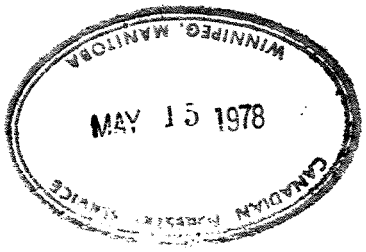

STUDY STATEMENTS

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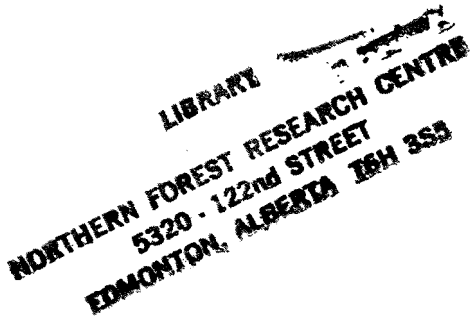


NORTHERN FOREST RESEARCH CENTRE

CANADIAN FORESTRY SERVICE

MAY 1978

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1978 - 79

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1978

1. Project: Fire management systems and guidelines.

2. Title: Fire retardant and airtanker evaluations and application.

3. New: Cont.: X 4. No.: NOR-5-037

5. Study Leader: R.G. Newstead

6. Key Words: airtankers, helitankers, retardants, aerial suppression, airtanker accuracy, effectiveness, drop patterns, static testing,tank and gating systems, simulation models, wildfires.

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.

Methods:

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 may 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 characteristics of various airtanker/fire retardant combinations, including helitankers.

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 and other fireline construction resources during fire suppression operations.

4. To evaluate new retardant mixing systems and their role on wildfire operations.

5. To analyze and disseminate information concerning resource use optimization to fire management agencies through technical assistance, consultation, and training.

10. Resources:

a. Starting date: 1968
b. Estimated year of completion: 1978 Revised: 1980
c. Estimated total Prof. man-years required: 3.2
d. Essential new major equipment items for 1978-79 with costs: Nil
e. Essential new major equipment items beyond 1979 with costs: Nil
f. 1978-79 man-years

Prof.	0.6	(R.G. Newstead)
Supp.	1.0	(R.J. Lieskovsky)
Casual	-	
Total	1.6	

11. Progress to Date:

Within the 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.

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. Work continues in assessing new retardants and mixing systems.

Aerial fire suppression research has evolved into a two-pronged approach within the Northern region. The first involves on-site evaluation of fire retardants and airtanker effectiveness on wildfires. The second is concerned with simulation of this theme, using parameters determined through static testing of tank and gating characteristics and utilization of available retardant delivery and fuel related models.

Airtanker accuracy has been investigated under simulated bombing conditions, however results achieved suggested that economically constrained sampling methods used were inadequate and statistically unreliable. Numerous variables within the experiment could not be accounted for in the analysis of results.

Studies of mixing and storage of long-term fire retardants in Alberta have demonstrated that continuous quality control in the preparation and storage of these commercial products is of utmost importance in maintaining their viability during relatively short and uncertain periods of demand.

Preliminary drafts of specifications for flame-inhibiting and water modifying fire retardants remain subject to continuing revision in order to incorporate user suggestions, up-dated technical information and potential corrosive and environmental damage.

12. Goals for 1977-78:

1. Continue to assess on-site effectiveness of fire retardants through experimental and wildfire evaluation. Cooperation of the Alberta Forest Service and other interested regional agencies is anticipated.

2. Provide technical assistance to regional government and industrial agencies involved in fire control. Specifically:

    1. Continued evaluation of modified prototype Fire-Trol 931 blending and thickening system at the Slave Lake tanker base.

2. Participate in the inaugurations of the Fire-Trol 931 retardant base operation at Meadow Lake, Saskatchewan. In concert with Department of Northern Saskatchewan staff quality control techniques will be demonstrated and applied to the introduction of this retardant mixing equipment upon its arrival at the Meadow Lake base.

3. Training and consultation as requested.

3. Complete field evaluation of Tenogum in an effort to further quantify the effects of various concentrations on drop pattern configuration. Also, the influence of winds and drop height on thickened water drops versus plain water drops will be determined for the PBY-5A Canso (Lieskovsky).

4. Conduct static tests on Field Aviation conversions of the PBY-5A Canso. These tests depend to a large degree upon the willingness of owner-operators to cooperate with aircraft availability and may be conducted in Saskatchewan, Alberta or the N.W.T., wherever desired cooperation and ease of performance permit.

5. Complete masters thesis at the University of Alberta.

6. Complete construction of retardant spray apparatus for use in the combustion laboratory (Lieskovsky).

7. Publish article on Tenogum in forthcoming issue of Forestry Report.

8. Let contract to modify an existing location-allocation model to account for short-term variability of optimal location of forest fire suppression resources.

9. Goal added: Participate in a retardant corrosion workshop in Missoula, Montana.

10. Goal added: Travel to southern California to view production and laboratory facilities at the Monsanto plant in Ontario, California; and discuss the U.S. Forest Service retardant testing and specifications program at San Dimas, Calif.

11. Goal added: Attend short-term retardant demonstration in Chico, Calif., as arranged by Chemonics Industries Ltd.

12. Goal added: Discuss details of S-2 Tracker airtanker conversion program with Conair Aviation Ltd. of Abbotsford, B.C.

13. Goal added: Undertake interim analysis of aerial observer forms completed by A.F.S. bird-dog officers on behalf of N.F.R.C. in order to determine feasibility of continuing this data collection process.

14. Goal added: Participate in a national fire research program meeting at Petawawa Forest Experiment Station.

15. Goal added: Continue retardant screening program as new and modified compounds are submitted for appraisal of performance characteristics.

16. Goal added: Publications.

1. Hodgson, M.J. and R.G. Newstead. 1977a. "Location-allocation models for one-strike initial attack of forest fires by airtankers", Can. J. For. Res.

2. Hodgson, M.J. and R.G. Newstead. 1977b. "Short-term variation of forest fire locations: toward a suppression strategy", The Canadian Geographer.

3. Hodgson, M.J. and R.G. Newstead. 1977c. "A model for allocating airtanker groups to airbases", Proceedings of the Fifth Pacific Regional Science Conference, Vancouver, B.C.

13. Accomplishments in 1977-78:

1. Wet weather and low fire incidence in the Slave Lake Forest during the designated mid-May to mid-June study period prohibited accomplishment of this goal. Similarly the experimental retardant evaluation burns near Slave Lake could not be carried out.

2. Specific technical assistance was provided as follows:

1. A modified prototype Fire Trol 931 retardant blending and thickening system was evaluated again in 1977 while on trial at the Slave Lake airtanker base. Owing to uncontrollable back and head pressures in the loading line and their effect on the pumping system, consistent quality control over the mixed product could not be demonstrated and the mobile unit was subsequently taken out of service before completion of the proposed drop tests.

2. In conjunction with the Department of Northern Saskatchewan, the study leader participated in the inauguration of the Meadow Lake airtanker base. Equipment performance was monitored and quality control techniques were demonstrated.

3. Training and/or consultation was provided to several organizations and fire control agencies as and when requested, including:

i) Separate presentations to the Alberta Forest Service mixmaster and bird-dog officer training sessions at the Forest Technology School at Hinton, Alberta.

ii) Seminar presentation on fire retardants and airtanker delivery systems at the University of Alberta.

iii) Submission of three separate reports to the Department of Northern Saskatchewan re: (1) eutrophication effects of fire retardant chemicals following disposal; (2) performance characteristics of selected wetting agents; and (3) technical interpretation of two comparable fire retardant chemicals.

iv) Submission of combined research findings by NFRC and FFRI to Canadian Committee on Forest Fire Control following 1976 Tenogum investigations.

v) Report to the Alberta Forest Service re: results of demonstration trials with Super PBY Canso airtanker.

vi) Other requested correspondence and technical consultation with fire control divisions of BCFS, Quebec L & F, Ontario MNR and Canadair Ltd.

3. The outcome of this goal was altered somewhat in response to requests by the Charles Tennant Co. and regional fire control agencies in an effort to consider the effects of different mixing and delivery systems and local water hardness on Tenogum short-term retardant. These trials were conducted in Manitoba, Saskatchewan and the Northwest Territories. Reports on each investigation were subsequently submitted to each cooperating agency. In addition, preliminary mixing and drop tests were conducted near Hay River, NWT with a prototype short-term retardant under development by Monsanto Canada Ltd.

4. Static tests proposed for the Field Aviation Canso conversion and delivery system were not completed primarily as a result of Saskatchewan's early Canso contract termination. Saskatchewan DNS was the only cooperator approached. Static tests were, however, re-run for the B-26 airtanker at Edson, Alberta because of earlier suspect results. This data is presently at the Northern Forest Fire Lab in Missoula, Montana awaiting processing. The 1976 Fairey conversion static test data was compiled while the study leader was in Missoula in March. However, analysis has not yet been completed.

5. Some progress has been made towards completion of the masters thesis but other program commitments and participation in publications stemming from studies at the U of A have delayed achievement of this goal.

6. The major components of the retardant spray apparatus have been fabricated with the cooperation of the AFS equipment development section. Following acquisition and assembly of electronic components final construction and calibration can be completed.

7. An article on short-term retardants, Tenogum in particular, was recently published in the NFRC Forestry Report (see publications).

8. Owing to alternate commitments of contract funds this contract was not let. As a result only a limited investigation of the variability of fire locations in Alberta could be considered by the study leader in conjunction with Dr. M.J. Hodgson at the University of Alberta.

9. Accomplishment added: Study leader participated in a retardant corrosion workshop in Missoula, Montana in May. A resultant report and support literature was forwarded to provincial fire control agencies and airtanker operators in central and western Canada.

10. Accomplishment added: Visited Monsanto's retardant production and laboratory facilities in Ontario, Calif., and discussed pertinent aspects of the retardant specifications and testing program with staff members at the U.S. Forest Service, San Dimas Equipment Development Centre in San Dimas, Calif., in March.

11. Accomplishment added: Travelled to Chico and Sacramento, Calif., in October with representatives of the NWL & F Service and Quebec Forest Protection Service to witness a demonstration of a new short-term retardant under development by Chemonics Industries Ltd.

12. Accomplishment added: Reviewed progress and details of the S-2 Tracker airtanker conversion program underway at Conair Aviation Ltd. of Abbotsford, B.C. in August.

13. Accomplishment added: Conducted interim analysis of NFRC designed airtanker drop report summaries as completed by AFS air attack officers in accordance with the cooperative fire retardant effectiveness study goal. Results to date have been transmitted to the AFS and further data collection is anticipated.

14. Accomplishment added: Attended a national fire research program meeting at the Petawawa FES in November.

15. Accomplishment added: Performed a series of laboratory tests for purposes of screening selected retardant performance characteristics. Products tested included AMGARD FF-240, Tenogum and Chemonics Ind. liquid polymer.

16. Accomplishment added: Publications in review 1977-78:

    1. Hodgson, M.J. and R.G. Newstead. 1977b. "Short-term variation of forest fire locations: toward a suppresion strategy", The Canadian Geographer (in review).

    2. Hodgson, M.J. and R.G. Newstead. 1977c. "A model for allocating airtanker groups to airbases", Proceedings of the Fifth Pacific Regional Science Conference, Vancouver, B.C. (in review).

14. Goals for 1978-79:

1. Continue effort to assess on-site effectiveness of fire retardants through experimental and wildfire evaluation. Cooperation and cost-sharing is assured by the AFS in support of this investigation throughout the province during the initial month of the airtanker contract season. Cooperation of other agencies (e.g., Saskatchewan, and NWT) is anticipated whenever the fire situation arises and access and logistical support are favorable.

2. Provide technical assistance to regional fire control agencies involved in fire control. Specifically:

    1. Respond to a request by the Department of Northern Saskatchewan concerning S-2 Tracker loading problems as affected by pumping facilities and/or delivery system characteristics.

    2. Assist the AFS in monitoring new developments in their air attack program as it may be affected by possible changes in the type(s) of retardant used, retardant mixing equipment and/or airtanker contracts.

    3. Assist the NWL & F Service in a retardant testing program where spoilage problems persist and where new or modified short-term retardant compounds are under consideration.

    4. Additional training and consultation as requested.

3. Conduct air drop tests with new or existing retardant products where such field trials are warranted or requested in support of laboratory investigations. Such tests are anticipated in Alberta in an effort to identify an optimal mixing ratio for a new Chemonics water thickening compound; and to determine the effect of changes in viscosity of gum-thickened Fire-Trol 931 on drop patterns.

4. Upon completion and calibration of a retardant spray apparatus, tests will be initiated to determine the coating and penetration effects of different retardant rheological properties.

5. Complete masters thesis at the University of Alberta.

6. Publish reports in review 1977-78.

15. Publications:

Up to 1977-78

Grigel, J.E. 1969. Preliminary evaluation of TX-350 - A new Long-term retardant. For. Br., Dep. Fish. For. Internal Rep. A-20.

Grigel, J.E. 1969. Evaluation of the nitrogen injection system of mixing Gelgard fire retardant in the PBY Canso water bomber. For. Br., Dep. Fish. For. Internal Rep. A-21.

Grigel, J.E. 1969. An injector system for mixing Gelgard fire retardant on land based airtanker operations. For. Br., Dep. Fish. For. Internal Rep. A-22.

Grigel, J.E. 1970. The use of airtankers for fire suppression in Canada. Can. For. Serv., Dep. Fish. For. Internal Rep. A-33.

Grigel, J.E. 1970. Fire retardants and their use in Western Canada. Can. For. Serv., Dep. Fish. For. Inf. Rep. A-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. Inf. Rep. NOR-X-8.

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

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

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

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

Grigel, J.E. 1974. Role of the helitanker in forest fire control. Can. For. Serv., Dep. Environ. Inf. Rep. NOR-X-123.

Grigel, J.E., R.G. Newstead, and R.J. Lieskovsky. 1975. A review of retardant delivery systems used in fixed-wing airtankers. Can. For. Serv., Dep. Environ. Inf. Rep. NOR-X-134.

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.

Forestry Report Vol. 4, No. 4. 1975
- Determining airtanker accuracy or How to make nobody happy.

Hardy, C.E. (contract report) 1975
- Operational assessment of the effectiveness of aerially applied fire retardants under wildfire operations (file report plus copy submitted to cooperative contractor A.F.S.).

1977-78 Publications

Forestry Report Vol. 5, No. 2 1977
- Water thickening compounds - how effective are they?

Hodgson, M.J. and R.G. Newstead. 1977a. "Location-allocation models for one-strike initial attack of forest fires by airtankers", Can. J. For. Res. (in press).

16. Signatures:

Investigator

Program Manager

Director G. T. Silver

NOR-5-086

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1978 - 79

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1978

1. Project: Fire management systems and guidelines.

2. Title: Fire behavior in boreal forest fuels.

3. New: Cont.: X 4. No.: NOR-5-086

5. Study Leader: Z. Chrosciewicz

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

7. Location of Work: Various areas within the western and northern region.

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 preventation 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 behavior in specific fuels.

The second phase, then, would be the development of fire spread and intensity tables 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 behavior 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 and fire effects for major fuel types within the Region.

9. Study Objectives:

1. To develop fire spread and intensity tables for major fuel complexes.

2. To assess fire effects in terms of fuel reduction and plant succession over a range of burning conditions.

3. To establish guidelines for rational uses of fire in manipulation of various fuel combinations.

4. To assist fire control agencies in application of the resulting tables and guidelines.

10. Resources:

a. Starting date: 1970
b. Estimated year of completion: 1973 Revised: 1983
c. Estimated total Prof. man-years required: 8.0
d. Essential new major equipment items for 1978-79 with costs: Nil
e. Essential new major equipment items beyond 1979 with costs: Nil
f. 1978-79 man-years

Prof.	1.0 (Chrosciewicz)
Supp.	1.0 (Gordey)
Casual	-
Total	2.0

12. Progress to Date:

The new Canadian Fire Weather Index was introduced to the Region in 1970 through a series of training sessions for the user agencies. Since then, fire behavior and fire effects were studied by means of experimental burning on a number of cutover sites and in uncut stands. Varying in area from 0.16 to 33.35 ha, the tests included 2 burns of black spruce slash, plus 17 burns of jack pine slash in Manitoba, 31 burns of jack pine slash in Saskatchewan, and 22 burns of lodgepole pine slash plus 2 burns of undisturbed black spruce in Alberta. Results are being published as they become available.

While this work was nearing completion, variations in moisture content and heat content of green conifer foliage (jack pine, black spruce, white spruce and balsam fir) were studied in Alberta to determine their seasonal lows (moisture) and highs (heat) that may contribute substantially to the incidence and the spread of crown fires. The foliage data, along with the associated weather information, are now being prepared for publication.

To study further fire behavior under undisturbed forest canopies, a series of 0.09-ha experimental plots were established in each of four mature stands in Alberta (jack pine, black spruce, white spruce-aspen, and aspen). In preparation for the burning tests, inventories of dead fuels and live vegetation were initiated in 1975 on 16 jack pine plots, and these were scheduled for completion in 1978.

Associated studies in the major forest cover types of Alberta are aimed at fuel appraisal for improved fire behavior predictions at the operational level.

12. Goals for 1977-78:

1. Publication:

(1) Chrosciewicz, Z. 1977. Large-scale operational burns for slash disposal and conifer reproduction in central Saskatchewan. Inf. Rep.

(2) Chrosciewicz, Z. 1977. Jack pine regeneration following burning and seeding treatments in central Saskatchewan. Inf. Rep.

2. Preparation:

(3) Chrosciewicz, Z. 1977. Moisture variations of conifer foliage in central Alberta. Can. J. For. Res.

(4) Chrosciewicz, Z. 1977. Calorific variations of conifer foliage in central Alberta. Can. J. For. Res.

3. Continuation of destructive sampling for preburn fuel-weight assessments on jack pine plots in central Alberta.

4. Experimental burning for fire behavior determinations on jack pine plots in central Alberta.

5. Experimental burning for aerial suppression studies on black spruce plots in central Alberta.

6. Postburn assessments of plant succession and pine regeneration on experimental plots in southeastern Manitoba.

7. Processing field and laboratory data as they become available.

8. Providing on request consultative services and conducting seminars.

13. Accomplishments in 1977-78:

1. Papers (1) and (2) were prepared; one is already published and one is now under review.

2. Papers (3) and (4) are in preparation, and they should be ready for publication in the early part of 1978.

3. Destructive sampling of fuel weights was continued on jack pine plots in central Alberta.

4. Only one, initial burn was carried out on jack pine plots in central Alberta. Reason: frequent rains in 1977.

5. No burns were conducted on black spruce plots in central Alberta. Reason: frequent rains in 1977.

6. Burned plots in southeastern Manitoba were revisited and plans set up for their 1978 sampling.

7. Field and laboratory data were processed as they became available.

8. Requested consultative services and seminars:

(1) Consultative services were provided to the Chairman of the Department of Forest Science re. postgraduate research funded by the Alberta Forest Development Research Trust. This involved one formal meeting on October 19, 1977, manuscript reviews, and several informal consultations.

(2) Consultative services were also provided to a group of senior forest management officials from northern Ontario and southeastern Manitoba. This included one-day field deliberations on October 19, 1977, east of Winnipeg, Man. re. the applicability of research results (Chrosciewicz 1976) to postcut use of fire on problem black spruce areas.

(3) Several seminars were conducted with the following topics:

1. "Moisture variations of conifer foliage in central Alberta" by Z. Chrosciewicz - University of Alberta, Edmonton, Alberta. February 17, 1977.

2. "Uses of fire in forest management" by Z. Chrosciewicz - Northern Forest Research Centre, Edmonton, Alberta. March 8 and 9, 1977 (two presentations).

3. "Burning for conifer reproduction" by Z. Chrosciewicz - University of Alberta, Edmonton, Alberta. October 6, 1977.

4. "Silvicultural uses of fire" by Z. Chrosciewicz - Canadian Institute of Forestry, Manitoba Section, Winnipeg, Manitoba. October 19, 1977.

5. "Silvicultural uses of fire in midwestern Canada" by Z. Chrosciewicz - Fire Ecology in Resource Management Workshop, Riviera Hotel, Edmonton, Alberta. December 6, 1977.

14. Goals for 1978-79:

1. Submission of the following for publication:

(1) Chrosciewicz, Z. 1978. Jack pine regeneration following burning and seeding treatments in central Saskatchewan. Inf. Rep.

(2) Chrosciewicz, Z. 1978. Moisture variations of conifer foliage in central Alberta. Can. J. For. Res.

(3) Chrosciewicz, Z. 1978. Calorific variations of conifer foliage in central Alberta. Can. J. For. Res.

2. Continuation of destructive sampling for preburn fuel-weight assessments on jack pine plots in central Alberta.

3. Experimental burning for fire behavior determinations on jack pine plots in central Alberta.

4. Experimental burning for aerial suppression studies on black spruce plots in central Alberta.

5. Postburn assessments of plant succession and pine regeneration on experimental plots in southeastern Manitoba.

6. Processing field and laboratory data as they become available.

7. Providing on request consultative services and conducting seminars.

15. Publications:

Up to 1977-78

Chrosciewicz, Z. 1967. Experimental burning for humas disposal on clear-cut jack pine sites in central Ontario. Can. Dep. For. Rural Develop., For. Br. 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. 1969. Brûlage expérimental afin de'éliminer l'humus dans les bûchés à blanc de pin gris en Ontario central. Can. Min Pêches Forêts Dir. Gen. Forêts, Publ. No. 1181F. 22 p.

Chrosciewicz, Z. 1970. Regeneration of jack pine by burning and seeding treatments on clear-cut sites in central Ontario. Can. Dep. Fish. For., Can. For. Serv. 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.

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

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

Quintilio, D. 1972. Fire spread and impact in lodgepole pine slash. Master's Thesis, Univ. Montana, Missoula, Mon. 69 p.

Quintilio, D. 1972. A burning index for lodgepole pine logging slash with descriptive hazard chart. Can. Dep. Environ., Can. For. Serv., North. For. Res. Cent. Supplement NFRC-1. 4 p.

Chrosciewicz, Z. 1973. Controlled burning in Saskatchewan. Environ. Can., Can. For. Serv., North. For. Res. Cent. For. Rep. 3(1):7.

Kiil, A.D., R.J. Lieskovsky and J.E. Grigel. 1973. Fire hazard classification for Prince Albert National Park, Saskatchewan. Environ. Can., Can. For. Serv., North. For. Res. Cent. Inf. Rep. NOR-X-58. 26 p.

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

Kiil, A.D. 1975. Fire spread in a black spruce stand. Environ. Can., Can. For. Serv. Bi-mon. Res. Notes 31(1):2-3.

Chrosciewicz, Z. 1975. Correlation between wind speeds at two dif ferent heights within a large forest clearing in central Saskatchewan. Environ. Can., Can. For. Serv., North. For. Res. Cent. Inf. Rep. NOR-X-141. 9 p.

Chrosciewicz, Z. 1975. The pill, the bomb ... and fire behavior. Environ. Can., Can. For. Serv., North. For. Res. Cent. For. Rep. 4(4):3.

Chrosciewicz, Z. 1976. Burning for black spruce regeneration on a lowland cutover site in southeastern Manitoba. Can. J. For. Res. 6(2):179-186.

1977-78

Quintilio, D., G.R. Fahnestock and D.E. Dubé. 1977. Fire behavior in upland jack pine: The Darwin Lake Project. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent. Inf. Rep. NOR-X-174. 49 p.

Chrosciewicz, Z. 1978. Slash and duff reduction by burning on clear-cut jack pine sites in southeastern Manitoba. Environ. Can., Can. For. Serv., North. For. Res. Cent. Inf. Rep. NOR-X-199. 16 p.

Chrosciewicz, Z. 1978. Slash and duff reduction by burning on clear-cut jack pine sites in central Saskatchewan. Environ. Can., Can. For. Serv., North. For. Res. Cent. Inf. Rep. NOR-X-200. 18 p.

Chrosciewicz, Z. 1978. Large-scale operational burns for slash disposal and conifer reproduction in central Saskatchewan. Environ. Can., Can. For. Serv., North. For. Res. Cent. Inf. Rep. NOR-X-201. 14 p.

16. Signatures:

Investigator

Program Manager

Director G. T. Silver

NOR-5-128

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1978 - 79

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1978

1. Project: Fire management systems and guidelines.

2. Title: Assessment and development of fireline systems.

3. New: Cont.: X 4. No.: NOR-5-128

5. Study Leader: D. Quintilio

6. Key Words: Fuel types, fire behavior, 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 firelines. 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).

Methods:

1. Ground attack systems

Major fuel types are stratified according to resistance to control.

A time and motion study has been designed to document productivity of bulldozers and handcrews.

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 wildfire 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 promote and extend research results to client agencies as required.

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 1978-79 with costs: Nil
e. Essential new major equipment items beyond 1979 with costs: Nil
f. 1978-79 man-years

Prof.	0.2	(Quintilio)
Supp.	0.4	(Maffey)
Casual	-	
Total	0.6	

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.

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 N.F.R.C.

N.F.R.C. personnel collected data on wildfires in Alberta and N.W.T. and 78 miles of bulldozer and 5 miles of handline observation are documented.

12. Goals for 1977-78:

1. Monitor selected wildfires throughout the region as a means of building data banks for airtanker, bulldozer and handcrew productivity rates.

2. Complete reports as listed:

Quintilio, D., G.R. Fahnestock and D.E. Dubé. 1977. Fire behavior in upland jack pine - The Darwin Lake Project. Dept. of Environ., Can. For. Serv., North. For. Res. Cent. Inf. Rep. NOR-X-174.

Murphy, P.J. and D. Quintilio. 1977. Handcrew fireline production rates in Alberta fuel types. Inf. Rep. NOR-X-197.

Quintilio, D. 1977. Fire control application of bulldozers. Inf. Rep.

Quintilio, D. and R.L. Ponto. 1977. Spring burns in a 50-yr-old aspen stand. Inf. Rep.

13. Accomplishments in 1977-78:

1. Bulldozer operations were observed on the Fishing Lakes Fire north of Prince Albert, Saskatchewan during the spring fire season of 1977. Production rates were recorded and will be compared with Alberta data and included in the final report. The DNS protection Branch was advised against manning down quickly during the mop-up operations since adjusted drought code values and on-site examinations indicated a ground fire problem.

2. Report status:

Quintilio, D., G.R. Fahnestock and D.E. Dubé. 1977. Fire behavior in upland jack pine - The Darwin Lake Project. Dept. of Environ., Can. For. Serv., North. For. Res. Cent. Inf. Rep. NOR-X-174 (published).

Murphy, P.J. and D. Quintilio. 1977. Handcrew fireline production rates in Alberta fuel types. Inf. Rep. NOR-X-197 (in press).

Quintilio, D. 1977. Fire control application of bulldozers Inf. Rep. (in preparation).

Quintilio, D. and R.L. Ponto. 1977. Spring burns in a 50-yr-old aspen stand. Inf. Rep. (in review).

14. Goals for 1978-79:

1. Consolidate bulldozer data and publish final report.

2. Terminate study.

15. Publications:

Up to 1977-78

Dubé, D.E. 1973. Fire control methods in the black spruce-Labrador tea-Cladonia fuel complex. North. For. Res. Cent., Edmonton, Alberta. File Report.

Kiil, A.D. and D. Quintilio. 1975. A resume of current forest fire research in Canada. File Report.

Lait, G.R. and W.C. Taylor. 1973. Backfiring and burnout techniques used in the Yukon. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-43.

Ponto, R.L. and G.M. Lynch. 1973. Use of electronic markers to relocate small forest fires. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-61.

Ponto, R.L., D. Quintilio, P. Bihuniak, and G.R. Lait. 1974. An incendiary priming and release mechanism for backfiring from aircraft. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-75.

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

1977-78

Murphy, P.J. and D. Quintilio. 1977. Handcrew fire-line construction: A method of estimating production rates. Dept. of Fish. and Environ., Can. For. Serv., North. For. Res. Cent., Inf. Rep. NOR-X-197 (in press).

Quintilio, D., G.R. Fahnestock and D.E. Dubé. 1977. Fire behavior in upland jack pine - The Darwin Lake Study. Dept. of Fish. and Environ., Can. For. Serv., North. For. Res. Cent., Inf. Rep. NOR-X-174.

16. Signatures:

Investigator

Program Manager

Director G. T. Silver

NOR-5-130

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1978 - 79

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1978

1. Project: Fire management systems and guidelines.

2. Title: Initial attack strategy and resources in fire suppression operations.

3. New: Cont.: X 4. No.: NOR-5-130

5. Study Leader: D. Quintilio

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

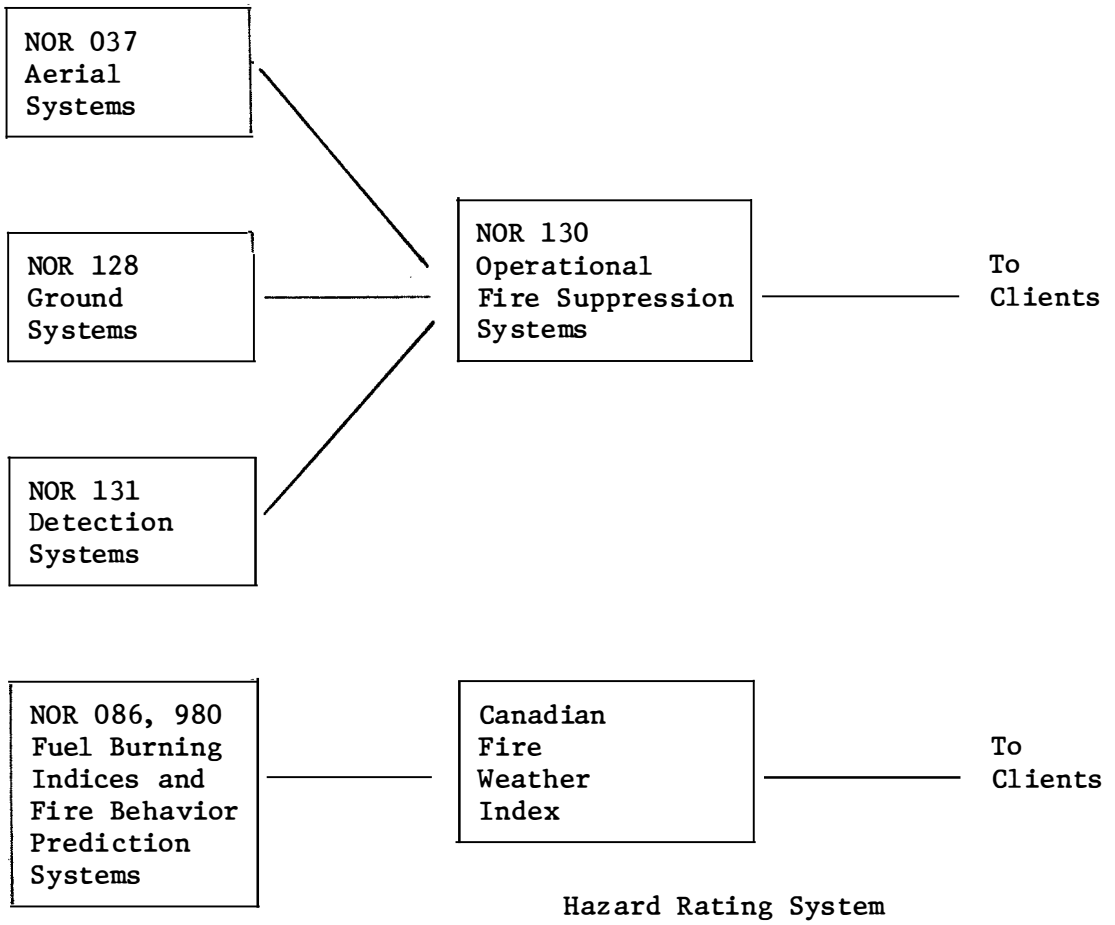
7. Location of Work: Northern Forest Research Centre.

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 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.

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.



Hazard Rating System

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-years of fire and weather data to IBM-360 tape.
- Compile line building capability of the initial attack systems.
- Design flow chart for the intial attack model.
- Program 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 1978-79 with costs: Nil
e. Essential new major equipment items beyond 1979 with costs: Nil
f. 1978-79 man-years

Prof.	0.3 (D. Quintilio)
Supp.	0.3 (M. Maffey)
Casual	-
Total	0.6

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.

Model development was completed and preliminary runs made for ground and aerial systems. At the request of the Alberta Forest Service the model was expanded to include: (1) a B-26 airtanker, (2) both land-based and amphibious PBY Canso's and (3) a 204B helicopter w/235 gal. bucket.

Final results of the first generation simulation runs were presented to the Alberta Forest Service, Protection Branch, on January 6, 1976, at NFRC.

A statistical analysis of 2000 individual AFS forest fire reports and 35 000 fire weather observations has been completed. Results indicate that the Fire Weather Index and components accurately reflect key aspects of fire behavior and fire-fighting difficulty, particularly during the early or initial attack phase.

The growth model has been re-designed and dispatch logic for simultaneous operation of helitankers and handcrews is complete. A computer program is in preparation to account for the changes.

12. Goals for 1977-78:

1. Continue running the simulation model for new airtankers and helitankers as requested (Quintilio).

2. Initiate a new integrated work program using simulation modelling as a tool for comparing the magnitude of differences between fire management alternatives. Develop study methodology and organization. Continue and expand work to develop fire spread and impact models for major vegetation types in the region. Initiate modelling work to simulate airdrop penetration through regional fuel types and expand work on fireline construction predictor. (Members of fire research group.)

3. Continue to serve on the following committees and task force groups (Kiil).

    1. Western Fire Weather Committee

    2. Central Fire Weather Committee

    3. Forest Committee - NFPA

    4. Development Committee - AES/CFS

    5. Regional Fire Research Committee

    6. CFS in-house task force on Federal Assistance to Forest Protection.

4. Firm up plans for a CFS-sponsored international symposium on fire behavior and effects in black spruce, including fire management implications, to be held in Edmonton in late 1978 (Kiil).

5. Coordinate and participate in a joint AFS/CFS fire behavior/retardant evaluation study in the Slave Lake Forest in spring, 1977 (Kiil and Quintilio).

6. Coordinate the Fire Research Program at NFRC (Kiil).

7. Goal added: Participate in the "Fire Ecology in Resource Management" Workshop.

8. Goal added: Attend the National Fire Research meeting at Petawawa Exp. Station.

9. Goal added: Respond to agency training requests.

10. Goal added: Calibrate the Fire Weather Index for the Northwest Territories.

13. Accomplishments in 1977-78:

1. The U.S. Forest Service, the Bureau of Land Management, and the Canadian Forestry Service exchanged information related to the Whitecourt Initial Attack Model and current U.S. work. Mr. Pat Borden, BLM, visited the NFRC, Hinton Forest Technology School, the University of Alberta and the Alberta Forest Service where study NOR-130 was discussed in detail. D. Quintilio visited the Riverside Fire Laboratory in California and discussed the FOCUS simulation model which is now operational in California and Alaska.

   The Whitecourt Model was programmed to combine the helitanker and handcrew routines on a single fire, and the fire growth sub-routine was placed on interactive, made at the U of A and the AFS Depot for demonstration and training use.

2. A number of workshops have been conducted by the fire research group and a study proposal reflecting a new approach to researching the fire management problem is submitted for the current program review.

3. Committee involvement is as follows:

   1. Western Fire Weather Committee - (Quintilio)

      - attended the annual meeting in Edmonton and reported on the overwinter adjustment procedure for the Drought Code.

   2. Central Fire Weather Committee - (Quintilio)

      - meeting scheduled for February 9, 1978.

   3. National Fire Protection Association - (Kiil)

      - attended the annual meeting in Harrisburg, PA., and reviewed the proposed 2nd edition of "Chemicals for firefighting handbook".

   4. Development Committee - (Quintilio)

      - will meet prior to the 1978 fire season.

   5. Regional Fire Research Committee - (Quintilio)

      - chaired the annual meeting in Edmonton to review research accomplishments and to identify new research needs and requirements in the region.

6. CFS in-house task force on Emergency Federal Assistance to Provincial Forest Protection Agencies - (Kiil, Quintilio)

   - prepared two reports for the Federal Drought Committee describing the potential effect of the spring drought on the upcoming fire season in terms of number of fires, acreage burned, and associated costs.

4. In abeyance until 1979.

5. Completed fuel inventories on black spruce and aspen plots in preparation for burning. Weather prescription was not met and this goal will stand for 1978-79.

6. Coordinated the Fire-Research Program during the review year. (Kiil, Quintilio)

7. Accomplishment added: Participated in the "Fire Ecology in Resource Management Workshop", and presented a paper entitled "Fire behavior in natural forest stands".

8. Accomplishment added: Attended the national fire research meeting at Petawawa Forest Exp. Station which was followed by a Fire Danger Rating Working Group session.

9. Accomplishment added: Presented two lectures at the Annual Fire Training Course, Meadow Lake, Saskatchewan.

   Presented two lectures during the Advanced Fire Management course, U of A, - "The structure of the Canadian Fire Weather Index, and "Fire management systems - A research overview".

   Demonstrated the interactive fire growth model at U of A, Hinton Forest Technology School and the AFS Depot.

10. Accomplishment added: Calculated the historical FWI codes for years 1970-76 at 14 AES weather stations in the NWT, and contracted for the summary of the 1970-76 fire report forms (KL015-7-0294).

14. Goals for 1978-79:

1. Continue serving on the following committees:

   1. Western Fire Weather Committee

   2. Central Fire Weather Committee

   3. AES/CFS Development Committee

   4. Regional Fire Research Committee

5. Intermountain Fire Research Council - Steering Committee

6. Fire Danger Rating Working Group

2. Conduct a joint AFS/CFS fire behavior/retardant evaluation study in Slave Lake Forest in spring of 1978.

3. In cooperation with the AFS, host the annual meeting of the Intermountain Fire Research Council (Montana, Idaho, Utah, Alberta) in Edmonton in the fall of 1978.

15. Publications:

Up to 1977-78

Quintilio, D. 1975. Simulation of three initial attack systems. For. Rep. Vol. 4, No. 4.

Quintilio, D. and A.W. Anderson. 1976. Simulation study of initial attack fire operations in the Whitecourt Forest, Alberta. Dep. of Environ., Can. For. Serv., North. For. Res. Cent., Inf. Rep. NOR-X-166.

1977-78

Chandler, C. and A.D. Kiil. 1977. Wildfires and tame fires. Fire Journal, Vol. 71 (6).

Kiil, A.D., R.S. Miyagawa and D. Quintilio. 1977. Calibration and performance of the Canadian Fire Weather Index in Alberta. Dep. of Environ., Can. For. Serv., North. For. Res. Cent., Inf. Rep. NOR-X-173.

Kiil, A.D. 1977. Integrating fire research into forest land management. For. Rep., Vol. 5, No. 2.

Kiil, A.D. 1977. Coping with forest residues. For. Rep., Vol. 5., No. 2.

Kiil, A.D. 1977. Overwinter monitoring the Drought Code is recommended. For. Rep., Vol. 5, No. 2.

Quintilio, D. 1977. Lodgepole pine flammability. For. Rep., Vol. 5, No. 2.

16. Signatures:

Investigator

Program Manager

Director G. T. Silver

NOR-5-131

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1978 - 79

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1978

1. Project: Fire management systems and guidelines.

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

3. New: Cont.: X 4. No.: NOR-5-131

5. Study Leader: Vacant (Vice J. Niederleitner)

6. Key Words: Aerial patrols, lookouts, forestry communications, weather data collection, storm tracking, wildfire smoke emission, wildfire mapping, remote sensing.

7. Location of Work: Alberta, National Parks, Yukon and Northwest Territories, Saskatchewan, Manitoba

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 user 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 with 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 wildfire surveillance and communications systems for the Northwest Territories, and other clients, on request.

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:
c. Estimated total Prof. man-years required:
d. Essential new major equipment items for 1978-79 with costs: Nil
e. Essential new major equipment items beyond 1979 with costs: Nil
f. 1978-79 man-years

Prof.	0.0	
Supp.	2.0	(C. Ogilvie, 1.0; Vacant 1.0)
Casual	-	
Total	2.0	

11. Progress to Date:

1. Yukon Territory - Inspected in the field, mapped and evaluated the existing detection and communication system of the Yukon Territory. Based on extensive field surveys designed and submitted to the Yukon Lands and Forest Service a proposed wildfire detection and

communications plan. The plan included details of area coverage, location and function of each existing and proposed lookout or communication site, within the system as well as details and plans describing type and quantity of equipment, installations and personnel needed.

Manning and operating rules, objectives to aim for and budgetory estimates were also provided. Most of our recommendations have been implemented.

2. Similar plans with less emphasis on the communications aspect were prepared for the Northwest Territories and the Wood Buffalo National Park. Both agencies have made considerable progress in implementing our recommendations.

3. Experimented with the AGA Thermovision 680 and 750 infrared scanning systems as well as Tivicon and Vidicon television system to establish if either instrument could contribute to fire detection or intelligence.

   While the Tivicon and Vidicon systems failed to produce convincing results, the Thermovision 750 system established the usefulness of hand-held infrared scanners in fire control. In 43 missions flown under widely differing conditions in various provinces the scanner convincingly showed that it can detect more holdover fires faster and more reliably than all other known methods combined.

   Numerous forestry personnel and representatives of private industry (170) as well as pilots (6) were exposed to the pertinent field operating techniques developed for the purpose of detecting holdover fires on forest land.

   The NFRC Sony vidicon system was successfully adapted to record the Thermovision imagery on tape in flight.

4. An NFRC developed 12 volt rechargeable heavy duty power supply unit designed to power remote sensing equipment in aircraft has operated trouble free for hundreds of hours during the last three years.

5. In order to provide client agencies with an opportunity to gain first hand experience in the operation of an infrared line scanner a "Barnes Airborne Fire Spotter" was purchased and tested. After power supply and mounting problems were overcome, the scanner was operated for several seasons by various fire control agencies on routine air patrol flights over selected targets. Despite some success all agencies found the unit too unreliable to be of value.

6. A joint project with the Alberta Forest Service to test "Quality Technology" lightning counters was abandoned because of conflicting results and difficulties to obtain a full complement of counters in time.

7. 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 infrared false color photography is a suitable medium for mapping fire damage in a variety of forest cover.

8. 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, A.F.S.

9. Met with Saskatchewan fire control official and arranged the work schedule for the 1976-77 phase of the detection system evaluation in that province.

10. Secured unpublished information and test results highlighting the fire potential of catalytic converters on vehicle exhaust systems and distributed this material to fire control agencies in western Canada.

11. Designed and built a simple sighting device to aid air observers in estimating distances on the ground. Ten models of the device were issued to field personnel for testing.

12. Held a one week lookoutman's training course at Whitehorse, Yukon Territory for three consecutive years and provided fire management agencies with consultation and training assistance as requested.

13. Completed field work as planning in Saskatchewan, i.e.:

    1. took photographs from all lookouts located west of 106° longitude (28),

    2. completed seen area field sketches,

    3. inspected lookout installations.

14. Processed field information collected in Saskatchewan as planned - including processing, assembling, interpreting photographs, profiling each site, determining seen area and prepared progress report to the agency.

15. Complete final report for Wood Buffalo National Park.

16. Trained aerial observers of the Yukon Lands and Forest Service in operating the Barnes Airborne Fire Spotter. Assisted the Ontario Ministry of Natural Resources in detecting holdover fires with the AGA Thermovision 750 during their severe fire flap in the Dryden area.

    Presented paper and slide shows on holdover fire detection techniques at the Third Infrared Information Exchange (IRIE) in St. Louis, Missouri, as well as to fire control personnel in California, the Yukon Territory, Manitoba, Saskatchewan and Alberta. Partly due to our efforts, hand-held infrared scanners will be used during the coming fire season by eight provinces and territories and some states in the U.S.A.

17. Built a prototype device intended to cover a strip of terrain approximtely two km wide with the AGA Thermovision 750. Initial field tests with the device were encouraging (AGA SCAN ADAPTER).

18. Subjected the Hughes Probeye and the AGA Thermovision 750 to comparative laboratory and field tests.

12. Goals for 1977-78:

    1. Continue the seen area mapping for Saskatchewan by selecting 25 lookouts in the settlement fringe area and:

        1. take sets of panoramic photographs from 25 existing lookouts,

        2. draw seen area field sketches from each site and investigating seen area obstructions or possible alternate sites in the immediate vicinity of each lookout location,

        3. inspect lookout installations for safety (lightning protection, helicopter landing hazards) and efficiency (accuracy of fire finder, location and state of weather instruments, available maps).

    2. Process field information collected as follows:

        1. process, assemble, annotate, orient and interpret panoramic photographs (40 photos per lookout site - total 1400 photographs),

        2. construct cross-section profiles for each lookout site (at least) 10° of azimuth out to 25 miles (40 km) from each lookout site (minimum of 1260 cross-section profiles),

        3. compile seen area maps for each lookout based on panoramic photographs and cross-section profiles,

4. compile and analyze all information, prepare a progress report to the client agency.

3. Complete all reporting in respect to the AGA Scan Adapter and the comparative tests of the AGA Thermovision of the Hughes Probeye. Publish the detection/communications plan for the Yukon and the N.W.T. as informatio reports.

4. Help the Northwest Lands and Forest Service and the Wood Buffalo National Park administration in implementing the recommendations contained in the submitted reports. Investigate the feasibility of additional lookout and communications sites for both administrative areas and survey possible sites in the field.

5. Examine the feasibility and develop procedures for the use of the Thermovision 750 System in fire mapping, observing fire behavior and monitoring airdrops through vision obscurring smoke.

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

7. Goal added: Investigate the extent of tree mortality caused by a pine budworm infestation in the pine stands of the Nesbit forest near Prince Albert. The addition of extra dead fuel in this already hazardous fuel complex would require an intensification of detection effort.

8. Goal added: Investigate the feasibility of using electronic devices to monitor lightning storm occurrence in sparsely settled areas.

9. Goal added: Upon request by the Air Quality Control Branch of the Alberta Environmental Protection Service, Environment Alberta, a subsurface fire within the city limits of Edmonton producing harmful gases was to be located, its extent delineated and a method to extinguish the fire developed.

13. Accomplishments in 1977-78:

1. Profiled 29 lookouts of the forest fringe area in Saskatchewan but because of poor visibility conditions photographed, field sketched, and inspected only 7 towers.

2. Processed field information of 7 towers.

3. Continued field testing of the AGA Scan Adapter. Reporting was to be done during winter months 1977-78. Prepared file report titled "Operational problems using the Barnes Airborne Fire Spotter Model 19-211".

4. Surveyed and photographed five new lookout sites in the NWT and two new sites in the Wood Buffalo National Park, analyzed the coverage for each site and submitted seen area map to the agency.

5. Although several hours of flying time provided by the Alberta Forest Service in an effort to expand the applications of the AGA Thermovision 750 were spent, only little progress was made because of lack of major forest fires.

6. Conducted two day training courses on the use of the AGA Thermovision 750 in Manitoba, Ontario, and the Yukon Territory.

7. Accomplishment added: A survey of the Nesbit forest revealed no appreciable tree mortality as yet despite some heavy defoliation in the infested pine stands.

8. Accomplishment added: It was determined that long range directional lightning detectors as developed by Dr. Phil Krider and marketed by Lightning Location and Protection Inc. of Tucson, Arizona appear to be best suited for the northern areas. A joint project with the NWLFS who planned to purchase one detector for test purposes was initiated.

9. Accomplishment added: Using the AGA Thermovision 750, the fires in the landfill site burning up to 15 m underground in four separate locations was located and a cost efficient method to extinguish the fires developed. The requesting agency reported that the fires were controlled following our recommendations.

14. Goals for 1978-79:

1. Complete the seen area mapping for Saskatchewan by profiling the remaining 14 lookouts and:

    1. take sets of panoramic photographs from 34 existing lookouts,

    2. draw seen area field sketches from each site and investigate seen area obstructions or possible alternate sites in the immediate vicinity of each lookout location,

    3. inspect lookout installations for safety and efficiency.

2. Process field information collected as follows:

    1. process, assemble, annotate, orient and interpret panoramic photographs,

    2. construct cross-section profile for each lookout site,

    3. compile seen area maps for each lookout based on panoramic photographs and cross-section profiles,

4. compile all information, prepare a final report and submit with all maps to the client agency.

3. Complete seen area mapping for Prince Albert National Park subject to good weather during photography field trips.

15. Publications:

Up to 1977-78

Prepared the following file reports:

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

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

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

4. Infrared Scanners for Cold Trailing. (Draft of a progress report to the Alberta Forest Service.)

5. Intermediate Report, Wildfire Detection Study, Yukon Territory.

6. Final file report to the Northwest Territories.

Niederleitner, J. 1971. Remote sensing in forest fire control. Report on symposium June 1971, Missoula, Montana. Inf. Rep. 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 (Infrared 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 behavior.

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

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

Niederleitner, J. and P. Bihuniak. 1976. A heavy duty 12 volt dc power pack to operate airborne remote sensing systems. Can. For. Serv. Inf. Rep. NOR-X-147.

Niederleitner, J. 1976. Detecting holdover fires with the AGA Thermovision 750 infrared scanner. Can. For. Serv. Inf. Rep. NOR-X-151.

Niederleitner, J. 1975. The fire mop-up "Shell Game". Odds now improved. Forestry Rep. 4(4). December 1975.

Niederleitner, J. 1976. A pocket fire size estimator for aerial observers. Can. For. Serv. Inf. Rep. NOR-X-157.

Niederleitner, J. 1976. Detecting low intensity sleeper fires with the airborne AGA Thermovision 750 infrared scanner. Paper presented at the Third Biennial Infrared Information Exchange at St. Louis, Missouri. Proceedings.

1977-78

Niederleitner, J. 1977. A look at fire mapping. Forestry Report 1978.

Niederleitner, J. 1978. Got a fire mapping job? Photography with infrared film may be your best bet. Forest Fire News 1978.

16. Signatures:

Investigator

Program Manager

Director G. T. Silver

NOR-5-168

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1978 - 79

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1978

1. Project: Fire management systems and guidelines.

2. Title: Evaluation of 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-5-168 (Formerly NOR-5-980)

5. Study Leader: D.E. Dubé

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

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 along with fire intensity. Fire has played a significant role in influencing the physical-chemical environment; in regulating dry-matter accumulation; in controlling plant species and communities, in determining wildlife habitat patterns and populations; in controlling forest insects, parasites, fungi, etc.; in controlling major ecosystem processes and characteristics such as nutrient cycles and energy flow, succession, diversity, productivity and stability. The "natural" fire regime has been obscured by man's intervention and the long-term consequences of fire suppression are now becoming clear.

Resource management problems are developing which require an understanding of the historical role of fire, the effects of fire on a variety of landscapes, the alternatives available to resource managers and approaches required to implement alternatives.

9. Study Objectives:

1. To develop and implement fire management programs in designated National Parks.

2. To define the needs and priorities of client agencies in the area of fire impact assessments.

3. To describe and elucidate the natural role of fire.

10. Resources:

a. Starting date: 1974
b. Estimated year of completion: 1984
c. Estimated total Prof. man-years required: 10
d. Essential new major equipment items for 1978-79 with costs: Nil
e. Essential new major equipment items beyond 1979 with costs: Nil
f. 1978-79 man-years

Prof.	0.9	(D. Dubé)
Supp.	1.0	(M.A. Walters)
Casual	-	
Total	1.9	

11. Progress to Date:

Client agencies are aware of the historical and natural role of fire. The implications of this heightened awareness has resulted in the development of programs, particularly in National Parks, aimed at integrating fire management, including ecological considerations, into resource management.

12. Goals for 1977-78:

1. Prepare as Information Reports:

    1. Early plant succession following fire in the subalpine forest of the Canadian Rockies by D. Dubé.

    2. Fuel build-up and successional development of four sites in subalpine forests.

    3. Fuel weight of lodgepole pine crowns in trees under 4" in dbh.

2. Develop a preliminary fire management plan for Nahanni National Park by determining the historical role of fire, the probable long-term pattern of occurrence and evaluating short- and long-term impact of wildfire on biophysical environmental factors.

3. Assist in the development of fire impact and assessment guidelines for the Northwest Lands and Forest Branch, Northwest Territories.

4. Advise and assist in prescribed burning program in Prince Albert National Park.

5. Prepare a progress report on prescribed fire at Henry House Prairie, Jasper National Park and continue the development of guidelines for fire management planning within the park.

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

7. Goal added: Assist in preparation of the following reports:

   1. Fire behavior in upland jack pine: The Darwin Lake Project.

   2. Trees and forests of Jasper National Park.

   3. Prescribed burning in Jasper National Park.

8. Goal added: Organize and coordinate a workshop on Fire Ecology in Resource Management.

9. Goal added: Complete instructor training course, sponsored by Canadian Committee on Forest Fire Control.

10. Goal added: Present paper at "Fire ecology in Resource Management" workshop.

13. Accomplishments in 1977-78:

   1. Not prepared because of other commitments.

   2. A progress report for 1977 has been submitted. Field work in 1977 has consisted of two trips to Nahanni Park. Seventy-eight sites were visited. Fire history and fuel information was collected. This data has been analyzed. Available fire records have been examined and summarized. Available climatological data has been gathered. A literature review is complete. A large map of the Park showing all sites sampled is nearing completion.

   3. Not accomplished: This goal was added based on a request from the N.W.L.&F. branch of the Northwest Territories. N.W.L.&F. has since advised to cancel the request due to changing priorities.

   4. Not accomplished: Spring burns were carried out, but we were not advised on time. Fall burns cancelled due to lack of appropriate weather conditions.

   5. Prepared a progress report on prescribed fire at Henry House Prairie. Discussions with park officials regarding other areas where prescribed fire may be usefully implemented, and overall fire management planning are continuing.

6. Participated in training sessions of client agencies and meetings relevant to study content, including the following:

    1. National Training School - Parks Canada.

    2. University of Alberta: Advanced fire management course.

    3. Alberta Provincial Parks.

    4. Forest Technology School - Hinton.

    5. Ad Hoc Fire Research Committee.

    6. Prairie & Western Region - National Parks.

7. Accomplishment added: Co-authored the following reports:

    1. Quintilio, D., G.R. Fahnestock, and D.E. Dubé. 1977. Fire behavior in upland jack pine: The Darwin Lake Project. Northern Forest Research Centre, Edmonton, Alberta.

    2. Stevenson, R.E., R.M. Waldron, P.A. Logan and D. Dubé. Trees and Forests of Jasper National Park. Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alberta.

    3. Dubé, D.E. 1977. Prescribed burning in Jasper National Park. Forestry Report: Vol. 5, No. 2. Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alberta.

8. Accomplishment added: Coordinated a workshop in "Fire ecology in resource management" on December 6, 7, 1977. The workshop was attended by 140 people from several government agencies and institutions.

9. Accomplishment added: Successfully completed instructor training course on October 21, 1977.

10. Accomplishment added: Presented paper at Fire Ecology Workshop titled "Prescribed fire on Henry House Prairie, Jasper National Park".

14. Goals for 1978-79:

    1. Prepare as Information Reports:

        1. Early plant succession following fire in the subalpine forest of the Canadian Rockies by D. Dubé.

        2. Proceedings: Fire Ecology in Resource Management - A Workshop. Compiled by D. Dubé.

2. Write an operational fire management plan for Nahanni National Park.

3. Prepare a study proposal and conduct field work to develop an operational fire management plan for Wood Buffalo National Park.

4. Prepare guidelines and operational plan for a prescribed fire in Elk Island National Park.

5. Develop guidelines for fire management planning in Jasper National Park.

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

15. Publications:

Up to 1977-78

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

Fahnestock, G.R. 1974. An opportunity for fire ecology research in Jasper National Park. Fire Report. NFRC, CFS. Edmonton.

Fahnestock, G.R. and D. Dubé. 1974. Prospectus for an exploratory study of the natural and historic role of fire in Wood Buffalo National Park. File Report. NFRC, CFS. Edmonton.

Johnson, E.A. and J.S. Rowe. 1974. Studies on vegetation and fire in the wintering ground of the Beverly caribou herd.

Rowe, J.S. and E.A. Johnson. 1974. Problem analysis and pilot studies of fire in the western subarctic with particular reference to the caribou range, N.W.T.

Fahnestock, G.R. 1975. Fires, fuels and flora as factors in wilderness management: The Pasayten Case. 15th Tall Timbers Fire Ecol. Conf. Proc.

Fahnestock, G.R. 1975. Suggestions for fuel management to protect settlements in Yukon Territory. File Report. NFRC, CFS. Edmonton.

Fahnestock, G.R. 1975. Operating plan for experimental prescribed burning in Prince Albert National Park. File Report. NFRC, CFS. Edmonton.

Heinselman, M.L. 1975. The history and natural role of forest fires in the lower Athabasca Valley, Jasper National Park, Alberta.

Johnson, E.A. and J.S. Rowe. 1975. The buried seed population in the subarctic forest, east of Great Slave Lake, N.W.T.

Fahnestock, G.R. 1975. Experimental prescribed burning in Prince Albert National Park. File Report. NFRC, CFS. Edmonton. (Progress Report No. 1).

Dubé, D.E. 1976. Early plant succession following a 1968 wildfire in the subalpine zone of the Vermilion Pass, Kootenay National Park. Unpubl. M.Sc. Thesis, U. of A. Edmonton.

Dubé, D.E. 1976. Guidelines and operational plan for a prescribed fire on Henry House Prairie, Jasper National Park. File Report. NFRC, CFS. Edmonton.

Dubé, D.E. 1976. Study proposal for development of a preliminary fire management plan for Nahanni National Park. File Report. NFRC, CFS. Edmonton.

Dubé, D.E. 1976. Fuel weight and depth by vegetation type and organic layers for prescribed burn units in Prince Albert National Park. File Report. NFRC, CFS. Edmonton.

1977-78

Quintilio, D., G.R. Fahnestock, and D.E. Dubé. 1977. Fire behavior in upland jack pine: The Darwin Lake Project. Inf. Rep. NOR-X-174. Northern Forest Research Centre, Edmonton, Alberta.

Stevenson, R.E., R.M. Waldron, P.A. Logan and D. Dubé. 1977. Trees and Forests of Jasper National Park. Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alberta.

Dubé, D.E. 1977. Prescribed burning in Jasper National Park. Forestry Report: Vol. 5, No. 2. Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alberta.

Dubé, D.E. 1977. Progress report for Nahanni Fire Management Study. File Report. NFRC, CFS. Edmonton.

16. Signatures:

Dennis Dubé
Investigator

C.D. Hunt
Program Manager

G.T. Silver
Director G. T. Silver

NOR-5-174

CANADIAN FORESTRY SERVICE

STUDY STATEMENT (PROPOSAL)

1978 - 79

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1978

1. Project: Fire management systems and guidelines.

2. Title: Decision-aid models for use in fire management.

3. New: X Cont.: No.: NOR-5-174

5. Study Leader: D. Quintilio, D. Dubé, R.G. Newstead.

6. Key Words: Fire behavior, fuels, fireline production, fire statistics, fire effects, decision models, fire management, computer systems.

7. Location of Work: Regional

8. Problem:

The economic impact of forest fires in Canada is significant; in this region alone about 2,000 fires burn 1.5 million acres annually and associated fire-fighting costs total 20 million. The protection role of regional fire management agencies is complicated by the extreme variability of the occurrence and behavior of wildland fires. The traditional solution to the wildfire problem is similar in all parts of Canada where climate and fuel situations support wildfire conflagrations. Seasonal suppression forces are annually hired by each fire management organization to meet the demands of an "average" fire-season. The fire management resource demand, however, varies considerably over relatively short time spans and is largely unpredictable.

During low and moderate hazards the often excessive expenditure is difficult to justify and there is a tendency to "overkill" many fires. During very serious fire situations resources are inadequate and the whole fire management process becomes less efficient. This dilemma will exist in Canada until the information required to accurately predict the demand function over time and space becomes available in a systemized form. The requirement of all fire management agencies, then, is decision-aids geared to providing an improved response to individual fire situations. These decision-aids (models) would integrate data on fuel inventory, fire behavior, fire effects and fireline production and much of this information is currently being generated at the NFRC.

Historically the fire research group at the NFRC has focused its resources on the short-term needs of fire management agencies. This effort has contributed to (1) a strong client-research relationship and a credible advisory program, and (2) accessibility to agency data in all operational areas. Output has been service-directed in response to immediate needs and given the experience of the fire group this information flow can continue, albeit with a reduced manpower commitment. A new thrust in the area of systematized data processing is being proposed here to add a new dimension to the fire program.

9. Study Objectives:

1. To identify the key factors relating the occurrence, behavior, and effect of wildfires to the cost-effectiveness of fire control decisions.

2. To build and test relevant decision-aid models which will improve the rationale of fire control logic during multiple-fire situations.

10. Resources:

a. Starting date: 1978
b. Estimated year of completion: 1985
c. Estimated total Prof. man-years required: 10
d. Essential new major equipment items for 1978-79 with costs: Nil
e. Essential new major equipment items beyond 1979 with costs: Nil
f. 1978-79 man-years

Prof.	0.5	(D. Quintilio)
	0.4	(R.G. Newstead)
	0.1	(D. Dubé)
Supp.	0.3	(M. Maffey)
Casual	-	
Total	1.3	

11. Progress to Date:

Nil

12. Goals for 1978-79:

1. Conduct a systems appraisal workshop to determine the current state of U.S.F.S. model development.

2. Collate and classify existing relevant data from regional sources.

3. Process and store data on magnetic tape in preparation for study use.

4. Test available spread models against documented AFS fires available from the Hinton Forest Technology School.

13. Signatures:

Investigator

Program Manager

Investigator

Director G. T. Silver

Investigator