STUDY STATEMENTS

1981-82

NORTHERN FOREST RESEARCH CENTRE

CANADIAN FORESTRY SERVICE

APRIL 1981

NOR-5-037

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1981 - 82

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 26, 1981

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 Leaders: R. G. Newstead and R. J. Lieskovsky

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 electronically or 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: 1981
c. Estimated total Prof. man-years required: 0.2
d. Essential new major equipment items for 1981-82 with costs: Hand-held radiometer, Est. $2,500.00 ;Platform & shelf trucks (2) $500.
e. Essential new major equipment items beyond 1981 with costs: Nil
f. 1981-82 man-years

Prof.	0.2	(R. G. Newstead)
Supp.	0.8	(R. J. Lieskovsky)
Casual	-	
Total	1.0	

11. Progress to Date:

Fire retardants and other water modifying additives are in common use throughout the Northern region. Investigations concerning retardant properties and quality control, airtanker delivery systems, retardant mixing and storage facilities, pilot accuracy and airtanker and helitanker drop patterns have resulted in more effective aerial fire control by user agencies.

Evaluation of on-site effectiveness of selected fire retardants on wildfires and prescribed fires has led to a better understanding of their role in fire control operations. Laboratory analyses and field trials concerning the chemical, physical and rheological properties of retardants and water thickening compounds and associated mixing equipment have provided necessary technical information to manufacturers and users alike. The results of these tests have enabled these organizations to make qualified decisions on the development and utilization of several commercial products. Guidelines on the selection and application of fire retardant and suppression compounds are being drafted in an effort to enhance this process.

The liaison and development functions of this study have effectively transferred technological achievements to regional, national and international forest fire research and suppression organizations.

Progress in the development of a computerized airtanker allocation model, the synthesis of ten years of airtanker drop pattern data, and three years of airtanker performance data is reported in the fire management systems Study NOR-5-174.

12. Goals for 1980-81:

1. Complete thesis manuscript and convocate from U. of A. Masters program.

2. Complete guidelines for development and selection of water thickening compounds, and publish same.

3. Complete revision of fire retardant chemicals summary, and publish same as a Forest Management Note.

4. Complete construction and calibration of fire retardant spray apparatus pending receipt of capital equipment requirements.

5. In co-operation with the AFS, conduct prescribed burns at Slave Lake black spruce plots in a continuing effort to assess the relative effectiveness of various fire retardants over time - as permitted by a predefined weather prescription.

6. In co-operation with the B.C.F.S., conduct static and drop tests with the recently modified Tracker Firecat aerial tanker at Abbotsford, B. C.

7. Provide technical assistance, training, and technology transfer to regional and other national and international fire control agencies and industrial organizations as requested.

8. Assess future intentions of present study format, make recommendations regarding future objectives, and accordingly modify or terminate study as appropriate.

9. Publish articles in forthcoming Forestry Report as follows:

   "Interim results of retardant effectiveness on two prescribed burns in black spruce".

   "Liquid polymer water thickener - a review of test results to date".

10. Prepare a slide-tape presentation on the role of airtankers and fire retardants in wildfire control.

Goals Added:

11. Assess relative viscosity-building characteristics or two gum thickeners used at Dept. Northern Saskatchewan retardant bases.

12. Attend Intermountain Fire Council annual meeting, Coeur D-Alene, Idaho, and steering committee meeting of IFC, Salt Lake City, Utah.

13. Attend annual AFS Forest Protection Officers meeting, Banff, Alberta.

14. Attend Western Forestry and Conservation Assn. annual meeting to present review of NFRC fire research program to Western Forest Fire Committee.

15. Participate in Regional Fire Research Subcommittee meeting, Edmonton, Alberta.

13. Accomplishments in 1980-81:

1. Completed M.Sc. thesis and convocated from U. of A. Masters program.

2. Guidelines for the development and selection of water thickening compounds remain in the initial draft stage and will not be published during the current study year.

3. The forest fire retardant chemicals summary has been revised and published as a Forest Management Note.

4. Construction of the retardant spray apparatus and associated burning table is nearing completion and following installation of pressure sensitive load cells, spray nozzle modifications and calibration procedures will be undertaken.

5. Prescribed burning in Slave Lake black spruce plots for the purpose of assessing the relative effectiveness of various fire retardants was postponed owing to the extreme fire load in Alberta during the optimal burning period. This study goal was subsequently terminated on the recommendation of the Alberta Forest Service, and prime co-operator, when it became apparent that prescribed burning conditions were not likely to coincide with AFS support capabilities.

6. In co-operation with the B. C. Forest Service a full range of retardant drop tests with the S_2F Tracker Firecat were successfully completed at Abbotsford, B. C. on a full cost-recovery basis. These data have subsequently been processed and analyzed for presentation to the B.C.F.S. and other co-operators (Monsanto Can., Chemonics Ind., and Conair Aviation). The results of these trials and the possibilities of further co-operative research projects in B. C. were discussed with B.C.F.S. personnel while in Victoria to attend W.F.C.A. meeting.

7. Provided technical assistance, training, and technology transfer as follows:

   a) National Forest Protection Evaluation Task Force interview.

   b) Assisted in revision of A.F.S. air attack information recording format.

   c) Completed series of water thickening compound evaluations for the Province of Manitoba Dept. of Natural Resources.

   d) Presented a series of prescribed burning and retardant application demonstrations to general public and T. V. media during open house and subsequently for CBC show production.

   e) Presented lectures to Alberta Forest Technology School resource students and division level fire control personnel.

   f) Conducted retardant quality control checks in association with Dept. Northern Saskatchewan fire control personnel at Prince Albert air attack base.

   g) Reviewed wetting agent characteristics and reported to regional fire control agencies on expected performance criteria of these products.

8. In concert with project leader and program manager reviewed present study format with the intention of developing modified objectives and goals in the upcoming study year.

9. Proposed Forestry Report was not published. Articles intended for submission remain in the first draft stage.

10. A comprehensive slide tape presentation on the "Effective use of airtankers, helitankers, and fire retardants" has been completed, presented to several audiences for appraisal, and subsequently modified for consideration by the CCFFC for training purposes.

Accomplishments Added:

11. Completed a laboratory evaluation of the relative viscosity-building characteristics of the Erco and Chemonics retardant thickening gums used in Saskatchewan. A full report on these findings enabled the DNS to prorate gum requirements to maintain consistent retardant quality and assisted in the settlement of a previous contractual commitment.

12. Attended and participated in the annual Intermountain Fire Council meeting in Coeur D'Alene Idaho and acted as Canadian representative on the IFC steering committee at a planning session in Salt Lake City, Utah.

13. Attended the annual Alberta Forest Service Forest Protection Officers meeting in Banff, Alberta and presented a summary of NFRC fire research achievements during 1980.

14. Presented a summary of recent fire research achievements at NFRC to the Western Fire Committee of the Western Forestry and Conservation Assn. during the annual meeting in Victoria, B. C.

15. Reviewed research progress and accomplishments at the Regional Fire Research Subcommittee meeting in Edmonton.

14. Goals for 1981-82:

1. Publish guidelines for the development and selection of water thickening compounds as a Forest Management Note (Newstead).

2. Contribute articles for publication in a Forestry Report as originally proposed for the 1980-81 study year (Newstead and Lieskovsky).

3. In co-operation with the Alberta Forest Service conduct on-site investigation of airtanker/retardant effectiveness in wildfire control. This goal is dependent upon the provision of suitable transportation to and from fire locations by the AFS during the initial month of the airtanker contract period; and the extent of wildfire occurrence during that period. If successful this goal could be extended to include additional fire seasons in the interest of developing a sound data base for future analysis. (Newstead and Lieskovsky).

4. Continue modification, instrumentation, and calibration of retardant spray apparatus and burning table. Inaugurate a series of lab tests designed to provide a better understanding of the fire suppression, retardancy, and rheological characteristics of present and proposed fire retardant compounds. (Lieskovsky)

5. Provide technical assistance, training, and technology transfer to regional, national, and international fire control agencies and industrial organizations as requested. (Newstead and Lieskovsky)

15. Publications:

Up to 1980-81

Total - 22

a) Journal, Proceedings, Thesis: 2

b) Information Reports, Forestry Reports, Forestry Notes: 13

c) File Reports, Internal Reports: 7

1980-81

a) Journal, Proceedings, Thesis:

Lane, E. D. and R. G. Newstead. 1980. "Three-dimensional Computer Mapping of Lakes". The Progressive Fish Culturist. Vol. 42, No. 3.

Newstead, R. G. 1980. "Optimal Airtanker Location in Alberta". M.Sc. Thesis, Univ. Alberta, Edmonton, Alberta.

b) Information Reports, Forestry Reports, Forestry Notes:

Lieskovsky, R. J. and R. G. Newstead. 1980. "Forest Fire Flame-Inhibiting (long-term) Retardants Used in Canada". Can. For. Serv., For. Man. Note No. 2, Environ. Can. Edmonton, Alberta.

c) File Reports, Internal Reports:

Newstead, R. G. and R. J. Lieskovsky. 1980. "Effective Use of Airtankers, Helitankers, and Fire Retardants". A slide-tape presentation prepared as a fire management training aid. Environ. Can., Nor. For. Res. Ctr., Edmonton, Alberta. 170 slides, 45 min. tape, 22 pp. text.

16. Signatures:

Investigator

A/Program Manager

Investigator

A/Director A.D. Kiil

NOR-5-086

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1981 - 82

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 26, 1981

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 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 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: 1983
c. Estimated total Prof. man-years required: 8.0
d. Essential new major equipment items for 1981-82 with costs: Nil
e. Essential new major equipment items beyond 1981 with costs: Nil
f. 1981-82 man-years

Prof.	0.9	(Chrosciewicz)
Supp.	1.0	(vice Berman)
Casual	-	
Total	1.9	

11. 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 recently completed on 16 jack pine plots. Burning and fire behavior studies were carried out on 12 of the plots in 1978 and 1979.

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 1980-81:

1. Summarization of updated information on the "Fire Hazard Ratings" for all 23 forest ecosystems in the Mixedwood Section B.18e of central Saskatchewan.

2. Submission for publication of reports on (1) "Jack pine and other forest regeneration following postcut burning and seeding treatments in central Saskatchewan", (2) "Foliar moisture variations in major conifers of central Alberta", (3) "Foliar calorific variations in major conifers of central Alberta", and (4) "Failures and successes in jack pine regeneration following postcut burning and seeding treatments in southeastern Manitoba.

3. Continuation of data analysis leading to the determination of basic relationships between fuels, fire behavior and weather for semimature jack pine stands in central Alberta.

4. Continuation of providing consultative services as required.

Goals Added:

5. Chemical analyses of foliar samples from four major conifer species in central Alberta.

6. Publication of a report on the state and methods of postcut forest reproduction in Canada.

7. Continuation of a membership in the International Committee on Forest Lands at Northern Latitudes.

8. Preparation of display materials for the 1980 Open House at the Northern Forest Research Centre, Edmonton, Alberta.

13. Accomplishments in 1980-81:

1. The field-adjusted "Fire Hazard Ratings" for forest ecosystems in central Saskatchewan were summarized, and this new information was then forwarded to the provincial forestry officials in Prince Alberta, Saskatchewan.

2. The individual manuscripts are in various stages of preparation, and all four reports will be available for review before the end of the fiscal year 1980-81.

3. Dimensional categorizations of total forest biomass (trees, shrubs, herbs, grasses, mosses, downed roundwood, surface litter, and raw humus) in semimature jack pine stands in central Alberta were continuing. More than 80 regression equations were solved so far, and just as many dry-weight tables were calculated over a period of some three months of intermittent computer use.

4. Consultative services were provided to several forestry officials and/or educators from various parts of Canada and from abroad (Newfoundland, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, Alaska, Arizona, California, Finland, Sweden, and Norway).

   Manuscripts of some outside authors (University of New Brunswick, University of Michigan, and Atmospheric Environment Canada) were critically reviewed as requested.

   Verbal presentations re. current research efforts were made to:
   (a) Departmental Evaluation Task Force on Forest Protection. Northern Forest Research Centre, Edmonton, Alberta (January 30, 1980).
   (b) Regional Subcommittee on Forest Fire Research. Northern Forest Research Centre, Edmonton, Alberta (December 16, 1980).

   In addition, illustrated talks were given as follows:
   (a) "Fire spread and intensity within jack pine stands in central Alberta" by Z. Chrosciewicz. Alberta Forest Service Depot, Edmonton, Alberta (January 28, 1980).
   (b) "Regeneration silviculture and controlled burning" by Z. Chrosciewicz. Canadian Institute of Forestry, Saskatchewan Section, Prince Albert, Saskatchewan (October 24, 1980.

Accomplishments Added:

5. Some 5760 chemical determinations were made from foliar samples of four major conifer species in central Alberta. When completed, the analyses will provide the much needed information on the causes of the observed seasonal variations in the foliar dry weights.

6. The report on "Some practical methods for securing adequate postcut forest reproduction in Canada" was published in the U.S.A. It reviews and comments on Canada's forest resources, the state of forest regeneration, major causes of regeneration failure, major remedial treatments, and future research needs.

7. On request from the International Committee on Forest Lands at Northern Latitudes, a preliminary outline was prepared for two chapters in the proposed monograph on white spruce regeneration.

8. Two-theme photographic displays were prepared for the N.F.R.C. Open House (October 17-19, 1980). The subjects were: (a) "Fire behavior" and (b) "Silvicultural uses of fire".

14. Goals for 1981-82:

1. Submission for publication of four reports, two on postburn jack pine regeneration in southeastern Manitoba and central Saskatchewan (one each), and two on foliar moisture contents, and foliar heat contents in major conifers of central Alberta (one each).

2. Preparation of text for two chapters in the proposed international monograph on white spruce regeneration.

3. Continuation of data analysis leading to the determination of basic relationships between fuels, fire behavior and weather for semimature jack pine stands in central Alberta.

4. Continuation of providing consultative services as required.

15. Publications:

Up to 1980-81

Journal Articles and Other Refereed Publications: 10
Information Reports, Forestry Reports and Notes: 11
File Reports: 2

1980-81

Journal Articles and Other Refereed Publications:

Chrosciewicz, Z. 1980. Some practical methods for securing adequate postcut forest reproduction in Canada. Pages 49-52 in M. Murray and R. M. Van Veldhuizen (eds.). Forest regeneration at high latitudes. The proceedings of an international workshop held in Fairbanks, Alaska, November 15-17, 1979. U.S.D.A. For. Serv., Pac. Northwest For. Range Stn., Gen. Tech. Rep. PNW-107.

Information Reports, Forestry Reports and Notes: None.
File Reports: None.

16. Signatures:

Investigator

A/Program Manager

A/Director A. D. Kiil

NOR-5-131

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1981 - 82

Responsibility Centre: Northern Forest Research Centre

Date: January 26, 1981

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: C.J. Ogilvie

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, and Northwest Territories, Saskatchewan, Manitoba

8. Problems:

Each year fire starts number at least 2000 in the prairie provinces and Northwest Territories. Many of these fires quickly become unmanageable prior to detection resulting in costly fire mapping and surveillance problems during suppression and mop-up activities.

The objective of this study is to improve fire detection and surveillance methods, and is oriented towards the immediate needs and requests of the client agenices. Since some of the user agencies in the region are, not operating fully developed fire detection and surveillance systems an excellent opportunity exists to improve their operations in these areas.

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

Many 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: 1983
c. Estimated total Prof. man-years required: Nil
d. Essential new major equipment items for 1981-82 with costs: Nil
e. Eddential new major equipment items beyond 1982 with costs: Nil
f. 1980-81 man-years

Prof.	0.0	
Supp.	0.8	(C. Ogilvie)
Casual	-	
Lotal	0.8	

11. Progress to Date:

Reports on communications and fire detection plans have been prepared for the Yukon, N.W.T. and Wood Buffalo National Park. These regions are all making use of their respective reports.

The "Barnes Airborne Fire Spotter" was tested and found to be unreliable under actual field conditions.

Experiments started in 1974 have resulted in the widespread use across Canada of the AGA 750 infra-red scanner for detecting holdover fires. N.F.R.C.'s Sony vidicon was successfully adapted to record the thermovision imagery. A power pack was constructed at N.F.R.C. to be used to run the AGA, the vidicon and other instruments.

A simple sighting device to aid air observers in estimating distances on the ground was designed and built.

A device known as a "scan extender" that will allow the AGA 750 thermovision to be used for systematic searches of large areas has been developed. The scan extender has been successfully used for surveillance of large fires in Alberta and Saskatchewan.

Detection system evaluations of Saskatchewan and Prince Albert National Park have been completed and submitted to D.M. Taylor of the Department of Northern Saskatchewan and E.B. Wilson of the Prince Albert National Park.

12. Goals for 1980-81:

1. Finish report on Saskatchewan detection system and submit it along with the maps and photographs to the Department of Northern Saskatchewan, and assist in the implementation of the recommendations made in the report.

2. Complete work on Prince Albert National Park detection system.

   (a) Prepare composite visible-area map.

   (b) Submit a report along with maps and photographs to Prince Albert National Park.

3. Begin a co-operative study with the Department of Northern Saskatchewan to investigate the feasibility of using the AGA scan extender in conjunction with their Lightning Location and Protection System to locate incipient lightning fires. In addition, localized fuel and weather data will be gathered at lightning fire locations discovered. This source of specific information is expected to support assessment of the correlation between lightning fire incidence and fuel and weather parameters.

4. Monitor effectiveness and level of use by Alberta Forest Service of the AGA scan extender and provide technical assistance upon request.

5. Develop user guidelines for the operational use of the AGA thermovision and scan extender as applied to forest fire detection.

6. Provide liaison and technical services among client agencies.

13. Accomplishments in 1980-81:

1. Completed report on Saskatchewan fixed detection system and submitted it along with all maps and photographs to the Department of Northern Saskatchewan.

2. Completed the composite visible area map of Prince Albert National Park and submitted it along with recommendations, other maps and photographs to the park superintendent.

3. A co-operative study with the Department of Northern Saskatchewan was begun. This study is to investigate the feasibility of using the scan-extender in conjunction with the Lightning Location and Protection System and the Canadain Fire Weather Index to locate incipient lightning fires.

   Preliminary work was done during the summer of 1980 on developing a method of truthing the LLP system.

   An attempt was made in 1980 to establish FWI parameters under which holdover fires will occur.

   The scan extender was used extensively on large fires in 1980, such as the Hotchkiss fire in Alberta and the Porcupine and Primrose fires in Saskatchewan.

   A study area has been chosen that has the Nipawin Provincial Park as the approximate centre and a radius of 75 to 100 miles.

4. Upon request by the Alberta Forest Service technical division a trip was made to the Hotchkiss fire in June to develop methods for using the scan extender on large fires.

5. User guidelines for the operational use of the AGA Thermovision as applied to forest fire detection are in the process of being developed. They will be finished by the end of the fiscal year.

6. Provided liaison and technical services among client agencies.

   a) Using methods developed in Alberta (Accomplishment 4) trained the Dept. of Northern Saskatchewan personnel ro use the scan extender on large fires.

b) Attended workshop on Lightning Location and Protection equipment. This workshop provided valuable background to the lightning location problem.

c) Travelled to Riding Mountain National Park to evaluate the Thermovision 720 and 110. Trained the chief warden and the fire boss on the use of the scanners and found some 20 hot spots.

Reported by letter to B. Lee of the Prairie Parks Region the advantages and disadvantages of each scanner.

d) Provided a short summary of the detection program to A.H. Kuschel of the University of Chile.

14. Goals for 1981-82:

1. Provide an article for the Forestry Report on the use of the scan-extender on large fires.

2. Write a Management Note on the scan-extender detailing its construction and uses.

3. Enter a co-operative study with the AFS to establish the capabilities of the Thermovision Scan-extender combination for various flying heights, target sizes and target composition.

4. Provide Forestry Report article on 3 years of detection effort in Saskatchewan.

5. Continue a co-operative study with the Department of Northern Saskatchewan to develop improved methods of detecting incipient lightning fires under different fuel and fire weather conditions.

6. Provide liaison technical services and training to client agencies as the need arises.

7. Terminate study and move 1981-82 Goal 5 to Study 174.

15. Publications:

Up to 1980-81

a) Journal articles, Proceedings: 2

b) Information Reports: 12

c) File Reports: 6

1980-81

a) Journal articles, Proceedings: Nil

b) Information Reports: Nil

c) File Reports: 1

Ogilvie, C.J. 1980. Evaluation of the Saskatchewan Forest Fire Lookout System. File Report NOR-5-131.

16. Signatures:

(For C. Ogilvie)

Investigator

J.M. Powell

A/Program Manager

A.D. Kiil

A/Director A.D. Kiil

NOR-5-168

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1981 - 82

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 26, 1981

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

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 1981-82 with costs: Nil
e. Essential new major equipment items beyond 1981 with costs: Nil
f. 1981-82 man-years

Prof.	0.4	(D. Dubé)
Supp.	0.2	
Casual	-	
Total	0.6	

11. Progress to Date:

Programs in National Parks aimed at integrating fire management into resource management plans are nearing completion.

12. Goals for 1980-81:

1. Publish as Information Report: "Early plant succession following wildfire, Kootenay National Park".

2. Publish in Forestry Report: "Prescribed burning in Elk Island National Park".

3. Publish paper: "Fire management in Wilderness Areas, Parks and other Nature Reserves, "in Fire in Northern Circumpolar Ecosystems Proceedings, University of New Brunswick.

4. Complete and submit fire management study for Nahanni National Park.

5. Complete and submit fire management study for Wood Buffalo National Park.

6. Provide advice and consultation for fire management planning in Western and Prairie National Parks.

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

Additional Goals 1980-81:

8. Present paper on fire behavior at the Northwest Section of the Wildlife Society in April, 1980.

9. Develop implementation strategy for fire management policy for National Parks in consultation with CFS and National Parks personnel.

10. Participate on three member board of review panel for fire #1980-6 in Riding Mountain National Park.

11. Member of Federal/Provincial task force addressing the Economic, Social and Environmental Impacts of the 1980 fire season in the Prairie Provinces, N.W.T. and northwestern Ontario.

12. Participate on three member board of review panel addressing fire control operations in Wood Buffalo National Park.

13. Accomplishments in 1980-81:

1. Information Report, "Early plant succession following wildfire in Kootenay National Park is still in review process.

2. Forestry Report not published. Paper "Prescribed burning in Elk Island National Park" is completed and ready for review process.

3. Paper titled "Fire management in Wilderness Areas, Parks and other Nature Reserves" completed and in press.

4. Final report on fire management study for Nahanni National Park not completed. Fire history maps and data analysis is complete.

5. Final report on fire management study for Wood Buffalo National Park not completed.

6. See attached "1980 log of activities". Includes two prescribed burns at Elk Island National Park.

7. See attached "1980 log of activities".

Additional Accomplishments:

8. Paper titled "Fire Behavior Variables" was presented at Northwest Section of Wildlife Society and an abstract of the paper included in the meeting proceedings.

9. Assisted in developing an implementation strategy for the 1979 National Park fire management policy.

10. Completed board of review for Riding Mountain National Park. Report in final draft.

11. Data acquisition for 1980 federal/provincial task force complete. Report due February 28/81.

12. Completed board of review for Wood Buffalo National Park. Report due February 15, 1981.

14. Goals for 1981-82:

1. Publish as Information Report "Early plant succession following wildfire, Kootenay National Park".

2. Publish in Forestry Report "Prescribed burning in Elk Island National Park".

3. Complete and submit fire management study for Nahanni National Park.

4. Complete and submit fire management study for Wood Buffalo National Park.

5. Assist in prescribed burning programs in Elk Island National Park, Banff and Prince Albert National Park.

6. Assess status of current study; make recommendations giving consideration to proposed CFS/National Parks agreement and modify or terminate study as appropriate.

7. Provide advice and consultation and participate in training sessions of client agencies and meetings relevant to study content.

15. Publications:

Up to 1980-81

1) Journal articles - Nil
2) Information Reports, Proceedings, Notes: 10
3) File Reports, etc.: 11

1980-81

Alexander, M. E. and Dennis E. Dubé. 1980. Fire management in Wilderness Areas, Parks and other Nature Reserves. In proceedings of "Fire in Northern Circumpolar Ecosystems". SCOPE. Publisher John Wiley & Sons. In Press. 42 p.

Dubé, Dennis and Dennis Quintilio. 1980. Fire Behavior Variables. In Abstracts of papers presented at Northwest Section of The Wildlife Society. April 8-10, Banff, Alta. 1 p.

16. Signatures:

Investigator

A/Program Manager

A/Director A. D. Kiil

1980 LOG OF ACTIVITIES

January	23	Meeting with Nahanni and Prairie region personnel to discuss fire management study.
	24	Meeting with provincial fish and wildlife biologist, Al Wisely, (Alberta) to discuss proposed prescribed burning possibilities in Kananaskis Country.
	30	Meeting with N.W.T. - John McQueen
	31	National Fire Task Force (Sinclair, Williams, Owen)
February	5	Reviewed two research papers (Rowe; Alexander). Discussed fire/wildlife relationships with A. Hawley, Environmental Lab, Vegreville.
	6 - 22	Gradient Modelling was in for this period resulting in several meetings, seminars, etc.
	7	Review of biogeoclimatic program.
	8	Demonstration of electronic mapping equipment by C. Kirby.
	12	Meeting with University Alberta; Elk Island National Park and Alberta Provincial Wildlife to discuss proposed prescribed burning study for graduate student.
	14	Meeting at A.F.S. to discuss study by P. Fuglem re: foliar moisture content.
	19	Fire effects lecture at Forest technology school - Hinton, Alberta.
	20	Attended siminar on fire growth model, by D. Quintilio. Visit from N.A.I.T. students and discussion of fire effects.
	25	Meeting with A.F.S. re: Swan/Marten Hills priority zoning study.
	26	Meeting with Ed Telfer re: prescribed burning in E.I.N.P. problem.
	27	Elk Island National Park to discuss prescribed burning program for 1980.
March	3	Slide-Tape presentation on retardant/airtanker.
	12	Fire effects lecture at University of Alberta to fire ecology class.

March	18	Meeting with S. Lewis to discuss "role of DOE N. of 60°.
	20	Attended first day of in-house "advanced computer basics course".
April	1	Lecture on fire management at Forest tech. school, Hinton.
	2	Meeting to discuss research proposal by M. Johnson.
	8	Presented paper at Wildlife Society meeting in Banff.
	10	Attended seminar at U. R. by H. Wright on burning in Texas.
	14	Fire effects/management lecture in Ft. Smith, N.W.T.
	21	Reviewed research paper by M.E.A.
	23	Travelled to E.I.N.P. to review burning sites.
	28	Conducted burn at E.I.N.P.
	29	Attended C.B.C. studios to discuss fire season on radio.
May	5	Conducted burn at E.I.N.P.
	6	Short discussion with students from Lacombe re: fire ecology.
	12 - 14	Toronto meeting with Parks Canada to discuss National fire management policy.
	15 - 17	Tour or prescribed burn sites at Sault Ste. Marie.
June	4	Meeting with Cliff White, Banff Park to discuss sampling techniques, etc. for study proposal.
	17	Meeting with A.F.S. in Hinton (D.K., D.Q., J.S.).
	23	Open House meeting.
August	10 - 11	Trip to Banff to examine prescribed burning site.
	15	Meeting with A.F.S. (B.M.) re: Slave Lake proposal.
	19	Trip to E.I.N.P. to examine effects of 1980 burn.
	25	Meeting with D.K. (2 hrs.).
	26	C.P.R. course at lab.

August	27	Meeting with A.F.S. to discuss retardant effectiveness program.
	28	Meeting re: C.F.S. update.
September	2	E.I.N.P. meeting at Lab.
	5	Computer Users Committee meeting.
	8 - 12	Middle Management Course in Edmonton
	18	Job interview for technical position.
October	6	Meeting with A.F.S. (J.S.) re: priority zoning proposal.
	7 - 9	Riding Mtn. National Park - Board of Review.
	15	Meeting with fire staff re: utilization of Computer technology (i.e. Che Lee).
	17 - 19	Open House
	29 - 30	Ottawa - Fed./Prov. Task Force
November	4 - 6	Winnipeg - Feb./Prov. Task Force
December	3	Lecture/discussion at U.A. to Adv. Fire Ecology Course Parks Cdn. meeting - Richard Leonard re: Prince Albert Meeting.
	9 - 11	Ottawa - Fed./Prov. Task Force
	16	Regional Fire Research Committee

1981

January	12 - 15	Wood Buffalo National Park - Bd. of Review

Meetings Missed: Fire History - Tuscon
F.C.O. - Banff
I.F.R.C. - Boise
West. For. - Victoria
Fire Weather - Prince Albert

NOR-5-174

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1981 - 82

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 26, 1981

1. Project: Fire management systems and guidelines.

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

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

5. Study Leaders: D. Dubé, R. G. Newstead, Z. Chrosciewicz, M. E. Alexander

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 2,000 fires burn 0.6 million ha 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. This new thrust in the area of systematized data processing will add a new dimension to the fire program.

9. Study Objectives:

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

2. To build, test, and operate relevant decision-aid models designed to assist fire management agencies in optimizing the allocation and use of available resources during demanding or multiple fire occurrence 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 1981-82 with costs: Nil
e. Essential new major equipment items beyond 1982 with costs: Nil
f. 1981-82 man-years

Prof.	1.0	M. Alexander
	0.8	R. G. Newstead
	0.6	D. Dubé
	0.1	Z. Chrosciewicz
Supp.	0.2	C. Ogilvie
	0.8	M. Maffey
	0.2	R. Lieskovsky
	3.7	

11. Progress to Date:

As is common with any new research undertaking, the initial phase is concerned with gathering the resource and data bases upon which a comprehensive program can be developed. During the three years since its inception, this study has acquired much of the necessary data management hardware and software in the form of the mini-computing system and programs now established at the NFRC. Systems analysis, computing and other related support staff functions have also become available to this study. Data files have been created

using regional fire and weather statistics. Pertinent simulation modelling routines have been brought on stream and "regionalization" and modification of these are underway. Contracts have also been let to various specialists to introduce specific aspects of fire modelling to the program, e.g. instructional seminars, fuels inventory requirements and gradient modelling (FORPLAN), etc.

12. Goals for 1980-81:

1. Refine, calibrate and field test the elliptical fire growth model. In conjunction with two AFS remote computer terminals located in separate forest protection jurisdictions, interactive model performance will be assessed relative to actual fire growth circumstances.

2. Continue synthesis of regional fuels data base and assess feasibility of integrating fuels data from other inventory and survey criteria (e.g. AFS Phase III, biophysical, biogeoclimatic). These data should provide the framework for the future development of a regional fire behavior model.

3. Analyze and synthesize relevant fire line production data (e.g. airtankers, dozers, and hand lines). These data can then be used in fire behavior modelling where fire containment parameters are required.

4. Assess the feasibility of conducting a fire history and fire effects study in the Swan Hills region of the Slave Lake Forest.

5. Collate 1979 fire statistics from Department of Northern Saskatchewan records. Transfer previous four years' statistics from FFRI computer files to NFRC files. These data can be used in conjunction with study NOR-5-131 goals concerning lightning fire detection and related measurement of fuels and weather parameters in northern Saskatchewan.

6. Complete analysis and compilation of accumulated fixed-wing airtanker drop pattern information initiated under Study NOR-5-037, and publish same.

7. Analyze airtanker effectiveness data collected by AFS aerial observers during the past four-year survey period.

13. Accomplishments 1980-81

1. A fire containment model which includes the "Whitecourt" elliptical fire growth subroutine has been developed for use with both the TI-59 hand held calculator and the Tektronix 4051

desk top computing and graphics system. Subsequent demonstrations indicate that this model has a high probability of acceptance and utilization by fire control agencies. The Alberta Forest Service will adopt the hand held calculator version in lieu of linking remote computer terminals to the NFRC PDP 11/60 system.

2. Synthesis and statistical interpretation of some regional fuels data is being done under contract and will be completed by March 31/81.

3. To date fire line construction data have not been assembled although interim data have been used in conjunction with fire containment model demonstrations.

4. The feasibility of conducting a fire history and fire effects study in the Swan Hills region has been completed and it has been determined that a modified version of this goal will be initiated in the 1981-82 study year to consider the AFS land resource priority zoning (values-at-risk) schedule. This will be persued upon the arrival of an additional study leader.

5. The 1979 Department of Northern Saskatchewan fire statistics have been collated and forwarded to the PNFI for preliminary analysis. The balance of the 5-year fire information files have not yet been returned to NFRC from PNFI.

6. All airtanker drop pattern data accumulated by NFRC since 1968 have been processed and converted to SI and are now ready for analysis. Photographic images of all drop patterns are now on file as a first stage in preparing them for analysis. Publication is expected to follow in 1981-82.

7. Alberta Forest Service aerial observer report summaries on airtanker operations have been compiled but not yet analyzed. A modified data collection form initiated by the NFRC has been adopted by the AFS and an additional year's information has been processed and added to the existing data base. Interim analysis of these data (1976-80) will be conducted in the 1981-82 study year.

Goals for 1981-82:

1. Publish an Information Report on the development and application of the fire containment model incorporating fire line productivity information, fire spread data and other required minor modifications. (Newstead)

2. Assemble, synthesize and organize regional fuels, weather and statistical fire data into a format, using in-house computer facilities, that enable easy and rapid retrieval. (Dubé, Alexander, Chrosciewicz and Delisle).

3. Prepare a regional forest fire atlas based upon historical fire statistics. (Delisle)

4. Initiate a cooperative program with the AFS to develop priority zoning guidelines aimed at providing more cost/effective fire management planning. (Alexander, Dubé)

5. Refine and calibrate the performance of a resource location-allocation model based on Masters thesis and apply same to updated fire occurrence data in co-operation with the Alberta Forest Service. (Newstead)

6. Publish an information report on the status of all airtanker/retardant drop patterns compiled and analyzed to date. (Newstead)

7. Complete preliminary analysis of AFS aerial observer report summaries (1976-80) compiled to date. The need for subsequent data collection and/or publication requirements will be determined during the 1981-82 study year. (Newstead)

8. Establish procedures and provide client agencies with the over-winter adjustment to the drought code for 1981 and on a regular, annual basis in subsequent years. (Dubé)

9. Publish information report on spring burns in a 50 year old aspen stand. (Dubé)

10. Publish Forest Management Note on forest fire containment model. (Newstead)

15. Publications:

Up to 1980-81 - Nil

1980-81

Quintilio, D. and M. W. Potter. 1980. "Initial attack review in the Peace River Forest". Final report prepared under contract by Alberta Ecosystem Consultants Ltd.

16. Signatures:

Investigator

Investigator

Investigator

Investigator

A/Program Manager

A/Director A. D. Kiil