

# Natural Disturbances

Real World Ecosystems  
Backgrounder  
Grade Level: 5-8



## Fire Destroys Alberta Forest, or Does It?

The year 1998 happened to be the warmest year ever recorded in North America to that date. Alberta was experiencing record-setting heat and drought. Forests, grasslands, and other **ecosystems** (a community of organisms together with the environment they inhabit and with which they interact) were tinder-dry. Conditions were ripe for fires all over the province, and many thousands of square kilometres burned. The Chip Lake fire, which occurred near Highway 16 west of Edmonton, was unusually intense. It burned 140 square kilometres of spruce and pine. Not only were trees killed, but in many places, the soil was burned to cinders.

Yet, just three years later, a new ecosystem was prospering. The fire-blackened forest was bursting with lush new plant growth. In almost no time at all, the forest was returning.

How do forests heal themselves after a fire? The truth is that fires create new habitats for many kinds of plants, animals, and other life. Fires often open up the forest cover, allowing sunlight to warm up the soil, while ashes left over from the fire add nutrients. Many kinds of plants are adapted to take advantage of these conditions. They are often called **pioneer species**. Soon after a fire, spores from mosses and fungi drift in on the wind, settle on the blackened earth and take root. Other plants such as fireweed and dandelion parachute in as wind-blown seeds and quickly take root. Aspen saplings shoot up from roots below the soil surface. The heat from the fire actually forces open the cones of some types of conifers so

they drop their seeds onto the fire-cleared soil below.

The smoke barely has time to clear before animals start taking up residence in the newly created habitat. Beetles begin to burrow into the bark of fire-killed trees, closely followed by woodpeckers in search of beetle larvae. Songbirds, moose, deer, bears, and many other **species** come to the burned forest to forage for food in the lush new plant growth.

The story of the Chip Lake fire is not unique: fires are very common in the **boreal forest** of Alberta. In fact, the northern forests burn at least once every 70 to 80 years on average. But it always surprises us how quickly new life gets going after the ashes have cooled. The lessons here are that fires are a fact of life in the boreal forest and that forests are usually able to recover quickly from disturbances such as fire.

**Boreal forest:** A type of subarctic forest that is dense with spruce, aspen, and birch trees and has some areas of muskeg. It extends as far north as the tree line at the southern edge of the tundra and is the largest vegetation zone in Canada.

## Did You Know? Controlled Burns Help Forests

Some forest fires have been deliberately started by humans to help protect ecosystems! It's true! The practice is called "controlled burning." Fire is such an important part of the life of many ecosystems that in

order to prevent forests from building up too much fuel and to encourage new growth, fires are lit under carefully controlled conditions.

### Insect Outbreaks

In the summer of 2003, Alberta experienced one of the biggest outbreaks of grasshoppers in the province's history. Some areas of farmland and grassland had hundreds of grasshoppers per square metre. The insects destroyed pastures, crops, and gardens.

Alberta is no stranger to devastating insect outbreaks. Large patches of the aspen parkland are regularly attacked by armies of forest tent caterpillars, which strip whole aspen groves of their leaves.

The **coniferous forest** also comes under attack from insects. (**Coniferous forest:** Also known as the taiga, or boreal forest. It extends in a broad band across North America, Europe, and Asia to the southern border of the arctic tundra. Conifers are also commercially important as a source of timber for the papermaking, building, and furniture industries). Spruce and pine trees are the favourite food of a great variety of insects and other small pests. One of the most destructive is the mountain pine beetle, which attacks live pine trees. Large tracts of pine forest are being destroyed by infestations of this beetle in Alberta, British Columbia, and other places.

### Diseases and Parasites

Diseases of plants and animals are normal and common in most ecosystems. Usually, they affect the health of small numbers of organisms and do not cause problems for the ecosystem as a whole. But, under certain conditions, they can cause a major disturbance in the life of an ecosystem. In forests, certain diseases can kill individual trees or large swaths of forest.

Many diseases of trees are caused by **fungi** (organisms that are primarily decomposers, taking their nutrients from dead and decaying organisms. Some, such as Athlete's Foot, are parasitic). They can

attack the leaves, roots, or trunks of trees, sometimes causing them to rot and fall down. The dead tree creates an opening in the canopy that lets light reach the forest floor. As the tree rots on the forest floor, its remains feed thousands of organisms. Eventually, the tree becomes part of the soil.

Some disturbance in ecosystems can be caused by parasites. Parasites are organisms that live in or on other organisms and get their food by slowly eating away at them. The organism that is infected by parasites is called the host. Parasites are very common among plants and animals. They can cause serious problems for entire populations.

Parasites and diseases are not just a problem for plants; they can be a serious problem for animals too. Parasites and diseases can severely reduce the populations of some animals in certain years. This can have a noticeable effect on forests. For example, in years where they are abundant, varying hares can cause serious damage to pine and aspen seedlings in a forest, in some cases killing nearly all the young trees. In years when hares are few in number, the numbers of young trees can be noticeably greater.

Most animals have parasites living in and on them. For example, a moose can be a host to a large community of parasites. Here is a list of the most common parasites of moose.

| Name         | What and Where  | Problems Caused   |
|--------------|---|---|
| Winter tick  | An eight-legged arthropod distantly related to spiders. Burrows into the skin to suck blood, particularly around the neck and back. | Moose rub off their fur trying to scratch the ticks off. This can lead to disease and weakening, especially in late winter. |
| Liver flukes | A flatworm that can live in the tissue of the liver.  | Can cause significant damage to the liver.  |

| Name            | What and Where   | Problems Caused   |
|-----------------|--|---|
| Tapeworm larvae | Immature tapeworms form cysts (fluid-filled pockets) in the lungs, liver, heart, and other organs. Mature worms infect wolves and coyotes. | Larval tapeworms cause damage to the organs as they burrow through the tissue and form cysts. |
| Leg worms       | Threadlike worms are found in the joints of the front and hind limbs, normally found in deer.  | Do not seem to cause problems in moose or deer.   |
| Bot fly larvae  | Large maggots that cling to the lining of the nasal passages.  | Cause small wounds in the skin; can lead to infections and weakening.                         |
| Warbles         | Fly maggots living under the skin of the back.   | Cause small wounds in the skin; can lead to infections and weakening.                         |
| Lungworms       | Threadlike worms that form cysts in the lungs.   | Can cause breathing problems in severe cases.   |

## Weather and Erosion

Ecosystems are often damaged by severe storms, droughts, floods, and other weather-related disturbances. Here is a list of some of the kinds of disturbances caused by weather and erosion:

- **Landslides:** In wet weather, soil on steep slopes can begin to move slowly or quickly, causing land vegetation in ecosystems to be disturbed.
- **Avalanches:** Mountain forests are very often destroyed by avalanches. In valleys where avalanches are an annual event, forests are prevented from growing.
- **Flooding:** Rivers may flood during rainy seasons or during spring runoff. This can damage forests

and other ecosystems but can also bring new supplies of water and nutrients to starving plants.

- **Wind:** High winds can push over trees in forests, creating many openings in the forest canopy. The effect is similar to a fire. The upturned tree roots expose new soil and provide homes for many plants and animals.
- **Droughts:** Droughts are a frequent occurrence across many parts of North America. Droughts can contribute to forest and grassland fires. They can cause lakes and streams to shrink or disappear altogether.

## Humans Are Changing the Boreal Forest

Humans are definitely a factor in the boreal forest! Human activities are changing the forest far more radically and more rapidly than natural disturbances are. We'll look briefly at some of these changes below.

### Agriculture

Since the late 1800s, large sections of Alberta's boreal forest have been converted to fields for growing crops and grazing cattle. The soils under Alberta's boreal forest are not good for growing grain, but they are able to produce good quality clover and grass for cattle feed. Some tracts of forest have been partially cleared, fenced and converted to community pastures for grazing cattle.

### Forestry

Most of Alberta's boreal forest has been made available to logging companies for wood harvesting. Harvesting operations lead to the creation of "cut blocks", or areas, of various sizes and shapes. By law, harvested areas must be quickly replanted with seedling trees. Over the next 50 years, the majority of forests in the northern and western parts of the province will be harvested and replanted.

### Urban Sprawl and Roads

Some communities in northern Alberta are growing very rapidly, at the expense of forested lands. Fort McMurray is a prime example of this. Each year, thousands of hectares of forest are cleared to make way for roads, schools, housing developments, and shopping malls. Highways are a serious barrier for

many species of wildlife, and are the cause of many road kills, especially of deer and moose.

### Air and Water Pollution

Pollution is becoming a problem around some communities and industrial facilities in the boreal forest. Rivers such as the Athabasca receive raw and treated sewage from towns, liquid industrial waste, contaminated runoff from streets, and other forms of pollution. Air pollution comes from the burning of wood wastes; refining of oil and gas; car and truck exhaust; road dust; and many other sources. Sulphur, in the form of sulphur dioxide and hydrogen sulphide gases, is becoming a serious problem, especially in the area around Fort McMurray, where Alberta's oilsands industry is centred.

### Mining and Energy Development

In the past few years, more of the boreal forest in northern Alberta is cleared or altered by the oil and gas industry than by logging. Oil, gas, and oil sands development require roads, well sites, surface mines, refineries, pipelines, and other kinds of facilities, all of which require the clearing of forests. Forests are broken into unnatural fragments with long straight edges. In the case of coal and oil sands mining, vast areas are simply dug up, to a depth of 20 metres or more. After the **landscape** (an area of natural features such as a prairie, woodland, or mountain) has been reshaped, a lot of work and time are needed to restore the forests.

### Recreation

Recreational activities in the boreal forest include hunting, fishing, camping, and, increasingly, trail riding with all-terrain vehicles (ATVs). Until recently, these activities have had little impact on the boreal forest. However, the boreal forest is showing increasing signs of wear and tear from recreation. For instance, sport fishing is the main cause of the sharp drop in the populations of game fish such as northern pike and walleye in most boreal forest lakes. Also, with more and more ATVs taking to the forests each year, problems such as soil erosion and damage to stream banks are increasing.

### Cumulative Effects

Some parts of the boreal forest are experiencing changes from several kinds of natural disturbance and human activity all at once. For instance, near the town of Lodgepole, oil and gas, logging, ATV use, and agriculture are all taking place on the same land simultaneously. Meanwhile, natural fires, erosion, insect outbreaks, and floods are also continuing as usual. The impacts of all these disturbances occurring together on the same land are known as "cumulative effects". Cumulative effects signal the beginning of landscape-scale changes that affect the way the basic way ecosystem works. The first symptoms of cumulative effects may be unexpected, such as the sudden disappearance of sensitive wildlife species.

One problem with cumulative effects is that their impacts are extremely complex and hard to predict. Another problem is sorting out which human activities have the greatest potential to add to cumulative effects. For instance, biologists observe that fish populations are dropping noticeably in many streams in the Alberta foothills. Of all the people and industries that use the forest, who should they blame — oil companies, logging companies, cattle ranchers, or people who fish for sport? Or, is the decline in fish purely natural? It is difficult to prove that any single industry is causing the fish population problem. It is even more difficult to get these different industries to cooperate to solve the problem.

### Did You Know? Some Plants Need Fire to Reproduce!

Some plants actually require fires before they can reproduce! For example, lodgepole pine, a common tree in western Alberta, has cones that are sealed with a tough glue that melts when there is fire. After the fire, pine cones open up and shower the exposed soil with seeds, giving the future forest a head start.

### Green Thumb: Destructive Hitchhikers Unwelcome!

If you go from one place to another on your holidays, you could be giving rides to unwanted hitch-hikers. These include the highly destructive mountain pine beetle, which hides in firewood or Gypsy moths and



their larvae, which live in green conifer branches, or any number of noxious weeds. As a general rule, get your firewood at the campground where you stay and do not take any with you when you leave. Be sure your boat, trailer, vehicle, and other gear are free of all weeds before you move them to a new location. This will help keep slow the spread of destructive insect and plant pests.

### **Natural Disturbance in Other Ecosystems**

The changes that occur in the boreal forest, including fires, insect outbreaks, erosion, flooding, are also typical of other ecosystems around the world. For instance, bushfires are a regular occurrence in Australia, South America, Africa, and Asia. Whether they are caused by lightning or humans, they have the effect of nourishing the soil and renewing plant growth.

Tropical rainforests are wet most of the year, so forest fires almost never happen. In fact, a disturbance is rare in the rainforest, and when it happens, it is usually local in nature. A disturbance may consist of an individual tree (often of huge size) falling to the forest floor, a small mudslide, or an eroded riverbank. As a consequence, many rainforests are very old. For example, the rainforests of central Brazil may be one of the planet's oldest ecosystems, having existed there for possibly several million years.

Ocean ecosystems experience disturbance too. Along the shores of continents and islands, occasional storms can do a great deal of damage to ecosystems such as coral reef lagoons, bays, and beaches. Here, as on the land, species of plants and animals are able to cope with the changes. Storms sometimes create new habitats where young marine organisms can get established.

Another important form of disturbance that affects some ecosystems around the world is a volcanic eruption. Volcanoes are more common along the mountainous edges of many continents. The "ring of fire" around the Pacific Ocean is a good example. Eruptions often produce huge storms of volcanic ash

that rain down on forests, killing every living thing in them. They can also cause deadly mud and lava flows, which race down the mountainside destroying everything in their path. Despite their destructive power, volcanoes have a good side: they bring rich supplies of nutrients to soils. Plants thrive in ash-enriched soils, and animals soon follow.

### **Did You Know? Alberta's Ecosystems Are Young**

Most of Alberta's ecosystems are quite young compared to Earth's history. The last ice age happened about 10,000 years ago. It wiped out most of the ecosystems in this part of North America. Since then, there have been long dry spells and other climate changes that changed the locations of forests and grasslands across our part of the continent.

### **Humans Are Changing Ecosystems Around the World**

Few places on earth have escaped the impact of humans. Some of the most dramatic changes happen wherever humans build towns and cities. Forests, grasslands, and other ecosystems give way to paved streets, buildings, homes, and other kinds of structures.

With a population of well over 7 billion people, humans are having a very big impact on most of the world's ecosystems, especially those where we live and obtain our food. This includes most of the world's oceans, tropical and temperate regions, even the world's deserts.

Here are a few examples of how humans are changing ecosystems around the world:

#### **Chemical Pollution of the World's Oceans**

Poisonous chemicals such as pesticides and industrial chemicals are now present throughout all the world's oceans. Toxins are beginning to accumulate in the tissues of fish, seals, whales, and other ocean creatures.

### Over-fishing

Fleets of fishing boats operating in most of the world's oceans have drastically reduced the numbers of large fish. It is estimated that these fish species have been reduced by as much as 90 percent from their original populations.

### Agriculture

The growing of crops and livestock has drastically altered much of the landscape around in most countries. In some cases around the world, 100 percent of the ecosystems have been taken over by farming. In Alberta, less than two percent of the prairie ecosystem remains, mainly a result of cattle ranching and grain farming.

### Forestry

Around the world, commercial logging has reduced many of the world's forests to a fraction of their original area. This is especially true in tropical areas where highly valuable hardwoods such as teak and mahogany grow.

### Foreign Invaders

Wherever humans have gone, so have their farm animals, pets, favourite food plants, along with unwanted pests. Foreign animal and plant species have come with Europeans to North America, Australia, and other places, often seriously upsetting parts of those ecosystems. For example, Australia's native marsupials (animals with pouches) and flightless birds are no match for introduced goats, rats, mice, pigs, cats, goats, rabbits, and other animals.

### Urban Sprawl

Cities are causing major changes in ecosystems, like pavement, buildings, sidewalks, and other structures replace natural ecosystems. Many of the world's cities are growing rapidly, and ecosystems are being paved over to make way for roads, houses, and businesses.

### Key Points to Remember

- Fire is the most frequent and important form of disturbance in the boreal forest.
- Ecosystems often grow back quickly after disturbances such as fire, floods, or diseases.
- Pioneer species of plants and animals come in and flourish in the changing landscape, creating conditions that favour yet more plants and animals.
- Parasites, pests, and diseases are an important cause of natural disturbance in forests.
- Droughts, wind, flooding, and other forms of severe weather can destroy or change ecosystems.
- Ecosystems respond to changes in climate.
- Natural climate changes such as warm spells and glaciations have had radical impacts on Alberta's ecosystems in the distant past.
- Humans are a significant cause of disturbance in the boreal forest.
- Disturbances such as fires, floods, storms, volcanoes affect ecosystems all around the world, both on land and in oceans.

### Think About...

- What tree species are most common in the boreal forest?
- What are the main causes of forest fires?
- How old do you think the average tree is in the boreal forest?
- What is the link between human-caused climate change and natural disturbance in the forest?
- What are some of the competing human activities that are contributing to disturbances in the boreal forest?
- Is disturbance an important ecological factor in all ecosystems?