

## Forest Fires

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### Abstract

About 10 000 fires burn 2.5 million hectares of forest in Canada each year. This map focuses on two themes in fire science: monitoring the location and extent of fires (shown in the Hotspots map layer), and determining the fire danger based on weather conditions and vegetation types (shown in the Forest Fire Danger Rating map layer).

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Wildfires are a significant agent of change in Canadian forest ecosystems. There are two distinct causes of forest fires in Canada: people and lightning. On average, lightning causes one-third of the fires in Canada, yet results in 90% of the area burned. Typically these lightning-caused fires occur in remote areas of the country where detection is more difficult. The other fires are the result of human activities, which are more numerous but smaller.

### Fire Suppression

In some national parks and northern areas, fires are allowed to burn uncontrolled as long as they do not threaten communities, merchantable timber, or other values at risk. However, most fires are suppressed. Fire suppression costs on average approximately \$400 million per year, and in terms of property damage (excluding lost timber value) over \$10 million per year.

However, there are many positive impacts of fire. It is an important natural part of the boreal forest ecosystem. The boreal forest has been called fire-dependent because of the role of fire in recycling biomass and nutrients. Some species, such as Jack Pine, depend on fire to reproduce. Its cones open in the heat of the fire, and the seeds then fall onto soil that has been cleared of vegetation and fertilized by ash.



**Figure 1:** Serotinous cones require the heat of fire to open  
**Source:** Canada. Natural Resources Canada. Canadian Forest Service. 2001.

Fire maintains biodiversity and stand age diversity by opening gaps in the forest canopy, allowing more sunlight onto the forest floor. Fire also acts as a fire regulator: where a fire has burned, the amount of fuel is reduced and the fire hazard is decreased.



**Figure 2:** The first species to grow in a burned area is frequently fireweed (*Epilobium angustifolium*).

**Source:** Canada. Natural Resources Canada. Canadian Forest Service. 2001.

## Fire Danger Rating in Canada

### Method

Fire danger rating is the process of systematically evaluating and integrating the factors that determine the ease of a fire starting and spreading, the difficulty of control, and the resulting impacts based on an assessment of ignition risk, the fire environment (fuels, weather, and topography) and values at risk. Fire danger rating systems produce indexes of fire potential that are used as a guide in a wide variety of fire management applications.

In Canada, fire danger is monitored using the Canadian Forest Fire Danger Rating System (CFFDRS) developed by the Canadian Forest Service. The CFFDRS comprises two primary subsystems: the Canadian Forest Fire Weather Index (FWI), which provides estimates of fire danger based on continuous records of weather observations taken daily at noon; and the Canadian Forest Fire Behaviour Prediction System (FBP) which uses fuel type and terrain (elevation, slope, aspect) data, along with the weather-based FWI system outputs, to make predictions of fire spread rate, fuel consumption, and fire intensity.

The FWI is probably best known from signs like this one that can be found in forested areas all over Canada.



**Figure 3:** Fire Hazard Sign

**Source:** Canada. Natural Resources Canada. Canadian Forest Service. 2001.

## Interpretation

In the fire danger rating layer, the FWI values have been classified into five groups. In a representative fuel type (a pine forest), the following fire behaviour can be expected:

- **Low:** smouldering or self-extinguishing fire. Flame height: less than 10 centimetres.
- **Medium:** creeping or gentle surface fire. Direct manual attack by firefighters with hand tools and water is possible. Hand-constructed fire guard should hold. Flame height: up to 1 metre.
- **High:** moderately vigorous surface fire. A hand-constructed fire guard will probably fail. Heavy equipment (bulldozers, pumpers, aircraft) is generally successful in controlling the fire. Flame height: up to 2 metres.
- **Very high:** intense surface fire. Frequent torching is possible. Control efforts at the fire's head may fail. Flame height: up to 3 metres.
- **Extreme:** crown fire. Control very difficult. Suppression action restricted to the fire's flanks. Indirect attack with aerial ignition (backfiring) may be effective. Flame height: 3 to 25 metres or more.

## Hotspots

A hotspot is a pixel in an infrared satellite image that contains the "spectral signature" of burning vegetation. Each image pixel, and therefore each hotspot, represents a 1 squared kilometre on the ground. The fire within the hotspot may cover the entire area, or it may be as small as 0.001 kilometres squared (about 30

by 30 metres). A particular pixel can be hot for several days in a row, as different areas within the pixel are burned.

There is a national fire information system that automatically identifies, monitors and maps large forest fires on a daily basis using infrared satellite images. After the hotspots have been identified, fire danger ratings are calculated for the hotspot locations.

This system gives a spatially-explicit overview of forest fire activity in Canada on a daily basis. Hotspots and other satellite data are also used to estimate area burned. However, the satellite sensors cannot "see" through cloud cover. Fires burning under cloudy conditions will not show up as hotspots on the maps.

## **Interpretation**

Most of the fires are found in the boreal forest, the broad band of mainly coniferous trees that stretches across the country from the Yukon to Newfoundland and Labrador. The boreal forest is prone to large, intense fires, especially in the west, because of its composition (needle-leaf trees), climate, and contiguity. Fire is a natural part of the boreal forest ecosystem, and plays a major role in nutrient and carbon cycling.

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## **Map Sources**

### **Fire Danger Rating**

The Forest Fire Danger Rating map provides estimates of fire danger based on a continuous record of weather observations taken daily at noon, fuel type and terrain data. The fire danger rating in this map is based on the Fire Weather Index (FWI), an indicator of the predicted fire intensity. The Fire Weather Index is a component of the Canadian Forest Fire Weather Index System. It is a numeric rating of fire intensity. It is suitable as a general index of fire danger throughout the forested areas of Canada. Canadian Forest Service, Canadian Wildland Fire Information System.

### **Forest Fire Hotspots, 2009**

This layer shows the location of all forest fire hotspots detected to date in 2009. Each hotspot represents an area of 1 km<sup>2</sup> on the ground. This map is normally updated each day between 2 AM and 4AM. Source: Canadian Forest Service, Canadian Wildland Fire Information System.

## **Related Web sites (1999 – 2009)**

### **Federal Government**

Environment Canada. Climate Change Web Site

<http://www.ec.gc.ca/cc/>

Environment Canada. Meteorological Service of Canada. Climate Research Branch.

Canadian Centre for Climate Modeling and Analysis

[http://www.cccma.bc.ec.gc.ca/eng\\_index.shtml](http://www.cccma.bc.ec.gc.ca/eng_index.shtml)

Welcome to CCCma online, the web site of the Canadian Centre for Climate Modeling and Analysis.

Environment Canada. Meteorological Service of Canada. Climate Research Branch.

Canadian Centre for Climate Modeling and Analysis. Canadian Global Climate Models

<http://www.cccma.bc.ec.gc.ca/models/models.shtml>

CCCma has developed a number of climate simulation models for climate prediction, study of climate change and variability, and to better understand the various processes which govern our climate system.

Environment Canada. Meteorological Service of Canada. Climate Research Branch.

Canadian Centre for Climate Modeling and Analysis. The Canadian Regional Climate Model

<http://www.cccma.bc.ec.gc.ca/models/crcm.shtml>

CCCma has developed a number of climate simulation models for climate prediction, study of climate change and variability, and to better understand the various processes which govern our climate system.

Environment Canada. State of the Environment Infobase. National Environmental Indicator Series Archives. Sustaining Canada's Forests: Forest Biodiversity. Bulletin, 1997

[http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/For\\_Bio/Bulletin/fbind1\\_e.cfm](http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/For_Bio/Bulletin/fbind1_e.cfm)

Indicator: Road Access, 1997

Environment Canada. State of the Environment Infobase. National Environmental Indicator Series Archives. Sustaining Canada's Forests: Forest Biodiversity. Bulletin, 1997

[http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/For\\_Bio/Bulletin/fbind2\\_e.cfm](http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/For_Bio/Bulletin/fbind2_e.cfm)

Indicator: Tree species mix in accessed versus non-accessed timber-productive forest, 1997

Environment Canada. State of the Environment Infobase. National Environmental Indicator Series Archives. Sustaining Canada's Forests: Forest Biodiversity. Bulletin, 1997

[http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/For\\_Bio/Bulletin/fbind3\\_e.cfm](http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/For_Bio/Bulletin/fbind3_e.cfm)

Indicator: Age-class Distribution in Accessed Versus Non-Accessed Timber-productive Forests, 1997



Environment Canada. State of the Environment Infobase. National Environmental Indicator Series Archives. Sustaining Canada's Forests: Forest Biodiversity. Technical supplements. Road Access, 1991

[http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/For\\_Bio/Tech\\_Sup/fbsup1\\_e.cfm](http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/For_Bio/Tech_Sup/fbsup1_e.cfm)  
Road Access in the Four Main Forested Ecozones, 1991

Environment Canada. State of the Environment Infobase. National Environmental Indicator Series Archives. Sustaining Canada's Forests: Timber Harvesting. Bulletin, 1999

[http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/Forest/Bulletin/foind4\\_e.cfm](http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/Forest/Bulletin/foind4_e.cfm)  
Indicator: Forest Fire Disturbance, 1999

Government of Canada. Climate Change Impacts and Adaptation Program

<http://adaptation.nrcan.gc.ca/>

The Government of Canada's Climate Change Impacts and Adaptation Program provides funding for research and activities to improve our knowledge of Canada's vulnerability to climate change.

Natural Resources Canada. Canadian Forest Service. National Forest Fire Situation Report

<http://fire.cfs.nrcan.gc.ca/firereport/report-rapport-eng.php>

Natural Resources Canada. Canadian Forest Service. Research: Forest Fires

<http://fire.cfs.nrcan.gc.ca/>

Natural Resources Canada: Climate Change in Canada. Posters

[http://adaptation.nrcan.gc.ca/posters/index\\_e.php](http://adaptation.nrcan.gc.ca/posters/index_e.php)

A series of seven posters depicting the regional impacts of climate change in Canada.

Statistics Canada. 1996 Census. Population Counts, Showing Distribution Inside and Outside Census Metropolitan Areas and Census Agglomerations, for Canada, Provinces and Territories.

<http://www.statcan.gc.ca/c1996-r1996/4129977-eng.htm>

A census table provided by Statistics Canada clearly demonstrates the higher population base of census metropolitan areas in relation to regions outside of these areas. A link to important information on 1996 census tables on the Internet is also available.

## Other

The Canadian Climate Impacts and Adaptation Research Network

<http://www.c-ciarn.ca/>

C-CIARN is a national network that facilitates the generation of new climate change knowledge by bringing researchers together with decision-makers from industry, governments, and non-government organizations to address key issues.

## **Inter-agency**

The Canadian Interagency Forest Fire Centre  
<http://www.cifffc.ca/>

