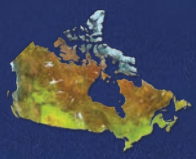
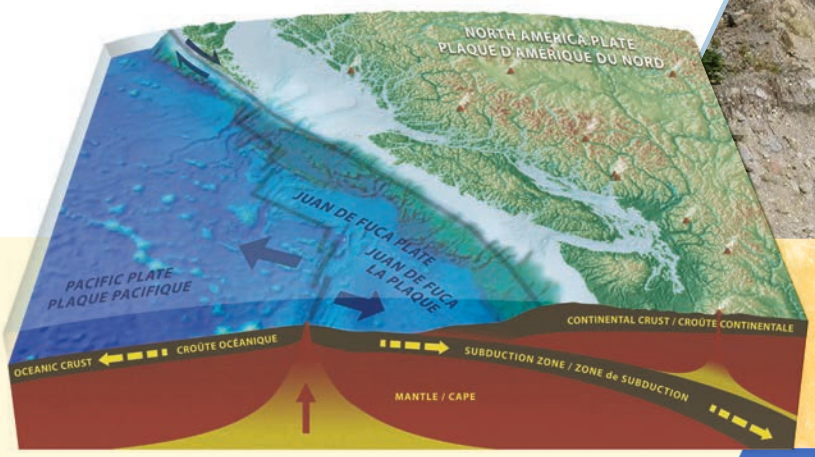
SEA TO SKY STORY: VOLCANOES



Potentially active volcanoes along the Sea to Sky Highway contribute to the natural beauty of southwest British Columbia's geologically dynamic environment. While there are no historical records of volcanic eruptions in southwest British Columbia, several have occurred within the last 10,000 years. In geologic terms, that's very recent!

Southwest British Columbia sits atop the North American tectonic plate while, west of Vancouver Island, the Juan de Fuca Plate is sliding eastward beneath the Earth's surface.



Much of Mount Garibaldi as seen today was built 13,000 -15,000 years ago. Repeated pyroclastic eruptions (consisting of hot lava fragments, gas and ash) built a cone onto the glacier during the last Ice Age. When the ice melted, part of the mountain collapsed.

Some of the most explosive, young volcanoes in Canada exist in the Garibaldi Volcanic Belt. These are also close to large populations. Mounts Garibaldi, Cayley and Meager are well-known stratovolcanoes built over thousands of years.

Through its long eruptive history, many massive landslides have occurred on Mount Cayley's steep southwest flank. One landslide, 4,800 years ago, removed enough rock (200 million cubic metres) to fill more than 80,000 Olympic-sized swimming pools.

As this oceanic plate descends, heat and pressure cause it to expel water and lower the melting temperatures of overlying mantle rocks. Melting mantle then rises and erupts through the volcanoes of southwest British Columbia's Garibaldi Volcanic Belt (GVB), the northern extension of the American Cascades.

A stratovolcano consists of many layers of lava and pyroclastic rocks, built over long time periods by alternating lava eruptions and explosive eruptions. Many famous stratovolcanoes, like Japan's Mount Fuji, have steep sides, a pointed top and a symmetrical shape, while others, like Mount Garibaldi, do not.

MOUNT MEAGER EXPLODED 2,350 YEARS AGO AND TEMPORARILY DAMMED THE LILLOOET RIVER. THIS DAM LATER COLLAPSED AND CAUSED A HUGE FLOOD AT LEAST 30 METRES DEEP, FIVE KILOMETRES DOWNSTREAM. ASH WAS SCATTERED SO WIDELY THAT A LAYER STILL EXISTS IN BOGS AND SOILS OF SOUTHERN BRITISH COLUMBIA AND PARTS OF ALBERTA.

As lava cools and contracts, it can form columnar joints. The Tricouni Southeast lava flow sequence, visible near the Sea to Sky Highway, possesses excellent examples of these.

Logger's Lake Volcano is another volcanic feature in the Whistler area that is easy to access. The volcano formed when lava erupted under an ice sheet, producing a pile of volcanic debris (probably less than 25,000 years old). Today the area is mostly covered with trees.

Most Sea to Sky volcanoes are dormant, not extinct:

Several things tell volcanologists that these volcanoes are still "alive": their rocks are geologically young, earthquakes occur beneath them, and heated (geothermal) springs exist nearby. But, no need to worry! Eruptions of Sea to Sky volcanoes occur hundreds or thousands of years apart and are likely to be preceded by weeks to years of increased seismic activity.

A nationwide seismograph network allows scientists to monitor earthquakes, including those that may have been caused by volcanic activity. This network can detect very small earthquakes to allow for ample warning in the unlikely event of an eruption.

Scientists at Natural Resources Canada gather geological and geophysical data related to volcanoes and take part in emergency planning and public education activities.

For more information, contact the Geological Survey of Canada, or visit the Natural Resources Canada website:

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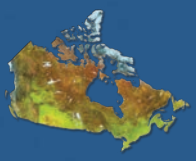


SEA TO SKY STORY: GLACIERS

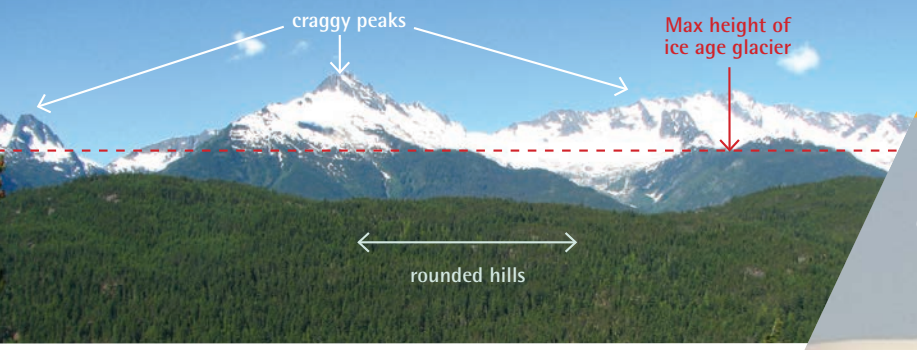
The Sea to Sky corridor from Vancouver to Whistler cuts deep into the Coast Range, the mountain wall that extends along the coast of British Columbia from Vancouver to the Alaska border. Moisture-laden air from the Pacific Ocean is forced up and over this range, leading to heavy winter snowfalls that, over thousands of years, have built vast ice fields and glaciers. These glaciers now inhabit high peaks, but the Sea to Sky highway offers some great opportunities for viewing glaciers, as does a trip up Whistler Mountain.

What are glaciers?

Glaciers form where snow accumulates faster than it melts. Over thousands of years, this snow compacts into dense masses of ice that move slowly downhill under the pull of gravity. An estimated 200,000 square kilometres of glaciers and ice fields cover the Canadian landscape - about two per cent of the country's total land area. Glaciers hold approximately three quarters of the fresh water on Earth. Such ice remains an important water source for communities in the Sea to Sky region.

At the Tantalus viewpoint, 13 kilometres north of Squamish, you can see alpine glaciers on the north side of the high peaks of the Tantalus Range. Shaded, north-facing slopes favor glacier growth. A close look at the Tantalus Glacier reveals deep cracks, or crevasses, in the brittle blue glacial ice.

This photo taken from the Tantalus viewpoint shows the maximum height of ice during the last Ice Age. The grinding action of the moving ice rounded the lower hills and mountains. Only the highest peaks that protruded above the ice retained their craggy shape.



The Pemberton Icefield, visible from the top of Whistler Mountain, is a massive alpine ice cap that covers a huge area between Whistler and Pemberton.

Sea to Sky country once looked like Greenland

Glaciers once dominated the Sea to Sky corridor. At the height of the last Ice Age, two kilometres of ice covered the present-day sites of Squamish and Whistler. Evidence of how that ice shaped the landscape is still visible throughout the Sea to Sky corridor.

MASSIVE ICE FLOWS POLISHED THE SURFACE OF THIS ROCK NEAR THE BASE OF STAWAMUS CHIEF, THE SECOND LARGEST GRANITE MONOLITH IN THE WORLD. THE SMOOTH AND SCULPTED SURFACE WAS POLISHED BY FINE ROCK GRIT IN THE BASE OF GLACIER. PEBBLES IMBEDDED IN THE ICE LEFT SCRATCHES THAT MARK THE DIRECTION OF ICE FLOW.

A changing climate is shrinking glaciers rapidly:

Glaciers all over the world are shrinking and the ice fields of the Sea to Sky region are no exception. This glacial retreat is direct evidence of a warming climate resulting from an increase in greenhouse gases.

The Wedgemount Glacier, flanking Wedge Mountain about 11 kilometres northeast of Whistler, has shown significant glacial melting, as these photos from 1979 and 1998 attest. This loss is typical of glaciers in the Coast Mountains.

If you are interested in studying glaciers and plate tectonics, consider a career with Natural Resources Canada's Earth Sciences Sector.

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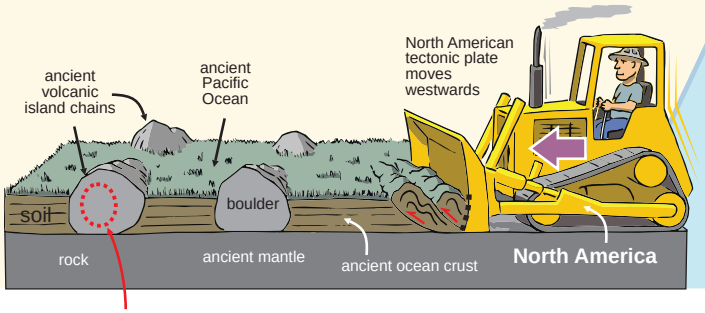
SEA TO SKY STORY: MAKING OF MOUNTAINS

British Columbia's mountains began forming 170 million years ago, and are still growing to this day. Seventy kilometres below the Sea to Sky corridor, the Pacific oceanic plate is sliding eastwards below the crust of British Columbia, part of the North American plate. This collision of tectonic plates is the source of British Columbia's coastal mountain range.

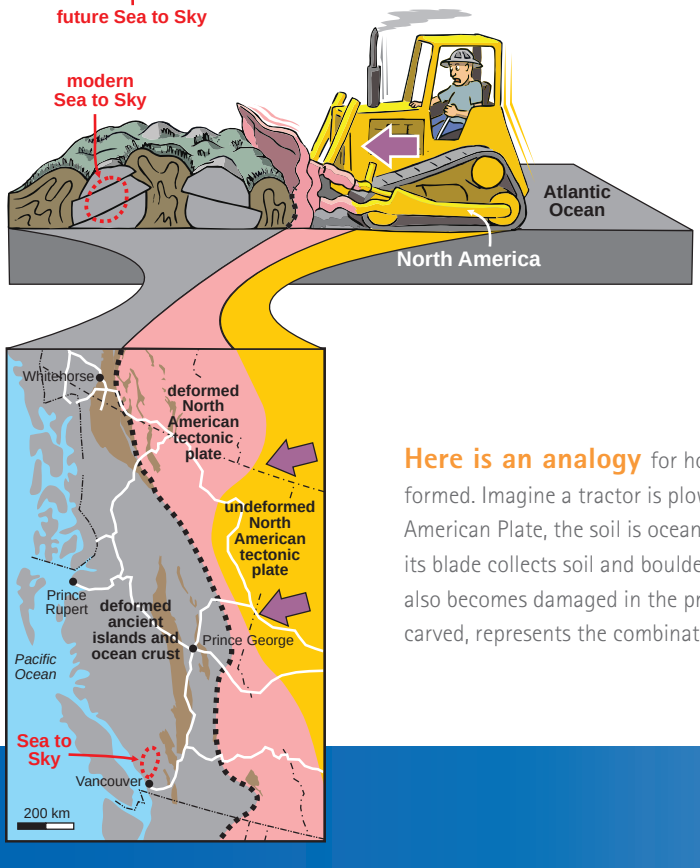
Crustal Collisions

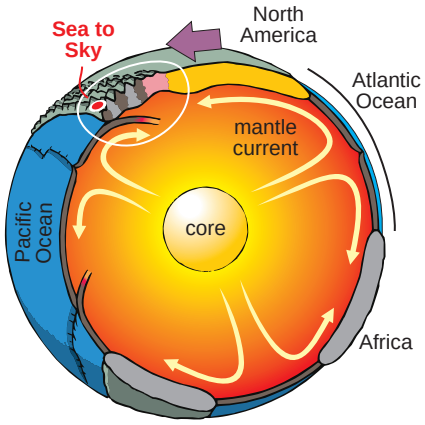
The surface of the Earth is made up of large pieces called tectonic plates. These plates are tens of kilometres thick and thousands of kilometres wide. They float on top of a layer of molten rock called the mantle. Currents within the mantle push these plates slowly and steadily in different directions.



British Columbia is on the leading edge of the North American tectonic plate which is colliding with the Pacific oceanic plate. Keep in mind that tectonic collisions happen in slow motion. The North American Plate is overriding the oceanic plate at a rate of four centimetres per year. That's about how fast a person's toenails grow!

Because of this collision, the compressed edge of the North American Plate is rising. This is the first step to creating mountains.





Here is an analogy for how British Columbia's land, and its characteristic mountain ranges were formed. Imagine a tractor is plowing a field with scattered boulders. The tractor represents the North American Plate, the soil is ocean floor and the boulders are ocean islands. As the tractor moves forward, its blade collects soil and boulders, deforming the soil and breaking the boulders. The tractor blade also becomes damaged in the process. Modern British Columbia, from which our mountains have been carved, represents the combination of broken boulder, deformed soil, damaged blade and tractor.

EROSION IS THE PROCESS THAT CARVES STEEP MOUNTAIN VALLEYS AND CRAGGY CLIFFS FROM THE RISING LAND. WITHOUT EROSION, COASTAL BRITISH COLUMBIA WOULD BE A HIGH PLATEAU. BUT THE RELENTLESS EROSION BY RIVERS AND GLACIERS HAVE CARVED THE PLATEAU INTO VALLEYS AND MOUNTAINS TO CREATE BRITISH COLUMBIA'S CHARACTERISTIC LANDSCAPE.

During the last Ice Age, glaciers covered British Columbia. These glaciers followed river valleys, carving them deeper and wider, and creating steep valley walls. And wherever they went, they took souvenirs with them.

Glaciers pick up rocks and rivers wash them away

Glaciers are constantly picking up rocky souvenirs. Steep, narrow river valleys become wide and round when glaciers flow through them for thousands of years. This is because glaciers pick up rock and debris as they travel. The sediment freezes into the glacier and moves along with it, grinding the underlying rock that it travels across.

When glaciers melt, all of the rock and debris they had been carrying drops on the ground, or is carried away by rushing water. Rivers carry the discarded silt, sand and other debris downstream and out to sea.

The height of the glaciers that flowed down Howe Sound during the last Ice Age can be interpreted from the shape of the local mountains. Only the highest peaks escaped the grinding and rounding effect of the glaciers.

Tongues of a great glacier extend down valleys on the edge of the Pemberton Icefield. When these glaciers retreat, they will leave a widened valley full of rocky debris.

Scientists at the Geological Survey of Canada have mapped the bedrock, the landscape and the seafloor of the Sea to Sky area. These maps provide a foundation for understanding the environment, hazards and mineral potential of the area.

The steep slopes of the Sea to Sky mountains are prone to landslides, which can damage local infrastructure and endanger communities and travellers. Natural Resources Canada scientists map potential landslide areas and take part in emergency planning to help keep British Columbians safe.

If you are interested in studying glaciers and plate tectonics, consider a career with Natural Resources Canada's Earth Sciences Sector.

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SEA TO SKY STORY: FORESTS

Some of Canada's most diverse geography and plant life lines the scenic Sea to Sky Highway. Leafy deciduous trees and evergreens border snow-topped mountains, an ocean fiord and glacier-cut valleys. British Columbia's coastline has the wettest weather and the tallest trees in Canada.

Stanley Park is a good introduction to British Columbia's coastal forests: western red cedar, western hemlock, and imposing Douglas-fir are a few of the characteristically West Coast species to see. Many of the trees in the park are over 150 years old.

Wetter lowlands

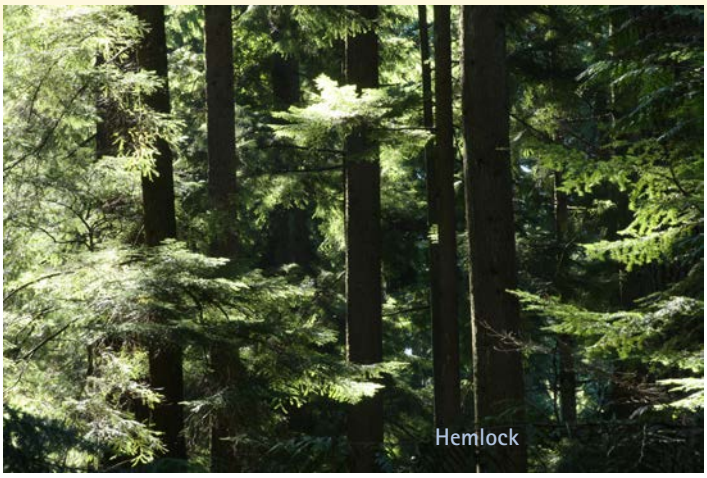
As Highway 99 leaves Stanley Park, it travels through forests dominated by young Douglas-fir with arbutus trees before reaching the coastal rainforest at Howe Sound. Covered with smooth, bronze-coloured bark, arbutus is the only broadleaf evergreen native to Canada.

Highway 99, also known as the Sea to Sky Highway, passes through two different climate zones, each with its own characteristic weather and tree species.

When you reach Squamish at the tip of Howe Sound, you will find whitebark pine, yellow-cedar, subalpine fir and mountain hemlock at higher elevations. Further north, around Cheekye, the forests are dominated by second growth Douglas-fir with many western hemlock seedlings growing beneath.

At Lions Bay Village, bigleaf maple replaces arbutus. Bigleaf maple is one of the largest and fastest growing maples in Canada with leaves that can reach more than 30 centimetres in diameter. Like eastern maples, bigleaf sap can be made into syrup.

AROUND BROHM LAKE, THE FIRS AND HEMLOCKS GIVE WAY TO LODGEPOLE PINE – PERHAPS AS A RESULT OF DRIER CONDITIONS IN THAT AREA. INTERPRETIVE SIGNS AND WALKS AT THE LAKE PROVIDE INFORMATION ON THE TREES IN THE AREA. THE LODGEPOLE PINE, A STAPLE OF THE BRITISH COLUMBIA FOREST INDUSTRY, HAS BEEN WIDELY ATTACKED BY THE MOUNTAIN PINE BEETLE. RED AND GREY DEAD TREES MARK THE PATH OF THE BEETLE AROUND THE PROVINCE, PRIMARILY IN THE INTERIOR BUT ALSO IN THE SEA TO SKY REGION. THE IMPACT OF THE PINE BEETLE IN BRITISH COLUMBIA IS ESTIMATED AT 14.5 MILLION HECTARES – AN AREA LARGER THAN THE SIZE OF ENGLAND.


Hemlock

www.naturallywood.com

Drier highlands

North of Squamish, the Sea to Sky Highway leaves the coast and travels inland into a drier climate zone. At Cheakamus Canyon, the valley floor opens up and the forest changes from one dominated by Douglas-fir and lodgepole pine to one of large western hemlock and western red cedar.

Forests in this area are very important for timber production. The Squamish Forest District produces about 25,000 truckloads of logs annually. The sustainable management of this working forest area requires an ongoing effort by forest managers to balance silvicultural practices, wildlife habitat and recreational use.

A significant percentage of the planet's temperate rainforest is located in British Columbia. The heavy rainfall and mild temperatures are perfect for growing record-breaking trees, both in size and age. Sitka spruce, western red cedar and Douglas-fir regularly grow up to 60 metres tall and can live to be over 800 years old. The Carmanah Giant, a 96-metre tall Sitka spruce on Vancouver Island is reputed to be the tallest standing tree in Canada and the tallest Douglas-fir is 94 metres tall.

Evergreens can be recognized by the colour and texture of their needles and cones.
From left: western red cedar cones, Douglas-fir cones, western red cedar needles, Douglas-fir needles.

The Canadian Forest Service of Natural Resources Canada conducts research into various aspects of forest ecology to further the sustainable use and competitiveness of our forests. Research efforts are focused on issues such as climate change, forest fires and invasive insects and diseases. Researchers work to predict and prepare for change in our forests. There is still much to learn about our forests. If you want to be part of the solution, consider a career with the Canadian Forest Service.

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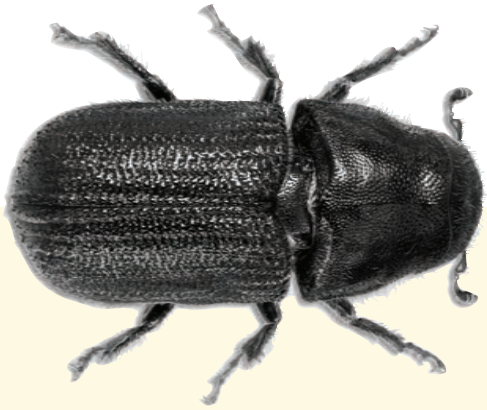
SEA TO SKY STORY: MOUNTAIN PINE BEETLE

Smaller than a grain of rice, the mountain pine beetle has spread across an estimated 14.5 million hectares of forest in British Columbia – an area larger than the size of England. The unusual red rust colour of the lodgepole pine trees along parts of the Sea to Sky Highway north of Squamish is evidence of the mountain pine beetle infestation.

The beetle also poses a real threat to Alberta's lodgepole pine forests, the jack pine stands of Canada's northern boreal forest and the pines in Eastern Canada. The long term economic and social impacts of the beetle are significant, particularly in forestry-dependent communities.

The mountain pine beetle is native to western pine ecosystems in North America. Similar bark beetles are present in other forest ecosystems around the world and are part of the natural life cycle of a forest.



Close up of a mountain pine beetle. The adults range from 3.7mm to 7.5mm in length.

Clusters of red trees are often evidence of beetle damage. First, the trees turn from a lush to pale green, and then to a dull yellow. By the time the tree turns red (also known as red attack) usually in the summer following the initial attack, most beetles have moved on to another tree.

Below: Under the bark.

Normally, small numbers of mountain pine beetle help the forest regenerate by burrowing under the bark of older trees, cutting off supplies of water and nutrients and killing them. The trees rot and provide the foundation for a new forest.

However, a decade of hot summers and moderate winters in British Columbia has contributed to a huge increase in the number of beetles. Hot, dry summers stress the trees, reducing their ability to defend against beetle attack and moderate winters contribute to lower beetle mortality rates. The mountain pine beetle usually attacks older pine, but when an outbreak happens, there are so many beetles they attack trees of all ages.

Mountain Pine Beetle along the Sea to Sky Highway

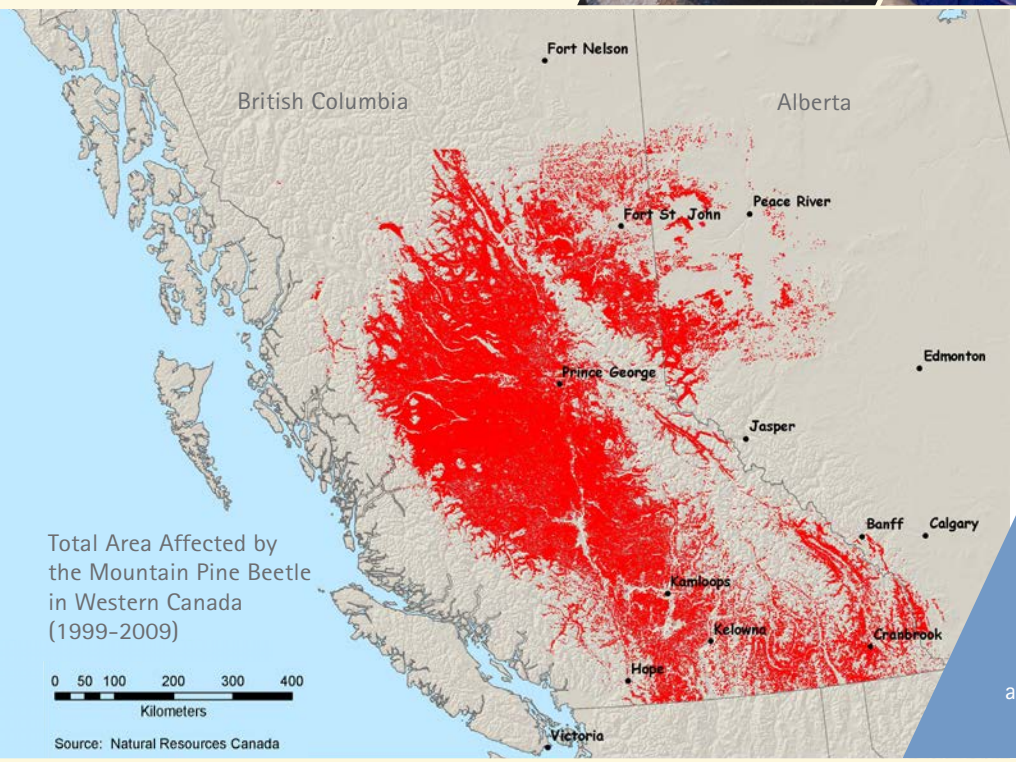
Scientists believe the mountain pine beetle migrated northward with the spread of the pine forests after the last Ice Age. The beetle has been active in the Squamish Forest District for thousands of years.

Extreme concentrations of the mountain pine beetle are mainly found in British Columbia's interior, but the beetle is also present on the northern stretch of the Sea to Sky Highway.

Visible along the highway north of Squamish, the red and grey dead trees indicate a recent mountain pine beetle attack. Travelling north, these trees become increasingly visible along the Whistler and Cheakamus Canyon area and in the Soo and Rutherford River area, just south of Pemberton.

Usable Wood

Canadian scientists have carefully studied and tested the properties and uses of beetle-killed wood. The wood is structurally sound and often has a slight blue colour – a by-product of the blue stain fungi carried by the beetle from tree to tree. This blue wood is as strong as non-beetle killed wood and is used in everything from framing in residential construction, to furniture making, to the roof of the Richmond Olympic Oval.



Tracking the Beetle

Natural Resources Canada scientists use satellite images to map and predict the presence of mountain pine beetle on the forest landscape. They conduct ground surveys to help forest managers locate prime beetle 'hot spots' for direct control and provide information on the severity and potential spread of the beetle.

Does forest science research interest you?
Become part of the team that finds the solution to the problem of the mountain pine beetle outbreak. Natural Resources Canada forest research scientists specialize in entomology (the study of insects), ecosystems, modeling and forest regeneration. Consider a career in science and help plan for the future of Canada's forests.

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