NOR-037

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1973

1. Project: Reduction of losses by improved fire suppression methods

2. Title: Fire retardant and airtanker tests and application

3. New: Cont.: X 4. No.: NOR-037

5. Study Leader: R.G. Newstead

6. Key Words: airtankers, helitankers, retardants, aerial suppression, airtanker accuracy, effectiveness, drop patterns.

7. Location of Work: Throughout region.

8. Problem:

This study is operational research oriented towards the immediate needs and requests of client agencies, namely Provincial and Territorial Forest Services. The intent is improvement of aerial suppression methods by optimizing the use and effectiveness of available airtankers, helitankers and retardants. Results from this study are integrated with those of NOR-128, 131 and 130. Benefits accruing will include reductions in fire suppression costs, and areas burned as well as limiting damage to the ecosystem by enhancing operational effectiveness in the control of wildfires by fire control agencies.

Through continuous co-operative effort and liaison with client agencies the probability of success will be high in the long run, although technological and financial considerations may somewhat affect the degree of utilization in the short run.

Results from this study will see almost immediate implementation because they will be aligned with present client policies, needs and objectives. Past experience supports this assessment.

Method

The methods associated with this study involve the use of a wide variety of fixed and rotary-wing airtankers normally employed in fire suppression operations within the region. Similarly there are

a variety of fire retardants, both long-term and short term which form an integral part of this study. Retardant drop pattern tests, airtanker effectiveness evaluations, and fire retardant mixing, quality control and effectiveness investigations all involve closely integrated field and laboratory study procedures. Air drop grids are established and calibrated to determine drop patterns under controlled conditions and often involve the preparation and supervision of contractual arrangements. Airtanker and helicopter retardant delivery systems are evaluated under controlled test conditions on the air drop grid and on wildfire operations. Retardant mixing and application criteria are observed and evaluated in the combustion laboratory and during field operations for both existing and new retardant products. Much related data is accumulated and disseminated through co-operation with other fire operations and research agencies and through communication with client agencies.

9. Study 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 optimize aerial fire suppression activities, presuppression planning and allocation of resources in terms of reduced costs, and benefits achieved per fire extinguished or per unit length of fire line held.

10. Resources

a) Starting date: 1968.
b) Estimated year of completion: 1978.
c) Estimated total Prof. man-years required: 5.0.
d) Essential new major equipment items for 1973/74 with costs: Nil.
e) Essential new major equipment items beyond 1974 with costs: Nil.
f) 1973-74 man-years

Prof.	1.0		
Supp.	1.0		
Casual	0.3		
Total	2.3	O & M funds req'd.:	$3,250.00
		R.D. contracts:	$6,000.00
			$3,500.00

11. Progress to Date: (excluding 1972-73)

Within this study, the use of fire retardants, long-term in particular, has been promoted to regional fire control agencies and, due in part to that liaison, development and service activity, fire retardants are now in common use with concomitant improvement in air drop effectiveness. Likewise in full co-operation with client agencies, the advantages of larger airtankers and the operations logistics of same have been promoted in this region and general acceptance by several agencies has resulted in improved aerial fire suppression, particularly through better initial attack.

Air drop patterns have been delineated for most airtankers and helitankers in use in the region and aid of improved aerial suppression throughout the region. Portable ground mixing units and retardant mixing systems within aircraft have been developed within this study and are being utilized to good effect by fire control agencies.

Fire control agencies within the region, by their co-operative attitude, permitted our staff to greatly improve our own capabilities and knowledge of fire suppression activities. This learning process is a continuing element of our co-operative studies with regional agencies.

12. Goals for 1972-73:

1. Evaluate Tracker airtanker.

2. Determine rates of application required for different retardants in regional fuel types.

3. Conduct Bell 204B helicopter/Alberta Forest Service monsoon bucket drop tests with Phos-Chek retardant.

4. Evaluate Monsanto's Phos-Chek eductor mixing system on (i) air drop tests, and (ii) wildfire operations.

5. Observation and evaluation of airtanker and helitanker operations on wildfires in Northwest Territories.

6. 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.

13. Accomplishments in 1972-73:

1. The Tracker airtanker project (R&D #936) was abandoned owing to a lack of operational opportunity to utilize this aircraft in western Canada in its prototype configuration. In lieu of this project the Bell 206B Jet Ranger helicopter and Sims 90 gallon bucket were evaluated and drop patterns assessed.

2. Application rates for different retardants in regional fuel types were not identified because an appropriate application device for use in the laboratory was not available.

3. The Bell 204B helicopter and AFS monsoon bucket drop pattern tests (R&D #935) were conducted successfully. This information is presently being compiled and prepared for publication under contract. The Bell 206B and Sikorsky S58T drop tests will be evaluated and published simultaneously under this same contract.

4. Monsanto's Phos-Chek eductor mixing system was used satisfactorily in conjunction with all of the helicopter drop tests and on one wildfire operation on Vancouver Island. No reports on this system are anticipated owing to the availability of factual information on this system as prepared by and distributed by the manufacturer.

5. Observations and evaluations of helitanker operations on wildfires in the Northwest Territories are available and will be submitted for publication, this fiscal year, by the contractor responsible for preparation of the helitanker drop pattern report mentioned in (3) above.

6. The first of three phases concerning the long term storage effects on fire retardants has been conducted in co-operation with the Alberta Forest Service and the retardant manufacturing firms of Chemonics Industries Ltd., and Monsanto Canada Ltd. A file report has been prepared outling the test procedures and some preliminary observations on mixing and cold weather storage effects noted during the initial test phase.

7. The subjects listed below were reported in the July 1972 issue of Forestry Report except the last two. The former of the two will be published upon completion of data evaluation presently under contract as in (3) above. The latter of the two reports will not be prepared for the reason given in (4) above.

   (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.

14. Goals for 1973-74:

1. Evaluate airtanker pilot target accuracy under simulated initial attack fire situations in an attempt to identify the extent of influence of the pilot on the accuracy of any given retardant drop.

2. Assess "on site" effectiveness of airtanker/retardant combinatons in a support role on going wildfires. The influence of the airtanker delivery system, retardant composition and drop characteristics on line holding ability will be considered.

3. Evaluate the length and rate of fireline construction by airtankers, relative to fuel type terrain, turn around distance and other factors influencing aerial construction of fireline.

4. Complete the last two phases of the fire retardant storage investigation - namely (a) settling-out and cold storage effects on fire retardants and (b) field mixing observations using a contract mixer (Chemonics Industries Ltd.) and an Alberta Forest Service batch mixer.

5. Prepare a draft of preliminary long term retardant specifications incorporating all data accumulated to date, including results of corrosion, tests performed under contract.

6. Establish a new contract proposal for further investigation into the corrosive effects of long term retardants on additional metals and other materials used in conjunction with airtanker operations.

7. Test recommended levels of application for different retardants on regional fuel complexes under laboratory conditions.

8. Prepare reports on the following subjects:

a) Recent developments in airtanker retardant delivery systems.
b) A guide to the operational support of airtanker operations.
c) Summary report on the effects of batch mixing and storage duration and conditions on long term retardants.
d) Preliminary specifications for long term retardants.
e) Results of corrosion tests performed under research and development contract by the University of Alberta.

15. Publications:

Up to 1972-73

Grigel, J.E. 1969. Preliminary Evaluation of TX-350 - A New Long Term Retardant. Forestry Branch, Department of Fisheries and Forestry, Internal Report A-20.

Grigel, J.E. 1969. Evaluation of the Nitrogen Injection System for Mixing Gelgard Fire Retardant in the PBY Canso Water Bomber. Forestry Branch, Department of Fisheries and Forestry, Internal Report A-21.

Grigel, J.E. 1969. An Injector System for Mixing Gelgard Fire Retardant on Land Based Airtanker Operations. Forestry Branch, Department of Fisheries and Forestry, Internal Report A-22.

Grigel, J.E. 1970. The Use of Airtankers for Fire Suppression in Canada. Canadian Forestry Service, Department of Fisheries and Forestry, Internal Report A-33.

Grigel, J.E. 1970. Fire Retardants and Their Use in Western Canada. Canadian Forestry Service, Department of Fisheries and Forestry, Information Report Z-X-38.

Lieskovsky, R.J. 1971. Drop pattern for Twin Otter Membrane Tank System. Canadian Forestry Service, Department of the Environment, Internal Report NOR-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.

In addition the following contributions were prepared for:

Forestry Report March 1971 Vol. 1 No. 1
- Short and long term fire retardants
- The B-26 Airtanker

1972-73

In Forestry Report Vol. 2 No. 1
- Portable helitanker retardant systems for the Yukon
- B-26 airtanker air drop tests with liquid concentrate
- PBY Canso air drop tests with Gelgard retardant
- Sikorsky S58T drop tests with Phos-Chek retardant
- Modification of chemical injection system in the PBY Canso airtanker
- Airtanker simulation model

Lieskovsky, R.J. and R. Kruger. 1973. Current evaluation of long term retardant mixing and storage tests in Alberta. Canadian Forestry Service, Department of the Environment, File Report NOR-Y-68.

16. Signatures:

R.G. Newstead, Investigator

Program Manager

G.T. Silver, Director

CANADIAN FORESTRY SERVICE NOR-087

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February, 1973

1. Project: Liaison and technical advisory services in forest management.

2. Title: Technical and advisory services program in fire.

3. New: Cont.: X 4. No.: NOR-087

5. Study Leader: D. Quintilio, G. Chrosciewicz, R. Newstead, J. Niederleitner.

6. Key Words: Canadian Fire Weather Index, Fire danger rating, retardants, storage, "smokes", task force.

7. Location of Work: Throughout region.

8. Problem:

Unanticipated requests for short-term research, liaison and development services are frequently directed to the Fire Research investigators. Many of the requests are sufficiently relevant to justify immediate attention. These non-scheduled activities do not warrant individual study statements, but do require to be recorded within the fire research program. This study was intended to serve as a vehicle for that purpose. It is being terminated in current year and services covered within individual studies.

9. Study Objectives:

1. To respond immediately to unanticipated short-term requests, with both professional and technical staff, independent of assigned studies.
2. Promote new knowledge in forest fire control.

10. Resources:

a) Starting date: 1968
b) Estimated year of completion: 1974
c) Estimated total Prof. man-years required: 0
d) Essential new major equipment items for 1973/74 with costs: Nil
e) Essential new major equipment items beyond 1974 with costs: Nil
f) 1973-74 man-years Prof. 0
Supp. 0
Casual 0
Total 0 0 & M funds required: 0

7. Location of Work: Hinton, Alberta.

8. Problem:

Heavily stocked (250,000 stems/acre) lodgepole pine stands have a tendency to stagnate at an early age and nearly all saplings appear to suffer from serious competition. Evidence of stagnation and inability of some stands to thin naturally has prompted the consideration of fire as an effective tool to reduce or eliminate the stocking in young, over-dense pine stands - burned by the Greg fire in 1956.

9. Objectives:

1. To determine feasibility of using prescribed fire to reduce or eliminate pine saplings in a 14-year-old, overdense pine stand of fire origin.
2. To determine the short-term effects of fire on pine saplings, duff layer, and lesser vegetation.

11. Progress to date: A one-acre test plot and 20' x 20' sampling plots were established and inventoried.

12. Goals for 1972-73:

1. Burn test plot under the following weather prescription:

temp.	60 - 80°F
R. H.	20 - 50%
wind	10 mph
fine fuel m/c	10%

13. Accomplishments in 1972-73: Non - weather unsuitable for burning.

14. Goals for 1973-74: Terminate, due to resignation of study leader.

15. Publications:

Up to 1972-73 - None

1972-73 - None

16. Signatures:

Investigator

Program Manager

Director

7. Location of Work: Throughout region.

8. Problem:

During the past ten years, all fire control agencies in this 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 agencies in Canada. The implementation of the new System in support of fire control planning and operations requires extensive training of headquarters and field staff, on assessment of the ability of the System to indicate fire potential, and development of approaches and procedures for refining the System to satisfy specific needs of individual fire control agencies.

9. Objectives:

1. 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.

2. 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 this Region.

11. Progress to Date:

Introduction of the new Canadian Fire Weather Index to agencies within the Region. Promotion of the System has been continuously carried out through lectures and training sessions.

12. Goals for 1972-73:

1. Prepare a field guide for use of the new System.

2. Maintain promotion through lectures and training.

13. Accomplishments in 1972-73:

An interagency meeting was hosted by the Northern Forest Research Centre to examine performance of the System after two years of use. Agencies were solicited for comments prior to the meeting and these served as a basis for discussion. Promotion lectures and training sessions were again maintained throughout the year. A field guide was published through the PFRC.

14. Goals for 1973-74: Terminate. Transfer objectives to NOR-086.

15. Publications:

Up to 1972-73 - Nil

1972-73 - Nil

16. Signatures:

Investigator

Program Manager

Director

7. Location of Work: Alberta.

8. Problem:

In Alberta, from 5 to 25 tons of logging debris per acre less than 4 inches in diameter are left behind on the 50,000 acres of forested land that are harvested annually. This fuel type represents a special fire control problem but there is much concern about the need for, and effectiveness of, conventional methods to reduce the hazard to an acceptable level. There is at present no standard procedure for rating fire hazard in clearcuts and for recommending treatment(s) to reduce the hazard to an acceptable level. This study has direct application to industry as well as provincial agencies and results are now available.

9. Objectives: To participate on a task force for establishment of Provincial Guidelines for reduction of slash hazard on logging operations.

11. Progress to date: A report based on several Task Force meetings, a field reconnaissance and a literature review was prepared and published.

12. Goals for 1972-73:

1. Guidelines for determining slash weight from cover type are to be prepared.
2. Further field evaluation of rating scheme.
3. All additional work dependent on status of Task Force report.

13. Accomplishments in 1972-73: Terminate due resignation of study leader.

14. Goals for 1973-74: None

15. Publications:

Up to 1972-73

Kiil, A.D. 1971. Fire hazard from large block clearcutting in Alberta. In Canadian Forestry Service, Inf. Rpt. NOR-X-6.

1972-73 - Nil

16. Signatures:

Investigator

Program Manager

Director

7. Location of Work: Alberta, Saskatchewan.

8. Problem:

The effectiveness of fire control programs depends partly on the fire manager's appreciation and understanding of forest fuel complexes in terms of fire behavior. There is no universally acceptable scheme for rating and mapping fuel types according to hazard to facilitate planning and conduct of fire control programs. The assessment of fire hazard in different fuels has been based on an individual's experience with fuels and fire behavior in a particular location. It is therefore important to interpret existing hazard rating schemes and on the basis of local conditions develop workable techniques and guidelines where required. In late 1969 the National and Historic Parks Branch requested the Canadian Forestry Service to initiate and conduct a study to develop a fire hazard rating scheme for Waterton Lakes National Park and in 1971 a similar request was received for Prince Albert National Park. In both parks the hazard rating scheme will be the basis for good pre-suppression planning.

9. Objectives:

1. To modify the present forest cover type maps of Waterton Lakes and Prince Albert National Parks for fire control purposes.

2. To develop a fire behavior rating scheme for these Parks.

11. Progress to date:

Field checks for Waterton National Park were conducted as a means of confirming preliminary type classification. Rate of spread and fire intensity classes were then assigned to each type for various levels of fire danger. A final map and report has been published detailing the Waterton work and a similar program initiated for Prince Albert National Park.

12. Goals for 1972-73:

1. Preparation of fire hazard classification including fuel type map for Prince Albert National Park.

13. Accomplishments in 1972-73:

Field checks for Prince Albert National Park were conducted and preliminary type classifications were confirmed. Rate of spread and fire intensity classes have been assigned to each type for a range of fire danger levels. A final map and report is currently in preparation through an R & D contract.

14. Goals for 1973-74: Terminate. Transfer objectives to NOR-086.

15. Publications:

Information Reports:

Up to 1972-73

Grigel, J.E., R.J. Lieskovsky and A.D.Kiil. 1971. Fire hazard classification for Waterton Lakes National Park. Canadian Forestry Service, Inf. Rpt. NOR-X-7.

1972-73

Kiil, A.D., R.J. Lieskovsky, J.E. Grigel. 1973. Fire hazard classification for Prince Albert National Park. (In preparation).

16. Signatures:

Investigator

Program Manager

Director

7. Location of Work: Yukon Territory.

8. Problem:

In some wildfire situations, backfiring and burnout of fuels are effective in controlling a rapidly-spreading fire when conventional suppression methods fail. As backfiring can be extremely hazardous if carried out from the ground an effective method of aerial ignition was requested.

With the aerial ignition technique the extended first attack coverage of fires in inaccessible, remote areas is possible. Fires in remote areas were fought in July 1972 using this method with satisfactory results.

The Yukon Forest Service intends to use this method operationally during 1973 with specially trained personnel.

The study was carried out in the following stages:

1. Literature review of backfiring and burnout procedures.
2. Determine Ministry of Transport regulations in regards to this type of operation.
3. Develop and test incendiary devices for fuel ignition and reliability.
4. Operational testing on remote wildfires from a variety of helicopters.
5. Assess feasibility and problems.
6. Development and testing of an efficient system for release of incendiaries.

9. Objectives:

To develop a system for backfiring and burnout of fuel in front of rapidly-spreading wildfires.

11. Progress to date: None - Proposal.

12. Goals for 1972-73:

Conduct a literature review on backfiring and burnout procedures and equipment with particular emphasis on aerial ignition. Develop and test incendiary devices on fuels to determine their suitability for backfiring and burnout. Testing of incendiaries and release methods on actual wildfire situations. Prepare operational guidelines and demonstrate use of system.

13. Accomplishments in 1972-73:

Incendiaries developed by the Australians were adopted, tested and used with excellent results on wildfires in the Yukon. A mechanical priming and release machine was developed and the user agency is satisfied that the system developed suits requirement.

14. Goals for 1973-74: Terminate. Objective moved to NOR-128.

15. Publications:

a) Journal Publications: Nil
b) Departmental Publications: Nil
c) Bi-monthly Res. Notes: Nil
d) Information Reports: Lait, G.R. & Taylor, W.C. Backfiring and Burnout Techniques used in the Yukon, 1972. Can. For. Serv. Inf. Rpt. NOR-X-13.
e) Miscellaneous: Forestry Report Vol. 2, No. 1.

16. Signatures:

Investigator

Program Manager

Director

7. Location of Work: Alberta

8. Problem:

The study consists of an evaluation of instruments and techniques used in wild fire surveillance and fire mapping.

The results of the study will facilitate the effective deployment of fire fighting forces and by providing much needed fireline intelligence resulting in cheaper and safer fire line operations.

There is a good chance that the study will succeed in providing new information.

Results of the study will most likely receive serious considerations by user agencies. Requests for this type information are already on file.

The planned course of action is:

1. Buy or lease potential fire surveillance tools or acquire the imagery procured with such instruments.
2. Test and investigate the application of such tools within the operating scope of user agencies in the region.
3. Devise operating techniques around the new tool.
4. Introduce user agencies to new tools and operating techniques.

9. Objective:

Improvement of fire mapping and surveillance techniques - ultimately - the reduction of losses by forest fires through more effective and safer fire line operations.

10. Resources: As NOR-087.

11. Progress to date: Nil

12. Goals for 1972-73:

Evaluate the advantages of using a Tivicon television camera and recorder as a fire line reconnaissance tool. Investigate the application of a "Barnes Airborne Fire Spotter", in collecting fire line intelligence particularly during the mop-up stage and during heavy smoke conditions. Conduct some high altitude CF-100 mapping experiments.

13. Accomplishments in 1972-73:

a) Tested Tivicon camera in laboratory.
Field tests could not be done because of lack of smoke in fires in the later part of the fire season.

b) Secured high altitude aerial photographs.
c) Purchased Barnes Fire Spotter (no field work accomplished because delivery of scanner occurred after fire season).
d) Demonstrated AGA Thermovision System 680 to potential users in Edmonton.

14. Goals for 1973-74: Terminate. Goals moved to NOR-128.

16. Signatures:

Investigator

Program Manager

Director

7. Location of Work: Alberta.

8. Problem:

The study consists of an evaluation of the Alberta wild fire detection system and an analysis of individual detection problems. The work is done through a joint AFS-CFS task force. The CFS provides one member to this task force.

It is hoped that recommendations of this task force will help to establish a realistic detection objective and bring the detection system in alignment with the problems posed by the current wild fire occurrence pattern in the forest community. Ultimately the study will help to reduce losses through forest fires and help to attain better results for every dollar spent on fire detection.

The probability of success are excellent. A part of the objectives has already been realized.

Because of the heavy involvement of the user agency, there is a good probability that the results are being put to practical use as soon as they become available.

The following course of action was worked out in co-operation with the user agency and was found mutually satisfactory:

1. Review of aerial and fixed detection program.
2. Analysis of available statistical material.
3. Identification of problems and shortcomings.
4. Recommendations of detection objectives.
5. Outline of a detection plan on a forest by forest basis listing alternatives designed to meet the objectives.
6. Test of this plan through a computer simulation model.
7. Implementation of the plan.

9. Objectives:

1. Formulation of detecting objectives.
2. Fire detection plan for each Forest within the Alberta Forest Service.
3. Ultimately an optimal detection system for the expenditures provided for forest fire detection.

11. Progress to date: Completed analysis and evaluation of present fire detection system.

12. Goals for 1972-73: Formulation of a detection objective expressed as fire size in acres at discovery time.

13. Accomplishments in 1972-73:

Detection objectives were established:

1. for the spring, summer and fall fire season
2. for the three major geographic regions in Alberta

Through intensive liaison work at all levels of the user agency, it was possible to solicit acceptance for the recommended detection objectives.

14. Goals for 1973-74: Terminate. Objectives moved to NOR-131.

15. Publications:

1. Journal Publications: Nil
2. Departmental Publications: Nil
3. Bi-monthly Res. Notes: Nil
4. Information Reports: Nil
5. Miscellaneous:
   Progress Report to user agency

16. Signatures:

Investigator

Program Manager

Director

7. Location of Work: Throughout the region but primarily in Alberta, Yukon and Northwest Territories.

8. Problem:

Long-term fire retardants are being used to control forest fires throughout much of Canada. The agencies making use of these compounds presently do not have any established criteria against which they may compare and evaluate characteristics,physical components and ecological impact of existing brands of retardants. Potential producers and suppliers of fire retardants do not have access to desirable optimum specifications for such products. Air regulations personnel, airtanker owners, and the general public cannot presently be made aware of implications pertaining to the use of long-term retardants. Existing U.S.D.A.-Forest Service specifications do not give full consideration to problem areas associated with retardant use, particularly in Canada. Additional information on corrosive characteristics and their ramifications are particularly urgent in the interest of safe air operations.

9. Study Objectives:

The objectives of this investigation are as follows:

1. To prepare a set of guidelines against which users of fire retardants can compare and evaluate products presently being marketed.
2. To establish a set of criteria in the form of specifications which may be used as reference guidelines and objectives by parties considering the development and introduction of new retardant compounds.
3. To give full consideration to all implications of the use of long-term retardants in fire control operations including their potential corrosiveness to metals, ecological impact and other beneficial or detrimental factors surrounding their use.
4. To communicate all interim information and results to user agencies as available while working towards finalized specifications format.

11. Progress to Date: Excluding 1972-73 -

Nil. Work was not initiated until September 1972.

12. Goals for 1972-73:

Draft of retardant specifications based on literature review to be sent to agencies involved for perusal and comments. A Research and Development contract (4,500.00) to be let with Department of Mining and Metallurgy, University of Alberta, to investigate corrosive characteristics of long-term retardants, on aluminum 2024T and

magnesium. Finalize test procedures and terminate project.

13. Accomplishments in 1972-73:

Observations and comments were received from user agencies indicating reaction to preliminary retardant specifications requirements. Respondent contributions were reviewed and will be held in abeyance pending the outcome of corrosion tests and other tests (environmental impact, effectiveness, application rates, etc.) presently under contract or being considered. A contract was let with the Department of Mining and Metallurgy, University of Alberta, to initiate retardant corrosion tests on aluminum and magnesium. Results of these tests are forthcoming but will not be available for further consideration this fiscal year. Owing to the merit of this investigation, termination within the anticipated time allotment is considered impractical.

14. Goals for 1973-74: Terminate: Goals moved to NOR-037.

15. Publications:

Up to 1972 - Nil

1972-73

Lieskovsky and Kruger (1973) Current evaluation of long-term fire retardant mixing and storage tests in Alberta.

Preliminary draft of retardant specifications.

A report from the contractor on the outcome of corrosion tests is pending.

16. Signatures:

Investigator

Program Manager

Director

7. Location of Work: Alberta, Saskatchewan.

8. Problem:

An ever increasing choice of instruments presumably suitable for fire detection per se or fire surveillance through smoke is becoming available to user agencies, marketing agencies are often not aware of the requirement of the user agencies and so fail to demonstrate the usefulness of their product in a convincing manner.

This study will test the Barnes Airborne fire spotter on an operational basis. The spotter will be mounted and flown on helicopter and fixed-wing aircraft during regular fire patrols in various locations.

The result of the study will provide user agencies with an opportunity to:

1. assess the usefulness of the instrument in their operation.
2. train or familiarize some of their staff in the operation of the scanner.
3. obtain information about the characteristics or existence of fire which would be difficult to obtain in any other way enabling them to take steps that can reduce fire losses or cut suppression costs.

There is a good probability that most of the sought after information can be secured during one season.

Any information obtained through this study will be appreciated by user agencies. Requests for this type of information are already being received.

The study will commence with the design and construction of a suitable mount for fixed-wing and rotor-wing aircraft as well as a satisfactory power supply to the unit. (Some of this work will be covered by R & D contract No.).

After initial test flying and calibration the instrument will be flown over various targets in the field preferably in conjunction with regular detection or fire reconnaissance missions.

9. Objectives:

The objectives of the study are:

1. To establish a reliable method of mounting the scanner on aircraft.
2. To provide a reliable and clean (free of interference) power supply.

3. To assess the usefulness of the scanner in
   a) fire detection
   b) mop-up
   c) fire mapping
   d) fire surveillance through smoke
   e) inspection of prescribed burns or debris disposal projects
   f) study the smoke and heat emission relationship of incipient wild fires.

10. Resources: As study statement NOR-131.

11. Progress to Date: Nil

12. Goals for 1972-73:

    1. Purchase of scanner.
    2. Complete mounting and calibration through R & D contract.
    3. Complete fire detection capability test.

13. Accomplishments 1972-73:

    Purchased scanner. Delivery occurred too late in the season to do any field work. R & D contract deferred to 1973-74.

14. Goals for 1973-74: Terminate. Transfer objectives to NOR-131.

15. Publications:

    Up to 1972073: Nil

    1972-73:

    Niederleitner, J. 1973. The role of the Barnes Airborne Fire Spotter in wildfire surveillance (Planned).

16. Signatures:

Investigator

Program Manager

Director

7. Location of Work: Throughout region.

8. Problem:

Minimum lapsed time from detection to initial attack is a fundamental requirement in any fire control plan. This is based simply on the fact that fires in their early growth stage require very little effort to control.

Ground crews often reach the fire early, but are faced with the time-consuming job of digging a fire guard and the fire growth may soon exceed initial attack capability.

Canadian Industries Ltd., Explosives Division, is now manufacturing an improved prima-cord product which shows potential as a specialized line-building tool. If it is applicable it could well restructure the handline system. The purpose of this study is to test its capability, and if warranted, demonstrate and encourage its use for fire control operations.

9. Objective:

To assess the potential of prima-cord for fireline construction.

11. Progress to date: Nil

13. Accomplishments 1972-73:

The study leader attended a CIL demonstration in interior B.C. to gain a working knowledge of the explosive technique. A field trial was then designed for the Boreal Forest region; specifically the Slave Lake Forest. CIL donated 1,000 ft. of explosive for research purposes and line-building capability was demonstrated in five major fuel types: (1) aspen, (2) pine, (3) muskeg, (4) white spruce, and (5) slash. Results were passed to CIL with the recommendation to include a retardant in the vinyl sheath to eliminate any risk of spot ignition as some fires were started from tests. Northern agencies and Alberta have been briefed on the results and are expected to use limited amounts of cord on an operational basis during 1973.

14. Goals for 1973-74: Terminate. Goals moved to NOR-128.

15. Publications:

Up to 1972-73: Nil

1972-73:

Quintilio, D. 1973. Explosives and fire control operations - a new perspective. Northern Forest Research Centre - Forestry Report.

16. Signatures:

Investigator

Program Manager

Director

NOR-128

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1973

1. Project: Reduction of losses by imporved fire suppression methods.

2. Title: Fireline productivity rates for hand crews, bulldozers, airtankers, and helicopters.

3. New: X Cont.: 4. No.: NOR-128

5. Study Leader: D. Quintilio

6. Key Words: Fuel types, fire behaviour

7. Location of Work: Region-wide

8. Problem:

The greatest percentage of the suppression budget is usually allocated to aircraft, bulldozers, and handcrews employed to build fireline. To maximize the effect of each suppression dollar by planning for optimum resource allocation, agencies require fundamental knowledge of production rates and effectiveness of the above techniques. To date little information exists describing line building capabilities of fireline systems, hence efficiency is much below acceptable levels. Along with assessing existing fireline systems the study will develop new techniques and concepts with modern capabilities.

This work will create a data bank of productivity rates for existing and potential fireline systems, which will eventually be used for optimum allocation models. Preliminary information from this study and NOR-037 and NOR-131 has already been incorporated into an initial attack simulation model (NOR-130).

Probability of success is high since all agencies are actively involved in assisting research crews to document productivity rates directly on the fireline. Extent of data collected in 1973, however, will depend primarily on the severity of the fire season. Preliminary data and analysis have already been presented to one agency and this will reflect in the 1973 operations.

Methods:

1) Ground attack systems

- major fuel types are stratified according to resistance to control.

- a time and motion study has benn designed to document productivity of bulldozers and hand crews.

- the use of explosives will be developed for fireline use and effectiveness, cost and productivity will be compared to handline work.

2) Air attack systems

- available drop patterns of airtankers and helicopters will be reviewed to determine fireline construction rates under ideal conditions.

- wildfires will be assessed to determine deviation of fireline construction rates under operational conditions, i.e. drop accuracy, drop height and speed, actual load carried.

- an aerial ignition device for backfiring and burnout will be developed and tested utilizing methods pioneered in Australia.

- an aerial marking device for relocating reported fires by initial attack crews will be developed utilizing the low frequency transmitter principle of wildlife tracking systems.

9. Study Objectives:

1. To provide accurate productivity rates of bulldozers, handcrews, and airtankers for fireline building in regional fuel types.

2. To develop experimental fireline systems utilizing modern techniques.

10. Resources:

a) Starting date: 1972.
b) Estimated year of completion: 1978.
c) Estimated total Prof. man-years required: 3.5.
d) Essential new major equipment items for 1973/74 with costs: Nil.
e) Essential new major equipment items beyond 1974 with costs: Nil.
f) 1973-74 man-years Prof. 0.8
Supp. 1.0
Casual 0.3
Total 2.1 O & M funds req'd.: $4,050.00
R.D. contracts: $4,900.00

11. Progress to date: Nil - (1972 proposal)

12. Goals for 1972-73:

1. Establish firm co-operative guidelines.

2. Prepare standardized documentation forms for time and motion study.

3. Record productivity rates on major fires during 1972.

4. Develop an aerial marking device for relocating reported fires.

5. Develop an aerial ignition system for backfiring and burnout on wildfires.

6. Assess the potential of prima-cord explosive for fireline construction.

13. Accomplishments in 1972-73:

The study was introduced to the Alberta Forest Service and co-operative guidelines were formed to facilitate the initial summer's work. A standardized format was prepared for the data collection pertaining to ground attack systems. This was reviewed by AFS field personnel and finalized for use during 1972. CFS personnel manned spring fires in the Whitecourt and Slave Lake Forest Districts and the format was improved based on field experience. Four hundred field forms have now been distributed to selected AFS districts for 1973 use.

All remaining regional agencies have been approached, through the Sub-Committee on Fires Protection, for co-operative commitments similar to those arranged for Alberta.

Both the aerial ignition system and the aerial marking device were developed at the Northern Forest Research Centre. The systems are being prepared for field testing during 1973.

A field trial was designed for the Boreal Region to test tha application of explosives for fireline construction. CIL donated 1000 ft. of prima-cord and line building capabilities were demonstrated in five major fuel types: (1) aspen, (2) pine, (3) muskeg, (4) white spruce and (5) slash. Northern agencies have been briefed on the results and are expected to use limited amounts of cord on an operational basis during 1973.

14. Goals for 1973-74:

1. Enlist field support from all Northern Forest Research Centre agencies for time and motion study of ground attack systems.

2. Distribute standard format to selected agency districts prior to 1973 fire season.

3. Review aircraft drop patterns (fixed wing and helicopters) relating to regional fuel types.

4. Field test the aerial igntion and marking systems.

5. Monitor data collection on major fires in the region during the 1973 fire season, including assessment of operational use of prima-cord.

6. Complete the following information reports:

Quintilio, D. 1973. The use of bulldozers for fireline construction.

Quintilio, D. 1973. Guidelines for optimum allocation of fireline systems.

Lait, G.R. & W.C. Taylor. 1973. Backfiring and biomont techniques used in the Yukon.

Ponto, R.L. & G.M. Lynch. 1973. Use of electronic markers to relocate small forest fires.

15. Publications:

Up to 1972-73 - Nil.

1972-73

a) Journal Publications - Nil.

b) Department Publications - Nil.

c) Bi-Monthly Research Notes - Nil.

d) Information Reports - Nil.

16. Signatures:

D. Quintilio, Investigator

Program Manager

G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February, 1973

1. Project: Reduction of losses by improved fire suppression methods.

2. Title: Initial Attack, Strategy and Resources in Fire Suppression Operations.

3. New Cont. X 4. No.: NOR-130

5. Study Leader: D. Quintilio (acting) ~~Officer~~ Head

6. Key Words: Detection, fire behavior, airtankers, simulation modelling.

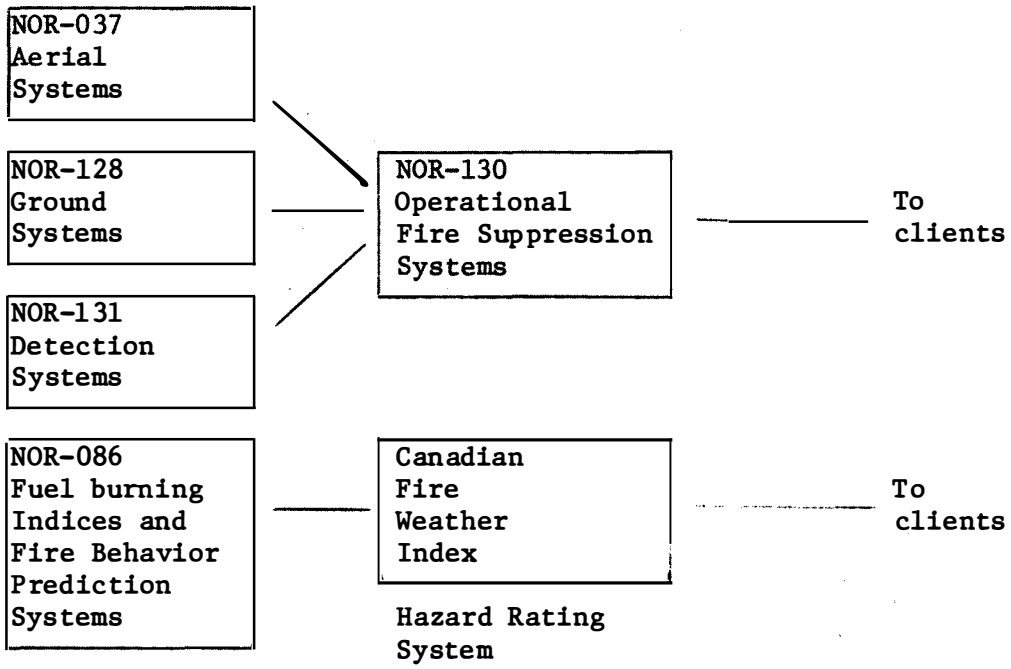
7. Location of Work: Northern Forest Research Centre.

8. Problem:

Fire control agencies serviced by the Northern Forest Research Laboratory in Edmonton spend between 10 and 15 millions of dollars annually on fire suppression. At least an equal amount is lost in the form of damage to various resources. In the past, fire control expenditures have been justified on the basis that fire damage must be reduced "at all cost". In the future, fire protection agencies will see greater competition for the fire control dollar.

In the defence of future budget requests fire protection agencies must place a greater emphasis on planning, including resource valuation. Suppression strategy and allocation must then be geared more closely to existing resource values and fire behavior to obtain maximum value of fire control dollar. The fire manager urgently requires guidelines specifically derived for the initial attack stage since benefits are maximized when the fire is controlled in its early growth stage. Data from the studies will be integrated into systems developed within this study.

The Alberta Forest Service is co-operating in the development of an initial attack simulation model for Whitecourt Forest District. It is designed to provide a relative assessment of initial attack systems and if the model proves satisfactory it will be introduced as an operational decision-making aid.



Methods:

- review agency operations to delineate and define the problem, and to select a prototype forest district.
- construct a study team of Alberta Forest Service field personnel, Alberta Forest Service headquarters personnel, Canadian Forestry Service personnel, and systems analyst consultant.
- conduct weekly meetings to determine the variables for a simulation model.
- sort and transfer 10-year fire and weather data to IBM-360 tape.
- compile line building capability of the initial attack systems.
- design flow chart for the initial attack model.
- program and run the model.
- analyze results and present guidelines.

9. Objectives:

1. To develop a simulation model for assessing initial attack systems over a range of burning conditions.

2. To provide guidelines for suppression strategy and optimum combinations of men and equipment to achieve successful initial attack.

10. Resources:

a) Starting date: 1972
b) Estimated year of completion: 1973 Revised: 1978
c) Estimated total Prof. man-years required: 3.4
d) Essential new major equipment items for 1973/74 with costs: Nil
e) Essential new major equipment items beyond 1974 with costs: Nil
f) 1973-74 man-years

Prof.	1.2		
Supp.	1.0		
Casual	.3		
Total	2.5	O & M funds required:	$1,800
		R & D contracts:	4,500

11. Progress to date: Nil - new study.

12. Goals for 1972-73:

Develop a simulation model for initial attack. Major factors to be included are ignition, rate of spread and fire intensity, major fuel types, travel times, dispatch considerations and productivity rates for air-tankers, helicopters, bulldozers and men. Implement model on computers. Judge the applicability, and reliability of model. Use results of initial attack model to familiarize fire managers with simulation modelling procedures and techniques.

13. Accomplishments in 1972-73:

An inter-agency study group was formed to develop a simulation model for three initial attack methods, i.e., helicopters, air-tankers and ground crews. Important variables were documented and 10 years of fire and weather data transferred to IBM-360 tapes. Coding and programming is complete and de-bugging is now in process.

15. Goals for 1973-74:

1. Analyze results of initial model run and provide guidelines for future simulation studies.

2. Introduce further initial attack methods and re-run model.

3. Judge the applicability and reliability of the prototype model and if warranted introduce it as a decision-making aid for AFS headquarters use.

Quintilio, D., et al. 1973. Simulated initial attack using helicopters, ground crews, and air-tankers. Information Report.

15. Publications:

Up to 1972-73 - Nil

1972-73

16. Signatures:

Investigator

Program Manager

Director

NOR-131

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date:

1. Project: Reduction of losses by improved fire suppression methods.

2. Title: Evaluation and planning of fire detection - surveillance - communications systems and methods.

3. New: X Cont.: 4. No.: NOR-131

5. Study Leader: J. Niederleitner

6. Key Words: Aerial Patrols, Lookouts, Forestry Communications, Weather Data collection, Storm tracking, Wildfire smoke emission, Wildfire mapping.

7. Location of Work: Yukon and Northwest Territories.

8. Problem:

The study consists of an analysis of fire records as well as of on site evaluations of existing wildfire detection - mapping and communication systems.

Research is done on factors influencing the performance and efficiency of such systems.

The results of the study will enable user agencies to increase the efficiency of their fire surveillance systems thereby reducing total fire losses and minimizing fire suppression costs.

Since many of the user agencies in the region are at this time not operating a fully developed fire surveillance system the study is bound to meet with a certain measure of success.

Much of the results achieved in this study so far are already being implemented and the prospects of further findings being put to practical use are excellent since most phases of the study are based upon users requests.

The following general course of action is being followed:

1. Discussion with respective user agencies to define and outline the problems to be solved.

2. On site evaluations of existing installation and systems as well as analysis of available data.

3. Formulation of objectives and arbitrary financial constraints to be considered when designing the new system.

4. Design of new systems or modifications of existing systems in order to achieve optimal returns under given local conditions and accepted constraints.

5. Assistance to user agency during implementation as well as research through short term projects solving day to day problems that have a bearing on systems design and operation.

9. Study Objectives:

1. Develop plans for wild-fire surveillance and communication systems for the Yukon and the Northwest Territory.

2. Identify the most advantageous detection medium (alternative) for given conditions.

3. Define and identify factors influencing the design of wildfire detection and communication systems.

4. Develop effective wildfire mapping and surveillance techniques.

10. Resources:

a) Starting date: 1971.
b) Estimated year of completion: 1975.
c) Estimated total Prof. man years required:
d) Essential new major equipment items for 1973/74 with costs: Nil.
e) Essential new major equipment items beyond 1974 with costs: Nil.
f) 1973-74 man-years

Prof.	- -
Supp.	2.0
Casual	0.3
Total	2.3

0 & M funds req'd.: $3,500.00

11. Progress to date:

1. Familiarization survey for Yukon Territory completed.

12. Goals for 1972-73:

1. Familiarization survey for Northwest Territories complete with analysis of detection alternatives and scrutiny of fire records for the past ten years.

2. Finalize survey of existing and proposed lookout sites (continuous detectors) in the Yukon Territory.

3. Establish criterion where and when continuous detectors should be employed.

4. Purchase and evaluate Barnes Airborne Fire Spotter as a fire surveillance tool.

5. Evaluate the application of the Tivicon camera and the AGA Thermovision system in forest fire surveillance.

6. Initiate a study on the feasibility of the use of small scale photography and imagery in forest fire surveillance and fire mapping.

13. Accomplishments in 1972-73:

1. Completed the survey of the existing continuous detectors (6) in the N.W.T. and established three new sites. All this work was south of 64° latitude.

2. Completed the survey of the eight existing continuous detectors in the Yukon Territory and established five new sites.

3. Purchased Barnes Airborne Fire Spotter but delivery was too late in the season to do any field work.

4. Conducted a brief test of the Tivicon and the AGA Thermovision system.

5. One set of small scale aerial photographs was secured over the Slave Lake study area.

14. Goals for 1973-74:

1. Finalize and stake all proposed continuous detector and communications relay stations in the Yukon and the Northwest Territories (depending on favorable weather conditions and aircraft availability).

2. Complete the fire detection plan for the Yukon Territory.

3. Finalize Mounting Procedure and field test the Barnes Airborne Fire Spotter.

4. Investigate the feasibility of small scale aerial photography in fire surveillance and forest fire mapping.

5. Complete the following reports:

The role of the Barnes Airborne Fire Spotter in wildfire surveillance;

Small scale imagery in forest fire mapping;

Fire detection and communication system for Yukon;

Fire detection and communication system for Northwest Territories;

15. Publications:

Up to 1972-73:

Niederleitner, J. 1971. Remote Sensing in Forest Fire Control, Report on Symposium June 1971, Missoula, Montana. Information Report NOR-1.

Northern Forest Research Centre - Forestry Report
Vol. 1 - 1 March 1971 - 8 pp.
Vol. 1 - 2 July 1972 - 8 pp.
These reports described in abbreviated manner results of current research at NFRC in fire suppression and fire behaviour.

Niederleitner, J. and G.R. Lait. 1972. Tivicon television camera: A new fireline reconnaissance tool; laboratory trials. Can. For. Serv., Internal Report NOR-15.

Niederleitner, J. 1972. Demonstration of AGA Thermovision System 680 in Edmonton. Can. For. Serv., Miscellaneous Report NOR-Y-16.

16. Signatures:

J. Niederleitner, Investigator

Program Manager

G.T. Silver, Director

NOR-035

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

February, 1973

1. Project: Reduction of losses by improved fire danger forecasting and assessment method.

2. Title: Development and use of fire behavior rating systems.

3. New: Cont.: X 4. No.: NOR-035

5. Study Leader: A. D. Kiil (resigned)

6. Key Words: fire danger, fire weather, fire reports, fuels, burning tables.

7. Location of Work: Throughout region.

8. Problem:

During the past 10 years all fire control agencies in this 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 this 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. The job of introducing the new System and providing initial training is now complete. Analysis of fire records related to past and present danger rating systems are also complete and hence this project will now terminate. The maintenance of training sessions plus all future refinements of the present System will now be carried by Study NOR-086, Supplement 4.

9. Study 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 this Region.

10. Resources:

a) Starting date: 1968.
b) Estimated year of completion: Continuous. Revised: 1973.
c) Estimated total Prof. man-years required: 0
d) Essential new major equipment items for 1973/74 with costs: Nil.
e) Essential new major equipment items beyond 1974 with costs: Nil.
f) 1973-74 man years Prof. 0
Supp. 0
Casual 0
Total 0 0 & M funds req'd.: Nil.

11. Progress to date:

Over 3,000 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 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. This information was related to the old Canadian Forest Fire Danger Rating System.

The new System was introduced in 1970 and a number of training sessions were conducted. Computer programs were written to facilitate rapid calculation of the U. S. and Canadian Fire Behavior Rating Systems.

12. Goals for 1972-73:

1. Prepare a field guide for use of new Canadian System.

2. Compare old U. S. and new Canadian Systems.

3. Analyze fire statistics in relation to fire weather and danger rating codes.

13. Accomplishments in 1972-73:

A field guide was utilized from the PFRC and this eliminated the need for a region effort. Five years of fire and weather data were analyzed (1965-69) as a means of assessing reliability of past and present systems.

14. Goals for 1973-74:

Terminate study. Continued training aspects in NOR-087.

15. Publications:

Up to 1972-73

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

Kiil, A.D. and J.E. Grigel. 1969. The May 1968 forest conflagrations in central Alberta. Inf. Rpt. A-X-24.

Kiil, A.D. 1970. Forest-habitat inventory requirements for fire danger rating (paper presented at the Workshop Symposium on Forestland inventory for Management, Edmonton, Alberta).

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.

1972-73

Kiil, A.D. 1973. The Canadian Fire Weather Indicies and Fire Statistics in Alberta, 1965-69. Canadian Forestry Service, File Report NOR-Y-69.

16. Signatures:

Investigator

Program Manager

G.T. Silver, Director

NOR-085

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February, 1973

1. Project: Reduction of losses by improved fire danger forecasting.

2. Title: Controlled burning in forest management.

3. New Cont. X 4. No. NOR-085

5. Study Leader: Z.Chrosciewicz.

6. Key Words: Pinus banksiana, Picea mariana, Picea glauca, Populus tremuloides, climates, sites, fuels, drought.

7. Location of Work: Hadashville, Manitoba and Candle Lake, Saskatchewan.

8. Problem:

Many cut-over areas in Manitoba and Saskatchewan are characterized by a) substantial accumulations of logging slash (fire hazard problem), b) frequent incidences of various parasites (sanitation problem), c) insufficient reproduction of conifers due to unfavorable seedbed conditions (silvicultural problem), and d) rapid reversions to grass, shrubs and inferior hardwoods (silvicultural problem).

However, available information indicates that the post-cutting conditions can be effectively rectified through a rational use of 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 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 burning followed by seeding or planting with subsequent application of herbicides as needed.

There are 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 use of fire for any well-defined purpose are extremely small. Study

NOR-085 is designed to furnish the necessary data in relation to the following variables:

Southeastern Manitoba
Climate: boreal-temperate, moist subhumid

Central Saskatchewan
Climate: moderate-boreal, medium subhumid

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Forest Types
jack pine, black spruce, aspen, white spruce-aspen

x

Cut-Over Sites
dry, fresh, moist

x

Drought Conditions
indices 3, 6, 9, 12 in the old system
or their equivalents in the new system

x

Seasons of Burning
spring, summer, fall

↓

Experimental Level 0.4-acre treatment units → Operational Level 20-acre plus treatment units

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.

Due to re-orientation of regional research effort in 1970, it had been decided to confine this program to jack pine sites only. The decision is reflected in various sections of this statement, including the revised year of completion.

9. Study Objectives:

The study 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 behavior as related to weather and fuel conditions at the time of burning.

9. Evaluation of cost-benefit relationships at the operational level of burning.

10. Evaluation of all burns in terms of the establishment and growth of forest reproduction.

10. Resources:

a) Starting date: May 29, 1968.
b) Estimated year of completion: 1983 Revised: 1975*
c) Estimated total Prof. man-years required: 1.0*
d) Essential new major equipment items for 1973/74: None
e) Essential new major equipment items beyond 1974: None
f) 73-74 man-years

Prof.	0.5
Supp.	0.2
Casual	Nil
Total	0.7

O & M funds required: $200

11. Progress to Date (End of 1971-72):

A series of meetings with the provincial forest services led to the submission and approval of a comprehensive project plan (FRE MS 107) in 1969. Since then, forty-seven burns were carried out on jack pine cutover areas in southeastern Manitoba and central

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* For completion of work on jack pine sites only.

Saskatchewan. Forty-three of them were 0.4-acre experimental burns covering a range of sites, fuels and drought conditions, and four of them were large-scale operational burns totalling some 240 acres. Various seeding and planting treatments were tested in connection with individual burns. Other related activities included (a) publication of four papers mostly on a similar work with controlled burning in central Ontario, (b) assessment of conditions after two provincial control burns on a black spruce site in southeastern Manitoba, (c) analysis of data as they became available from the jack pine burns in southeastern Manitoba and central Saskatchewan, and (d) preparation of some material for publication in 1972-73.

12. Goals for 1972-73:

1. Completion of post-burn fuel assessments in Saskatchewan.

2. Completion of post-burn seeding and planting of pine in Saskatchewan.

3. Planning and implementation of large-scale burning operations with seed trees in Saskatchewan.

4. Processing of available data and, where applicable, their final analysis.

5. Reporting on the physical aspects of burning in both Manitoba and Saskatchewan.

13. Accomplishments in 1972-73:

1. Residual fuels were measured and mapped on all 1972 burns in Saskatchewan. A total of fourteen 0.4-acre sample plots were involved.

2. The 1972 burns were seeded and/or planted to pine and spruce by the Saskatchewan Department of Natural Resources at their own expense. Included in the operations were eight 0.4-acre experimental areas and some 240 acres of other cut-overs.

3. A combination of burning and seed-tree system was tested on nearly 70 acres. The jack pine stand was cut by the Prince Albert Pulpwood Ltd., and tree marking plus burning were the responsibilities of the Saskatchewan Department of Natural Resources. Specifications and research were provided by the Canadian Forestry Service.

4. All major computations of data were completed, including some final analyses.

5. Two new papers were submitted for publication and four others are in preparation.

14. Goals for 1973-74:

1. Cultivation of contacts with provincial forest services and industry.

2. Lending scientific advice in matters pertaining to practical uses of fire in forest management.

3. Assessment of post-burn conditions (plant succession, tree reproduction, etc.) on recently treated areas.

4. Publication of results on various weather-fuel relationships and fire behavior as follows:

Chrosciewicz, Z. 1973. Regeneration of black spruce by burning lowland cutover in southeastern Manitoba - in preparation for For. Chron.

Chrosciewicz, Z. 1973. Large-scale operational burns for slash disposal and conifer reproduction in central Saskatchewan - in preparation for For. Chron.

Chrosciewicz, Z. 1973. Experimental burning on clear-cut jack pine sites in southeastern Manitoba - intended Inf. Rep.

Chrosciewicz, Z. 1973. Experimental burning on clear-cut jack pine sites in central Saskatchewan - intended Inf. Rep.

15. Publications: Up to 1972-73:

Chrosciewicz, Z. 1967. Experimental burning for humus disposal on clear-cut jack pine sites in central Ontario. Can. Dep. For. Rur. Dev., Publ. No. 1181 (23 p.)

Chrosciewicz, Z. 1968. Drought conditions for burning raw humus on clear-cut jack pine sites in central Ontario. For. Chron. 44(5):30-31.

Chrosciewicz, Z. 1970. Regeneration of jack pine by burning and seeding treatments on clear-cut sites in central Ontario. Can. Dep. Fish. For., Inf. Rep. O-X-138 (13 p.)

Kiil, A.D. and Z. Chrosciewicz. 1970. Prescribed fire - its place in reforestation. Can. Coun. Res. Min., For. Reader, Pap. No. 7.... also For. Chron. 46(6):448-451.

In 1972-73:

Journal Publications

Chrosciewicz, Z. 1973. Evaluation of fire-produced seedbeds for jack pine regeneration in central Ontario - submitted to For. Chron. (7 p.)

Chrosciewicz, Z. 1973. Correlation between wind speeds at two different heights within a large forest clearing - submitted to For. Chron. (4 p.)

16. Signatures:

Investigator

Program Manager

Director

NOR-086

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

February 15, 1973

1. Project: Reduction of Losses by Improved Fire Danger Forecasting.

2. Title: Burning Indices for Major Fuel Types.

3. New: Cont.: X 4. No.: NOR-086

5. Study Leader: Z. Chrosciewicz

6. Key Words: Canadian Forest Fire Weather Index, fire behaviour, danger rating.

7. Location of Work: Hondo and Slave Lake, Alberta - plus other areas as needed.

8. Problem:

Intensive fire control management requires improved methods of assessing and forecasting fire danger for all major fuel types over a wide range of weather and site conditions. Although such methods would not prevent fires from occurring, they would undoubtedly result in substantial reduction of losses through better planning and implementation of various fire control measures all the way from prevention to suppression.

A good start in the development of such methods was made with the publication of the new Canadian Forest Fire Weather Index tables in 1970. The main index as well as the component codes are designed to summarize and rate the important weather variables that affect the ignition and spread of forest fires. The entire system provides means for daily rating of fire danger across the country. However, as the system uses primarily weather-dependent scales, it does not provide means for rating fire behaviour in specific fuels.

The second phase, then, would be the development of burning indices for important fuel types by major sites and climates within the Region. Studies of moisture relationships in different fuels will help to determine the degrees of deviation from the standard curves as originally used to working out the Fire Weather Index. Experimental ground burns and observations of natural crown fires will provide data on fire behaviour over a wide range of weather and site

conditions for each of the fuels. The resulting tables will then relate some of the main characteristics of ground and crown fires to the Fire Weather Index and its component codes. This in turn will provide means for a more precise rating and forecasting of fire danger for major fuel types within the Prairies Region.

9. Study Objectives:

1. To assist fire control agencies in promoting the use of the new Canadian Fire Weather Index

2. To develop fire spread and intensity tables for major fuels as supplements to the Fire Weather Index.

10. Resources:

a) Starting date: 1970.
b) Estimated year of completion: 1973. Revised: 1980.
c) Estimated total prof. man-years required: 5.0.
d) Estimated new major equipment items for 1973/74: Nil.
e) Estimated new major equipment items beyond 1974: Nil.
f) 73-74 man-years

Prof.	1.5		
Supp.	0.8		
Casual	0.6		
Total	2.9	O & M funds req'd.:	$4,000.00
		R.D. contracts:	$4,900.00

11. Progress to Date: (End of 1971-72):

The new Canadian Fire Weather Index was introduced to the Region in 1970 through a series of training sessions for user agencies. During the same year, forty-eight 0.25-acre plots were established and prepared for burning in stands of white spruce-aspen, aspen and jack pine, southeast of Slave Lake, Alberta. A pilot burn in the aspen stand was carried out in 1971.

12. Goals for 1972-73:

A reassignment of duties to adjust for the resignation of the suppression project leader moves Mr. Quintilio to suppression research and Mr. Chrosciewicz to fire behaviour 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. Chrosciewicz, following a summer of reconnaissance and familiarization, will continue the study. Promotion of the Fire Weather Index through training sessions is to be maintained.

13. Accomplishments in 1972-73:

Thirteen spring test burns were carried out on some of the aspen plots to assess fire behaviour in relation to weather and available

fuels (Quintilio's work). Following an inspection of the overall field setup, plans for the 1973 field season had been formulated (Chrosciewicz' work). Interagency meetings were held to examine performance of the Fire Weather Index after its use over the past three years. The usual program of training was maintained throughout the year.

14. Goals for 1973-74:

a) Continuation with training sessions for user agencies;

b) Establishment of two master weather stations, each in the open near a group of existing plots;

c) Establishment of weather substations under forest canopies of four different types;

d) Maintenance of weather instrumentation from mid-April to mid-October;

e) Daily sampling of green (crown) and dead (ground) fuels for moisture content determinations in stands of white spruce-aspen, black spruce, aspen and jack pine.

15. Publications: None

16. Signatures:

Z. Chrosciewicz, Investigator

Program Manager

G.T. Silver, Director

NOR-091

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

February, 1973

1. Project: Reduction of Losses by Improved Fire Danger Forecasting and Assessment

2. Title: The effect of stand composition on forest-floor fuels in Alberta

3. New: Cont.: 4. No.: NOR-091

5. Study Leader: A. D. Kiil (resigned)

6. Key Words: Classification, pine, spruce, aspen, weight, heat of combustion

7. Location of Work: Alberta

8. Problem:

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 behavior. 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.

9. Study 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.

10. Resources:

a) Starting date: 1968.
b) Estimated year of completion: 1972. Revised: 1973.

c) Estimated total Prof. man-years required: 0.
d) Essential new major equipment items for 1973/74 with costs: Nil.
e) Essential new major equipment items beyond 1974 with costs: Nil.
f) 1973-74 man-years Prof. 0
Supp. 0
Casual 0
Total 0 O & M funds req'd.: Nil.

11. Progress to Date:

Sampling units were selected on the basis of A.F.S. permanent sample plot 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 in 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. An additional five one-square-foot samples were collected for each cover type in 1971.

12. Goals for 1972-73:

1. Complete data analysis.

2. Terminate project.

13. Accomplishments in 1972-73:

The analysis was completed and a manuscript is in preparation.

14. Goals for 1973-74:

Terminate project. Transfer data to NOR-086 for review and use.

15. Publications:

Up to 1972-73 - Nil.

1972-73 - Nil.

16. Signatures:

Investigator

Program Manager

G.T. Silver, Director

NOR-124

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

February, 1973

1. Project: Reduction of Losses by Improved Fire Danger Forecasting and Assessment Methods.

2. Title: Evaluation of the fuel complex at different stages of vegetative succession.

3. New: Cont.: X 4. No.: NOR-124

5. Study Leader: A.D. Kiil (resigned) via D. Dube.

6. Key Words: weight, distribution, energy, lodgepole pine, white spruce, fir, classification.

7. Location of Work: Banff and Kootenay National Parks

8. Problem:

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.

9. Study 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.

10. Resources:

a) Starting date: 1971.
b) Estimated year of completion: 1973.

c) Estimated total Prof. man-years required: 0.
d) Essential new major equipment items for 1973/74: Nil.
e) Essential new major equipment items for beyond 1974: Nil.
f) 1973-74 man-years Prof. -
Supp. -
Casual -
Total - 0 & M funds req'd.: Nil.

11. Progress to date:

A detailed field reconnaissance and interpretation of aerial photographs of the Vermilion Pass area was 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 four vegetative types.

12. Goals for 1972-73:

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.

13. Accomplishments in 1972-73:

Rainfall duration and amount was measured at four sites throughout the summer and square-foot duff samples were collected systematically to determine moisture profiles. Data has been analyzed and reports are in preparation.

14. Goals for 1973-74:

Terminate project.

15. Publications:

Results of work will be published as Masters Thesis by D. Dube.

16. Signatures:

Investigator

Program Manager

G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February, 1973

1. Project: Reduction of losses by improved fire danger forecasting and assessment methods.

2. Title: Fire hazard rating for Cladonia fuels.

3. New X Cont. 4. No.: NOR-129

5. Study Leader: A.D. Kiil (resigned)

6. Key Words: Heat energy, moisture content, classification, fire behavior

7. Location of Work: Footner Lake Forest, Alberta

8. Problem:

Cladonia fuels are widespread throughout the boreal forest and extremely flammable within a few hours of a saturating rainfall. Cladonia fires spread rapidly and consume part or all of the fuel, depending on its continuity and moisture content. Even a moderate-intensity fire may consume 50 years of Cladonia growth. Fire control personnel are concerned about the Cladonia fire hazard and require more detailed guidelines on fire spread and intensity in this fuel type. Information on short and long term fire effects in this fuel type would also be of use to wildlife managers responsible for caribou habitat management.

Resignation of the study leader terminated progress toward successful completion of a burning table for this fuel type. It will now be included in the objectives of NOR-086, however field work is not scheduled for 1973.

Methods: Now replaced by those of NOR-086.

9. Objectives:

1. To determine the drying and wetting characteristics of Cladonia fuels.

2. To measure fire behavior characteristics in Cladonia fuels over a range of burning conditions.

3. To prepare a burning table for Cladonia fuels.

10. Resources:

a) Starting date: 1972.
b) Estimated year of completion: 1973 Revised:
c) Estimated total Prof. man-years required: 0.6.
d) Essential new major equipment items for 1973/74 with costs: Nil.
e) Essential new major equipment items beyond 1974 with costs: Nil.
f) 1973-74 man-years Prof. 0
Supp. 0
Casual 0
Total 0 0 & M funds req'd.: Nil.

11. Progress to date: None - proposal.

12. Goals for 1972-73:

Select a study area to map and sample Cladonia and to establish and maintain a fire weather station. Determine drying and wetting characteristics of Cladonia after different rainfall intensities and for 24-hour periods throughout fire season. Observe and measure fire behavior in this type over a range of burning conditions (if arrangements can be made to go to wildfires or to conduct prescribed burns). Prepare a burning table and guidelines for Cladonia fuels.

13. Accomplishments in 1972-73:

The extensive Cladonia fields in the northern portion of the Footner Lake Forest were mapped during early June, 1972. A sampling site was then chosen on the Stein River and a weather station established. Moisture contents were measured during selected 24-hour periods prior to a scheduled prescribed burn. A four-acre plot was then prescribed burned and rate of spread and fuel consumption documented.

14. Goals for 1973-74:

Project is terminated and this fuel type study will be absorbed in Study NOR-086.

15. Publications:

Up to 1972-73 - Nil.

1972-73

Unpublished Report submitted to A.F.S.

Huey, G. Cladonia Fuel Type Mapping - An aerial survey in the Footner Lake Forest.

16. Signatures:

Investigator	Program Manager
	G.T. Silver, Director

NOR-003

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 10, 1973.

1. Project: Improved Regeneration Methods for Commercial Forest Species.

2. Title: Prescribed burning following cutting of spruce/fir in the foothills section of Alberta.

3. New: Cont.: X 4. No.: NOR-003

5. Study Leader: F. Endean

6. Key Words: Regeneration, planting, container stock, sowing, soil temperature, Boreal Region B19C (Rowe, J.S. Bull 123).

7. Location of Work: Hinton, Alberta

8. Problem:

In 1967 a significant part of the pulpwood harvest area of North Western Pulp & Power Ltd. was from over mature spruce/fir stands. Following clearcutting natural regeneration was inadequate and attempts at artificial regeneration unsuccessful. The immediate cause of this failure was deep accumulations of organic material which were also regarded as a symptom of long term site degradation. This study in co-operation with NOR-004 and NOR-092 was intended to determine the degree of site amelioration and increased success in regeneration which could be expected from prescribed burning.

The probability of success on sites with less than six inches of organic matter was high, with more than this chances were regarded as low but had to be tested.

At that time N.W.P.P. were willing to apply the results on problem sites, they have done so since. Two sites, one with deep and one with approximately six inches of organic accumulation were chosen, 4 x 12 - 20 acre blocks were set out at each site, to be burned at three different hazards having an unburned control. After burning a variety of transplants were planted and selected parts were seeded, depth of burn, mineral soil exposure and recolonization by vegetation, soil temperature and annual seedling growth were measured.

9. Objectives:

1. To describe the effects of prescribed burning at a range of intensities on the site factors regarded as important to regeneration establishment.

2. To evaluate the effect and permanency of these changes in terms of seedling survival and growth.

3. From these facts to decide whether prescribed burning has any silvicultural value on these and similar sites.

10. Resources:

a) Starting date: 1967 delayed until 1968.
b) Estimated year of completion: Original 1973.
c) Estimated total prof. man years required: 0.1
d) Essential new major equipment items for 1973-74: Nil
e) Essential new major equipment items for beyond 1974: Nil.
f) 1973-74 man years:

Prof.	0.1
Supp.	-
Casual	-
Total	0.1

0 & M funds req'd: Nil.

11. Progress to Date:

Tallies of survival and seedlings sampled for dry weight analysis have been done in 1970, 71, and 72. Soil temperature has been monitored in the growing season since 1968. Surveys of mineral soil exposure resulting from the fires were completed in 1969 and a complete assessment of recolonising vegetation was completed in 1972.

Results have not yet been analysed but it appears that survival and growth are better on the burned plots, that bare root seedlings have maintained size superiority, the the scorched organic layer (only an average of 1.1 inches was removed) is a most unsatisfactory seed bed for germination and that soil temperature does rise after burning.

12. Goals for 1972-73:

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

13. Accomplishments in 1972-73:

Growth and survival remeasured.
Soil temperature monitored.
Vegetation recolonization assessed.
First draft of final report near completion.

14. Goals for 1973-74:

A final report will be completed by March 31st and the study terminated.

15. Publications:

Up to 1972-73

Endean, F. Prescribed burning research in Alberta. Forestry Report Vol. No. 2. May 1971.

1972-73

Endean, F. Soil temperature, seedling growth and white spruce regeneration. In. Proc. of a symposium on white spruce C.B.A. Edmonton, Alberta. Dept. of Env., Can For. Serv., Northern For. Res. Centre Info. Rept. NOR-X-40. June 1972.

16. Signatures:

F. Endean, Investigator

K. H. Ackerman
Program Manager

G.T. Silver, Director

NOR-004

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 10, 1973

1. Project: Improved regeneration methods for commercial forest species.

2. Title: Effects of prescribed fire on Peaty Humic Gleysol and on Gray Wooded soils under spruce-fir forest.

3. New: Cont.: X 4. No.: NOR-004

5. Study Leader: G.L. Lesko

6. Key Words: Soil temperature, soil moisture, mineral nutrients, Picea glauca, Abies lasiocarpa.

7. Location of Work: Hinton, Alberta.

8. Problem:

Prescribed fire is a possible method of seedbed improvement for regeneration, therefore its effect on soil properties must be known (See study statements 001 and 003).

The study will show if the fire is harmful, beneficial or neutral to soil properties. The probability of finding answers to these questions is high.

The results will not be put into practice because they serve as background information.

Method: Measurement of soil properties before and in successive years after prescribed fire.

9. Study Objectives:

1. To determine the moisture and heat regimes of the above soil after prescribed fire.

2. To determine long and short-term effects of fire on soil reaction, essential macro nutrients, organic carbon content and cation exchange capacity.

10. Resources:

a) Starting date: 1967.
b) Estimated year of completion: 1980.
c) Estimated total Prof. man years required: 0.5.
d) Essential new major equipment items for 1973/74 with costs: Nil.
e) Essential new major equipment items beyond 1974 with costs: Nil.
f) 1973-74 man-years

Prof.	0.2	
Supp.	0.2	
Casual	-	
Total	0.4	O & M funds req'd $600.00

11. Progress to date:

1. Field measurements of soil moisture and temperature were conducted for 5 years.

2. Soil samples were collected in four successive years to study chemical changes.

3. Chemical analysis of the samples are completed.

4. Preliminary results were summarized in an Internal Report in 1971.

12. Goals for 1972-73:

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

13. Accomplishments in 1972-73:

1. Field measurement were completed by soil moisture and temperature observations from May to October.

2. 110 samples were analyzed for pH, cation exchange capacity, Ca, Mg, K, Na, N and P.

14. Goals for 1973-74:

1. Recovery of all equipments from the field and collection of soil samples from the observation sites.

2. Calibration of the Colman soil moisture units used in the field measurements.

3. Compilation and evaluation of the collected data.

4. Reporting on the short term effects of the prescribed fire.

5. Analysis of collected soil samples.

15. Publications:

Up to 1972-73:

Internal Report:

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

1972-73:

Miscellaneous:

Lesko, G.L. 1972. Immediate effects of a prescribed fire on soil properties. Forestry Report, C.F.S., N.F.R.C., Edmonton Alberta. Vol. 1. No. 6. p. 4.

16. Signatures:

G.L. Lesko, Investigator

Program Manager

G.T. Silver, Director

NOR-047

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 4, 1973

1. Project: Improved Regeneration Methods for Commercial Forest Species.

2. Title: The role of fire in the ecology of jack pine.
Part (a) Ecological effects of burning.
Part (b) The effect of depth to water table on tree seedling growth.

3. New: Cont.: X 4. No.: NOR-047

5. Study Leader: H.P. Sims

6. Key Words: Pinus banksiana, root, growth, competition, nutrients, burn, mammals, Picea mariana, Picea glauca, Pinus resinosa.

7. Location of Work: Sandilands Provincial Forest, Manitoba.

8. Problem:

Part (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.

Several areas were prescribed burned and vegetation, soil nutrients and microclimate (temperature and moisture) studied on the burned sites.

Part (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.

9. Study Objectives:

Part (a)

To determine the effects of fire on the environmental factors affecting germination, growth and development of jack pine.

Part (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.

10. Resources:

a) Starting date: 1961.
b) Estimated year of completion: 1973. Revised: 1974.
c) Estimated total professional man years required: 0.4.
d) Essential new major equipment items for 1973-74 with costs: Nil.
e) Essential new major equipment items beyond 1974 with costs: Nil.
f) 1973-74 man years

Prof.	0.2
Supp.	-
Casual	-
Total	0.2

O & M funds req'd Nil.

11. Progress to date:

Part (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 1972 ecological effects of prescribed were studied on five areas. Effects on lesser vegetation, physical and chemical soil characteristics, and rodent populations were studied.

In 1964 a paper was published on the root growth of jack pine on a burned over dry site.

In 1968 a paper was published on effect of extracts of burned pine litter on germination of jack pine seed.

In February 1970 a paper was published on the recovery of vegetation after a light burn on a mixed pine-hardwood cover.

In 1971 a manuscript was prepared on re-invasion of rodents on burned areas and submitted for publication.

Part (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 simulate 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 weighted. 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.

12. Goals for 1972-73:

Part (a)

Completion of dissertation; check of vegetation establishment on

burns; re-submission of manuscript.

13. Accomplishments in 1972-73:

Part (a)

1. Dissertation was completed and successfully defended to complete requirements for the PhD degree in forest ecology.

2. Vegetation was photographed and sampled on permanent plots established on 1969 burns.

3. Publication was submitted to American Midland Naturalist, revised, and re-submitted.

14. Goals for 1973-74:

Part (a)

Publication of dissertation material.

15. Publications:

Up to 1972-73:

Part (a)

Sims, H.P. 1964. Root development of jack pine on burned over dry sites in southeastern Manitoba. Canada Dept. of Forestry Publ. 1061.

Sims, H.P. 1968. Effect of water extracts of burned pine duff on germination of jack pine seed. Bi-monthly Research Notes 24(2).

Sims, H.P. and N.G. Bruce. 1969. Recovery of vegetation and its effects on survival of planted jack pine seedlings after a light burn on a mixed pine-hardwood cutover. Pulp and Paper Magazine of Canada, February, 1969.

Sims, H.P. 1965. The ecological effects of prescribed burning in jack pine - southeastern Manitoba. Establishment and Progress report 65-MS-17:20 pp.

Sims, H.P. and N.G. Bruce. 1966. The ecological effects of prescribed burning in jack pine - southeastern Manitoba. Internal Report MS-27:24 pp.

Bruce, N. 1967. The ecological effects of prescribed burning in jack pine - southeastern Manitoba. Internal Report MS-46: 19 pp.

Bruce, N. 1968. The ecological effects of prescribed burning in jack pine - southeastern Manitoba. Internal Report MS-77:9 pp.

Bruce N. 1969. The ecological effects of prescribed burning in jack pine - southeastern Manitoba. Internal Report MS-84:6 pp.

Part (b)

Mueller - Dombois, D. and H.P. Sims. 1966. Response of three grasses to two soils and a water table depth gradient. Ecology 47:644-648.

Sims, H.P. and D. Mueller - Dombois. 1968. Effect of grass competition and depth to water table on height growth of coniferous tree seedlings Ecology 49:597-603.

1972-73:

Study (a)

Sims, H.P. The effect of clear-cutting and burning on the populations of some small mammals in southeastern Manitoba. Submitted to American Midland Naturalist.

Sims, H.P. 1973. Some ecological effects of prescribed burning on cut-over jack pine (Pinus banksiana) sites, southeastern Manitoba. PhD dissertation submitted in fulfillment of requirements Duke University - Accepted.

16. Signatures:

H.P. Sims, Investigator

Program Manager

G.T. Silver, Director

NOR-049

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

March, 1973

1. Project: Improved regeneration methods for commercial forest species.

2. Title: Use of prescribed burning in jack pine management in southeastern Manitoba.

3. New: Cont.: X 4. No.: NOR-049

5. Study Leader: H.P. Sims

6. Key Words: Regeneration, Pinus banksiana, planting, seeding, barrel, scarification site preparation.

7. Location of Work: Sandilands Provincial Forest, Manitoba.

8. Problem:

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.

Fall and spring seeding and planting of jack pine are being tested at various intervals after burning or burning and scarifying. Survival and growth of planted stock and germination, stocking and growth of germinants on direct seeding plots are measured each fall for three years, and at five years.

9. Study 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.

10. Resources:

a) Starting date: 1967.
b) Estimated year of completion: 1968. Revised: 1975.
c) Estimated total professional man years required: 0.2.
d) Essential new major equipment items for 1973/74 with costs: Nil.
e) Essential new major equipment items beyond 1974 with costs: Nil.
f) 1973-74 man years Prof. Nil
Supp. 0.1
Casual Nil
Total 0.1

O & M funds req'd: $400.00

11. Progress to date:

Accomplishments to beginning of fiscal year under review:

First, second and third year spring and fall seeding and planting have been completed on areas logged during the winter of 1966-67 and treated (burned, burned and scarified, scarified only) in 1967.

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

12. Goals for 1972-73:

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

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

13. Accomplishments in 1972-73:

The second year examination of the third year spring and fall seeding and planting was completed.

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

14. Goals for 1973-74:

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

15. Publications:

Up to 1972

Walker, N.R. and R.C. Dobbs. 1968. The use of prescribed burning in jack pine management in southeastern Manitoba. Internal Report MS-74:15 pp.

Walker, N.R. 1969. The use of prescribed burning in jack pine management in southeastern Manitoba. Internal Report MS-92:10 pp.

1972-73: Nil.

16. Signatures:

H.P. Sims, Investigator.

R.F. Ackerman, Program Manager

G.T. Silver, Director