

# Living With Fire in the Boreal Forest

**Dr. Marty Alexander, RPF**

**Adjunct Professor – Wildland Fire Science & Management**

**Department of Renewable Resources**

**University of Alberta, Edmonton, AB**



**Partners in Protection 13<sup>th</sup> Annual General Meeting  
Jasper, AB – October 15, 2009**



## ABSTRACT

Solutions to the wildland-urban interface or intermix (WUI) fire problem may vary considerably across ecosystems. A case in point is the boreal forest regions of northern Canada and Alaska – i.e., “northern solutions are needed for northern problems”. This lecture recapitulates a series of presentations given at several different forums in the Northwest Territories, Yukon Territory, Alaska, Alberta and Saskatchewan between 1996-2001 and reflects the author’s 35+ year experience as a “student of wildland fire”. These presentations were designed to heighten the awareness about the wildfire threat to community safety and to propose possible long-term solutions that would possibly mitigate against the chances of a northern community being exposed to a high-intensity crown fire occurrence that so readily typifies the boreal forest fire regime. Using existing knowledge acquired from research studies and operational experiences, the topics covered with illustrative photos, graphs and video footage (e.g., 1996 Millers Reach Fire, Alaska) included historical fire incidence, fire ecology and fire behavior principles, and the physical limits of fire suppression effectiveness. The concept of catastrophic fire prevention through fuels management as a means of achieving harmony with nature was advanced on the basis that the elimination of ignition risk in the WUI was not foreseen at possible and that addressing the “fuel” component of the fire environment triangle offers the only possible course of action left open. This may involve logging and/or prescribed burning, including high-intensity crown fires. The ultimate intent of undertaking these presentations was to galvanize local community support to lobby local, territorial or provincial, and federal government bodies to initiate development of fuel-vegetation management plans at the stand and landscape scale that would ensure that northern communities could minimize the impact and/or their exposure to the incidence of a wildfire burning under extreme fire weather conditions.

While it does seem theoretically possible to completely eliminate the threat of at least human-caused conflagrations, this is unlikely to happen. Even with the most highly effective fire prevention, fuels management and fire suppression programs, it seems that the possibility of members of the public will encounter a high-intensity wildfire event at some point in their lives is ever increasing as long as they continue to live, recreate, and work in a fire-prone environment such as the boreal forest. Co-existence or living with fire involves taking a proactive stance, including being prepared for the day when wildfire comes knocking!

# This presentation is largely based on a dozen or so presentations made in communities across the western Canadian boreal forest from 1996 to 2001

## Forest fire expert comes to Smith with message

*Changing composition of local forests the key to preventing devastating wildfires, fire researcher says,*

by Darren Campbell

The threat of a forest fire which could wipe out an entire community is a real one in the Northwest Territories. But one expert in the field believes communities have to look at a different way of fighting them.

That is the message Edmonton-based Fire Research Officer Marty

Alexander brought to Fort Smith last week. Alexander was in town to give two seminars to the volunteer fire department and the GNWT Forest Management Division about defending against out-of-control crown fires.

Alexander's main message was simple: less flammable forests reduce the risk of forest fires that can

threaten communities. Alexander, who has 21 years of experience in the field, said if communities like Fort Smith can change the kind of trees that grow in the forest surrounding them, they can reduce the risk of a major fire happening.

"With the flooding going on in Manitoba, there is very little they can do to prevent the damage. In

natural disasters like hurricanes and tornadoes very little can be done," he said. "But with forest fires, if you can create a forest not prone to high intensity crown fires, that can help a lot."

Alexander pointed out that most communities in the territories depend on fireguards just outside of town and the local fire departments to fight forest fires near towns. However, because fires can spread at a rate of two-to-four kilometres an hour, there is not much local departments can do once the fire is out of control. Alexander said changing the kind of trees that grow in the area can save a town.

Alexander said the answer to preventing these fires is to have a forest with more hardwood trees and less conifers. Hardwood trees include birch, aspen and

rounding Fort Smith has a large percentage of conifers.

Hardwood trees are not prone to catch fire and when they do, the fires are usually of low intensity. Alexander noted if you have a forest with many of these trees, the chance of a major fire is reduced.

"There are still going to be fires," he said. "But what we're trying to do is eliminate the number of large destructive fires."

In the territories, large forest fires are a fact of life and they can threaten communities. Alexander said it happened in 1995, when a crown fire almost reached Fort Norman. What towns like Fort Smith have to do he said is create a situation where a forest fire is not a threat to the town.

"These things keep happening and the outcomes might not be successful in the future," he said. "Is it



with the support of

Industrie Canada Industry Canada

Yukon  
Tourism  
Heritage Branch  
Doug Phillips, Minister

presents

# FIRES IN THE BOREAL FOREST

## WHAT HAPPENS WHEN THE TREES BURN?

by **MARTY ALEXANDER**  
Fire Research Officer, Canadian Forest Service

Forest fires have been a part of the boreal forest ecosystem since trees appeared on the land. We are beginning to understand how fire has shaped and sustained the boreal forest and we now realize that the boreal forest depends on fire to remain healthy over the long term. Marty Alexander will discuss natural fire regimes and the implications for forest and ecosystem management.

**WHITEHORSE SUNDAY, APRIL 14**  
7:30 p.m. Westmark Whitehorse

THANKS TO OUR MAJOR LECTURE SERIES SPONSORS:

Yukon News Westmark Whitehorse Innovators in the Schools

ADMISSION IS FREE AND OPEN TO ALL  
Coffee and tea will be provided at all the lectures.  
For more information please call 667-2979.

# BOREAL FOREST

# **“Road Map” to Presentation**

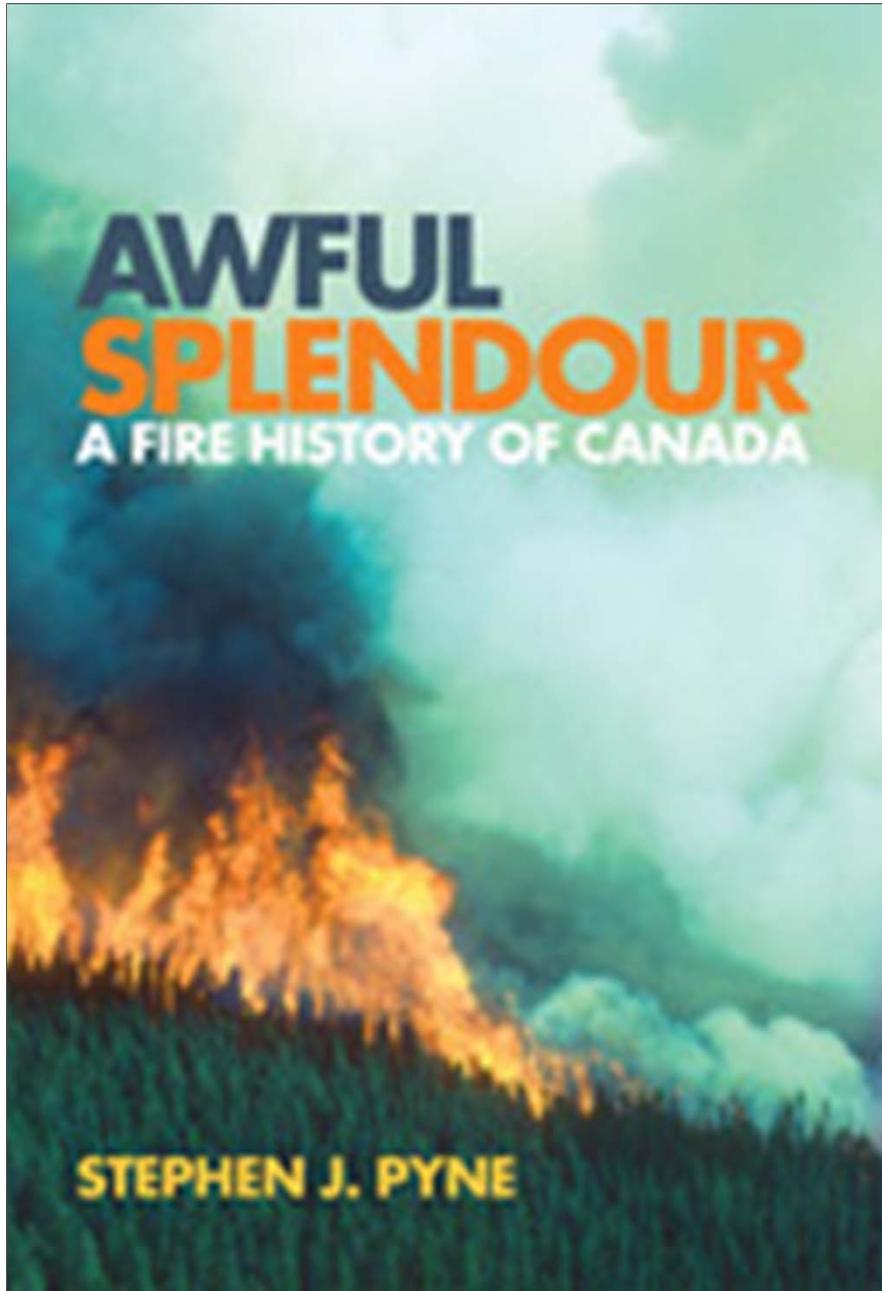
- Wildland Fire and the Canadian Landscape**
- The Harsh Realities of Wildland Fire**
- Wildland Fire Behavior 101**
- Fire Behavior and the Connection to Fire Suppression**
- The Concept of Fuels Management**
- Pragmatic Take-home Messages**

# **Wildland Fire and the Canadian Landscape**

# Basic National Fire Statistics

- **8600 fires have burned about 2.5 million hectares annually since 1980**
- **Lightning responsible for ~ 50% of the fires but about ~ 85% of the area burned (mainly June-July)**
- **Fire management expenditures have reached \$500-600 million annually and are growing**





Published in spring of 2007

**“Fire is a defining element in Canadian land and life.**

**With few exceptions, Canada’s forests and prairies have evolved with fire.**

**Its peoples have exploited fire and sought to protect themselves from its excesses, and since Confederation, the country has devised various institutions to connect fire and society.”**

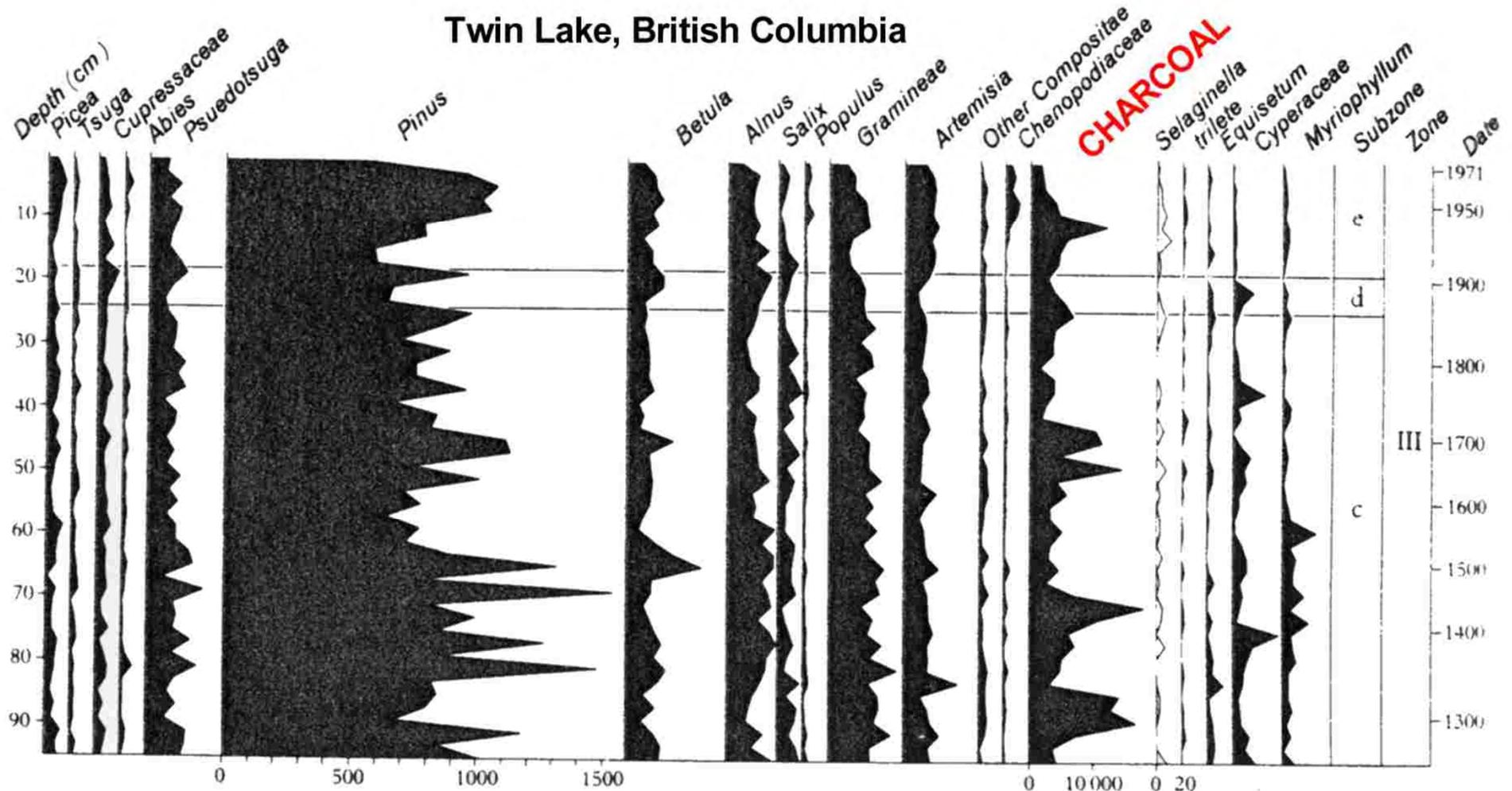
# Fire is a “Pervasive” Force:

(pervasive – tending to pervade or spread throughout)

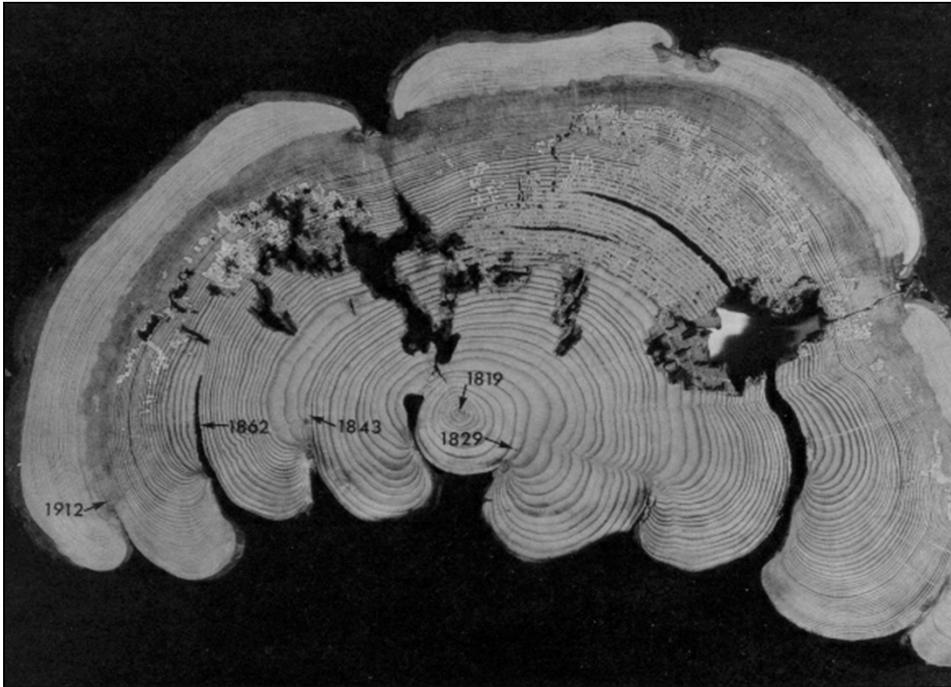


**Serotinous  
cones of jack  
pine  
following  
crown fire**

- **evolutionary fire adaptations**



- charcoal deposits in lake sediments dating back hundreds of years



**Cross-section of lodgepole pine in Jasper National Park showing fires in 1825, 1842, 1862, and 1912.**

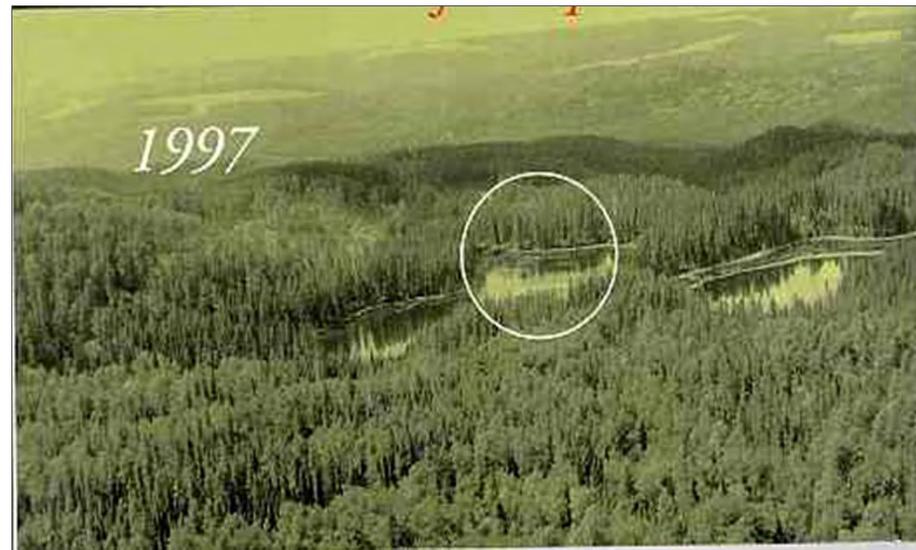


- **basal fire scars on trees**



**Wildhay Valley – 1912:  
without forest  
protection**

**Wildhay Valley – 1997:  
with forest protection**

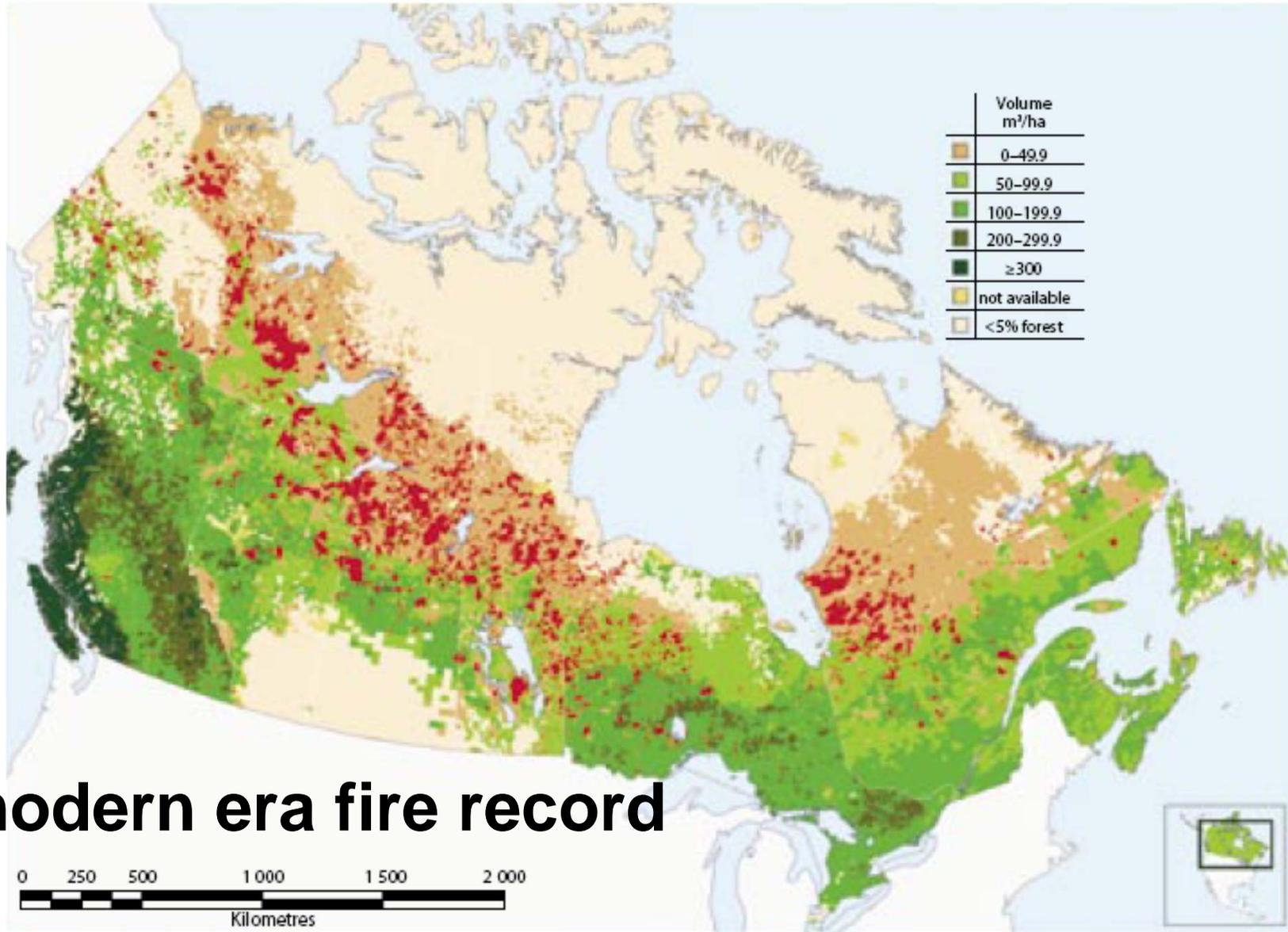


- **historical photographs & repeat photography**



- **written accounts (e.g., diaries), paintings**

# Area Burned by Wildfires Greater Than 200 Hectares in Size, 1980-2001 (in red) in Relation to Timber Volume



- modern era fire record

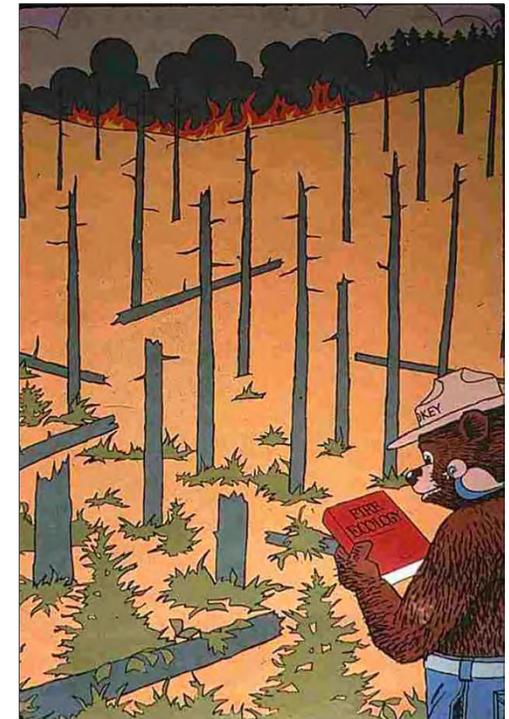


**What happens when a forest burns?**

# Roles of Fire as an Ecological Process:

(from Wright and Heinselman 1973)

- Fire influences the **physical-chemical environment**
- Fire controls **plant species and communities**
- Fire regulates **dry-matter production and accumulation**
- Fire determines **wildlife habitat patterns and populations**
- Fire influences **insects, parasites, fungi, etc.**
- Fire controls **major ecosystem processes and characteristics**



# Fire's Dichotomous Role

A prescribed fire can, if properly executed, accomplish many beneficial purposes. On the other hand, it may actually be damaging, **depending on the time of year and the fire's behavior**. For example:

## Prescribed Fire Can:

1. Reduce flammable fuels
2. Remove organic matter
3. Expose mineral soil
4. Kill viable seeds in duff
5. Kill understory species
6. Reduce insect numbers
7. Kill pathogens
8. Increase soil nutrient availability
9. Open serotinous cones
10. Thin overstocked stands

## Or it May:

- Eventually increase fire hazards
- Contribute more
- Permit it to erode
- Stimulate germination
- Cause their roots to sprout
- Enhance insect environment
- Provide entry for fungi
- Reduce soil water-holding capacity
- Destroy other seed sources
- Promote overstocking

# **The Harsh Realities of Wildland Fire**

# Fire is a Threat to Human Safety and other Values-at-Risk



**The WUI fire problem in Canada is not  
new issue *per se***



Dawson City, Yukon, 1898

# 1916 – Matheson Fire - NE Ontario

~ 300 fatalities



Mass graves

# Fire Protection in the Formative Years



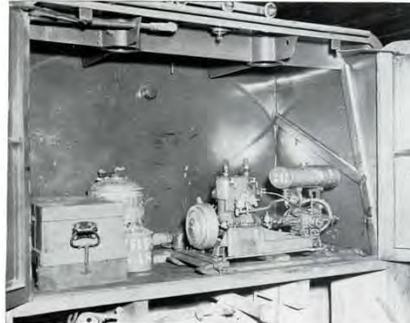
AERIAL DETECTION CONTROL CENTRE AT CAMPBELLTON



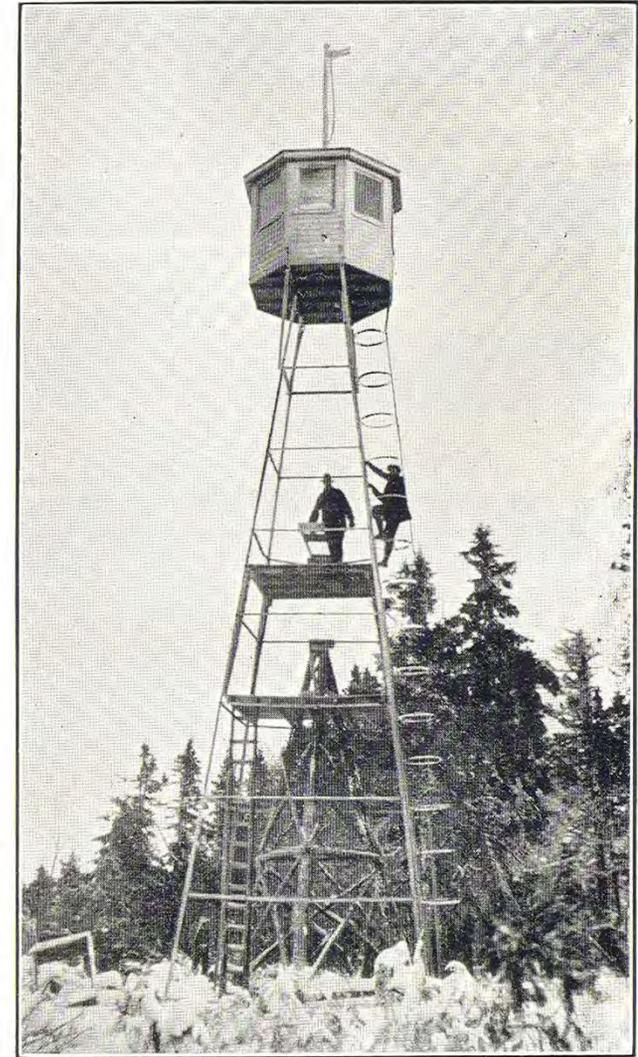
The Back Tank, an important weapon on the fire line



Tanker with Tandem drive rear axles. These are more satisfactory to woods roads than single rear axles on the dual wheels.



PUMP ATTACHED TO TANK READY FOR IMMEDIATE USE IN FOREST FIRE CONTROL



Steel Tower erected on Blue Mountain in 1923. Blue Mountain is situated at the head of the Benjamin River in Restigouche County. Elevation 1800 feet. Twelve miles of woods telephone line was built. The Geodetic Survey co-operated in the erection of the Tower and the Louison Lumber Company in the free use of their five mile private telephone line.

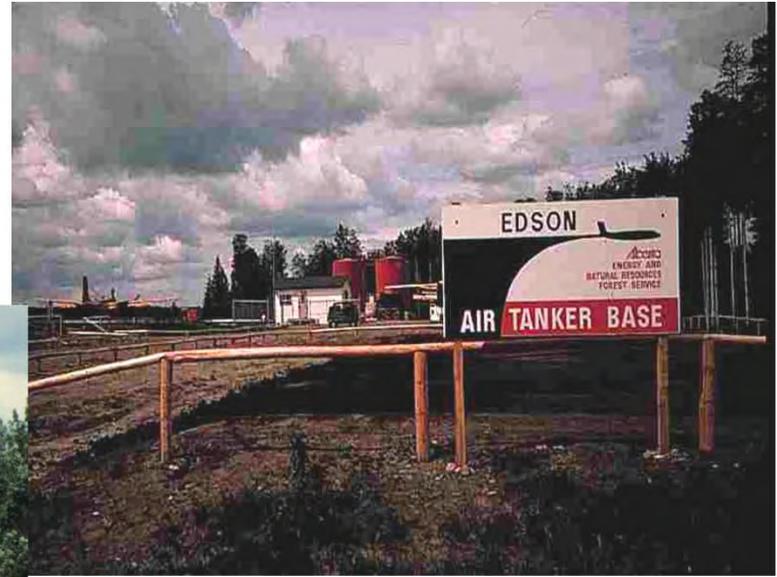


Beaver aircraft equipped with amphibian landing gear under contract by Department of Lands and Mines for forest fire patrol.



Field Kitchen at Forest Fire

# Modern Era Fire Protection Today



**Is it not possible to simply eliminate wildfire?**



The goal of fire prevention  
is to reduce fire occurrence

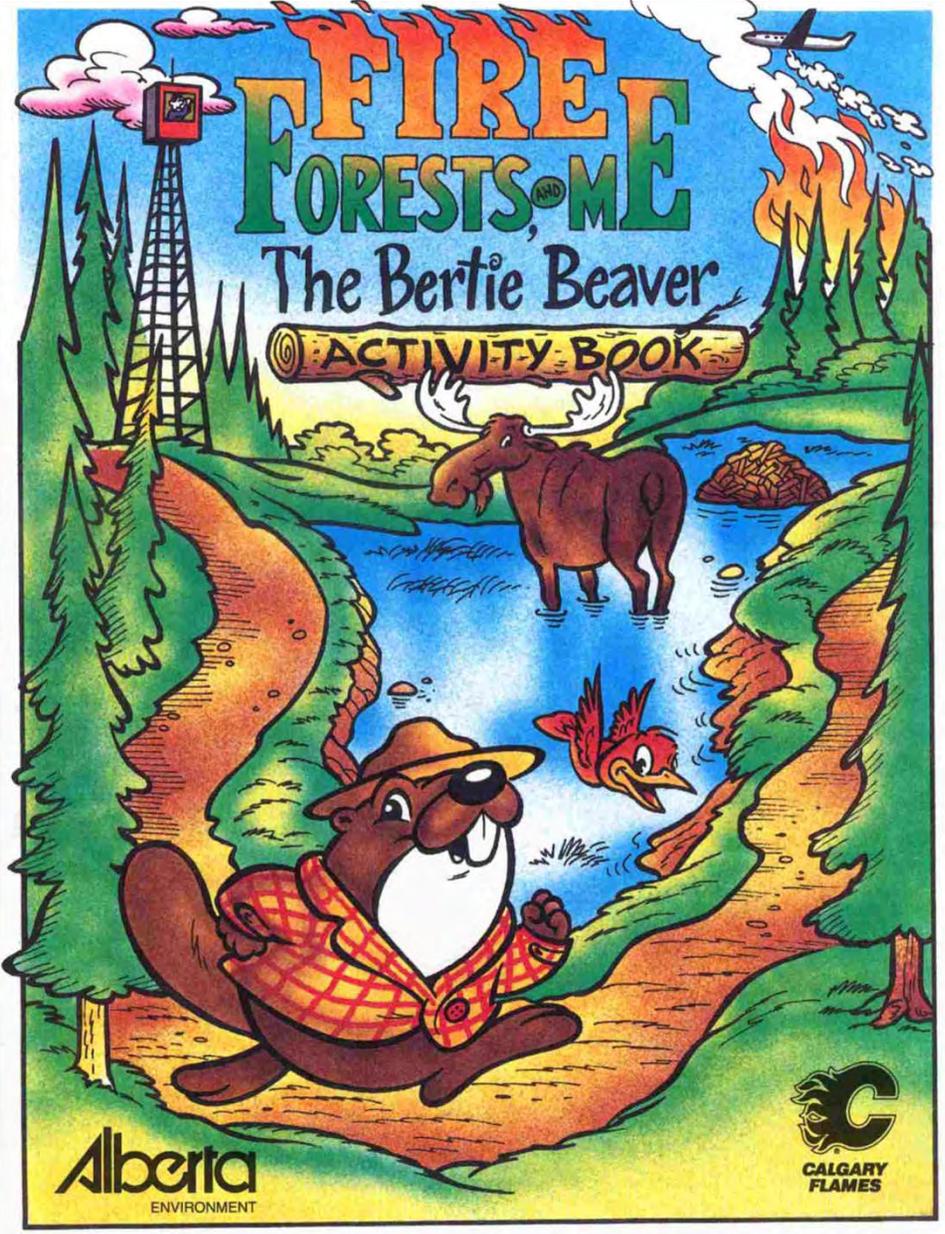
**FIRE**

THE GOVERNMENT OF CANADA  
REQUESTS YOUR CO-OPERATION  
IN PREVENTING FOREST FIRES

FIRES WHICH THREATEN  
DAMAGE SHOULD BE PUT OUT IF POSSIBLE  
OTHERWISE REPORTED AT ONCE TO THE  
NEAREST GOVERNMENT OFFICER

MINISTER OF MINES AND RESOURCES

**FIRE**  
**FORESTS AND ME**  
The Bertie Beaver  
ACTIVITY BOOK



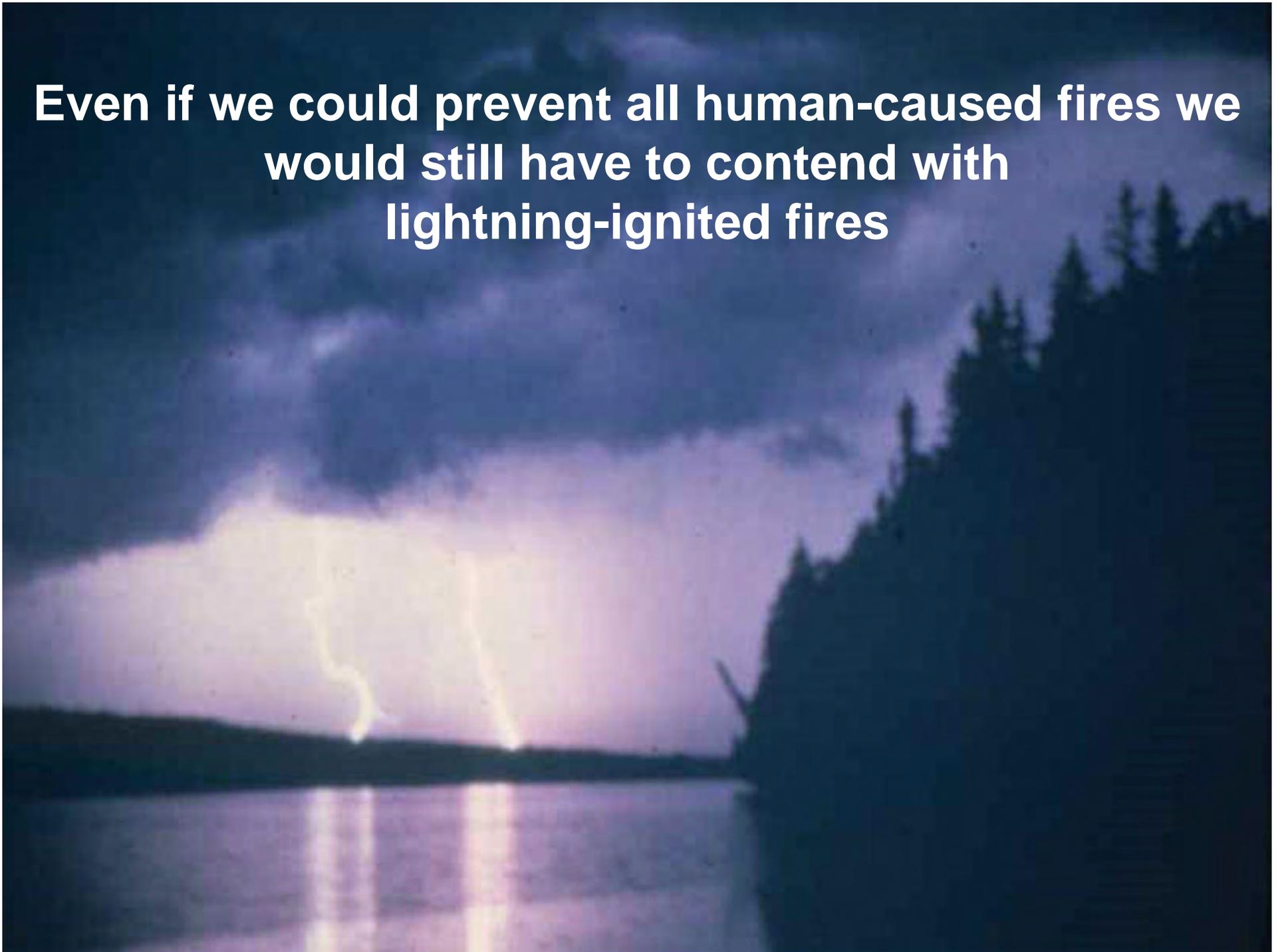
Alberta  
ENVIRONMENT

CALGARY  
FLAMES

**Every human-caused fire is a fire prevention failure!**



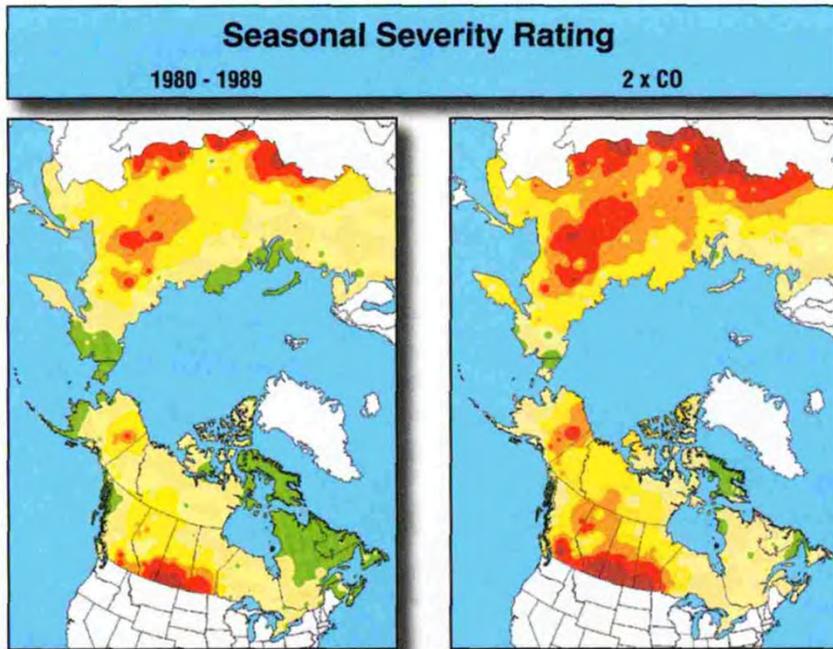
**Even if we could prevent all human-caused fires we  
would still have to contend with  
lightning-ignited fires**





**Is it realistic to expect we can control all fires before they reach conflagration levels?**

**... especially in light of increasing frequency of severe fire weather and forest health issues**

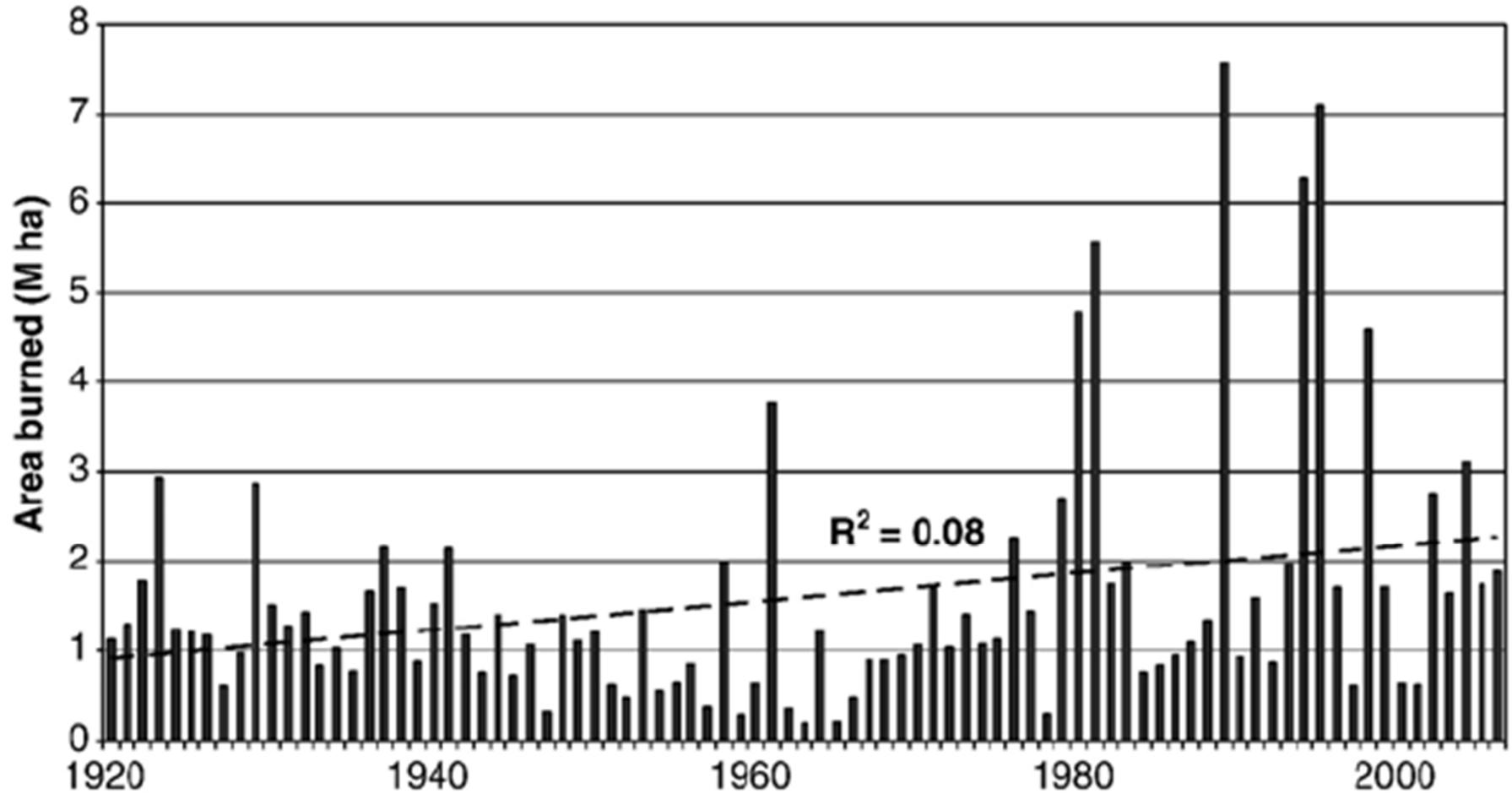


*General circulation model-projected changes in circumpolar fire danger levels with a doubling of atmospheric carbon dioxide.*



Crown fire in mountain pine beetle infested forest

# Is Wildfire Activity Increasing?



# The growing number of wildland-urban interface fires is compounding the problem



# Halifax – April 2009





**Socially irresponsible to jeopardize the safety of firefighters in the wildland/urban interface because of homeowner expectations regarding fire protection**



**THE BEST FIRE COVERAGE  
ON THE MARKET.**

**THE LAST WORD ON YOUR FIRST LINE OF DEFENSE.**

When wildfires threaten people and property, the need for an immediate response is paramount to prevent losses. And there is no better tool in aerial firefighting than the Canadair® 415 amphibious aircraft. Period. The Canadair 415 can be on its way within minutes. Skimming the water surface, it scoops over 1,600 gallons of water in just 12 seconds, and releases fire-smothering foam with precision, again and again. To learn more about the effectiveness of the Canadair 415, contact us at: P.O. Box 6087, Station Centre-ville, Montreal, Quebec, Canada H3C 3G9. Tel.: 1-514-855-5000. Fax: 1-514-855-7604.

[www.canadair415.com](http://www.canadair415.com)

**BOMBARDIER**  
AEROSPACE



**FASTER THAN FIRE** *canadair 415*

© Canadair is a registered trademark of Bombardier Inc.

***No radically  
new concept  
in fire  
suppression  
can be  
anticipated.***

**Would more  
airtankers  
eliminate the  
wildfire  
problem?**



# Are these realistic solutions to the wildfire problem?



An  
Introduction to  
**FIRE  
DYNAMICS**



Dougal Drysdale

***“ ... further major advances in combating wildfire are unlikely to be achieved simply by continued application of the traditional methods. What is required is a more fundamental approach which can be applied at the design stage ...***

***Such an approach requires a detailed understanding of fire behaviour ... ”***

**Wildland  
Fire  
Behavior  
101**

# Fire Behavior !

What is it?



Fire behavior is defined as the manner in which fuel ignites, flame develops, fire spreads and exhibits other related phenomena as determined by the the **fire environment**.

# The Fire Environment Defined

*The surrounding conditions, influences and modifying forces of topography, fuel and fire weather that determine fire behavior.*



# Fire Environment Factors

## Fuel Characteristics:

- Quantity
- Moisture
- Size & Shape
- Depth/Height
- Arrangement



## Weather Characteristics:

- Wind Speed & Direction
- Relative Humidity
- Air Temperature
- Rainfall Amounts & Duration
- Cloud Cover
- Atmospheric Instability



## Topographic Characteristics:

- Slope Steepness & Aspect
- Elevation
- Configuration
- Barriers to Fire Spread

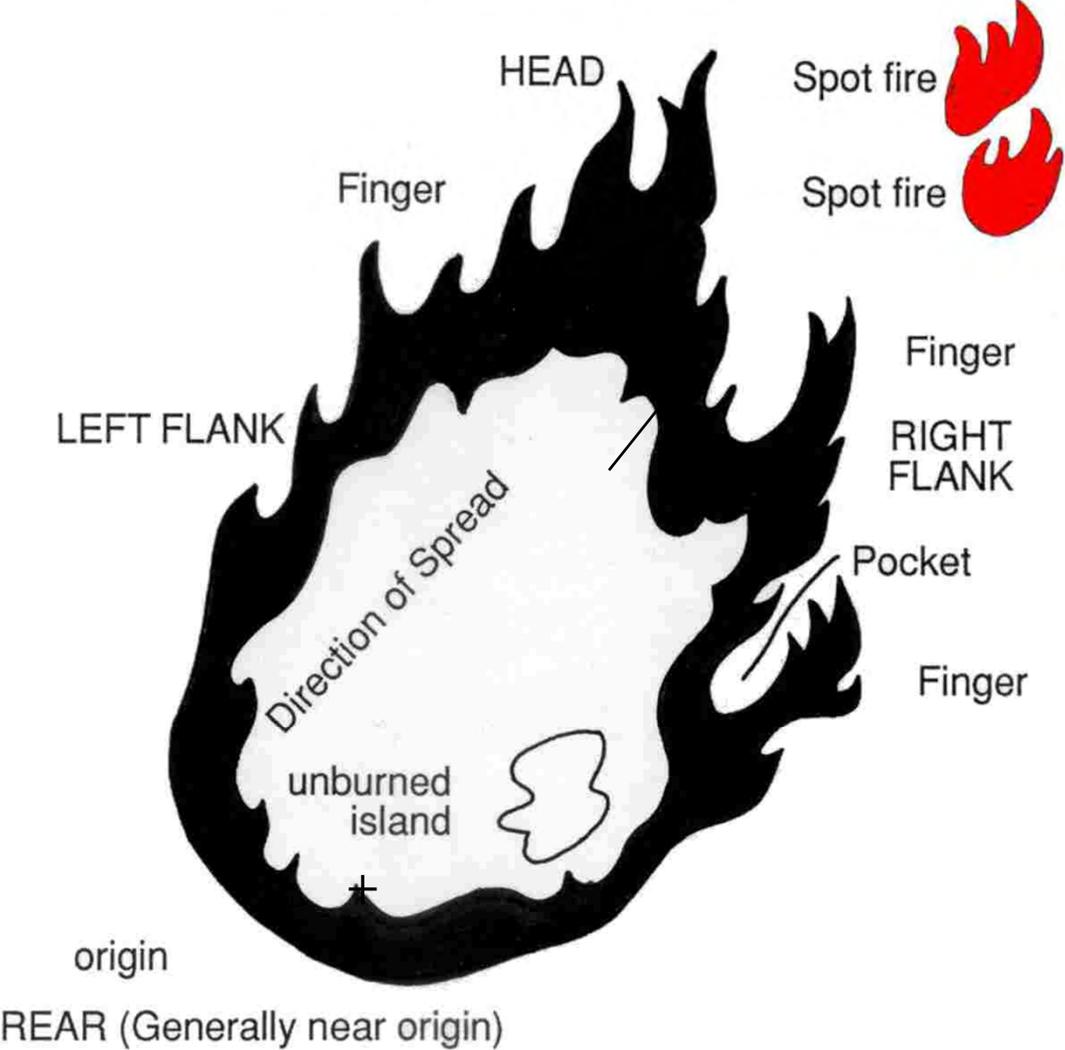


# The more important fire behavior characteristics from the practical standpoint of fire suppression are:

- **Forward Rate of Spread**
- **Fire Intensity**
- **Flame Front Dimensions**
- **Spotting Pattern (densities & distances)**
- **Fire Size and Shape**
- **Rate of Perimeter Increase**
- **Burn-out Time**



# PARTS OF A FIRE



**Extreme fire behavior** represents a level of fire activity that often precludes any fire suppression action. It usually involves one or more of the following:

- **High Rate of Spread & Intensity**



- **Crowning**



- **Prolific Spotting**



- **Large Fire Whirls**



- **Well-developed Convection Column**





**What distinguishes wildland fires from structural or urban fires is their horizontal spread potential.**

**Most forest or wildland fires start from a point.**



# Porter Lake Experimental Point Source Fire P2



# Porter Lake Experimental Point Source Fire P2



14 min



**A fire originating from a single point source gradually increases its rate of forward progress until a rate of spread approaching an equilibrium steady state is reached.**

# Basic Features of a Wildland Fire:

**It spreads ...**



**it  
consumes  
or  
“eats” fuel  
and ...**



**it produces  
heat energy  
and light in  
...**



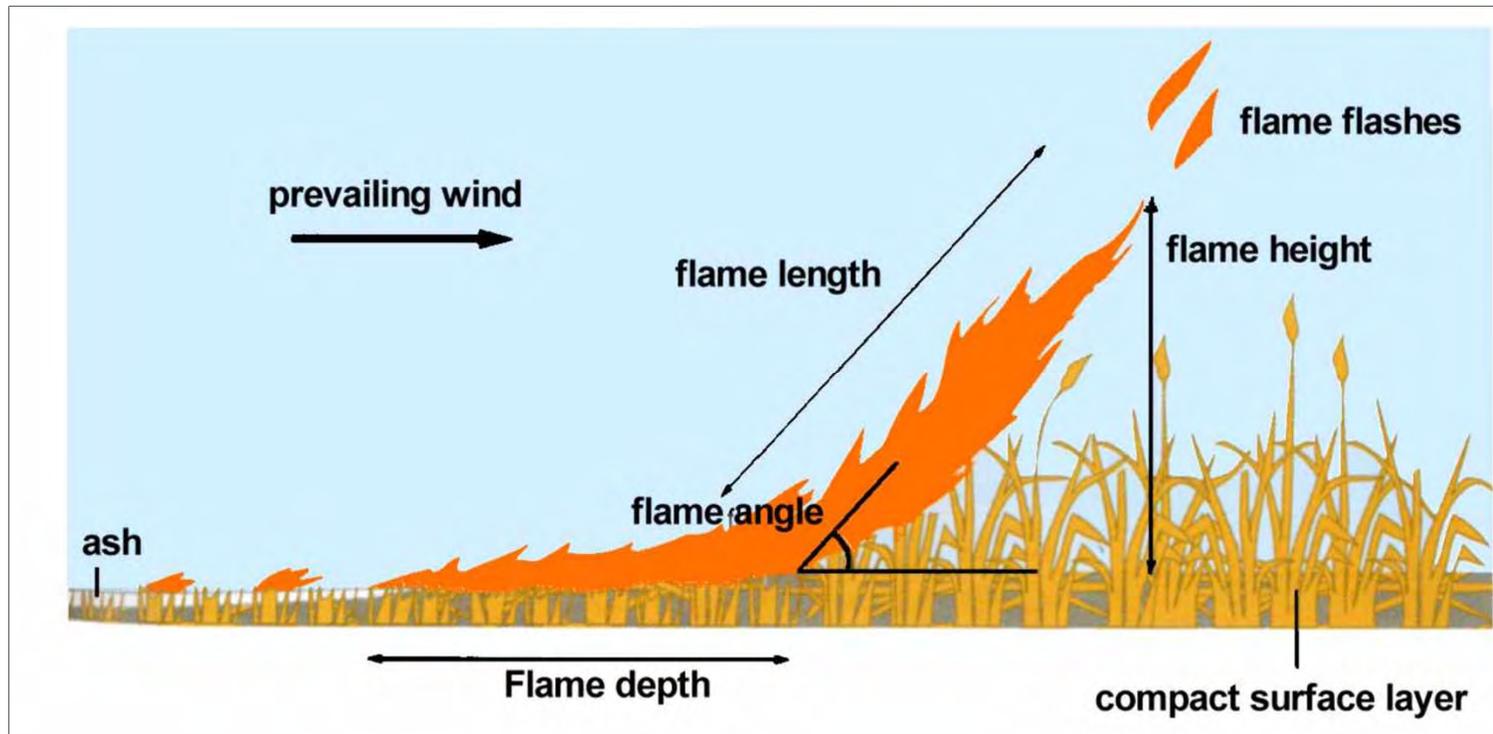
**... a visible  
flaming  
combustion  
reaction.**



**The transition from a surface fire to a crown fire is obviously of great interest and concern to fire managers since crown fires represent a level of fire behavior that normally precludes any direct fire suppression action.**



# Fire intensity is related to size of flames



## Simple Formula for Field Use

$$I = 300 \times (L)^2$$

$L$  = Flame Length (metres)

## Rough Rule of Thumb

**Minimum Firebreak or Fireguard Width  
[in the absence of severe spotting]**

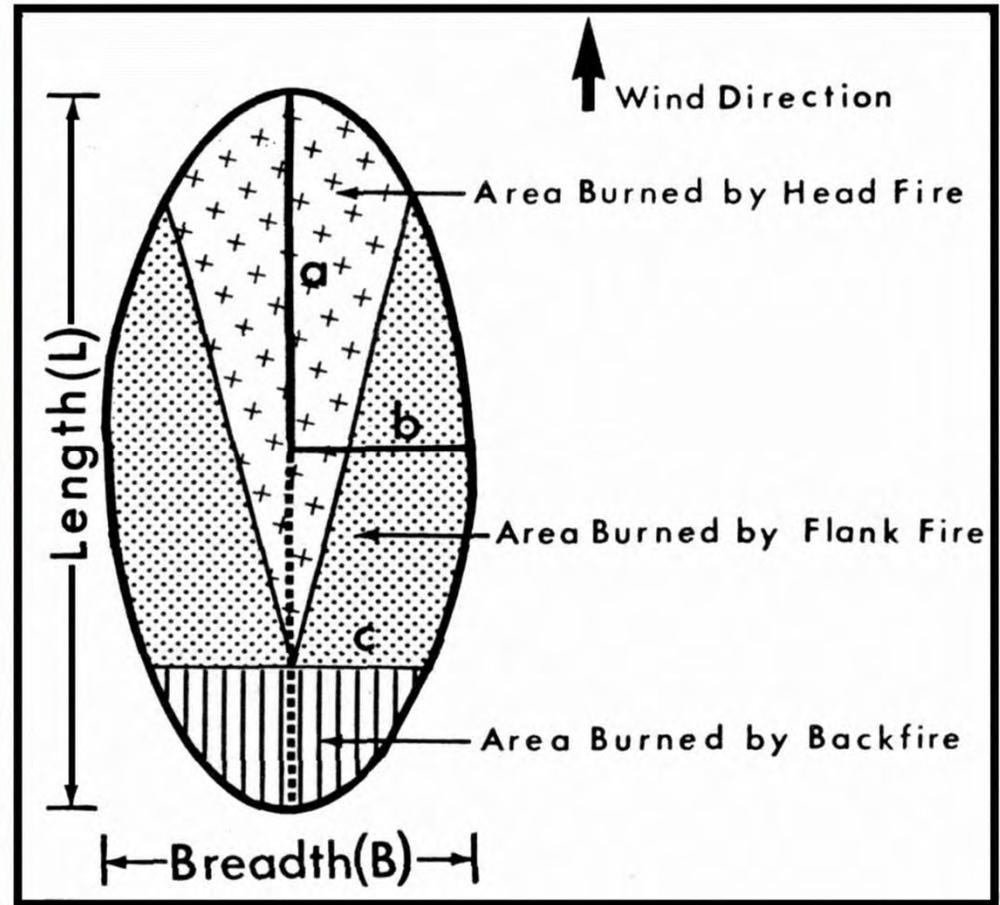
**= Flame Length X 1.5**



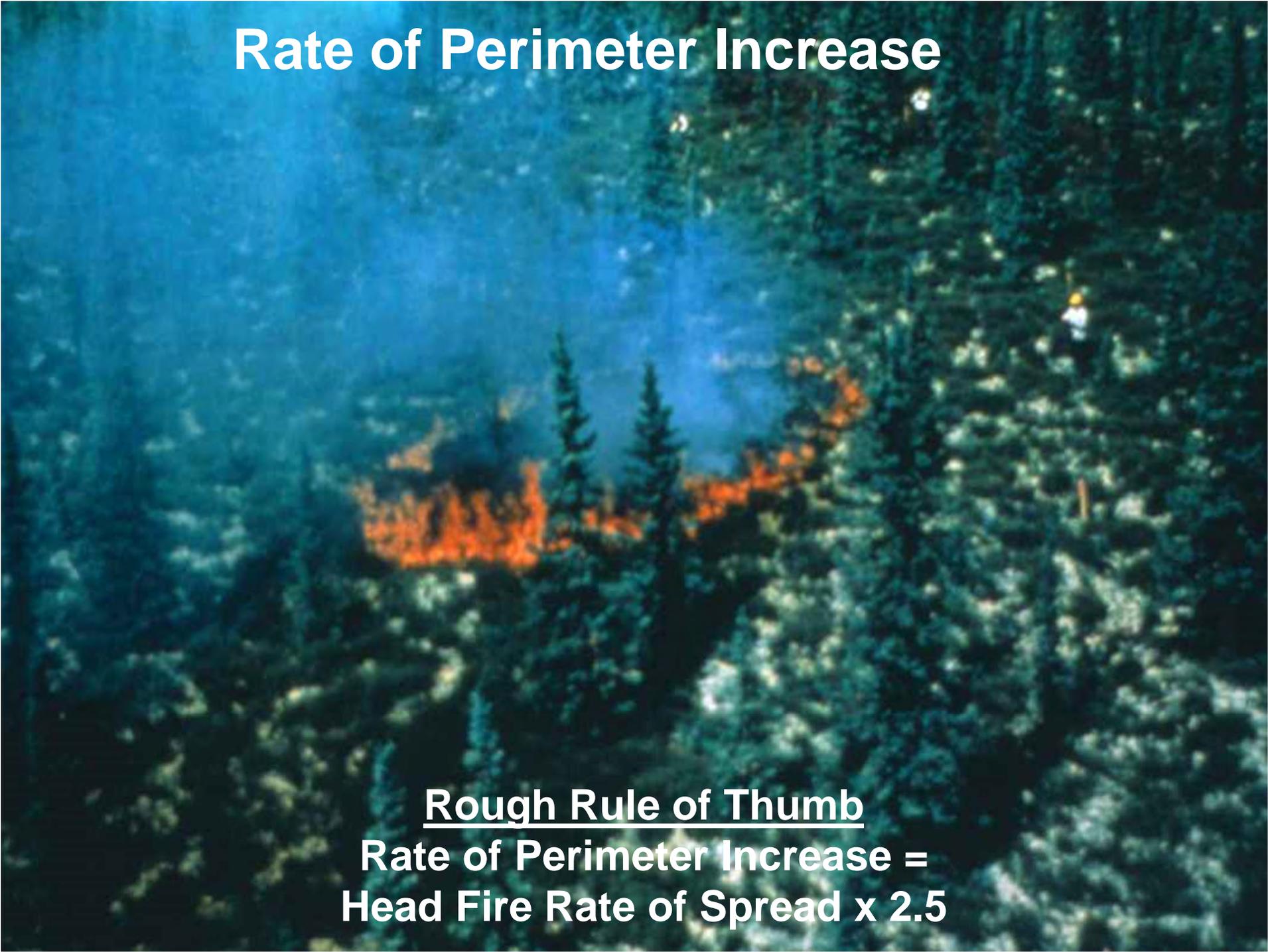
# Spotting Pattern (density and distance)



# Fire Size and Shape



# Rate of Perimeter Increase

An aerial photograph of a forest fire. The fire is visible as a bright orange and red area in the center of the image, surrounded by dark green trees. A red line is drawn around the perimeter of the fire, indicating the rate of perimeter increase. The background is a dense forest of evergreen trees.

## Rough Rule of Thumb

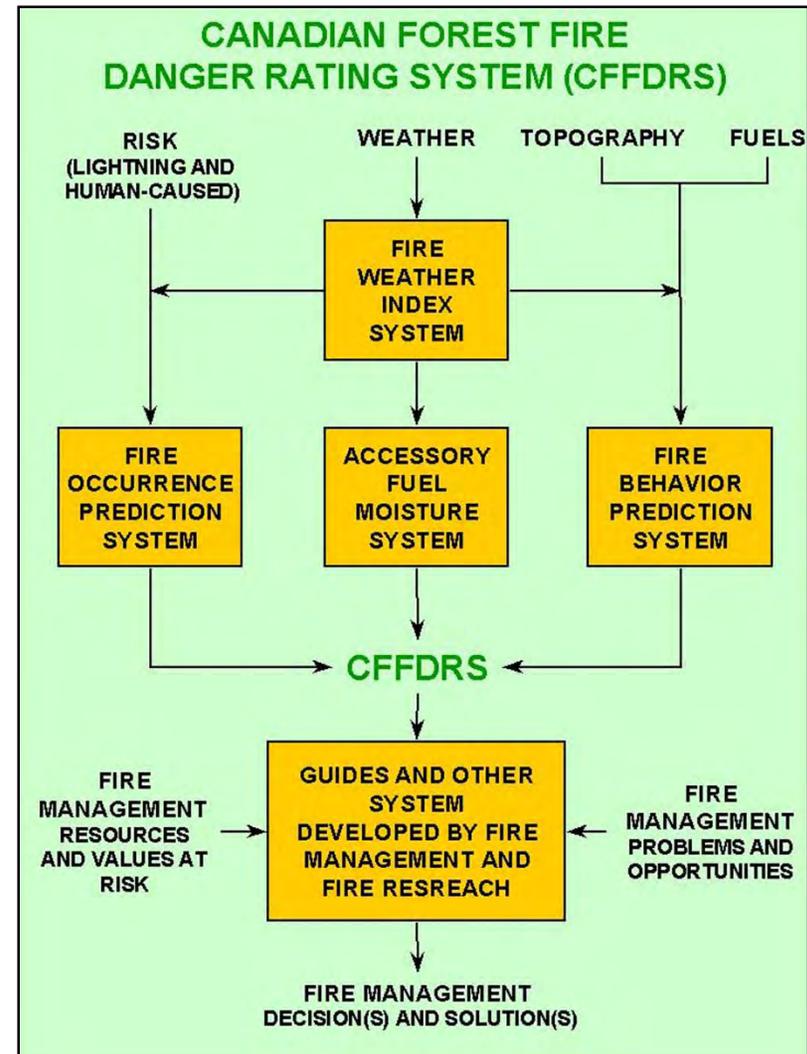
Rate of Perimeter Increase =  
Head Fire Rate of Spread x 2.5

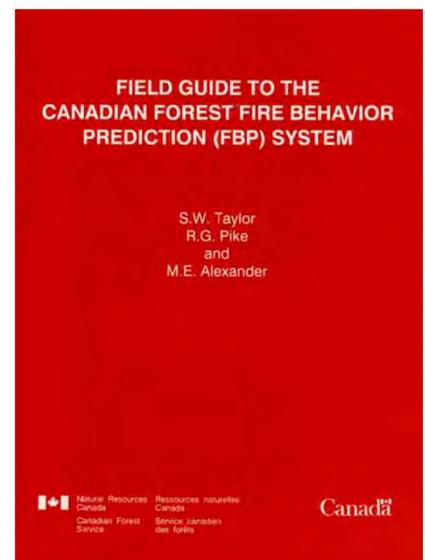
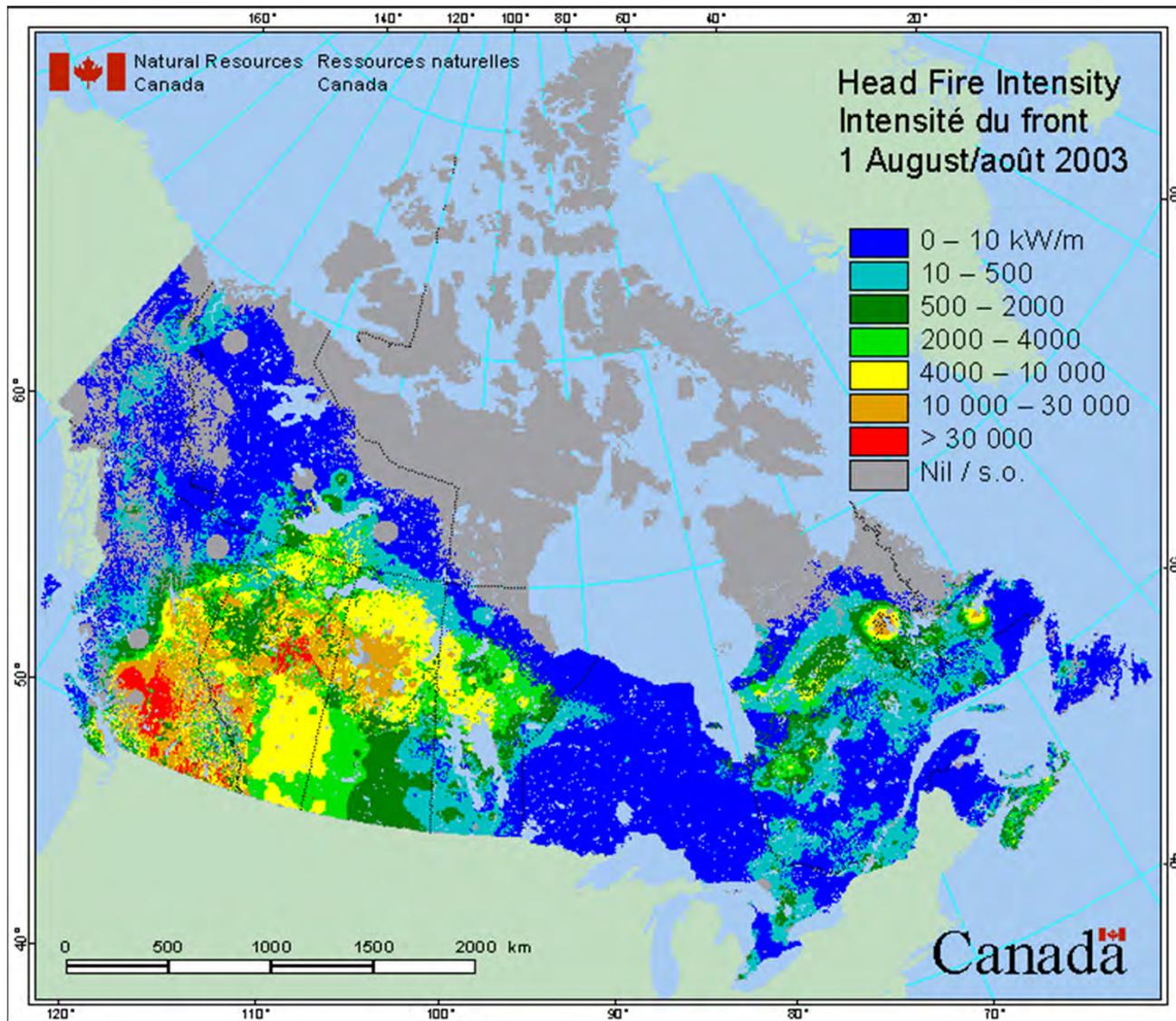


**Burn-out Time**

# Practical Guide to Predicting Fire Behavior

The Canadian Forest Fire Danger Rating System (CFFDRS) includes all the guides to the evaluation of fire danger and the prediction of fire behavior.





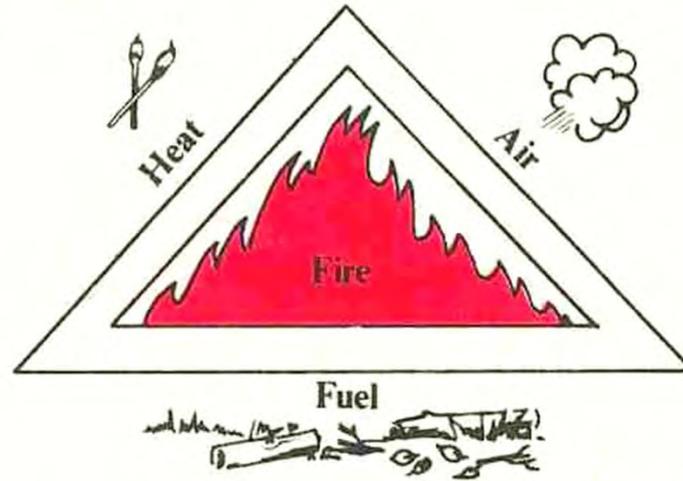
**Fire Behavior  
and the Connection to  
Fire Suppression**

FOR A FIRE TO BURN,  
YOU MUST HAVE...

HEAT

AIR

FUEL



TO STOP A FIRE FROM BURNING,  
YOU MUST REMOVE EITHER...

HEAT

AIR

FUEL





## Fire Intensity

< 500 kW/m

500-2000 kW/m

2000-4000 kW/m

4000+ kW/m

## Minimum Control Requirements

hand tools

water under pressure and/or heavy machinery

helitankers & airtankers using chemical retardants

very difficult to control

**In order to achieve successful fire containment the fireline production rate of the appropriate suppression resource must exceed the rate of perimeter increase**



# Fire behaviour as a factor in forest and rural fire suppression

Martin E. Alexander



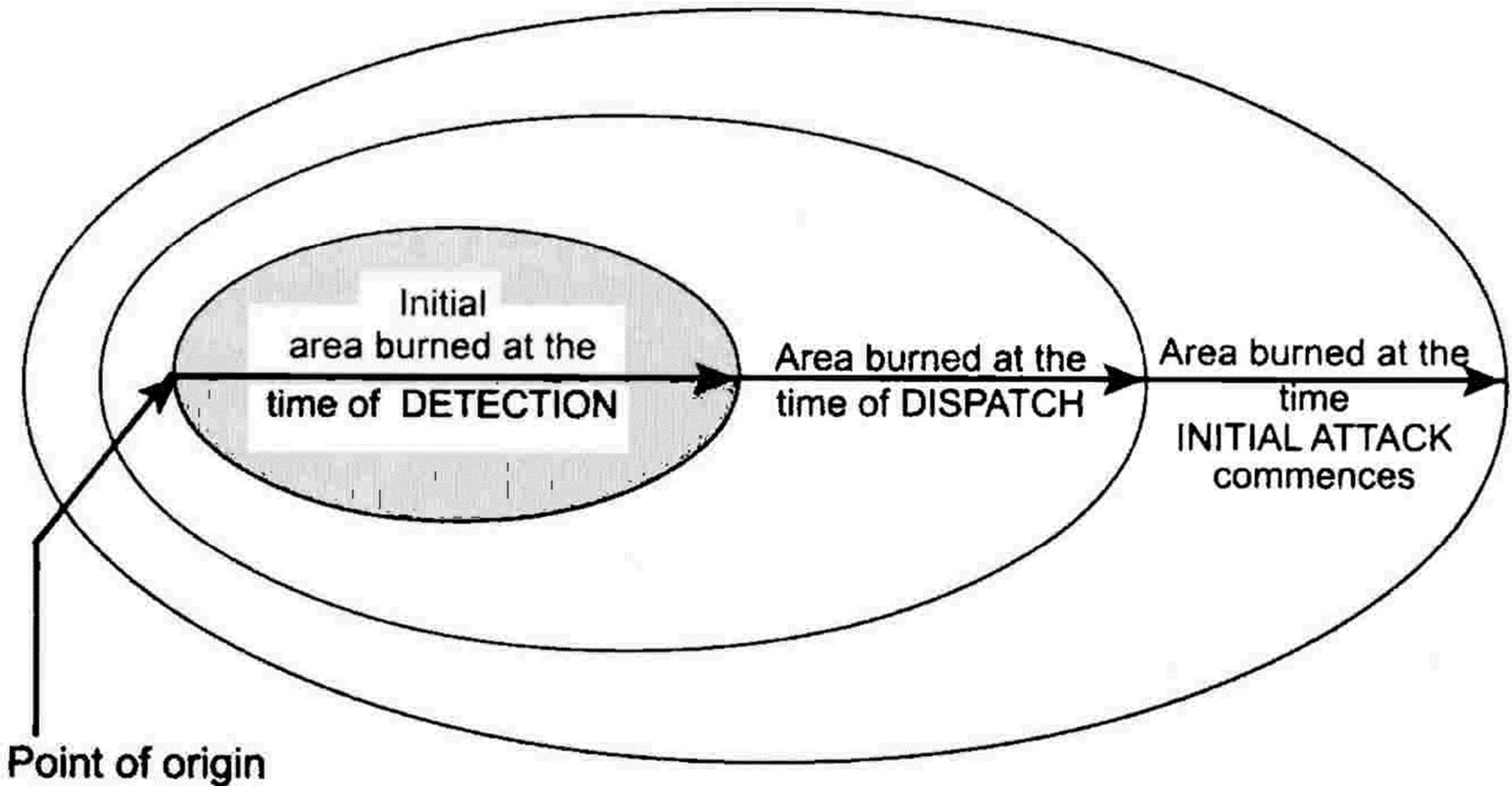
Forest Research Bulletin No. 197  
Forest and Rural Fire Scientific and Technical Series  
Report No. 5

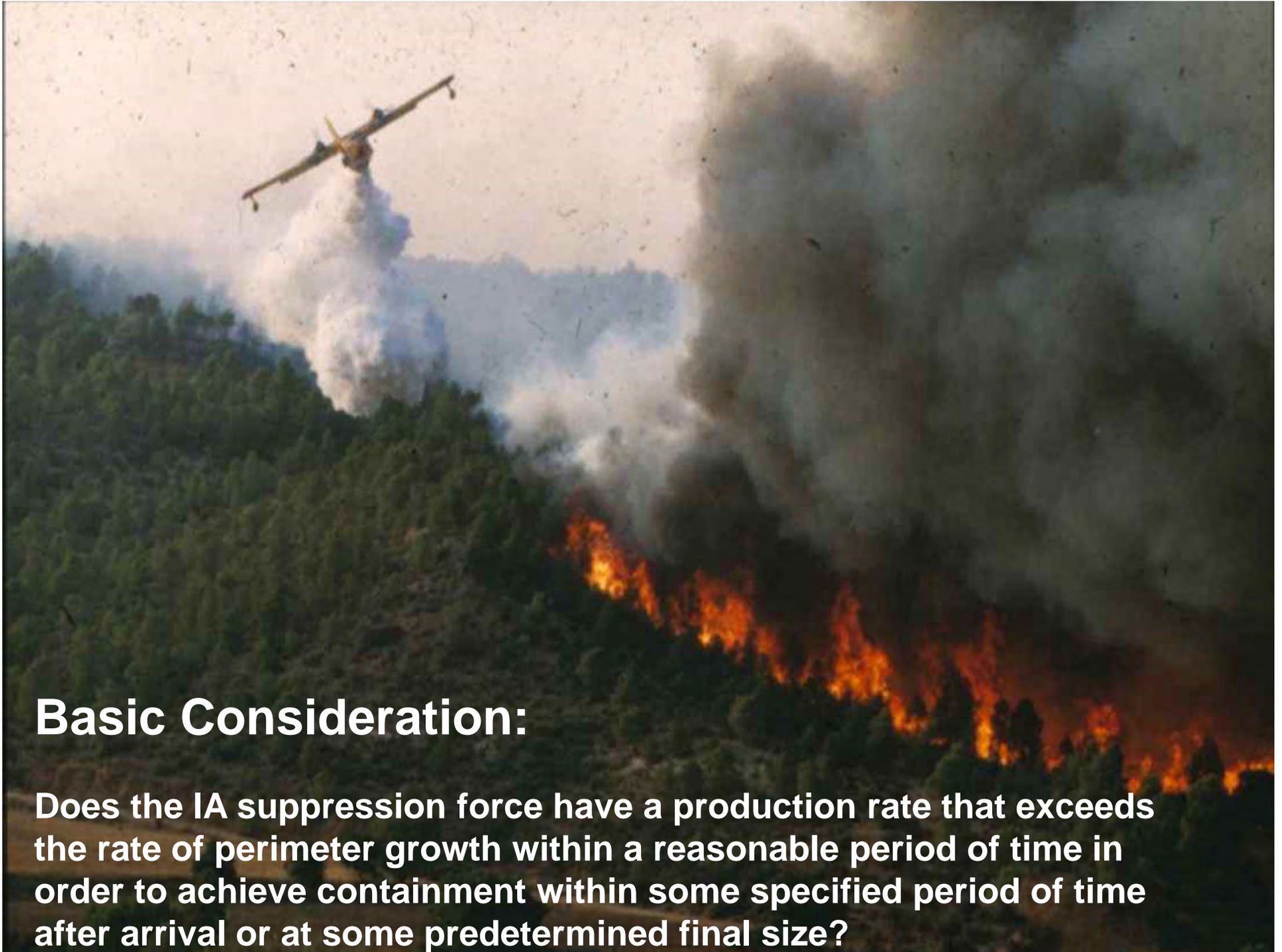


# TIME as a factor influencing fire behavior is not adequately or fully appreciated.



# Free-burning fire growth with the passage of elapsed time since ignition before containment action begins





## **Basic Consideration:**

**Does the IA suppression force have a production rate that exceeds the rate of perimeter growth within a reasonable period of time in order to achieve containment within some specified period of time after arrival or at some predetermined final size?**



**On some days adverse fuel, weather and topographic conditions coupled with an ignition source lead to instances of extreme fire behavior which are impossible to contain until burning conditions ameliorate.**

**So just how can we ever  
hope to possibly accomplish this?**

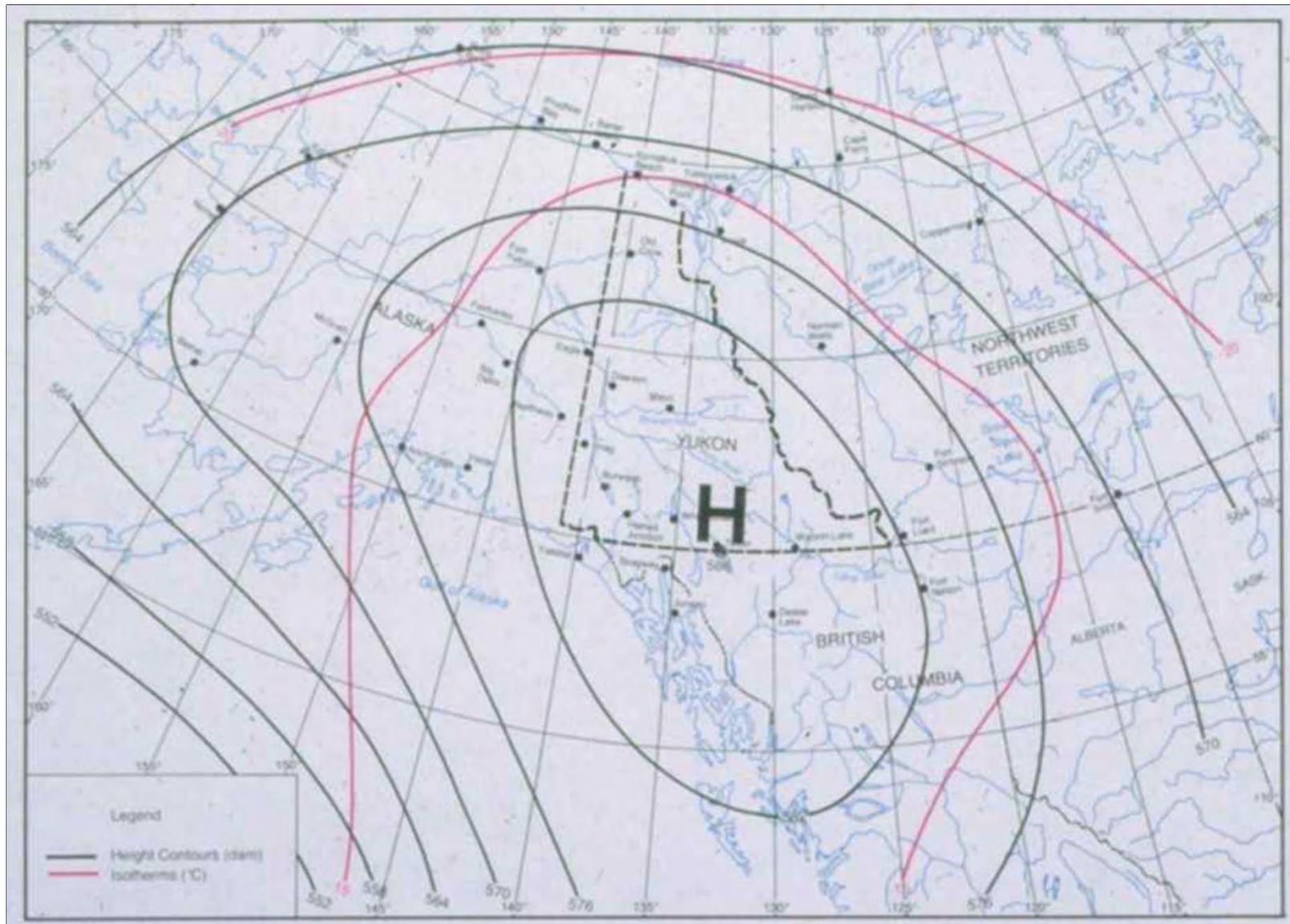


# **The Concept of Fuels Management**

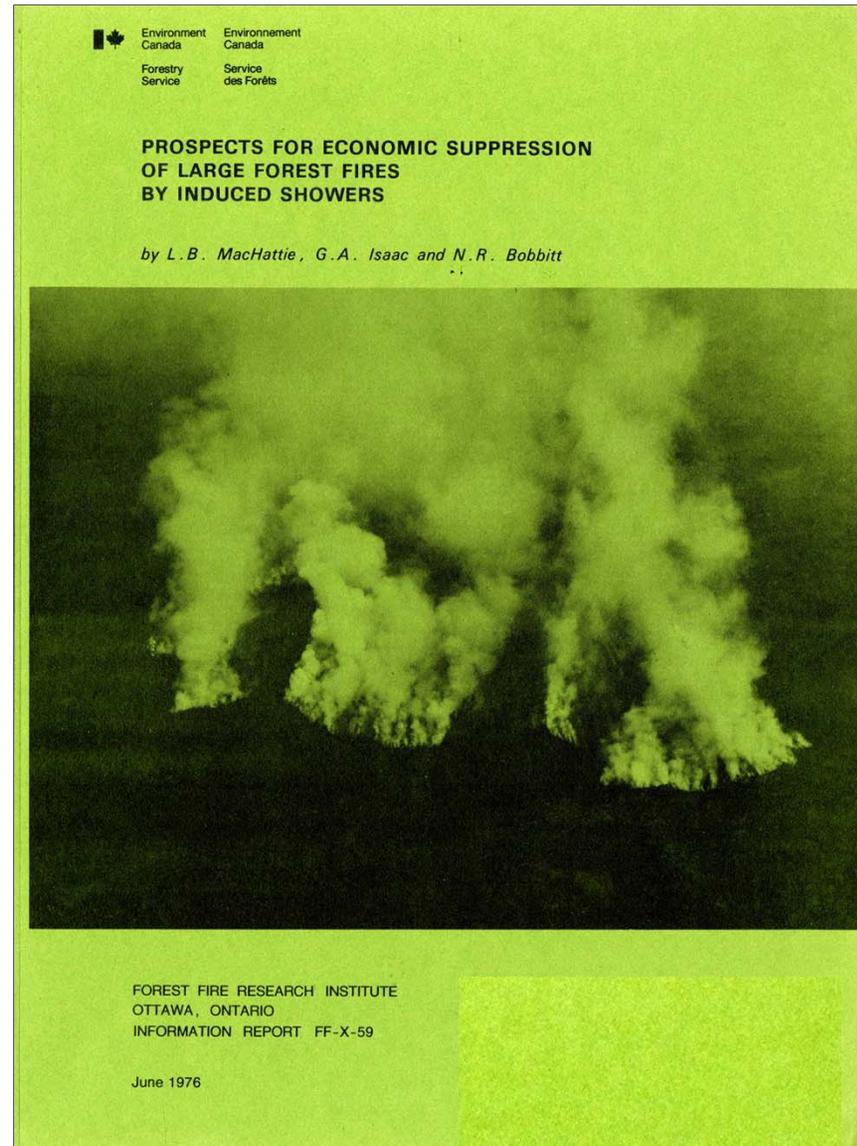
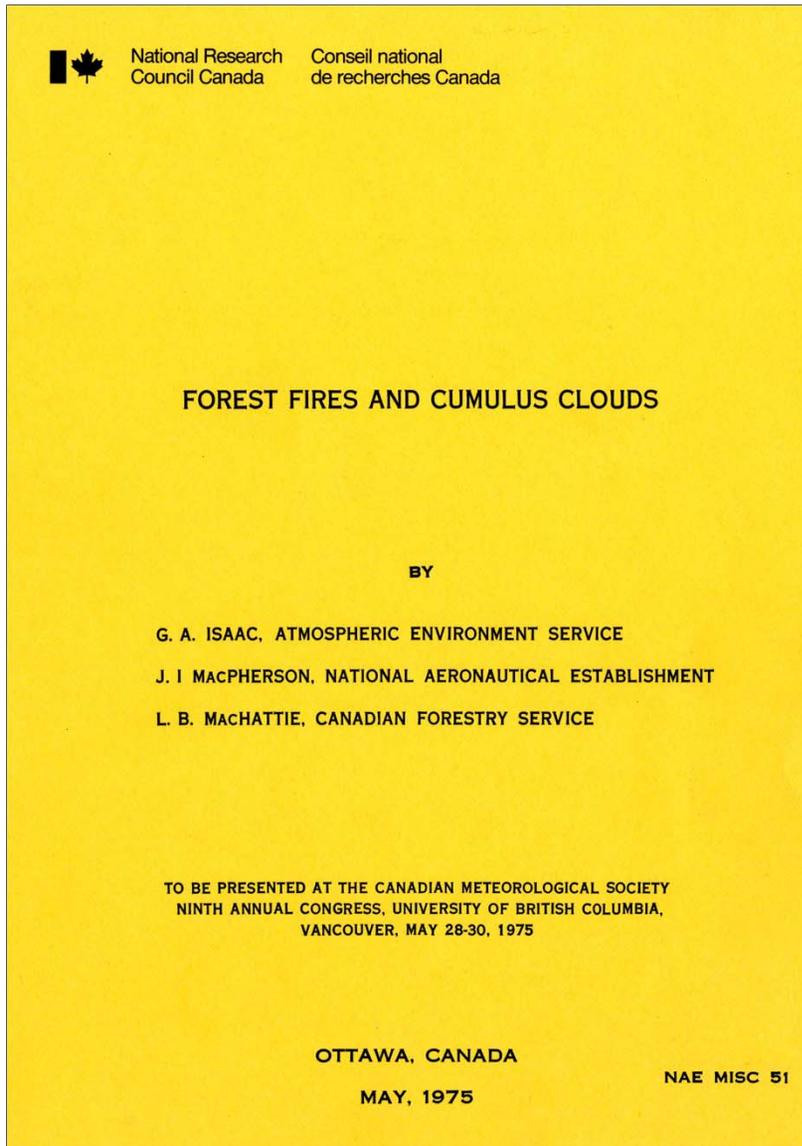
**We cannot readily modify the topographic component of the fire environment**



# Nor can we readily modify the air mass or weather component of the fire environment

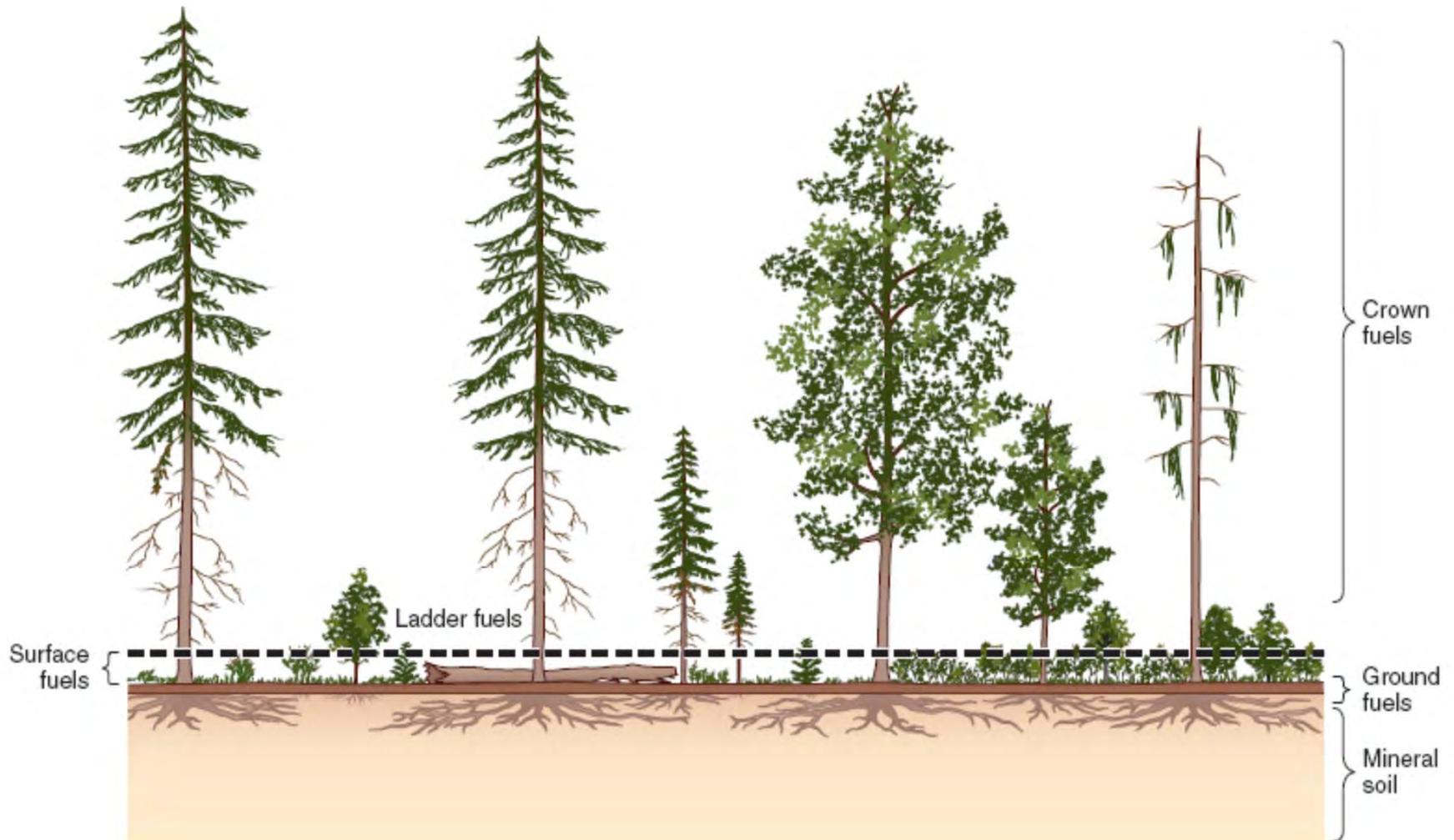


# Or can we?



How about the fuel component of the  
fire environment?

Can we manage the fuels  
(i.e., **Fuels Management**)?





## The **Burning** Question

*The BC forest service is among the best in the world at fighting and preventing fires. The downside of that is becoming increasingly evident.*

By David Holmes

Each year in British Columbia forest fires consume thousands of hectares of forest land, destroying millions of dollars worth of timber in the process. Fire crews, both from industry and those operating under the control of the Ministry of Forests, battle these blazes with all of the resources and technology at their disposal. Over the decades these efforts have saved hundreds of thousands

of hectares of range and forest land from being consumed.

But today a new school of thought is emerging among the ranks of fire fighting professionals, the thought that perhaps all of this manpower and technology may simply be doing too good a job of halting the spread of fire.

"What I now realize is that all we're doing is building up the [potential for] catastrophic wildfires," says Dennis Hutcheson, Manager of the BC Forest

Service's Kamloops Fire Center. According to Hutcheson and many other forestry experts, fire is a natural part of the life cycle of a forest. If fires are prevented, or halted before they can spread through an area, the result can be a tremendous buildup of needles, branches, undergrowth

*Forest fuel cells created by fire prevention efforts create the potential for catastrophic fires and insect attack.*  
(BC Forest Service photo)

**Fire managers are now publicly acknowledging that they need fuels management to assist them in controlling wildfires in the future.**

# What is the Basic Premise Behind Fuels Management?

We cannot really do much to control the **weather** or reshape the **topography** but we can and of influence the quantity and character of wildland **fuels**.



# What is the Purpose of Fuels Management?

The goal is to proactively lessen the potential fire behavior and thereby increase the probability of successful containment and minimize adverse impacts.

More specifically, it's to decrease the rate of fire spread and in turn fire size and intensity as well as crowning and spotting potential.

# Fuels management can be accomplished by three principal means:

- Reduction & Manipulation



- Conversion



- Isolation



A painting of a forest scene. In the foreground, several tall, dark brown tree trunks stand vertically. The ground is covered in a dense layer of dry, brownish-yellow brush and undergrowth. In the background, a bright, hazy light suggests a fire or a very bright sun, creating a warm, golden-brown atmosphere. The overall style is somewhat impressionistic with visible brushstrokes.

## Fuel Reduction

**Some forest types lend themselves to prescribed underburning**

# Fuel Manipulation

**BEFORE**



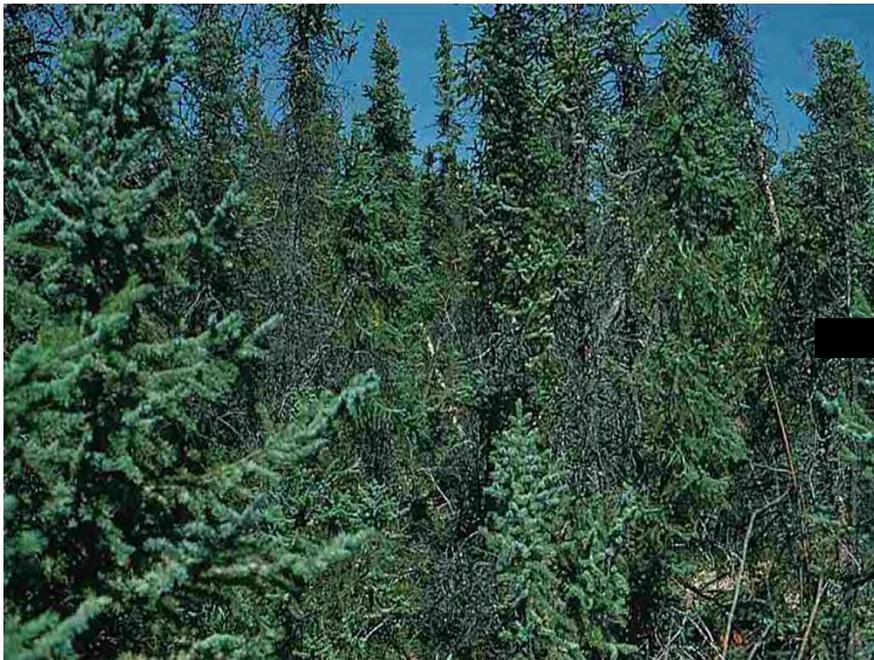
by thinning, pruning and dead-down woody surface fuel removal

**AFTER**

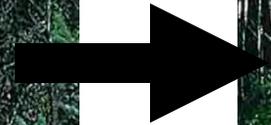


# Fuel Conversion:

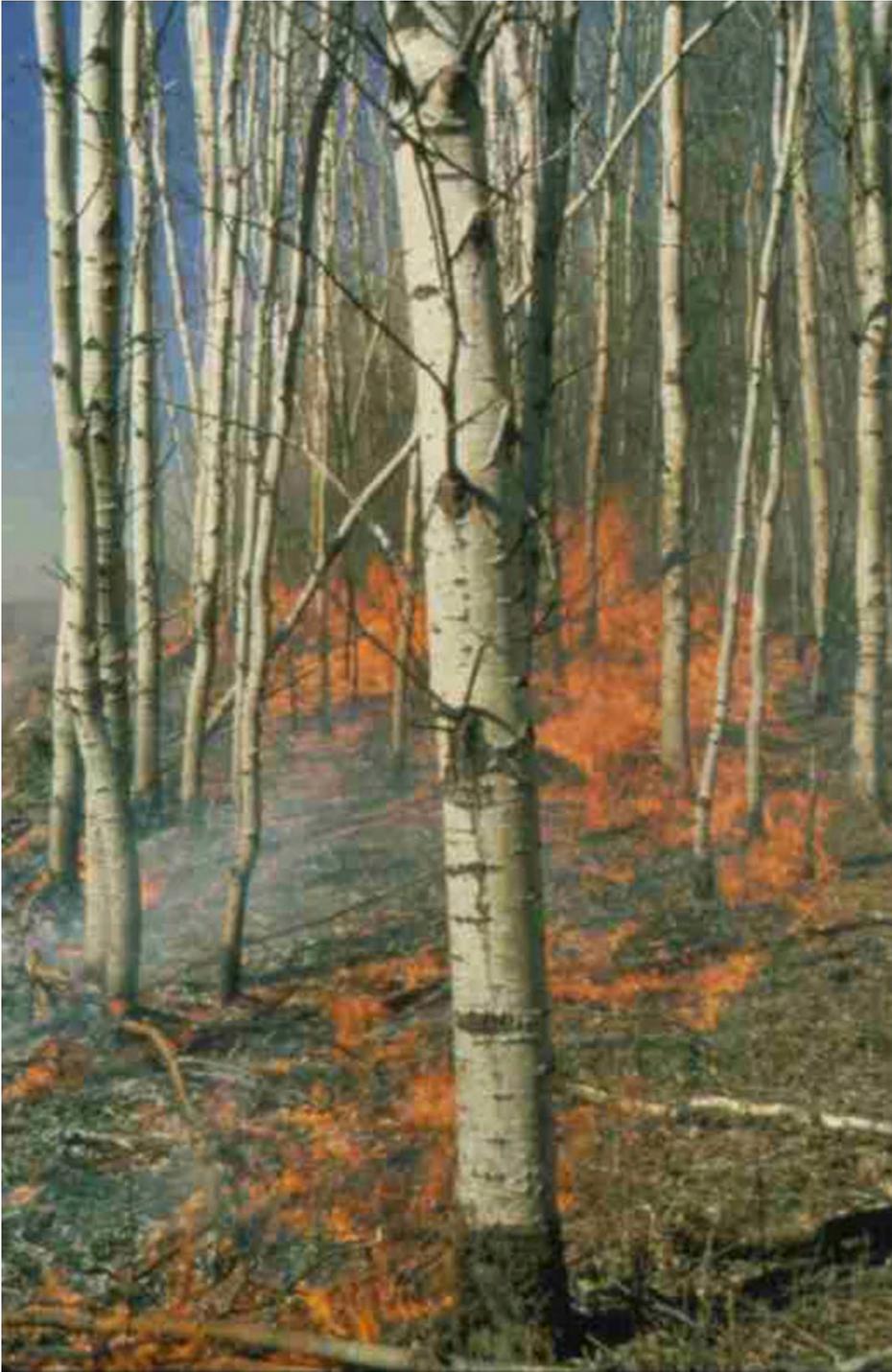
**fuels are replaced by less flammable ones**



Black spruce stand



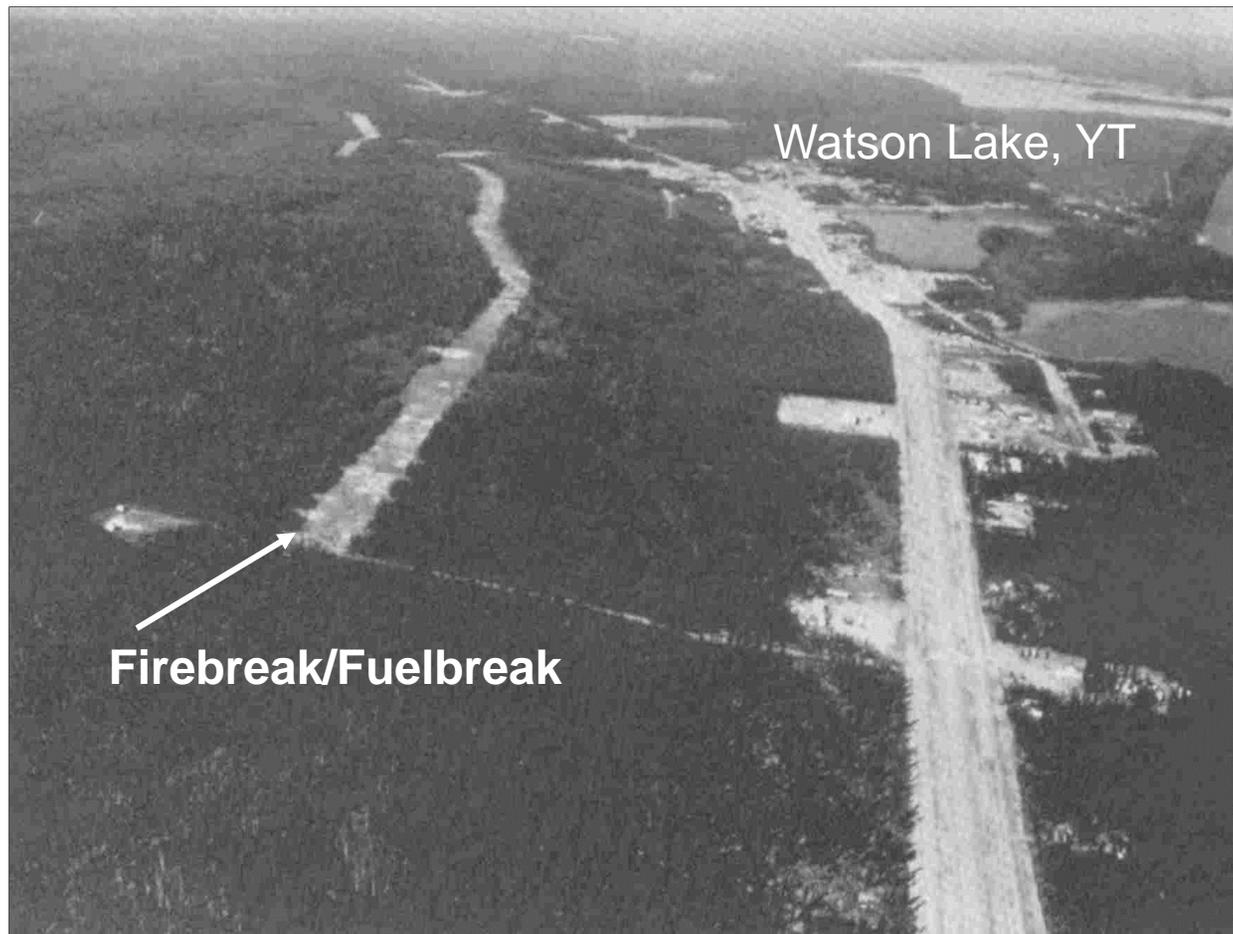
Aspen stand



**Aspen stands are still subject to low- to moderate intensity surface fires in the spring and fall.**

## Fuel Isolation:

large expanses of fuels are broken up with firebreaks and fuelbreaks



**Immediately after the fire**

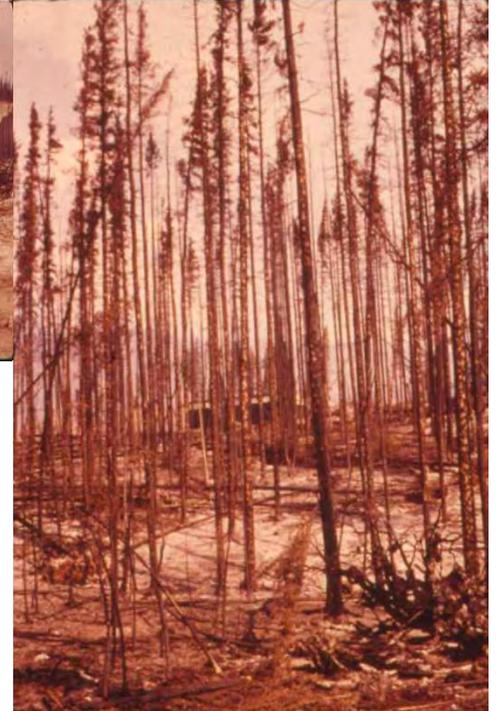


**Unfortunately most communities under go "fuel conversion" from unplanned fire events!**

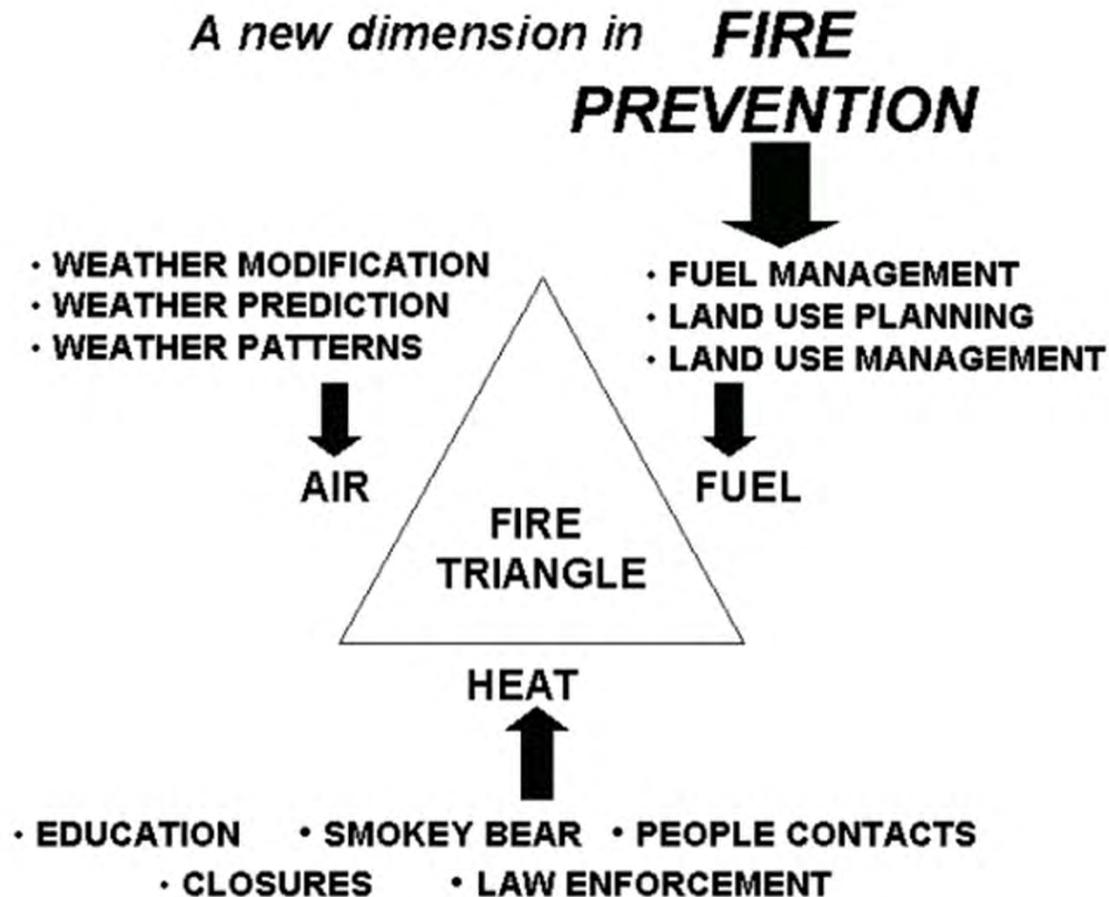
**Present day**



**1969  
Faro Fire,  
Yukon**



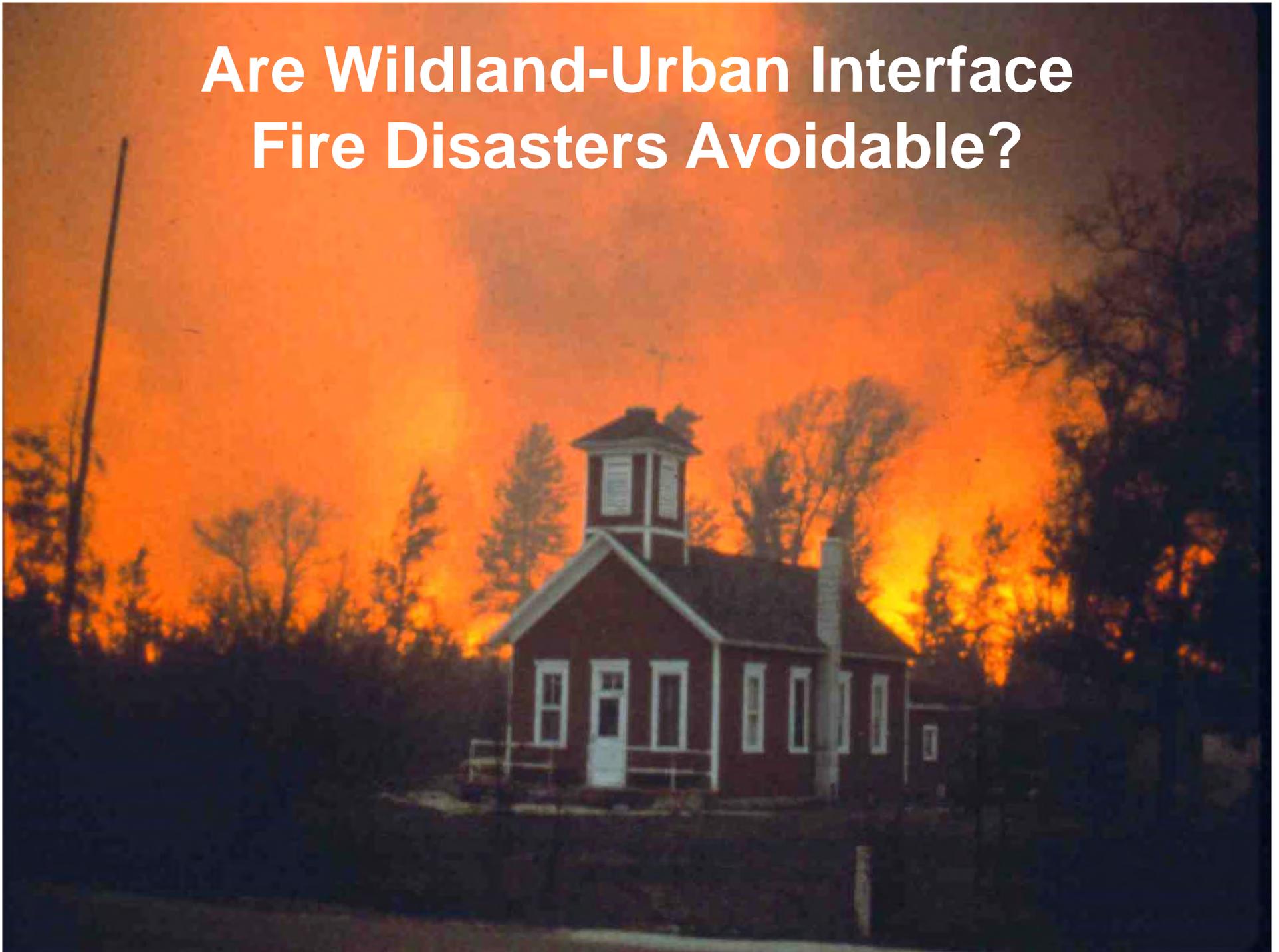
# Preventing the Occurrence of “Large” Fires Through Fuels Management



**“Northern Solutions for Northern Problems”?**

# **Pragmatic Take-home Messages**

# Are Wildland-Urban Interface Fire Disasters Avoidable?





**CANADIAN WILDLAND FIRE STRATEGY:  
A VISION FOR AN INNOVATIVE AND INTEGRATED  
APPROACH TO MANAGING THE RISKS**







**CANADIAN WILDLAND FIRE STRATEGY:  
BACKGROUND SYNTHESSES,  
ANALYSES, AND PERSPECTIVES**

K.G. Hirsch and P. Fugère, Technical Coordinators





**A Summary of the  
Canadian Wildland  
Fire Strategy**

**Managing the Risk**

Each summer the media carry stories of wildfires raging across the Canadian landscape, threatening our communities, causing evacuations, and at times burning public and private property. This portrayal of fire as a menace to society is often accurate, but it is only part of the story. In Canada, fire is nature's primary way of keeping the wildlands we value and enjoy (including forests, grasslands, and parks) healthy and productive. As a result, we are faced with the complex and difficult task of managing wildland fires so that their astronomical benefits are maintained and simultaneously the risk to people and property is minimized.

**A New Approach**

Recognizing that the challenges of today and the future cannot be solved by simply using the approach and methods of the past, the provincial, territorial and federal governments have worked together under the auspices of the Canadian Council of Forest Ministers (CCFM) on a new Canadian Wildland Fire Strategy (CWFS). Based on the principles of risk management, the CWFS will address the symptoms and the root causes of wildland fire management by modernizing our approaches and capabilities. It provides a comprehensive vision of integrated activities that will increase public safety, improve the health and productivity of our forests, enhance intergovernmental cooperation, and apply public funds efficiently.

**The Role of Fire in Canadian Forests**

Fire has been a very dominant feature in Canada's forests since the last Ice Age, particularly in the vast boreal region that stretches from the Yukon to Newfoundland. Many plant species — such as pine, spruce and larch, to name just a few — have not only adapted to fire but rely on it for their renewal. Fire has also created a mosaic of habitat types and ages, which are needed by various animal species. Wildfires burned freely in most of Canada until the late 19th century until European-influenced views of fire and forestry prevailed in policies that sought to suppress all fires. In recent decades there has been a growing recognition that the elimination of all fires from our wildlands is neither economically desirable nor ecologically possible.

# Canadian Wildland Fire Strategy

- ❑ **Canadian FireSmart Initiative**
- ❑ **Improved Preparedness and Response Capability**
- ❑ **Public awareness campaign**
- ❑ **Innovation through S&T**

# The Bottom Line

**While it does seem theoretically possible to complete eliminate the threat of at least human-caused conflagrations, this is unlikely to happen.**

**Even with the most highly effective fire prevention, fuels management and fire suppression program, that members of the public will encounter a high-intensity wildfire event at some point in their lives is gradually increasing as long as they continue to live, recreate, and work in a fire-prone environment such as the boreal forest.**

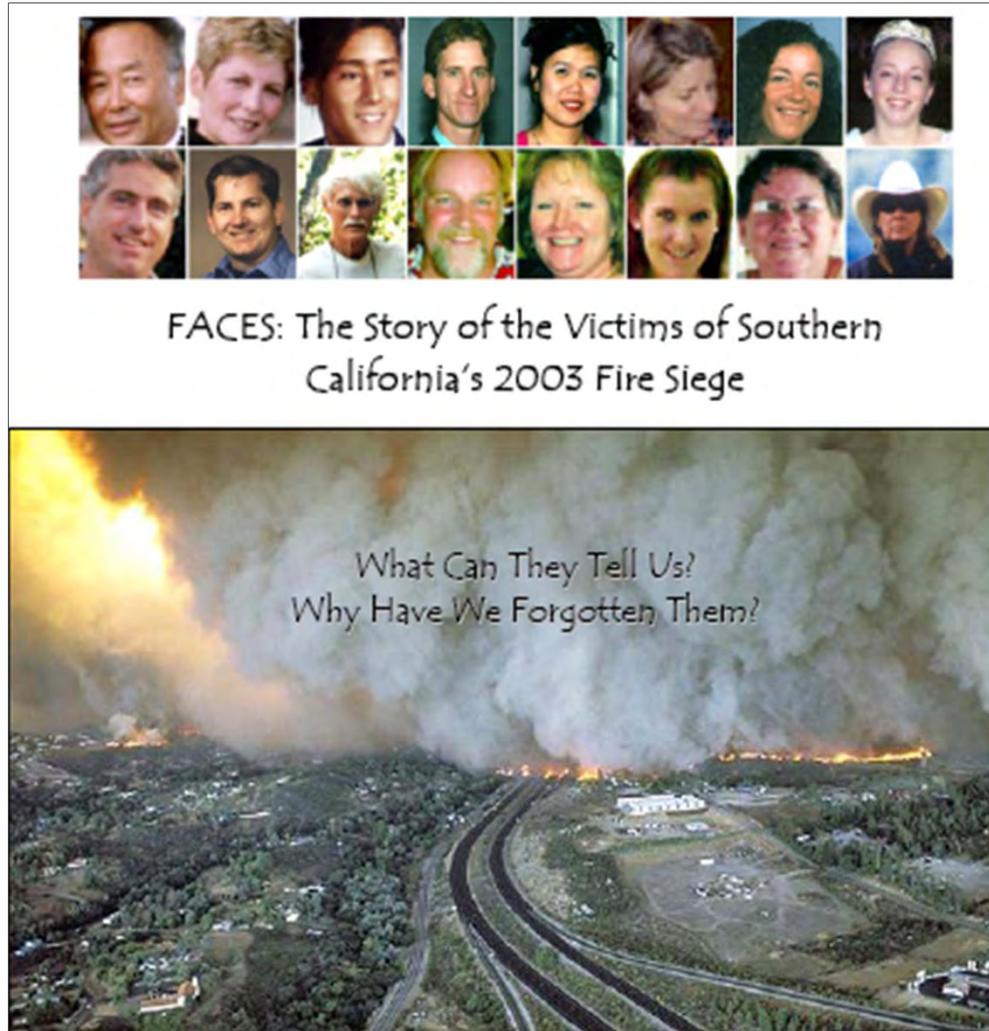
**Co-existence or living with fire involves taking a proactive stance, including being prepared for the day when wildfire comes knocking!**



...there is one overriding challenge to fire management: that of **maintaining full respect for the power of fire and the effects of this power** on both wildland environments and the people who live and work in these environments.

**Jack S. Barrows (1974)**

# Southern California Fires – 2003 & 2007



**31 Fatalities**

# The Greek Fire Tragedy – 2007



**67 Civilian Fatalities**



# 7<sup>th</sup> February 2009 Victoria, Australia

**173 Fatalities and Counting**

# Evacuations are not a Panacea for Ensuring the Safety of the Public from Wildfires



Alberta - 1995



Houses protect people and people  
protect houses

“Prepare, Stay and Defend or Go Early”

# Four Basic Options for Surviving a Wildland Fire Entrapment or Burn-over (in no particular order)

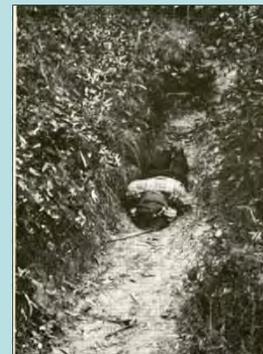
- Retreat from the Fire and Reach a Safe Haven



- Burn Out a Safety Area



- Hunker in Place

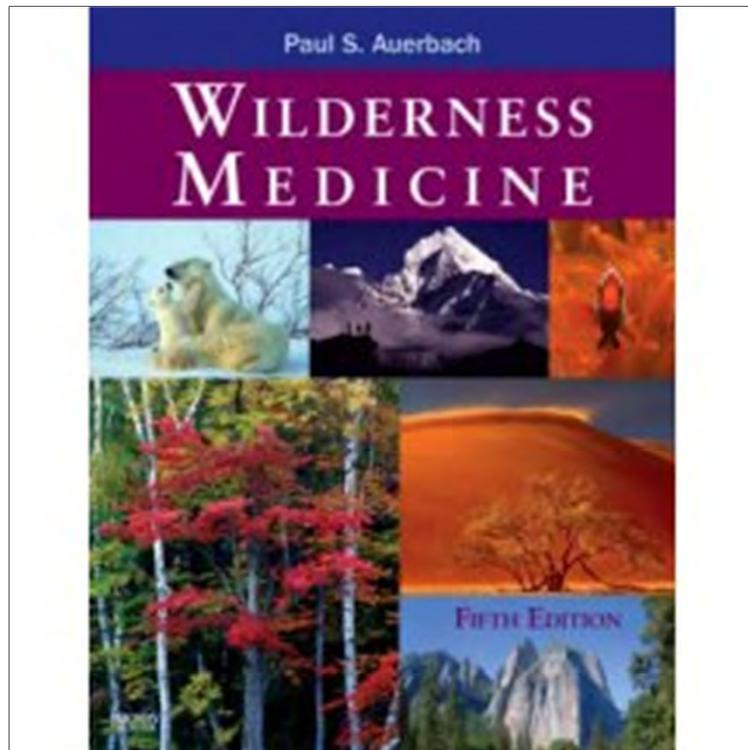


- Pass Through the Fire Edge into the Burned-out Area

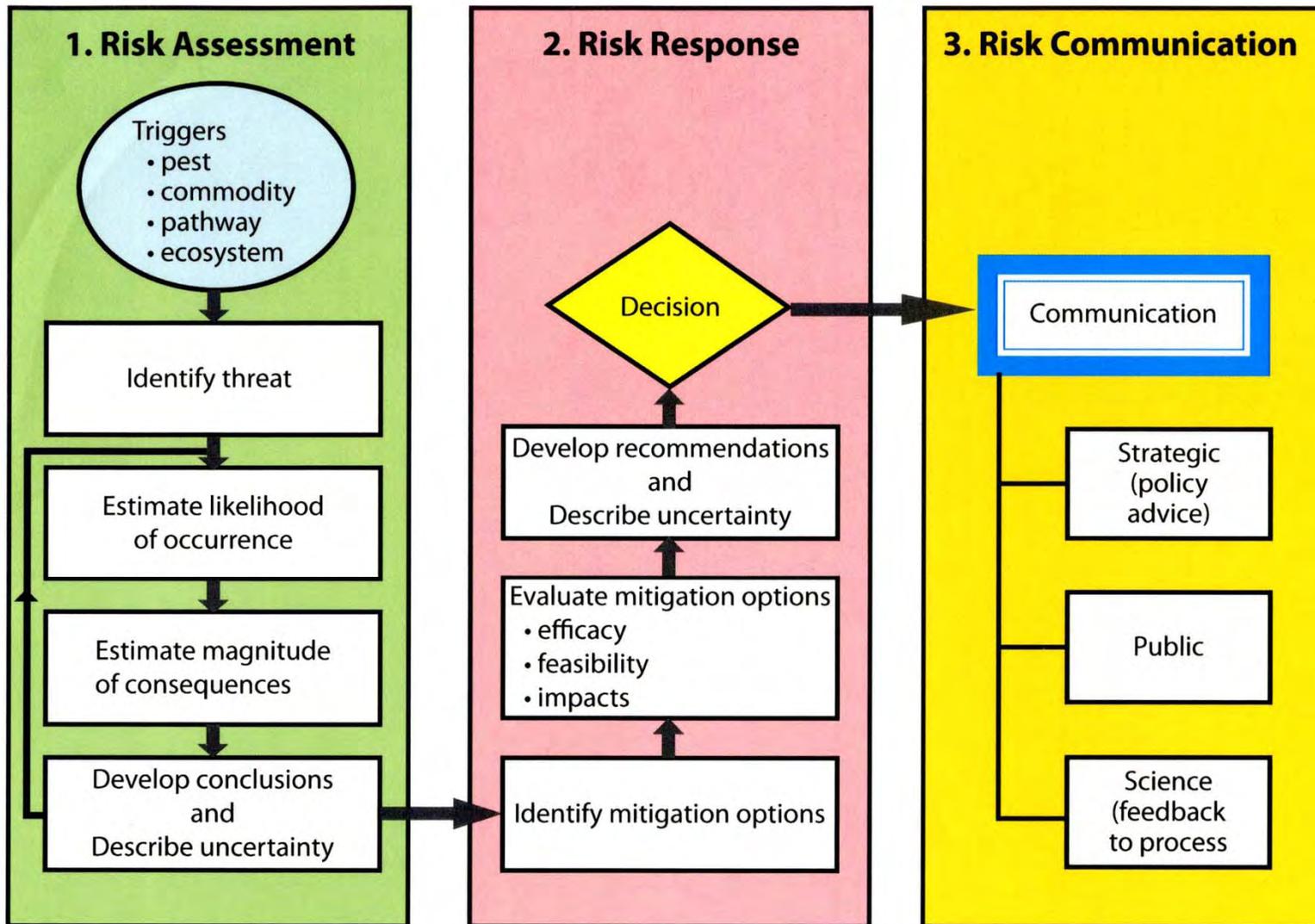


# For More Information

Alexander, M.E.; Mutch, R.W.; Davis, K.M. 2007. Wildland fires: Dangers and survival. in Auerbach, P.S. (Ed.), Wilderness Medicine. 5th edition. Mosby, Philadelphia, PA. pp. 286-335.



# RISK ANALYSIS



# Turner's (1986) Disaster Model

**Stage I: Predisaster Point**

**Stage II: Incubation Period**

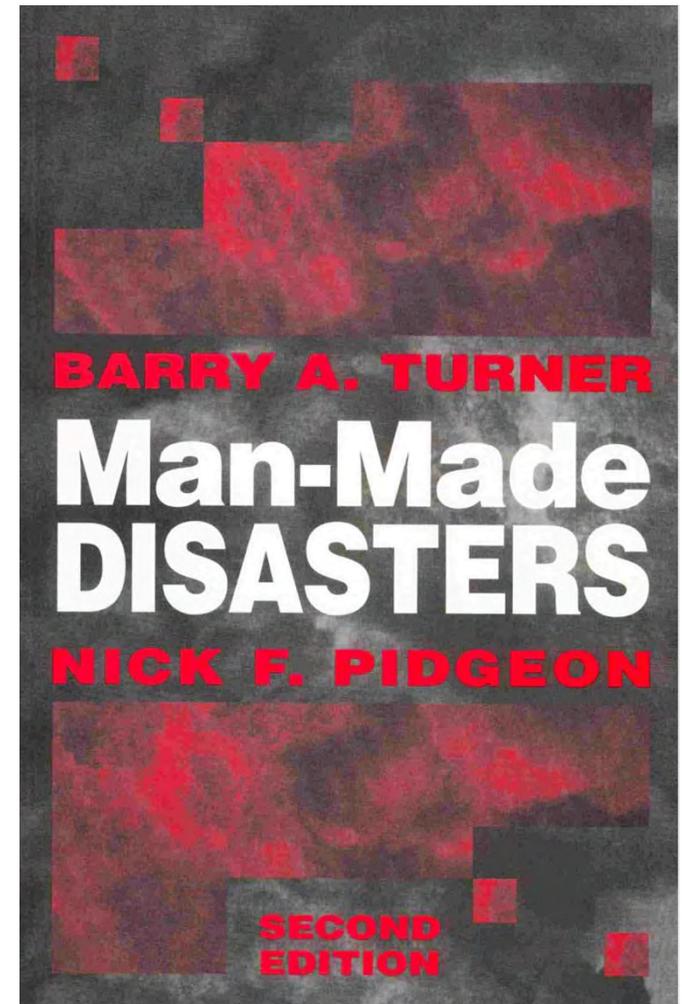
*The accumulation of events that detracted from adhering to safe work practices.*

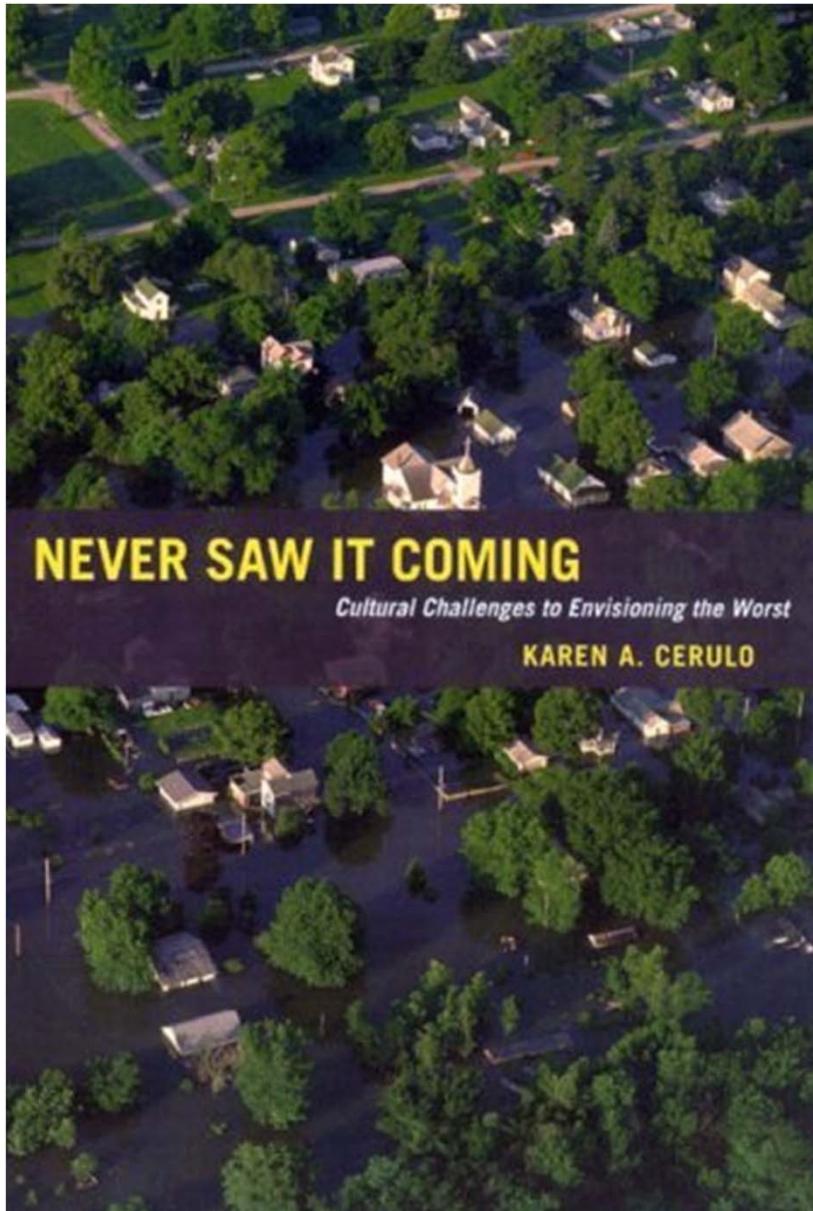
**Stage III: Precipitating  
Undesirable Event**

**Stage IV: Onset**

**Stage V: Suppression,  
Rescue and  
Salvage**

**Stage VI: Full Cultural  
Readjustment**





People are by and large optimists.

The book “**Never Saw It Coming**” examines one of the most common, yet least studied, human traits – a blatant disregard for worst-case scenarios.

# Leadership and Fire Management: Challenges for the Future



- **Always strive for vigilance -- resist complacency or “resting on your laurels” – don’t hesitate or fail to fear the worst**
- **People have short memories so establish and maintain an institutional memory regarding fire**
- **Appreciate the importance of succession planning and mentorship in your organization**
- **Try to avoid having disasters take place in order for change to occur**

# The End

**“Those who cannot learn from history are doomed to repeat it.” – George Santayana (1906)**

