STUDY STATEMENTS

1975 - 76

NORTHERN FOREST RESEARCH CENTRE

CANADIAN FORESTRY SERVICE

MAY, 1975

NOR 037

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1975 - 76

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 10, 1975

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 operational research study is oriented towards the immediate needs and requests of client agencies, namely Provincial and Territorial Forest Services. The intent is to improve aerial suppression methods by optimizing the use and effectiveness of available airtankers, helitankers and retardants. Results from this study complement 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 forest resource by enhancing operational effectiveness in the control of wildfires by fire control agencies.

Through continuous cooperative effort and liaison with client agencies the probability of application of study results 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 use 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 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 cooperation with other fire operations and research agencies and through communication with client agencies.

9. Study Objectives:

1. To measure and evaluate the drop patterns of various airtanker/fire retardant combinations, including helicopters.

2. To evaluate fire retardants and determine the optimum 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 retardant application and supporting activities, presuppression planning and allocation of resources in terms of reduced costs and increased benefits.

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 1975-76 with costs: Nil
e. Essential new major equipment items beyond 1976 with costs: Nil
f. 1975-76 man-years

Prof.	1.0
Supp.	1.0
Casual	0.3
Total	2.3

11. Progress to Date:

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 cooperation with client agencies, the advantages of more effective airtankers and the operations logistics of same have been promoted in this region. 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 in aid of improved aerial suppression throughout the region. Portable ground mixing units and retardant mixing systems within aircraft have been developed and are being utilized to good effect by fire control agencies.

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

Additional Progress:

Study of mixing and storage of long-term fire retardants in Alberta demonstrated that quality control could not be achieved unless higher-powered mixers with better impellers were adopted and either extended storage were terminated or more efficient recirculation methods developed.

A preliminary draft of specifications for long-term fire retardants was well-received by client agencies. It is subject to continuing revision to incorporate user suggestions, up-date technical information, and take cognizance of potential environmental impacts.

Corrosion tests indicated that Fire Trol 100 and 931 severely affect magnesium alloy AZ63-T4, but these two retardants and Phos Chek 202XA have only slight to moderate effects on Alcladding and aluminum alloy 7075-T6.

12. Goals for 1974-75:

1. Further evaluate airtanker drop accuracy under simulated initial attack conditions as opportunity permits.

2. Provide guidance and technical assistance to the Alberta Forest Service in evaluation of the following:

a. AFS designed and constructed a 300-gallon Monsoon bucket with emphasis on controlled gate opening and fluid flow control for both water and long-term retardants. These tests will assist in maximizing effectiveness of this bucket through improved drop patterns.

b. AFS designed and constructed in-line retardant eductor as employed in fixed-wing and helitanker operations.

c. On board calibration of the short-term retardant injection system used in contracted Canso airtankers.

d. Fixed-wing airtanker inspection programme with particular emphasis on tanking and gating design and efficiency. To include training of an AFS inspection team.

e. Assumed benefits of using the short-term retardant (water thickener) Tenogum as related to the rheologic properties of this commercial product.

3. Let a contract for the assessment of "on-site" effectiveness of airtankers and retardants on wildfire suppression operations.

4. Contract for additional testing of corrosive and other degradational properties of long-term chemical fire retardants as they affect metal alloys used in aircraft construction and other metals and materials in common use at airtanker bases.

5. Enroll study leader in graduate programme at University of Alberta combining agricultural economics, operations research, and forest fire science.

6. Prepare the following publications:

Newstead, R. G. and J. Niederleitner. Guidelines on the specifications and use of long-term fire retardants. Information Report.

Newstead, R. G. and J. Grigel. The operational use of helitankers in forest fire control. Information Report.

Newstead, R. G. and J. Grigel. A review of airtanker delivery systems. Information Report.

Goal added in 1974-75:

7. Participate in provincial and federal forest service training sessions.

13. Accomplishments in 1974-75:

1. Completed second year retardant drop accuracy tests in Alberta with two pilots flying B-26 airtankers. A total of 12 individual pilots on two types of airtankers (B-26 and Canso) were utilized over the 2-year period. The test sites for the drop trials were similar, i.e. 50-60 foot standing timber on a 20% slope. Smoke targets were generated from the top of a 45 foot mast to simulate a spot fire.

   Several constraints were encountered during the trials:

   a. Smoke volume insufficient and inconsistent (caused confusion for pilots trying to relate smoke emission point to base of target).

   b. Dropping water for the tests versus retardant (complaints from tanker B-26 pilots as to unfamiliarity with the drop characteristics of water).

   c. Water drops not visible in the canopy during successive drops in order for bird-dog officer and pilot to use as reference markers to close in on target.

   d. Tactics used by bird-dog officer sometimes questionable (pilot/bird-dog officer discrepancies).

   Results indicate that the B-26 pilots (7 in total) scored an average of 39% accuracy with a low of 13% and a high of 63%. The Canso pilots (5 in total) scored an average of 63% with a low of 30% and 3 pilots at a high of 80%.

   Therefore all Canso drops were more accurate than all B-26 drops.

   A final report on this 2-year project is being prepared.

2. Provided technical assistance to the Alberta Forest Service in the following investigations:

   a. Re-scheduled to 1975 evaluation of the Alberta Forest Service 300-gallon Monsoon bucket at request of AFS.

   b. Re-scheduled to 1975 field evaluation of the Alberta Forest Service in-line powdered retardant eductor also because of a low fire incidence in areas where eductor bases are located and delayed introduction of these units.

   c. Inspected and calibrated short-term retardant injection systems used in contract Canso airtankers; trained AFS personnel to perform this recurring task.

d. Inspected fixed-wing airtankers and trained Alberta Forest Service inspection team to make future inspections.

e. Deferred evaluation of the short-term retardant, Tenogum, until an improved powder injection system is available in water skimming aircraft.

f. Tested Fire-Trol 100 dry form to determine the extent of impurities (sand, silt) found in its attapulgite clay component. Results of these tests forwarded to Alberta Forest Service for inclusion in subsequent fire retardant contracts.

3. In cooperation with Alberta Forest Service, contracted with C. E. Hardy to develop a method of evaluating on-site effectiveness of airtankers in fire suppression. Contractor proposed a preliminary evaluation technique and data-collection form but was unable to test it for lack of fire activity. Final report received recommending (a) collection of extensive data on tree crown characteristics of regional forest types, (b) static testing of airtankers, (c) use of data from (a) and (c) to calculate expected retardant interception and through-fall, (d) data collection scheme for operational air-drop evaluation.

4. Did not contract for additional study of corrosive and/or degradational properties of long-term retardants because information already obtained appeared adequate, and U. S. Forest Service has major contract in progress.

5. Study leader entered graduate study program at University of Alberta.

6. Contractor has submitted report on use of fire retardants in Canada; (final report held in abeyance pending revisions and upgrading of interim retardant specifications).

Lieskovsky, R. J., R. Kruger, and R. G. Newstead. June 1974. Problems in Mixing and Storage of Long-term Retardants in Alberta. NOR-X-94. (Replaces file report NOR-Y-68.)

Grigel, J. E., R. J. Lieskovsky, and R. G. Newstead. February 1974. Air Drop Tests with Helicopters. NOR-X-77.

Grigel, J. E. December 1974. Role of the Helitanker in Forest Fire Control. NOR-X-123.

Additional Accomplishments:

7. Participated in the following training activities:

Northwest Lands & Forest Service Ass't. Resource Officers, Yellowknife; retardant dropping demonstration, Hay River.

Parks Canada warden training at Yoho, Prince Albert, and Jasper National Parks.

Alberta Forest Service bird-dog officers, Grande Prairie.

Department of Northern Saskatchewan, Prince Albert.

14. Goals for 1975-76:

1. Assess on-site and/or simulated effectiveness of airtanker/retardant combinations through contract, Alberta Forest Service cooperation, and NFRC resources.

2. Provide technical assistance to the Alberta Forest Service in the following investigations:

   a. Performance evaluation of the Alberta Forest Service 300-gallon Monsoon bucket.

   b. Evaluation of the Alberta Forest Service in-line powdered retardant eductor at permanent airtanker bases.

3. Provide consultation to Department of Northern Saskatchewan, Manitoba Department of Mines, Resources and Environmental Management, and Northwest Lands and Forest Service; determine their needs for technical services and research, and incorporate in future NFRC research plans.

4. Construct a fire retardant spray apparatus for the Fire Laboratory for testing required application levels of fire retardants on different fuels under various burning conditions.

5. Continue enrollment of study leader in U. of A. graduate studies.

6. Prepare publications on:

   Grigel, J. E. and R. G. Newstead. A Review of Airtanker Retardant Delivery Systems.

   Newstead, R. G. and R. J. Lieskovsky. Pilot Accuracy Trials in Alberta and Saskatchewan.

7. Participation in regional training sessions where and when requested.

15. Publications:

Grigel, J. E. 1969. Preliminary Evaluation of TX-350 - A New Long-Term Retardant. Forestry Branch, Dep. Fisheries and Forestry, Internal Rep. 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, Dep. Fisheries and Forestry, Internal Rep. A-21.

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

Grigel, J. E. 1970. The Use of Airtankers for Fire Suppression in Canada. Can. For. Serv., Dep. Fisheries and Forestry, Internal Rep. A-33.

Grigel, J. E. 1970. Fire Retardants and Their Use in Western Canada. Can. For. Serv., Dep. Fisheries and Forestry, Inform. Rep. Z-X-38.

Lieskovsky, R. J. 1971. Drop pattern for Twin Otter Membrane Tank System. Can. For. Serv., Dep. Environ., Internal Rep. NOR-2.

Grigel, J. E. 1971. Air drop tests with Fire-Trol 100 and Phos-Chek 205 fire retardants. Can. For. Serv., Dep. Environ., Inform. Rep. NOR-X-8.

Grigel, J. E. and Lieskovsky, R. J. 1972. A comparison of the B-26 and Thrush Commander airtankers. Can. For. Serv. Dep. Environ., Inform. Rep. NOR-X-17 (Replaces unpublished Internal Report NOR-6).

Bradford, Samuel A. 1973. Corrosion of metals in fire retardants. Can. For. Serv., Dep. Environ., Inform. Rep. NOR-X-66.

Lieskovsky, R. J., Kruger, R., and Newstead, R. G. 1974. Problems in mixing and storage of long-term retardants in Alberta. Can. For. Serv., Dep. Environ., Information Rep. NOR-X-94. (Replaces file report NOR-Y-68).

Grigel, J. E., Lieskovsky, R. J., and Newstead, R. G. 1974. Air drop tests with helitankers. Can. For. Serv., Dep. Environ., Inform. Rep. NOR-X-77.

Grigel, J. E. 1974. Role of the helitanker in forest fire control.

In addition the following contributions have been prepared for:

Forestry Report Vol. 1, No. 1
- Short and long-term fire retardants.
- The B-26 airtanker.

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.

Forestry Report Vol. 3, No. 1
- Recent airtanker drop tests.
- Quality control - a must.

16. Signatures:

Investigator

Program Manager

Director G. T. Silver

NOR 128

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1975 - 76

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 10, 1974

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

2. Title: Assessment and development of fireline systems.

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

5. Study Leader: D. Quintilio

6. Key Words: Fuel types, fire behaviour, bulldozers, airtankers, handcrews

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

   a. Major fuel types are stratified according to resistance to control.

   b. A time and motion study has been designed to document productivity of bulldozers and hand crews.

   c. 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

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

   b. 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.

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

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

9. Study Objectives:

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

   b. 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 1975-76 with costs: Nil
   e. Essential new major equipment items beyond 1976 with costs: Nil
   f. 1975-76 man-years

Prof.	0.5	(Quintilio)
Supp.	1.0	(Ponto)
Casual	0.3	
Total	1.8	

11. Progress to Date:

The study was introduced to the Alberta Forest Service and cooperative 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 were distributed to selected AFS districts for 1973 use.

All remaining regional agencies have been approached, through the Sub-Committee on Fire Protection, for cooperative 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 the application of explosives for fireline construction. CIL donated 1,000 feet 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.

A prescribed burn was conducted at Steen River in cooperation with the Alberta Forest Service. Participating CFS personnel (Dubé, Quintilio, Niederleitner, Lieskovsky) monitored fire behavior, long and short term retardant effectiveness, backfiring, prima-cord explosive, and infra-red imagery associated with the burn. A summary file report is listed under publications.

Both the aerial ignition system and electronic fire marker were field tested and demonstrated during 1973. A final Information Report (including blueprints) detailing operational use of the ignition system was published. The electronic marker is considered operational in Alberta with the planned construction of 44 units for 1974.

The bulldozer fireline assessment format was introduced to provincial agencies during the annual Fire Plans Course at Hinton, May 19, 1973. Two hundred forms were distributed to sector and cat boss personnel and a field exercise was conducted on the school forest. Fourteen fires were subsequently monitored by the Alberta Forest Service and data for 29 miles of fireline construction were received at NFRC. These reports will be grouped with 1972 CFS data.

NFRC personnel collected data on wildfires in Alberta and NWT and 78 miles of bulldozer and 5 miles of handline observation are documented.

12. Goals for 1974-75:

1. Continue monitoring of wildfires as a means of building data banks for airtanker, bulldozer, and handcrew productivity rates in regional fuel types. Encourage agencies to continue their participation and assistance.

2. Summarize 1972-1973-1974 bulldozer data and prepare report.

3. Supervise contract NOR-5-1.

Added Goal:

4. Participate in the Darwin Lake prescribed burning study.

13. Accomplishments in 1974-75:

1. Obtained data from an additional 20 miles of bulldozer line (contributed principally by Alberta Forest Service field staff) and 2 miles of handline construction. Described study to industry and provincial representatives at Hudson Bay, Saskatchewan.

2. Deferred report on bulldozer productivity for one year as a result of adding Item 4.

3. Obtained report on contractual study of handline construction rates in relation to fuels; used data in NOR 130. The contractor (Professor P. J. Murphy) has developed a unique method for expressing production rate as a function of fuels, which will be tested in 1975.

4. Provided alternate leadership and miscellaneous services to CFS/AFS experimental burning study at Darwin Lake, Alberta.

14. Goals for 1975-76:

1. In cooperation with the Alberta Forest Service plan criteria for their continuation of the study once CFS results and reports are completed.

2. Continue monitoring wildfires throughout the region as a means of building data banks for airtanker, bulldozer and handcrew productivity rates.

3. Supervise handcrew contract with Professor P. J. Murphy, University of Alberta.

4. Publish the following reports:

Quintilio, D. 1975. Fire control application of bulldozers. Infor. Report.

Murphy, P. J. and D. Quintilio. 1975. Handcrew fireline production rates in Alberta fuel types. Infor. Report.

15. Publications:

Up to 1974-75

Lait, G. R. and W. C. Taylor. 1973. Backfiring and burnout techniques used in the Yukon. Information Report NOR-X-43. Can. For. Serv., Northern Forest Research Centre. Edmonton, Alberta.

Ponto, R. L. and G. M. Lynch. 1973. Use of electronic markers to relocate small forest fires. Information Report NOR-X-61. Can. For. Serv., Northern Forest Research Centre. Edmonton, Alberta.

Ponto, R. L., D. Quintilio, P. Bihuniak, and G. R. Lait. 1974. An incendiary priming and release mechanism for backfiring from aircraft. Information Report NOR-X-75. Can. For. Serv., Northern Forest Research Centre. Edmonton, Alberta.

Dubé, D. E. 1973. Fire control methods in the Black Spruce - Labrador Tea - Cladonia fuel complex. File Report, Northern Forest Research Centre. Edmonton, Alberta.

1974-75

Ponto, R. L. 1974. Electronic fire marker being tested in Canada. USDA Forest Serv. Fire Management 35(2):15.

16. Signatures:

D. Quintilio
Investigator

R W Reid
Program Manager

G T Silver
Director G. T. Silver

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1975-76

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 10, 1975

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

6. Key Words: Detection, fire behaviour, airtankers, simulation modelling, hand crews, helicopters.

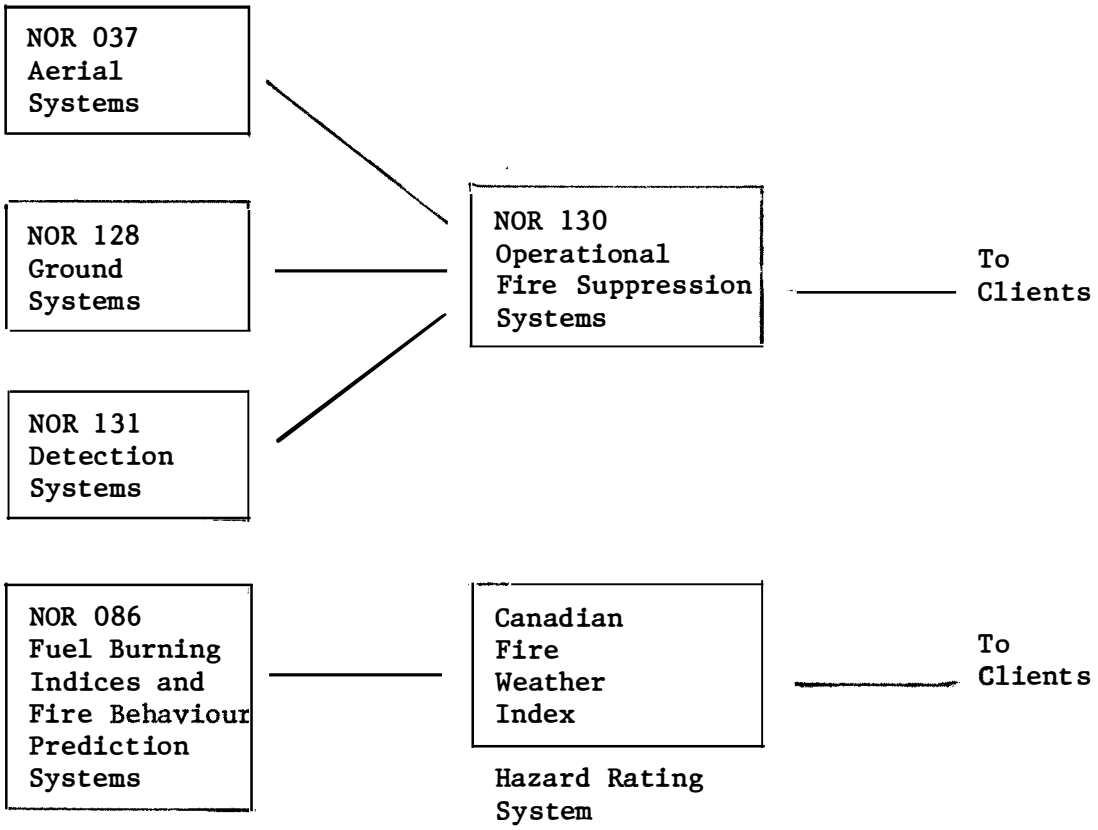
7. Location of Work: Northern Forest Research Centre.

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 behaviour 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 cooperating 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.
- Programme and run the model.
- Analyze results and present guidelines.

9. Study 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.

3. To promote and extend research results to client agencies through lectures and training sessions.

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 1975-76 with costs: Nil
e. Essential new major equipment items beyond 1976 with costs: Nil
f. 1975-76 man-years

Prof.	0.5	(Quintilio)
Supp.	0.0	
Casual	0.0	
Total	0.5	

11. Progress to Date:

An inter-agency study group was formed to develop a simulation model for three initial attack methods, i.e. helicopters, airtankers, and ground crews. Important variables were documented and ten years of fire and weather data transferred to IBM-360 tapes. Coding, programming and de-bugging were completed and the model was run with System 1 input (hand crews).

12. Goals for 1974-75:

1. Following completion of the second (airtankers) and third (helicopter w/bucket) model runs, the CFS-AFS study team will review the combined summaries and submit recommendations on the application of the simulation model.

2. Discuss input data, initial attack model, and results with FFRI personnel and determine the studies relationship with the proposed Fire Management Centre.

3. Complete the following report:

Quintilio, D. *et al.* 1974. Simulated initial attack using helicopters, ground crews, and airtankers. Information Report.

4. Continue promotion on training related to the regional use of CFWI.

5. Participate in national Task Force study to provide a CFWI User's Manual and new metric CFWI tables in 1976.

13. Accomplishments in 1974-75:

1. Completed model development and summarized hand crew, helicopter and airtanker results and, at the request of the Alberta Forest Service, expanded the model to consider a B-26 and Canso in System 2 (airtankers) and a 204B in System 3 (helicopters). Report in preparation (delayed by study leaders assignment to FWI Task Force).

2. Deferred discussion of the simulation model with the FFRI pending final analysis.

3. Report not completed due to other commitments.

4. Participated in FWI training sessions at Yellowknife, N.W.T.; Prince Albert National Park, Sask.; Jasper National Park, Alberta.

5. Assigned to national FWI Task Force October, 1974; prepared contribution to User's Manual for January 31, 1975 deadline; continuing assignment.

14. Goals for 1975-76:

1. Review results of simulation model with the Alberta Forest Service; develop new goals and appropriate research direction.

2. Participate in FWI Task Force development work.

3. Supervise R & D contract for further initial attack simulation with Prairie-Agri Management Consultants.

4. Publish Information Report:

Quintilio, D. *et al*. 1975. Simulated initial attack using helicopters, ground crews, and airtankers.

15. Publications:

Up to 1974-75 - Nil

1974-75 - Nil

16. Signatures:

D. Quintilio
Investigator

R. Reid
Program Manager

G. T. Silver
Director G. T. Silver

NOR 131

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1975 - 76

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 20, 1974

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

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

3. New: Cont.: X 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: Alberta, National Parks, 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 loses and minimizing fire suppression costs.

Since some 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:

a. Develop plans for wildfire surveillance and communications systems for the Northwest Territories, and other clients, on request.

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

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

d. Develop effective wildfire mapping and surveillance techniques.

10. Resources:

a. Starting date: 1971
b. Estimated year of completion:
c. Estimated total Prof. man-years required:
d. Essential new major equipment items for 1975-76 with costs: Nil
e. Essential new major equipment items beyond 1976 with costs: Nil
f. 1975-76 man-years

Prof.	0.0	
Supp.	2.0	(Niederleitner, Ogilvie)
Casual	0.0	
Total	2.0	

11. Progress to Date:

1. Conducted a field survey of the existing detection system (8 lookouts, 2 radio repeater stations) and located, flagged and photographed five proposed new lookout and radio repeater sites in the Yukon Territory as part of a new proposed combination ground-air detection system.

2. Inspected and photographed for further evaluation all existing lookout sites in the Wood Buffalo National Park (6).

3. Completed a familiarization survey in respect to fire detection requirements and a field evaluation of all existing lookout and communications relay sites in the Northwest Territories. Also located and flagged three new lookout and radio relay sites as a part of a new expanded ground-air detection system.

4. Purchased a "Barnes Airborne Fire Spotter", designed and built an independent self-contained power supply unit and aircraft mount and field tested the instruments on single engine fixed-wing patrol aircraft. Tests in 1973 proved inconclusive because of lack of targets in the test area.

5. Conducted limited tests with a "Tivicon" television camera and the AGA Thermovision 680 system to establish their application in wildfire intelligence work. The AGA Thermovision appeared to be useful in mop-up work and in detecting hold-over and ground fires. Further tests are warranted.

6. Sets of small scale aerial photography and satellite imagery were secured over a study area in the Slave Lake Forest, containing fire scars of various vintage. It was established that 1:120,000 aerial infra-red false color photography is a suitable medium for mapping fire damage in a variety of forest cover.

7. Concluded work as member of a joint AFS Detection Task Force 69-4. This work is summarized in:

   Joint Task Force AFS 69-4 (Korsten, H., R. S. Miyagawa, J. Niederleitner). 1974. Detection System Analysis. Unpublished report to S. R. Hughes, Head, Forest Protection Branch, AFS.

8. Prepared the following reports:

   a. Wildfire Detection Study, Yukon Territory Telecommunications Supplement. (Draft of a progress report to the Yukon Forest Service.)

   b. Intermediate Report, Wildfire Detection Study, Mackenzie Forest. (Draft of a progress report to the Mackenzie Forest Service.)

   c. Interim Report, Wood Buffalo National Park, Wildfire Detection System. (Draft of a progress report to the Wood Buffalo Park administration.)

   d. Infra-red Scanners for Cold Trailing. (Draft of a progress report to the Alberta Forest Service.)

12. Goals for 1974-75:

1. Finalize and mark all proposed continuous detector and communications sites in the Northwest Territories (weather and availability of aircraft permitting) and find still needed sites for Yukon on topographic maps.

2. Establish several suitable continuous detector locations in the Wood Buffalo National Park in order to complete the present lookout system.

3. Devise and carry out a series of tests in cooperation with the Alberta Forest Service designed to establish the application of the new Thermovision 750 system as a tool for inspecting wildfire and prescribed burn mop-up.

4. Test the Barnes Airborne Fire Spotter on an operational basis as infra-red aid to the aircraft observer.

5. As a joint venture with the Alberta Forest Service test a group of six lightning sensors for their value as auxiliary instruments at manned lookout sites.

6. Prepare or finalize seen area map for all existing and proposed fixed detector sites in the Yukon Territory, in the Northwest Territories and in the Wood Buffalo National Park (time permitting).

7. Let and administer contracts on a computer simulation approach to test air patrol-lookout relationship in N.W.T.

Goal added in 1974-75:

8. Provide training and consulting services to client agencies.

13. Accomplishments in 1974-75:

1. Established, checked in the field and flagged the location of 15 new proposed continuous detector (lookouts) and communications relay sites in the Northwest Territories along the Mackenzie Corridor. Excepting two sites of dubious value in the Inuvik district, this concludes the field work in the N.W.T.

2. Completed the field work in Wood Buffalo National Park by locating the remaining sites needed for the lookout system.

3. Experimented with the AGA Thermovision System 750 on wildfires in Alberta. The system proved satisfactory in respect to being operated in a small helicopter. Otherwise no conclusive results were obtained because generally moist conditions prevented the development of ground fires.

4. The Barnes Airborne Fire Spotter was flown for one week on air patrols in the settlement fringes of the Slave Lake Forest. The scanner was of little value because of its sensitivity to sunlit roads and fields.

5. Testing of "Quality Technology" lightning stroke counters in Alberta had to be abandoned after a grid of sites was established because the manufacturer was unable to deliver the counters before the end of the fire season.

6. Aside from four sites in the Yukon Territory all visible area maps for all existing and proposed lookout sites in the Yukon, the Northwest Territories and the Wood Buffalo National Park were completed. (Total of 30 sites.)

7. Because of lack of funds no computer simulation contract was let.

8. Gave lectures and training courses in basic photo interpretation for fire managers, procurement and interpretation of fire reconnaissance photography and infra-red imagery, and lookoutmen training courses at the Yukon Forestry Training School at Whitehorse and at the Forest Technology School at Hinton.

9. Prepared file reports to the client agencies:

   Intermediate Report, Wildfire Detection Study Yukon Territory.

   Progress Report, Wildfire Detection Study Northwest Lands and Forest Service.

14. Goals for 1975-76:

1. Complete all reporting in respect to the work done in the Yukon Territory, in the Wood Buffalo National Park and the Northwest Territories. Publish the detection/communication plan for the Yukon and the detection plan for N.W.T. as information reports.

2. Help the Northwest Lands and Forest Service and the Wood Buffalo National Park administration in implementing the recommendations contained in the submitted reports by guiding construction crews to the respective sites, advise on type of installations to be used, etc.

3. Provide fire management agencies with consultation and training in the field of fire detection, surveillance or communications as requested.

4. Investigate the feasibility of using the AGA Thermovision 750 system for detecting hold-over or ground fires during actual operating conditions. This is a joint venture with the AFS who will provide assistance in the form of flying time, instrument rental and manpower.

5. Complete seen area mapping of the remaining Yukon sites.

6. Initiate work on the fire detection systems in Saskatchewan and Manitoba.

15. Publications:

Up to 1974-75

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 - pp.8.
Vol. 2 - 1 July 1972 - pp.8.
Vol. 3 - 1 June 1973 - pp.8. (Infra-red assistance to the aerial observer)
Vol. 3 - 3 Oct. 1973 - pp. 12. (Mapping burned-over forests)

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 fire line 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.

Niederleitner, J. 1973. Infra-red assistance to the aerial observer. Forestry Rep. 3(1), June.

Niederleitner, J. 1973. Mapping burned over forests. Forestry Rep. 3(3), Oct.

1974-75

Nil

16. Signatures:

Investigator

Program Manager

Director G. T. Silver

NOR 980

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1975 - 76

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 10, 1975

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

2. Title: Problem analysis: The role of fire in forest and intermingled vegetation in the Prairie Provinces, Rocky Mountains, and Far North.

3. New: Cont.: X 4. No.: NOR 980

5. Study Leaders: G. R. Fahnestock and D. E. Dubé

6. Key Words: Fire ecology, fire history, fire cycle, fire type, fire climax, fire scar rating, let burn policy.

7. Location of Work: Region wide.

8. Problem:

Within broad climatic limitations, fire has been the most important single, natural influence on vegetation throughout the region for about the past 10,000 years. Areal and temporal patterns of burning have varied. Fire intensity, matched to fuels and weather, has influenced the woodland/prairie ecotone, the mountain forests and the boreal forests. Fire has played a significant role in the dynamic stability of the region's ecosystems. The "natural" fire regime has been obscured by man's intervention. Resource management problems are developing which require an understanding of the historical role of fire.

9. Study Objectives:

Undertake and complete a problem analysis relating to short and long term effects of forest fires, consequence to natural succession of various suppression treatments, and definition of broad guidelines for fire management with particular reference to National Parks.

10. Resources:

a. Starting date: 1974
b. Estimated year of completion: 1975 Revised: 1976
c. Estimated total Prof. man-years required: 6
d. Essential new major equipment items for 1975-76 with costs: Nil
e. Essential new major equipment items beyond 1976 with costs: Nil
f. 1975-76 man-years

Prof.	2.0
Supp.	1.0
Casual	0.0
Total	3.0

11. Progress to Date:

N/A. New Study

12. Goals for 1974-75:

1. Review literature on fire history and fire ecology of the region.

2. Assemble, compile, and duplicate available fire records and fire history maps of the Provinces, Territories, and Parks.

3. Make reconnaissances of Jasper, Wood Buffalo, Riding Mountain and/or Prince Albert National Park and determine what opportunities exist for fire ecology studies that will contribute to improved fire management.

4. Draft a problem analysis relative to objectives.

5. Publish the following:

Dubé, D. E. Early plant succession following fire in the subalpine forest of the Canadian Rockies.

Fahnestock, G. R. and D. E. Dubé. Opportunities for fire ecology research in the prairies, Rocky Mountains and boreal forests of Canada: a problem analysis.

Additional Goals:

6. Prepare draft of Master of Science Thesis, "Early Plant Succession Following Fire in the Subalpine Forest of the Canadian Rockies", by D. Dubé.

7. Provide leadership and fuel-measurement service for CFS/Alberta Forest Service cooperative experimental burning project at Darwin Lake, Alberta.

8. Inventory surface fuels and related vegetational characteristics of 13 stands of known age near Hinton, Alberta.

9. Provide consultation regarding interpretation of fire-related characteristics of vegetation along the "eco-trail", Kananaskis Forest Experiment Station.

10. Participate in training conferences at Yellowknife, N.W.T.; Jasper, Prince Albert, and Yoho National Parks; Hudson Bay, Sask.; gave three lectures to forestry classes at U. of Alberta, two talks on fire ecology to school organizations in and around Edmonton, and two seminars each at U. of New Brunswick and U. of Minnesota.

11. Publish the following: 1) Douglas, G. W. 1974. Ecological impact of chemical fire retardants. Inform. Rep. NOR-X-109

12. Participate in the following meetings:

    a. 15th Tall Timbers Fire Ecology Conference sessions in Missoula, Montana, and Portland, Oregon; present paper.

    b. Fire Working Group of North American Forestry Commission, Jasper Alberta.

    c. U. S. National Parks - Wilderness Fire Management Workshop, Missoula, Montana.

13. Accomplishments in 1974-75:

    1. Began review of pertinent literature.

    2. Obtained available fire summaries and maps (or access to them) for Alberta, Saskatchewan, Manitoba, and Wood Buffalo, Prince Albert, and Jasper National Parks.

    3. Made limited reconnaissance of Wood Buffalo and Jasper National Parks. In Wood Buffalo the reconnaissance consisted of

        a. Locating sites that provided a broad range of vegetation types and ages and were easily accessible.

        b. Observing a 1971 burn and noting the rapid recovery of vegetation, the obvious importance of hydrological factors on the vegetation, the uneveness of fire intensity and the conspicuousness of bulldozer fire lines.

        c. Discussion of priorities with Parks personnel and gathering historical records.

        d. Preparing a prospectus for an exploratory study. (Fahnestock, G. R. and D. Dubé. 1974. The natural and historic role of fire in Wood Buffalo National Park).

        In Jasper National Park the reconnaissance consisted of

        a. Briefly examining the vegetation of the lower reaches of the park. (valley bottoms and lower slopes) and noting the apparent effect on the vegetation of man-caused historical fires and protection subsequent to them.

        b. Discussion with Parks personnel of current management policies and practices and alternatives to them.

        c. Preparing a prospectus for a preliminary study (Fahnestock, G. R. 1974. An opportunity for fire ecology research in Jasper National Park).

4. Rescheduled writing of problem analysis to 1975-76 because the Darwin Lake project prevented completion of necessary background investigations.

5. Rescheduled publications to 1975-76 for same reason.

6. Completed draft of Master of Science Thesis, "Early Plant Succession Following Fire in the Subalpine Forest of the Canadian Rockies", by D. Dubé.

7. Provided leadership and fuel-measurement service for CFS/Alberta Forest Service cooperative experimental burning project at Darwin Lake, Alberta.

8. Inventoried surface fuels and related vegetational characteristics of 13 stands of known age near Hinton, Alberta.

9. Provided consultation regarding interpretation of fire-related characteristics of vegetation along the "eco-trail", Kananaskis Forest Experiment Station.

10. Participated in training conferences at Yellowknife, N.W.T.; Jasper, Prince Albert, and Yoho National Parks; Hudson Bay, Sask.; gave three lectures to forestry classes at U. of Alberta and two talks on fire ecology to school organizations in and around Edmonton.

11. Publish the following:

    Douglas, G. W. 1974. Ecological impact of chemical fire retardants. Inform. Rep. NOR-X-109.

12. Had the following accepted for publication or published:

    a. Fahnestock, G. R. 1975. Fires, Fuels, and Flora as Factors in Wilderness Management: the Pasayten Case. 15th Tall Timbers Fire Ecol. Conf. Proc. (In press).

    b. Attended and prepared minutes for the 9th Fire Management Study Group of the North American Forestry Commission.

    c. Dubé and Fahnestock attended U. S. National Parks - Wilderness Fire Management Workshop in Missoula, Montana.

14. Goals for 1975-76:

    1. Complete Master of Science Thesis, "Early plant succession following fire in the subalpine forest of the Canadian Rockies", by D. Dubé.

    2. Complete literature review on fire history and fire ecology in the territory served by NFRC.

3. Assemble fire records and maps in form suitable for ready reference.

4. Make reconnaissances of Prince Albert and Riding Mountain National Parks.

5. Write fire ecology problem analysis based on the above and directed towards the stated needs of management agencies with emphasis on the development of broad guidelines for fire management with particular reference to National Parks.

6. Participate with Canadian Wildlife Service in prescribed burning study in Prince Albert National Park.

7. Participate in training sessions of client agencies and meetings relevant to study content.

15. Publications:

Douglas, G. W. 1974. Ecological impact of chemical fire retardants. Inform. Rep. NOR-X-109.

Fahnestock, G. R. 1975. Fires, Fuels and Flora as Factors in Wilderness Management: the Pasayten Case. 15th Tall Timbers Fire Ecol. Conf. Proc. (In press).

16. Signatures:

George R. Fahnestock
Investigator

Program Manager

Investigator

Director G. T. Silver

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1975 - 76

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 10, 1975

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 unfavourable 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

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 reorientation of regional research effort in 1970, it has 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 (f), development of prescriptions based on minimum drought and burning requirements for each of the objectives listed under (a) to (e).

8. Delineation of essential control requirements based on the anticipated fire behaviour as related to weather and fuel conditions at the time of burning.

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

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

10. Resources:

a. Starting date: 1968
b. Estimated year of completion: 1983 Revised: 1976
c. Estimated total Prof. man-years required: 0.6
d. Essential new major equipment items for 1975-76 with costs: Nil
e. Essential new major equipment items beyond 1976 with costs: Nil
f. 1975-76 man-years Prof. 0.6 (Chrosciewicz)
Supp. --
Casual --
Total 0.6

O & M funds req'd.:
SR Cont.:

11. Progress to Date: (end of 1973-74)

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 Saskatchewan. Forty-three of them were 0.4-acre experimental burns covering a range of sites, fuels and drought conditions, and five of them were large-scale operational burns totalling some 320 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.

12. Goals for 1974-75:

1. Assessment of post-burn conditions (plant succession and tree regeneration) on more recent experimental and operational burns in central Saskatchewan.

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

   a. Chrosciewicz, Z. 1974. Regeneration of black spruce by burning lowland cutover in southeastern Manitoba - in preparation for For. Chron.

   b. Chrosciewicz, Z. 1974. Large-scale operational burns for slash disposal and conifer reproduction in central Saskatchewan - in preparation for Information Report.

   c. Chrosciewicz, Z. 1974. Experimental burning on clearcut jack pine sites in southeastern Manitoba - intended Information Report.

   d. Chrosciewicz, Z. 1974. Experimental burning on clearcut jack pine sites in central Saskatchewan - intended Information Report.

3. Goal added: If necessary, revision of the following papers:

   e. Chrosciewicz, Z. 1974. Evaluation of fire-produced seedbeds for jack pine regeneration in central Ontario - prepared for Can. J. For. Res.

   f. Chrosciewicz, Z. 1974. Correlation between wind speeds at two different heights within a large forest clearing in central Saskatchewan - prepared for Can. J. For. Res.

13. Accomplishments in 1974-75:

1. Assessment of post-burn conditions was carried out as planned. This included a regeneration survey on 18 plots.

2. Paper "a" was prepared and submitted for publication to the Canadian Journal of Forest Research. Papers "b" , "c" and "d" are nearing completion as Information Reports.

3. Paper "e" was revised and published by the Journal. Paper "f" was revised and resubmitted to the Journal.

14. Goals for 1975-76:

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

2. Submission of the following for publication:

Chrosciewicz, Z. 1975. Large-scale operational burns for slash disposal and conifer reproduction in central Saskatchewan.

Chrosciewicz, Z. 1975. Experimental burning on clear-cut jack pine sites in southeastern Manitoba.

Chrosciewicz, Z. 1975. Experimental burning on clear-cut jack pine sites in central Saskatchewan.

Chrosciewicz, Z. 1976. Jack pine regeneration following burning and seeding treatments in central Saskatchewan.

3. Termination of this study and transfer of unfinished segments re fuels vegetation and fire behavior to NOR 086.

15. Publications:

Chrosciewicz, Z. 1967. Experimental burning for humus disposal on clearcut 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 clearcut 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 clearcut sites in central Ontario. Can. Dep. Fish. For., Inf. Rept. 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.

Chrosciewicz, Z. 1971. The growth response of young jack pine to moderate and extreme stand densities. Bi-Monthly Res. Notes 27(1):6.

Chrosciewicz, Z. 1971. Silvicultural uses of fire. Can. Forestry Serv., Prairies Reg., Forestry Rep. 1(1):4-5.

Chrosciewicz, Z. 1973. Controlled burning in Saskatchewan. Can. Forestry Serv., N.F.R.C. Forestry Rep. 3(1):7.

Chrosciewicz, Z. 1974. Evaluation of fire-produced seedbeds for jack pine regeneration in central Ontario. Can. J. For. Res. 4(4):455-457.

16. Signatures:

Investigator

Program Manager

Director G. T. Silver

NOR 086

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1975 - 76

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 10, 1975

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 in 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. Essential new major equipment items for 1975-76 with costs: Nil
e. Essential new major equipment items beyond 1976 with costs: Nil
f. 1975-76 man-years

Prof.	0.4	(Chrosciewicz)
Supp.	1.0	(Gordey)
Casual	0.3	
Total	1.7	

O & M funds req'd:
SR Cont.:

11. Progress to Date: (end of 1973-74)

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 100 by 100-foot plots were established for burning in stands of jack pine, aspen and white spruce-aspen, between Hondo and Slave Lake, Alberta. Following a pilot burn in 1971, thirteen spring burns were carried out on aspen plots in 1972. Starting early in 1973, Z. Chrosciewicz took responsibility for this study from D. Quintilio due to general reassignment of duties, and since then fifteen additional 100 by 100-foot plots were established in the Slave Lake area for burning in lowland black spruce. Other work in 1973 included weather and fuel moisture studies in each of the four forest types (jack pine, aspen, white spruce-aspen and black spruce) to determine how closely the daily Fire Weather Index and its component codes represent the actual stand conditions. Also, heat content determinations were done on some important fuels from each of the four forest types to provide means for a more precise fuel classification.

12. Goals for 1974-75:

1. Maintenance of weather instrumentation from mid-April to at least mid-August.

2. Continuation of sampling green (crown) and dead (ground) fuels for moisture content determinations in stands of jack pine, aspen, white spruce-aspen and black spruce, with the aim to cover more fully the normal drying range for the area.

3. Analysis and preparation of available data in a form suitable for publication.

4. Participation in national effort to develop a Universal Fire Behaviour Index System.

5. Goal added. Preparation of a problem analysis re seasonal changes in moisture content of conifer foliage.

13. Accomplishments in 1974-75:

1. Because of writing commitments in Study NOR 085, no weather instrumentation was maintained.

2. For the same reason, only green foliage of common conifers (jack pine, white spruce, balsam fir and black spruce) was sampled to determine seasonal variations in its moisture content. Some 1,680 samples were involved (4 species x 4 foliage ages x 5 replications x 21 weekly or semi-monthly samplings).

3. All moisture data were computed and plotted as they became available.

4. Sessions on the development of a Universal Fire Behaviour Index System were attended.

5. A brief problem analysis was prepared re seasonal change in foliar moisture of conifers and their probable effects on the incidence and magnitude of forest fires.

14. Goals for 1975-76:

1. Continuation with the sampling of green foliage for one month (June) to determine the consistency of periodic highs and lows in its moisture content.

2. Analysis of foliage-moisture data and submission of a report for publication.

3. In preparation for burning in 1976, initiation and completion of stand inventories (trees, shrubs, ground vegetation, dead dimensional fuels, litter, duff, etc.) on 16 jack pine plot near Hondo, Alberta. If time permits, the inventory work will be extended to black spruce plots near Slave Lake, Alberta.

15. Publications:

Kiil, A. D., R. J. Lieskovsky and J. E. Grigel. 1973. Fire hazard classification for Prince Albert National Park, Saskatchewan. Can. Dep. Environment, Canadian Forestry Service, Information Report NOR-X-58. 26 p.

16. Signatures:

Investigator

Program Manager

Director G. T. Silver

NOR 047

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1975 - 76

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 20, 1975

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

2. Title: The role of fire in the ecology of jack pine.
   Study (a) Ecological effects of burning.
   Study (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:

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.

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 these 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 southeastern Manitoba, but are of immediate importance for planting.

9. Study Objectives:

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

   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: 1975
   c. Estimated total Prof. man-years required: 0.2
   d. Essential new major equipment items for 1975-76 with costs: Nil
   e. Essential new major equipment items beyond 1976 with costs: Nil
   f. 1975-76 man-years Prof. 0.1
      Supp. -
      Casual Nil
      Total 0.1 O & M funds req'd: Nil

11. Progress to Date:

Study (a)

In 1964 a combined fire research program was initiated in south-eastern Manitoba to study the use of fire for seedbed and planting site preparation (MS 245), fire behaviour (MS 603) and ecological effects of prescribed burning (MS 243). Prior to 1964 some ecological studies had been carried out on wild fire 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 burning were studied on five areas. Effects on lesser vegetation, physical and chemical soil characteristics, and rodent populations were studied.

Progress reports were prepared annually to 1968 for each of the two studies combined under this project. In 1964 a paper was published on the root growth of jack pine on a burned over dry site.

In 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 1973 a manuscript on reinvasion of rodents on burned areas was published.

In 1974 a manuscript on effects of prescribed burning on physical soil properties was submitted to Journal of Forest Research. Preparation of a second manuscript on effects of prescribed burning on vegetation was started.

Study (b)

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

Tanks were watered to 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 weighed. Soil texture, pH,

permanent wilting percentage, field capacity, organic matter content, and total exchange capacity were measured. The experiment was repeated except that three grasses were grown in the tanks to provide competition.

Four reports have been published and the study terminated.

12. Goals for 1974-75:

Preparation of two publications from dissertation material -

1. The effects of prescribed burning on some physical soil properties of dry sites in southeastern Manitoba.

2. Vegetation development following prescribed burning of dry sites, southeastern Manitoba.

13. Accomplishments in 1974-75:

1. A manuscript "The effects of prescribed burning on some physical soil properties of dry sites in southeastern Manitoba" had been submitted to J. of For. Research.

2. Manuscript "Vegetation development following prescribed burning of dry sites, southeastern Manitoba" is in initial stages of preparation.

14. Goals for 1975-76:

1. Completion of manuscript on vegetation development following burning in southeastern Manitoba.

2. Preparation of manuscript "The effects of prescribed burning on some chemical soil properties of dry sites in southeastern Manitoba".

15. Publications:

Up to 1974-75

Study (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. Effects 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. 1973. Some ecological effects of prescribed burning on cutover jack pine (*Pinus banksiana)* sites southeastern Manitoba. Ph.D. dissertation submitted in fulfillment of requirements, Duke Unviersity - Accepted.

Sims, H. P. and Charles H. Buckner. 1973. The effects of clear-cutting and burning of *Pinus banksiana* forests on the populations of small mammals in southeastern Manitoba. Amer. Midl. Nat. 90(1):228-231.

Study (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.

1974-75

Nil

16. Signatures:

H. P. Sims
Investigator

L. Ackerman
Program Manager

G.T. Silver
Director G.T. Silver

NOR 049

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1975 - 76

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 20, 1975

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

2. Title: The 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 two years, and at five years.

9. Study Objectives:

a. To determine the effect of post-burn intervals before planting and seeding.

b. 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: 1976
c. Estimated Total Prof. man-years required: 0.2
d. Essential new major equipment items for 1975-76 with costs: Nil
e. Essential new major equipment items beyond 1976 with costs: Nil
f. 1975-76 man-years

Prof.	0.1		
Supp.	0.1		
Casual	Nil		
Total	0.2	O & M funds req'd:	100

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 and third year spring and fall seeding and planting have been completed.

The fifth year examination of the first and second spring and fall seeding and planting has been completed.

12. Goals for 1974-75:

The fifth year examination of the third year spring and fall seeding and planting will be completed. This will be the final field measurement of this study.

13. Accomplishments in 1974-75:

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

14. Goals for 1975-76

1. Compilation and analysis of data; preparation of publication.

2. Terminate study.

15. Publications:

Up to 1974-75

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.

1974-75

Nil

16. Signatures:

N. P. Sims
Investigator

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G. T. Silver
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