PROGRESS REPORT

(May 1973)

PROJECT GLC-3 FOREST FIRE RESEARCH IN ONTARIO

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Introduction

In Ontario, during the 10-year period between 1960 and 1969, forest fires burned an average of 142,760 acres of productive forest land annually, consuming an average of 167,000,000 cubic feet of merchantable timber. The total cost of fire protection for the province, including fire suppression costs, was approximately $14.5 million out of a total Ontario Ministry of Natural Resources (OMNR) budget of approximately $71.5 million for the 1970-71 fiscal year. To these tangible costs must be added the detrimental socio-economic, recreational, environmental and aesthetic consequences of wildfire. In Ontario, the Ministry of Natural Resources is responsible for all of the operational aspects of fire prevention, detection, suppression and fire protection legislation. Over the years, the province has developed one of the world's foremost forest fire control organizations but in spite of the tremendous strides that have been made on the tactical side of fire detection and suppression, little progress has been made on the strategic side, i.e., in the important area of presuppression planning.

Following consultation with OMNR officials, and at their request, forest fire research by staff of the Great Lakes Forest Research Centre (GLFRC) has been directed toward the development of improved presuppression planning techniques for application in Ontario. The ultimate goal is a computerized system containing current and updated data on fuel types and probable fire spread and behavior in these types, travel times, accessibility factors, forest values and resource and equipment inventories for the fire district being managed. Fire weather forecasts will be fed daily to the computer. These data will then be readily available for use in decision making when fires are reported. Such a modern technique will provide forest protection managers with a scientific approach to decision making as it relates to all aspects of fire detection, resource allocation and fire control and suppression.

Because of the complexity of the overall problem and the need for a truly practical technique for presuppression planning that will meet the operational requirements of the OMNR, all aspects of the project are developed in close consultation with fire protection staff of the OMNR and with the Forest Fire Research Institute of the Canadian Forestry Service.

Objectives

Simply stated, the objective of the forest fire research project at GLFRC is to develop an improved technique of presuppression planning for Ontario based on the combined use of a refined fire damage rating system, a fire weather forecasting technique and a method of fuel classification, mapping, and fire risk rating.

Although the eventual aim of this project is a centralized computer mapping and storage system that will accurately predict fire danger, fire behavior, and the effect of fire control alternatives which take into consideration accessibility, resources and stand values, new information covering the various aspects of the project is continually made available to the OMNR as part of the cooperative approach. This not only serves to test the feasibility of the partial solutions obtained, but also allows for a continual updating of current presuppression planning techniques as the project is developed and new information becomes available.

In order to achieve this objective the forest fire research project at GLFRC is currently comprised of three distinct but interrelated studies, each with its own objective:

1) Study 03-062 Fire Danger Rating in Ontario (B.J. Stocks)

An accurate system of fire danger rating is essential for the achievement of our overall objective. The Fire Weather Index (FWI) being used at present, though a definite improvement over past systems, is based solely on weather and provides a numerical rating of fire intensity in a standard fuel type. To make it more directly applicable to the Ontario situation, it is necessary that burning indexes be developed for the major fuel complexes in the province. Therefore, this study is directed toward the development of these burning indexes so as to include the effects of fuel, topographical variables and weather on fire behavior in slash and standing timber in the major fuel types.

2) Study 03-063 Forest Fuel Classification and Mapping in Ontario (J.D. Walker)

The diversity of fuel, topographic and climatic conditions across the province make the development of fuel classification techniques which lend themselves to rapid mapping methods and computer storage of information a formidable task. However, a wealth of information already exists in inventory maps and aerial photos. This study is designed to develop a workable system for classifying and mapping forest fuels in the province by investigating ground fuel weights and regressions of fuel weight on stand parameters (as determined from the inventories and air-photo analyses). The system will be evaluated in relation to the observed and reported fire behavior in wild and prescribed burns.

3) Study 03-077 Wind Patterns Associated with Major Fuel Complexes in Ontario (R.H. Silversides)

Wind is an important factor in fire behavior and a sensitive component of the FWI. For example, under identical fuel conditions windspeed estimates of 5, 10 and 15 mph can result in predicted fire danger ratings of moderate, high and extreme, respectively. Variations in windspeed of this magnitude can occur as a result of topography, ground cover, and diurnal effects. Large errors in estimating fire danger rating are unacceptable to managers in presuppression strategy. The current study is intended to investigate means of improving estimates of windspeeds in forested locations and of thereby increasing the effectiveness of the FWI.

While the foregoing studies are the separate responsibilities of the three researchers involved, the studies themselves are closely interrelated and the work is carried out in the same experimental areas with very close cooperation, joint participation, and in many cases common data collection and utilization by all concerned.

Experimental Areas and Approach

The initial research work on this project was undertaken in 1970 in the Kirkland Lake District in northeastern Ontario, and involved the cooperative effort of two fire researchers working on (1) fire behavior and its relation to the FWI and (2) fuel assessment in terms of burning potential and characteristics. During the 1970 and 1971 field seasons a total of 24 one-acre experimental fires were conducted in jack pine logging slash in the Kirkland Lake area. By establishing the burn plots on areas of similar topography and fuel quantity a replicated series of 24 burns was carried out with weather being the only major variable changing between fires. Each burn plot was instrumented and intensively sampled in order to gather as much information as possible for each burn. All burns were ignited and controlled by OMNR personnel. The GLFRC and the OMNR have a cooperative arrangement in which the Ministry provides trained fire crews for ignition and control of the burns. Preparation of the plots for burning, data gathering and analysis are responsibilities of the GLFRC.

After completion of the jack pine slash burns a series of 24 one-acre plots was established in an undisturbed, mature jack pine stand near White River. These plots were laid out, firelines were constructed and intensive fuel sampling was undertaken during the 1972 field season. Experimental burning is scheduled to start in May, 1973 on these plots.

Experimental burning plots are also being established in an immature (24-year-old) jack pine stand approximately 50 miles north of Thessalon. These plots will be blocked out, firelines will be constructed, and sampling will be undertaken in the 1973 field season. It is hoped that some experimental fires can be conducted in this fuel type this year.

Progress

After the completion of the experimental burns in jack pine slash a burning index was developed for this fuel type, containing tables relating fire rate of spread to Initial Spread Index (ISI), and slash and duff consumption to Adjusted Duff Moisture Code (ADMC). (Both the ISI and ADMC are component indexes of the FWI.) A fire hazard chart relating fire intensity to the ISI and ADMC was included in the burning index package. This prototype burning index was issued to all OMNR districts in the spring of 1972 as a supplement to the FWI tables. As indexes are developed for further fuel types they will be issued for inclusion in the FWI binders at all OMNR weather stations.

By relating wildfire occurrence and size to the FWI and its component indexes through annual observation of OMNR weather data and fire report forms, the FWI has been calibrated and class boundaries delineated for Ontario. Gathering of OMNR weather and fire report data will continue and future FWI analysis is planned.

A simple subjective fuel classification system has been designed for Ontario and has been tested near Dryden for one field season. The system, based on information readily obtained from existing forest inventory maps, considers species, age, stocking and season, takes into account whether the fuel type is coniferous, hardwood or slash, and gives a definite numerical rating. This rating is being and will continue to be tested against actual wildfire behavior.

The meteorological study on wind over various fuel types and during experimental fires is starting in 1973 and should provide valuable data hitherto unavailable.

Fire researchers at the Forest Fire Research Institute in Ottawa have recently proposed a Fire Management Centre (FMC) concept similar to the system envisioned as the ultimate goal of the fire research project here at the Great Lakes Forest Research Centre. The FMC will incorporate models for fire occurrence spread, detection, initial attack and FWI prediction and it is proposed that perhaps six of these centres be set up eventually across Ontario. The Forest Fire Research Institute is working on most theoretical aspects of the FMC, while research to develop burning indexes, classify fuels and study wind characteristics will continue at Great Lakes Forest Research Centre, as these will be vital inputs into the FMC. All models will be tested in relation to the Ontario situation, and revised and updated by replacing theory with factual information as it becomes available. The FMC has been established as a cooperative endeavor involving Great Lakes Forest Research Centre, Forest Fire Research Institute and Ontario Ministry of Natural Resources.

As a result of this experimental burning in these and subsequent fuel types, burning indexes will be developed for major Ontario fuel types. These indexes will express such fire behavior parameters as rate of spread, fuel consumption, and fire intensity in terms of the FWI and its various component indexes. When used in conjunction with the FWI they will enable the forest protection manager to predict his most hazardous fuel types on any given day and allocate his resources accordingly.

As a means of gathering further fire behavior information, five large wildfires were visited in Ontario during the 1970 and 1971 fire seasons. Through measurements made after the fire, and through discussion with OMNR personnel involved in suppressing the fire, a great deal of valuable fire behavior data can be obtained and the fire itself reconstructed. This practice of augmenting fire data with wildfire information will continue in the future.

Fire weather data from 90 OMNR stations throughout Ontario have been collected and run through computer programs to calculate the FWI and its component indexes for each station. Nine years of data (1963-1971) are now on IBM cards and magnetic tape and this information is used along with data from Ontario fire report forms (also on file) to study wildfire behavior in all fuel types throughout the province. By studying the range and distribution of FWI values throughout the province from year to year it is possible to calibrate this national index for the Ontario situation.

Fuel classification work, in addition to that carried out on these experimental fires, is also under way at Dryden in northwestern Ontario where a subjective prototype fuel classification system is being applied to a large crown management unit. Fuel types in this area are being classified by OMNR personnel using this system, and fire behavior characteristics of any wildfires occurring in the typed area are being monitored. This aspect of the study will be expanded and continued in future years.

The meteorologist assigned to fire research will begin studying the effects of wind and stability on fire behavior during the experimental fires that are to be carried out in jack pine stands at White River and north of Thessalon. He will also conduct studies on windspeeds and patterns over typical Ontario fuel complexes. A tethersonde system and pibals will be used to measure vertical profiles of wind, temperature, and relative humidity. Sensitive anemometers and tetroons will be used to monitor winds on experimental fires as well. This rather precise measurement approach is being used to develop useful relationships between wind patterns and gross-scale features of weather and topography. These will provide a climatology of wind patterns of significance to fire weather and improve techniques for forecasting surface winds over forested terrain.

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