab. Study No. NOR 085. Service Proj. No. NOR 085.
10. Status at time of statement preparation: Active.
11. Estimated total man-months utilized to date: Prof.: 25 Other: 48
12. Man-months utilized in fiscal year under review: Prof.: 10 Other: 16
13. Man-months requirements in next fiscal year: Prof.: 10 Other: 14
14. Location of Work: Hadashville, Man. and
Candle Lake, Sask.
15. Background Statement:
 - a - Study proposed by: Provincial Forest Services in
Manitoba and Saskatchewan.
 - b - Objectives: The project includes integrated
elements of fundamental and applied research with specific aims
of burning directed toward:

- (1) Elimination of slash fire hazard (minimal reduction of raw-humus depth).
- (2) Sanitation of fungus, insect-, and mistletoe-infested sites (minimal to moderate reduction of raw-humus depth).
- (3) Improvement of aspen asexual reproduction (moderate reduction of raw-humus depth).
- (4) Preparation of sites for planting pine and spruce (moderate reduction of raw-humus depth).
- (5) Preparation of sites for seeding pine and spruce (moderate to substantial reduction of raw-humus depth).
- (6) Development of raw-humus-reduction curves for predicting the outcome of burning over a wide range of drought conditions by major forest types, sites, climates and seasons of burning.
- (7) Using the curves under "6", development of prescriptions based on the minimum drought and burning requirements for each of the objectives listed under "1" to "5".
- (8) Delineation of essential control requirements based on the anticipated fire behaviour as related to weather and fuel conditions at the time of burning.
- (9) Evaluation of cost-benefit relationships at the operational level of burning (through participation of economists and management officers).
- (10) Evaluation of all burns in terms of the establishment and growth of forest reproduction.

c - Need for study: Many cut-over areas in Manitoba and Saskatchewan are characterized by (1) substantial accumulations of logging slash (fire hazard problem), (2) frequent incidences of various parasites (sanitation problem), (3) insufficient reproduction of conifers due to unfavorable raw-humus-seedbed conditions (silvicultural problem), and (4) rapid reversion to grass, shrubs or inferior hardwoods (silvicultural problem).

However, available information indicates that the post-cutting conditions can be effectively rectified through a rational use of controlled burning either in presence of seed trees or followed by direct broadcast seeding as in cases of facilitating pine and spruce reproduction, and through a controlled burning alone as in cases of improving asexual aspen reproduction on some more productive sites. Conversion of other sites either from brush or from diseased and poorly growing aspen to some of the better suited conifers is also quite feasible by the use of controlled burning followed by seeding or planting with subsequent application of herbicides as needed.

There are also indications that the use of burning as a basic treatment will be much less expensive than mechanical operations serving a similar purpose. Added benefits at no extra cost will normally include elimination of slash fire hazard on all treated sites and a high degree of sanitation on pest infested sites, both of which cannot be effectively realized by mechanical means. However, little is known in Manitoba and Saskatchewan about the minimum drought requirements for burning the desired amounts of fuels involved and, without this knowledge, the chances of successful and economical burning for any well-defined purpose are extremely small. Project PRS-085 is designed to furnish the necessary data in relation to the following variables:



Various weather, fuel, site and vegetation studies associated with the individual burns will aid in the factorial evaluation of the burns themselves, and post-burn seeding or planting of conifers will often be required to make the findings more meaningful. Other related studies will include the determination and evaluation of effects on seedbed quality, tree reproduction, plant succession and certain soil properties. The results will be published in the form of tables, prediction curves and recommendations for practical field use by resource managers.

d - Co-operating agencies: Manitoba Department of Mines and Natural Resources, Saskatchewan Department of Natural Resources, Saskatchewan Pulpwood Limited.

The provincial governments in both Manitoba and Saskatchewan actively supported this project by providing men and equipment during all burning, planting and seeding operations at their own expense. The pulpwood industry in Saskatchewan co-operated in some of the burning trials of 1971.

16. Accomplishments to beginning of fiscal year under review:

A series of meetings with the provincial forest services led to the submission and approval of a comprehensive project plan (MS 107) in 1969. During the same year, a total of 50 treatment plots were established, 24 in southeastern Manitoba and 26 in east central Saskatchewan. This was followed by burning 17 of the Manitoba plots and 18 of the Saskatchewan plots in 1969 and 1970, respectively. The Manitoba plots were then broadcast seeded to pine in 1970.

17. Goals set for fiscal year under review:

(a) Assessment of pine reproduction on 17 plots in southeastern Manitoba.
 (b) Burning on 8 additional plots in east central Saskatchewan.
 (c) Planning and implementation of several large-scale burning operations for demonstration purposes in east central Saskatchewan.
 (d) Processing of available data in preparation for final analysis.

18. Accomplishments during fiscal year under review:

Because of budgetary restrictions, nothing was done in southeastern Manitoba, all efforts were concentrated to fully implement the existing program in east central Saskatchewan. The resulting 1971 progress in Saskatchewan was as follows:

(a) Experimental burning was completed on pine sites by increasing the number of burns from 18 to 26.
 (b) Large-scale demonstration burns were carried out on 4 clear-cut pine areas totalling some 240 acres.
 (c) Seeding and/or planting of pine were conducted on most of the burns for demonstration purposes.

The work on each burned plot or area included:

(a) Estimation of plant cover before burning--overall listing of major species by height strata, and general classification of shading.

(b) Determination of slash height and cover both before and after burning--direct measurements on 200 milli-acre quadrats in 10 transects.

(c) Mapping raw-humus cover both before and after burning--direct measurements on 200 milli-acre quadrats in 10 transects.

(d) Determination of raw-humus depths both before and after burning--direct measurements at 200 semi-permanent observation points, randomly marked with steel pins along centre lines of 10 transects.

(e) Determination of slash moisture by 0.25-inch diameter increments up to 1.0 inch immediately before burning--10 branch samples per diameter from exposed locations, 2 feet above ground.

(f) Determination of raw-humus moisture immediately before burning--10 full-core samples for each of two typical exposures, outside slash and under slash.

(g) Determination of fire temperatures on and below raw humus--multiple sets of Tempil pellets at one location for each of two typical exposures, outside slash and under slash.

(h) Mapping back--and head-fires with reference to flame height, frontal advance, spread pattern and convection tendency--estimated heights and distances over time.

(i) Description of fire-control effort--number of men, type of equipment, special precautions, normal duties, emergency actions, etc.

Other work applicable to all

burned plots or areas included:

(a) Establishment of one master station and several site-substations, plus subsequent daily weather instrumentation from April to September.

(b) Daily determinations of fire indices, and routine contacts with provincial fire control personnel.

(c) Processing of available data and their partial analysis.

19. Goals for next fiscal year: fuel assessments in Saskatchewan.

(a) Completion of post-burning

seeding and planting of pine in Saskatchewan.

(c) Planning and implementation

of large-scale burning operations with seed trees in Saskatchewan.

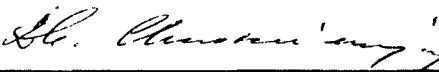
(d) Processing of available data

and, where applicable, their final analysis.

(e) Reporting on the physical

aspects of burning in Manitoba and Saskatchewan.

20. Signature:



March, 1972.

Z. Chrosciewicz,
Investigator.