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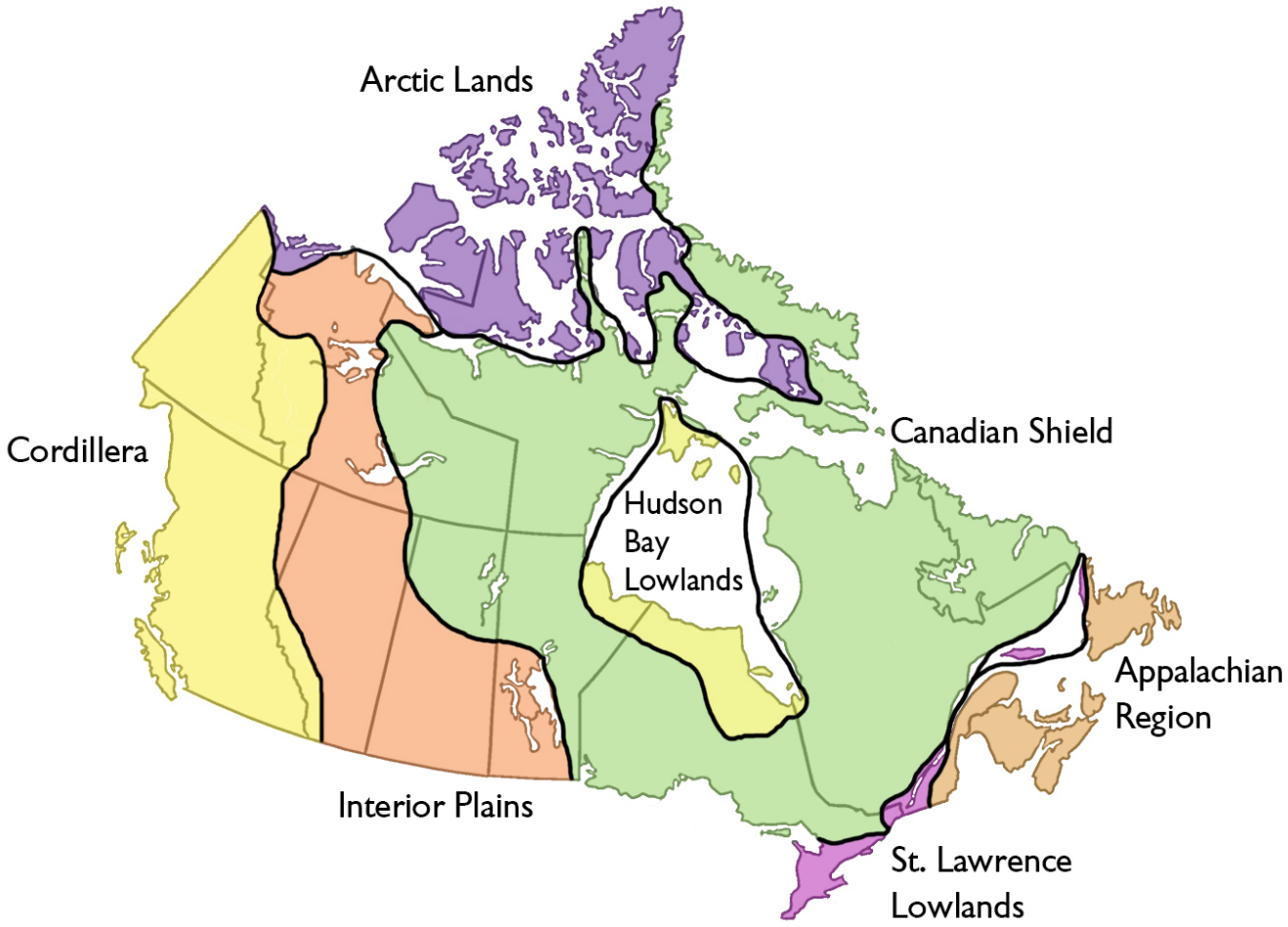
Canada's Physiographic Regions:

Characteristics & Climate Change Implications

Canada is divided into seven physiographic regions: Arctic Lands, Cordillera, Interior Plains, Hudson Bay Lowland, Canadian Shield Forest Lands, St Lawrence Lowlands and Appalachia. Each area has its own distinct physical geography and climate change challenges.



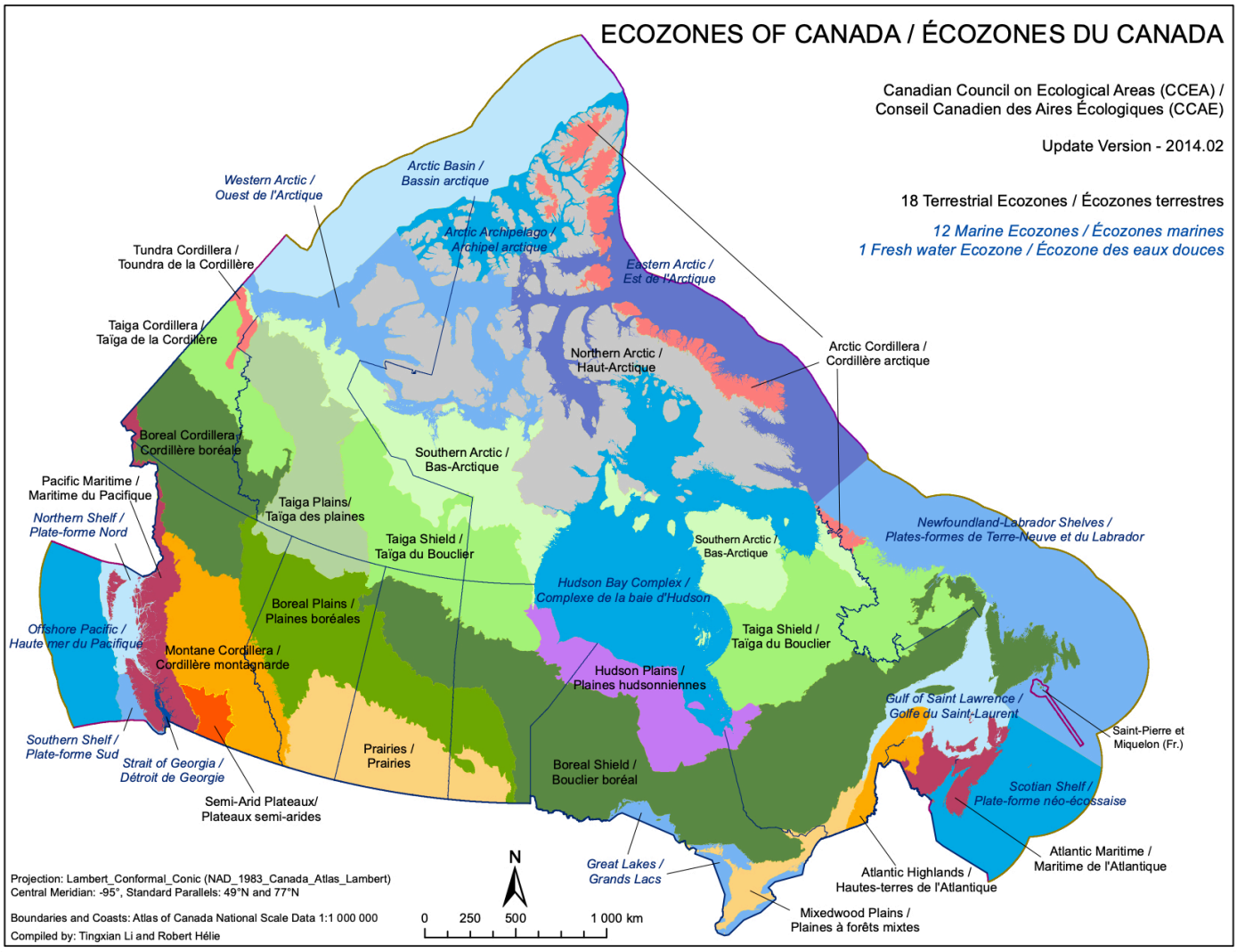
Map Source: https://www.thecanadianencyclopedia.ca/en/article/physiographic-regions

Ecozones

Within each region, Canada has a variety of distinctive ecosystems. Traditionally, 20 major ecosystems or ecozones in Canada were identified: 15 terrestrial ecozones and 5 marine ecozones. The marine ecosystems cover parts of three major oceans settings---the Pacific, Atlantic and Arctic. The terrestrial ecozones largely cover a broad range of forested, taiga and arctic ecosystem types. More recently, the Canadian Council on Ecological Areas (CCEA) has updated ecozone categories/maps and are now presenting both marine and terrestrial Ecozones on one map and have added three additional terrestrial Ecozones and expanded marine zones to 12. *(Note: Much of the information below is based on the original ecozones as resources more readily available under original categories)*

Original Ecozones Maps/Info: http://ecozones.ca/english/zone/index.html

Updated/Expanded Map (see below): https://www.ccea.org/ecozones-introduction/



Arctic Lands

Arctic Lands At-a-Glance

- Provincial Areas: Primarily upper NWT & Nunavut (Includes the Arctic Coastal Plains and Arctic Lowlands, the Innuitian Region of the High Arctic, and parts of the Canadian Shield in Nunavut, northern Québec and Labrador)
- Lie north of the treeline and cover 2.6 million km^2 (26 per cent of the country)
- Taken together, Canada's Arctic and Subarctic Lands comprise nearly 40–45 per cent of Canada's land surface.
- Short summers (w/ almost continuous daylight), long cold, dark winters
- Known for permafrost (ground frozen all year), glaciers, fjords, barren tundra, pingos (huge mounds of solid ice) treeline, northern lights (aurora borealis) and the polar ice pack (permanently frozen sea ice)
- Lowest population in Canada due to climate
- Industries –Oil/gas, Mining (lead, zinc, silver, diamonds) hunting/fishing
- Climate Change – Thawing sea ice & permafrost is disrupting natural habitats, infrastructure, traditional ways of life, increasing marine traffic

Ecozones

Mainly Northern Arctic Terrestrial Zone & Arctic Basin Marine Zone, Parts of Arctic Archipelago Marine Zone

Overview

Northern Arctic

- Among the largest arctic ecosystems in the world.
- Winters pass in near darkness with the polar night measured in weeks and months rather than hours.
- Snow may fall any month of the year and usually remains on the ground from Sept to June.
- Extremely low temperatures
- When not covered in snow, much of the landscape is typified by barren plains covered in frost-patterned soils and the occasional rock outcrop
- Desolate, cold, and dry land but yet full of wonder (Wildflowers, Horned Lark, Muskoxen)

Arctic Basin

- Essentially the parts of the Arctic Ocean that remain under permanent ice cover
- More than 90% of the region consists of a giant permanent ice cap floating on the ocean.

Landforms/Climate

Northern Arctic

- Low rolling plains covered with soil and rock debris left by glaciers
- Frost-patterned soils, frost-shattered limestone, sandstone
- Many coastlines - wide flat plains which were once submerged beneath the sea.
- Broad plateaus are common in the interior area
- Perennial frozen ground known as **permafrost** lies beneath
- The constant freezing and thawing creates unstable soils that form cell-like shapes known as "patterned ground."
- Summers short and cold, with mean daily temperatures above freezing only in July and August.
- While the northern islands have the least precipitation of the arctic ecozones, moisture is plentiful -- in lakes and rivers, in muskegs and permafrost, in the snow cover, in the permanent ice, and in the Arctic Ocean.

Arctic Basin

- True oceanic ecozone in that it touches almost no land
- Undersea geography is dominated by the Canada Basin
- Includes Lomonosov Ridge, a submarine mountain range rising to 1 000 metres below the ocean surface
- Climate is extremely cold and dry, there is life in Canada's Arctic

Wildlife

Northern Arctic

- Extreme cold, harsh soils, and limited plant communities thus relatively low diversity and abundance of mammals
- Only 20 of Canadas' 200+ mammals here, but Home to Muskox, Caribou, and Polar Bear
- Peary Caribou, found only on the high arctic islands
- Only small mammal hardy enough to survive the harsh climate of this region is the Collared Lemming
- To Arctic Fox, Ermine, and birds such as the Gyrfalcon and Snowy Owl, Lemming a vital source of food
- A reduction in lemming numbers, caused by severe weather or as yet unexplained population cycles, can have a ripple effect in many arctic food chains.
- In spring thousands of migrant birds breeding, nesting, and rearing young
- Snow Geese, Brant, and Canada Geese nest in moist wetlands that line coastal areas and river valleys.
- Eider and Oldsquaw Ducks nest beside small ponds on grassy tundra. These areas also support a surprising number of shorebirds, including the Black-bellied Plover, Ruddy Turnstone, and Red Phalarope. Hoary Redpolls, Horned Larks, and Snow Buntings need very little vegetation cover for nesting and thus can survive in even the most sparse arctic landscape.
- Few insect species, no reptiles and amphibians.

Arctic Basin

- Due to phytoplankton and algal blooms, some higher animal species have adapted to life on or near the permanent ice pack
- Along the more southerly borders of this ecozone live Walrus, Polar Bears, Beluga Whales, Narwhals, and Bearded, Harp, Ringed and Harbour Seals. Migratory birds pass through the ecozone, Ivory Gull lives year round
- Life is present beneath the ice, but it is sparse compared with warmer waters.Arctic Cod and Ogac, Arctic Char, Sculpin, Eelpout, and Snailfish the most common.
- Estimated that half the creatures are benthic, or bottom-dwelling, organisms such as anemones, clams, sea worms and sea stars - crucial to the Arctic food web

Plants

Northern Arctic

- Sparse/stunted plant life due to the exceedingly dry climate, permafrost, frost-churned and calcareas soils, and gale force winter winds
- Relatively lush "oases" are found confined mainly to coastal lowlands, sheltered valleys, and moist, nutrient-rich corridors along streams and rivers & often support sedges, mosses, and lichens, vital to many species of wildlife.
- Adaptations to this harsh ecosystem: perennial because too little energy is received for plants to germinate, bloom, and produce seeds during one brief summer. To avoid the chilling arctic winds, most plants are very short.
- Examples: Arctic Willow (ground-hugging) , Moss Campion and Yellow Oxytrope dense mats to reduce heat loss)

- Arctic Poppy - parabolic shape, heat-absorbing centre, and ability to track the sun's movements through the sky make it a natural solar collector, raising its internal temperature by up to 10°C and hastening the formation and ripening of seeds. This strategy further promotes reproduction by attracting pollinating insects that come to bask in the flower's warmth.

Arctic Basin

- Because of the constant ice cover and an almost total absence of tides, the waters of the Arctic Basin do not mix as they do in other oceans, so there is no opportunity for the introduction of nutrients from other ecozones.
- Despite these obstacles, algae grows on the underside of sea ice in the summer. Biological hotspots consisting of blooms of microscopic plants known as phytoplankton occur in spring and summer along the edges of the pack ice or in stretches of open water, called polynyas, where currents are strong enough to keep the water from freezing. These blooms are the basis of the Arctic food chain.

Human Activities/Industries

Northern Arctic

- Among the least populated areas of the world
- The Inuit, who have occupied the area for a thousand years or more, form majority of the population and consist of regional groups that share a unique heritage and one language with several dialects.
- Mixture of traditional and cash economies
- Rich in mineral and hydrocarbon reserves
- Hunting, trapping, and fishing, mining (copper, gold, zinc, diamonds), oil and gas development, construction, services, tourism and government activities

Arctic Basin

- Since the ecozone touches almost no land, human presence is limited to small-scale hunting parties along the edges of the pack ice
- Scientific expeditions have concentrated largely on finding oil and gas reserves along the edges of the ice pack
- Scientists have tracked the spread of toxic chemicals through the food chain in the Arctic

See also ***Arctic Archipelago*** Marine Zone:

http://ecozones.ca/english/zone/ArcticArchipelago/index.html

Climate Change

- Arctic life depends on the annual cycle of sea-ice formation, but climate change is making these cycles less predictable.
- Ice-dependent species such as polar bears, walrus, narwhals, belugas and bowhead whales are watching their habitats shrink, move and change.
- Damage to buildings, roads, pipelines, power lines, and airstrips due to thawing permafrost
- Reduced and disrupted access to communities and facilities due to warmer summer temperatures
- Sea-ice deterioration is expected to lead to increased marine traffic (authorized and unauthorized), and the increased risk of pollution and other threats that accompany that traffic.
- Easier access to Canada's north will also likely reduce the overall cost of exploration, extraction, and shipment of natural resources, making such projects more economically viable. There is considerable potential for development of natural resources (minerals and oil & gas) in northern Canada
- Maintaining and protecting aspects of traditional and subsistence ways of life in many Arctic Aboriginal communities will become more difficult in a changing climate.
- While the impacts of climate change are already being felt by communities, a warming Arctic has ramifications for the whole planet. As the Arctic warms, it has less ability to help cool the planet.

(Info about climate change in NWT & Nunavut can also be found in "Interior Plains" and "Canadian Shield" sections as these areas intersect with more than one physiographic region)

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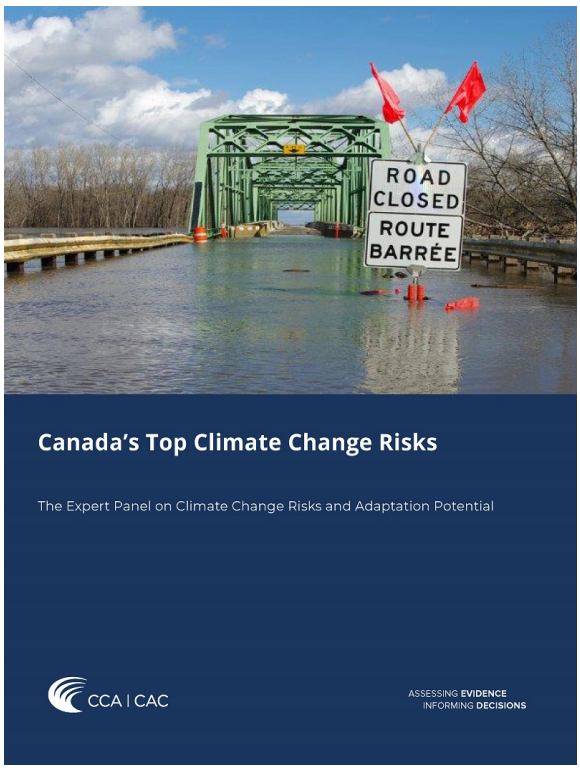

Cordillera At-a-Glance

- Provincial Areas: Primarily BC & Yukon (Southwestern parts of NWT & Rocky Mountain border with Alberta), 16% of Canada
- Variety of climates and landscapes incl. mountains, plateaus, valleys, plains, forests within 5 ecozones: *Pacific Marine, Pacific Maritime, Montane Cordillera, Boreal Cordillera, Taiga Cordillera*
- BC Coast - mild/wet, interior - colder/dryer/snowier
- Most people live in extreme south lowlands such as Vancouver area and southern plateau due to warmer climate.
- Industries – *forestry, agriculture/fruit orchards, mining, fisheries, tourism
- B.C. has most extensive park system
- The Port of Vancouver is Canada's largest/busiest, $ billions in goods traded around the world
- Yukon - known for gold rush, Northern Lights, Canada's 5 highest mountains, boreal forest - Vast regions, varied ecosystems, and relatively sparse human population make Yukon haven for grizzly & black bears wolves, caribou, moose, muskox, migratory birds
- Climate change challenges – water shortages, extreme weather hazards, forest fire/pest issues, permafrost thaw/sea ice melt, food security, infrastructure vulnerability

Ecozones

Pacific Marine, Pacific Maritime, Montane Cordillera, Boreal Cordillera, Taiga Cordillera

Landforms & Climate

Pacific Marine

- Fjord-dominated west coast and runs out to sea over a narrow continental shelf and slope, leading edge of the great North American tectonic plate
- Massive geological forces at work where the shelves meet cause undersea volcanoes and the famous west coast earthquakes.
- Sea ice generally absent as land barrier imposed by the Alaskan peninsula prevents much of the cold arctic currents from flowing down the west coast
- Stable temperatures

Pacific Maritime

- Coast Mountains dominate most of the ecozone - Glaciers and snowfields cap the tallest range
- Rugged mountains of Vancouver Island and the Queen Charlotte Islands - Igneous and sedimentary rocks lie beneath most of the area while fallen rocks and glacial deposits predominate on the surface
- Estevan Coastal Plain - long narrow strip of rocky coastline dotted by the occasional beach (west coast of Vancouver Island) constantly changing due to Pacific's waves/winds.
- Fiords and channels - coastline from Vancouver to Alaska
- Zone lies within the Pacific Ring of Fire, a narrow, semi-circular area known for volcanic eruptions and earthquakes caused by friction between the Earth’s crustal plates (hot springs result)
- Some of the warmest and wettest weather in Canada

Montane Cordillera

- Most diverse of Canada's terrestrial ecozones: some of the driest, wettest, coldest, and hottest conditions
- Ranging from alpine tundra and dense conifer forests to dry sagebrush and grasslands.
- Much of the region is rugged and mountainous
- Columbia and Rocky mountains - complex geology of folded and faulted sedimentary bedrock.
- Moist Pacific air carried by westerly winds drops large amounts of rain and snow as it ascends the windward side of the Coast Mountains.
- The air drops over the eastern slopes into the Montane Cordillera, where it compresses and warms, causing clouds to thin out.
- South-central interior - driest climate of B.C.
- Interior continental climate dominated by easterly moving air masses that produce cool wet winters and warm dry summers.

- Temperatures vary with altitude
- Ponderosa Pine forests are driest and, in summer, the warmest forests in B.C.

Boreal Cordillera

- **C**onsisting of extensive mountains and valleys separated by wide lowlands - spans 444 000 square kilometres, occupying the southern Yukon and northern half of British Columbia
- Contains most of the Yukon's population
- Encompasses the St. Elias, Skeena, Cassiar, Ominica, and northern Rocky mountains as well as the Stikine, Yukon and Klondike plateaus
- Plateaus generally display the flat to rolling features of mature erosional surfaces and are dissected by streams
- Climate is an interior subalpine type - Winters are long and cold, summers brief and cool.
- Moist Pacific air frequently causes sudden, often violent storms during summer. A more stable air mass usually prevails in winter, but cold spells can be broken by warm chinook winds.
- Above the treeline alpine weather is the norm - cold, windy and snowy and characterized by low temperatures during the growing season and a short frost-free period.

Taiga Cordillera

- Straddles the Yukon-Northwest Territories border
- Mountains, rivers, rock walls, uplands dominated by alpine and arctic shrubs and flowers, vast wetlands and spruce-lined valleys
- Some of Canada's largest waterfalls, deepest canyons, and wildest rivers.
- Most active period of mountain building occurred about 100 million years ago, when local stresses beneath the Earth's crust forced red-hot molten rock toward the surface to produce the igneous rocks visible today
- Since then, rocks have undergone slow but sure destruction by a variety of erosive forces
- The cyclic freezing and thawing action of permafrost-rich soils enhances these processes of disintegration - resulting polygon and stripe-like patterns
- Cold and humid climate, with long, dark winters and short, cool summers
- Snow and freshwater ice-cover persist for six to eight months annually.

Wildlife

Pacific Marine

- Home to about 3 800 species of invertebrates, a mixture of oceanic, subpolar, neritic (living in the tide waters and landwashes), and benthic (bottom-dwelling) plankton
- The Pacific Herring is the most abundant, while Salmon, Halibut, Steelhead, and Dolly Varden, among others, form the backbone of commercial fisheries. Over the years, salmon and herring stocks have been overfished, and although herring stocks are rebounding, the health of salmon stocks remains precarious.

- Marine mammals include Steller Sea Lions, Sea Otters, Northern Fur Seals, Orcas and Gray Whales.
- Large breeding bird populations include ducks and geese, Petrels, Guillemots, Murrelets and Auklets, with some Puffins and Murres. Several species of raptors, including Bald Eagles and Osprey, feed in the near-shore wetlands and rivers

Pacific Maritime

- Land mammals - Black-tailed Deer, Black and Grizzly bears, Mountain Lion (or Cougar), Fisher, and American Pika.
- Bird species unique to this area include the American Black Oyster Catcher, Tufted Puffin, Chestnut-backed Chickadee, Northern Saw-whet Owl, Northern Pygmy Owl, Steller's Jay, Bald Eagle, Blue Grouse
- Several species and subspecies of wildlife evolved on the islands of the region (ie. Vancouver Island Marmot, "Blond" or "Kermodei" bear, Roosevelt Elk
- Many seabirds, (ie. Marbled Murrelet) nest along the coast. The area's many
- Islands, estuaries and fiords provide critical habitat for countless migrating shorebirds and waterfowl (Trumpeter Swan, Sandhill Crane)
- Typical marine mammals - Northern Sea Lion, Northern Fur Seal, Harbour Seal, a host of whales: the giant Beaked Whale, Sperm Whale, Grey Whale, Killer Whale, Pacific Pilot Whale and Blue Whale.
- Several species of salmon and their spawning streams are located throughout the ecozone. Pacific Herring and Pacific Halibut are also found here. Common freshwater species include the Cutthroat Trout, Dolly Varden, and Steelhead.

Montane Cordillera

- In the alpine tundra, the snowpack does not melt until well into summer and plantlife is sparse. Several species have adapted to the harsh climate, including Mountain Goat, Gyrfalcon, White-tailed and Willow Ptarmigan, Water Pipit and Rosy Finch.
- Mule Deer, Rocky Mountain Elk, Stone Sheep, Grizzly Bear and Black Bear are common in lush meadow habitats and the stunted spruce groves known as krummholz
- Mule Deer, Rocky Mountain Elk, Stone Sheep, Grizzly Bear and Black Bear are common in lush meadow habitats
- Grizzly Bear and Black Bear - most common large mammals.
- Conifer forests are also important habitat for fur-bearers such as Marten, Fisher, Red Squirrel and Wolverine and a diverse collection of birds that feed on conifer seeds, bark insects and small mammals.
- Common birds - Pileated Woodpecker, Northern Flicker, Clark's Nutcracker and Red Cross-bill.
- Ponderosa Pine parklands provide habitat for species that forage on large conifer seeds (Clark's Nutcracker, Pygmy Nuthatch and Yellow-pine Chipmunk), bark insects (Northern Flicker and White-headed Woodpecker) or flying insects (Common Poorwill).
- Southern species such as Pallid Bat, Burrowing Owl and Short-horned Lizard reach their northern breeding limit here.
- Northern species - Snowy Owl and Gyrfalcon, can be found on open rangelands in winter.

- Encroachment and pressures of development on the grasslands and lower slopes of many of the valleys within this ecozone have led to the destruction of habitat for many indigenous species
- 10 bird species vulnerable or threatened and four -- Mountain Plover, Sage Thrasher, Burrowing Owl and Peregrine Falcon (anatum) - endangered

Boreal Cordillera

- Late summer many species migrate south to avoid the abrupt transition to cooler autumn weather and the long cold winters
- Moose and Caribou are the most abundant and widespread ungulates
- Mountain Goats are year-round
- Dall Sheep, Grizzly Bear and Black Bear, Spruce Grouse, Common Raven, Gray Jay, Boreal Chickadee, Red-breasted Nuthatch, Three-toed Woodpecker, Ruby-crowned Kinglet, Red Squirrel, Wolverine and Marten.
- No reptiles are present and the Western Toad, Wood Frog and Spotted frog are the only amphibians.

Taiga Cordillera

- Because of its diversity of habitats - spruce forests to arctic tundra, from alpine mountain peaks to marshy flats - wide array of wildlife species representative of both arctic and temperate climates.
- Mammals most common in alpine terrain include the American Pika, Hoary Marmot, Grizzly Bear, and Dall's Sheep.
- Woodland Caribou, Lynx, Marten, and Black Bear are common mammals of the lower forested habitat
- Common birds in this zone include the White-winged Crossbill, Varied Thrush, and Gray Jay
- Yukon's Old Crow Flats represent only a small part of this ecozone, yet it is a large and notable wetland that has received international recognition
- Largest concentration of Wolverines

Plants

Pacific Marine

- Freshwater discharges from the Fraser, Skeena, Nass, and other rivers carry vast amounts of nutrients to the ocean, stimulating the growth of phytoplankton, algae, and other marine plant life, prolific ocean ecosystem
- In the intertidal zones (between high and low tide and always underwater) lie vast forests of Macrocystis, or Giant Kelp, along with several varieties of seaweed and coral reefs.
- Along the water's edge, coastal salt marshes and mudflats contain large beds of eelgrass, important spawning sites for Pacific Herring schools.

Pacific Maritime

- The combination of heavy rainfall and year-round mild temperatures support some of the most spectacular temperate rain forests in the world.
- Canada's most productive forests and its biggest and oldest trees (Douglas Fir, Western Red Cedar)
- Forest ecosystems vary with elevation and precipitation
- Coastal temperate rainforests are globally scarce - These forests contain ecosystems with the highest biomass per hectare on Earth
- A unique forest ecosystem in the dry rainshadow climate of the Gulf Islands and Saanich Peninsula is the Arbutus and Garry Oak woodland. Among B.C.'s rarest forests, it is considered one of the most endangered ecosystems in North America.
- Urbanization, wildfire suppression and the introduction of exotic species such as Scotch Broom have destroyed about 95% of its original range.

Montane Cordillera

- Vegetative cover varies widely; alpine environments contain various herbs, lichen and shrubs
- Subalpine regions are dominated by tree species such as Alpine Fir and Englemann Spruce
- three forest groups: a marginal band at upper elevations characterized by Engelmann Spruce, Alpine Fir and Lodgepole Pine; a second zone characterized by Ponderosa Pine, interior Douglas Fir, Lodgepole Pine and Trembling Aspen in much of the southwest and central portions; and another featuring western Hemlock, western Red Cedar, interior Douglas-fir, and western White Pine in the southeast.
- High-elevation forest gives way to one dominated by White Spruce, interior Douglas Fir and Lodgepole Pine at mid elevations
- At lower elevations, particularly along dry valleys, Ponderosa Pine is dominant. Wildfires play an important role maintaining these forests.
- Grasslands featuring bunchgrasses and other grasses and shrubs appear in the valley bottoms and on plateaus in south-central B.C
- Much of the valley wetlands have been destroyed by urbanization and agriculture

Boreal Cordillera

- Lower elevations - White Spruce and Subalpine Fir
- Best forest growth is associated with White Spruce on fine-textured moist soil near wetlands and water. Subalpine Fir dominates higher up, especially on northern and eastern slopes, where it often forms nearly pure stands.
- Upper elevations near treelines are dominated by deciduous shrubs, mainly scrub birch and willows
- Alpine vegetation consists of shrubs, herbs, moss and lichen, with much of this area totally lacking in vegetation and dominated by rock, ice and snow.

Taiga Cordillera

- Types of plants strongly influenced by their position on mountain slopes, which determines the amount of available soil moisture and sunlight
- Western slopes often have more luxuriant plant cover than eastern ones, since clouds deposit most of their moisture on western slopes before continuing east

- Four main vegetation zones: alpine tundra (lichens, sedges, and mosses), subalpine transition zone (Alpine Fir trees, Willow and Shrub Birch), montane zone (spruce-lichen woodlands and flat benches of Lodgepole Pine), lowland zone (sheltered conditions, abundant moisture and relatively well-developed soils promote the growth of dense spruce-feathermoss forests and riverside communities of Balsam Poplar, Willow, and Alder, marshes, wetlands)

Human Activities/Industries

Pacific Marine

- Temperate climate, esthetically pleasing scenery, and often healthy economy make Canada's Pacific Coast a most desirable place to live
- Throughout the ecozone, fishing, shipping, tourism and marine recreation are the main human activities contributing to the area's high standard of living.
- These activities, along with pollution from ship traffic, urban run-off, destruction of shoreline habitat, and industrial pollution, are also in combination the main sources of ecological stress.

Pacific Maritime

- Pacific Maritime ecozone is rich in wild fauna, flora, and ecosystems, however much of the south is heavily stressed by population growth, urban development, and the forestry and pulp and paper industries.
- Three-quarters of British Columbians live here. (Most in the Georgia Basin, the area embracing the large urban centres of the Lower Mainland and Victoria)
- Logging and related forest industries economic mainstay - changed the landscape dramatically (clearcutting)
- Commercial fishing industry (Issues - overfishing, habitat damage, toxins
- Important marine transportation route
- Water-based tourism

Montane Cordillera

- Two of the few significant agricultural areas of the province: the Creston Valley and the Okanagan Valley. In the latter, favourable soils, when irrigated, are used for orchards and vineyards as well as cash crops.
- Forested lower slopes - summer range for cattle.
- Forestry main industry of the lower and middle slopes with the interior wet belt being the most productive area for fibre production of all of the inland areas of B.C.
- Pulp and paper mills are located throughout the ecozone.
- Canada is the largest exporter of forest products in the world and B.C. produces 45% of the Canadian total.
- Mining - Five of B.C's eight coal mines and three of Alberta's 11 occur within its boundaries. A major lead-zinc refinery is located at Trail. Copper, gold, silver, molybdenum and other precious metals are also mined within the ecozone and two areas are seeing active diamond exploration.
- Six national parks, including the oldest in Canada, Banff National Park

- Dry valleys and lower slopes have intense recreational use, including hiking, cycling, horseback riding and some hunting and fishing.
- Major lakes - tourist attractions - beaches and hot summers
- The labour force increasingly service-oriented
- Urbanization and industrialization have placed increased pressures on both the quantity and quality of water supplies

Boreal Cordillera

- Close to half of the ecozone's labour force is engaged in public administration or services, others in commerce. This reflects, in large part, the nature of Whitehorse, the capital and commercial centre of the Yukon
- Most historic and present-day placer mining is confined to the Klondike plateau
- Because placer deposits are associated with streambeds, much activity is within the floodplains of streams, which may be dammed, diverted and stripped of vegetation. As a result, impacts on fish habitat and water quality persist long after mining has ceased.
- Important mineral deposits - Casino deposit (copper-gold-molybdenum), Carmacks deposit (copper-gold) and the Mount Nansen deposit (gold-silver)
- Forestry operations centred around Watson Lake in the Yukon and areas of northeastern British Columbia. The forestry sector is growing and expected to become the major employer and economic contributor for the southeast Yukon

Taiga Cordillera

- Sparsely populated (home to the Vuntut Gwich'in)
- Much of the area remains essentially untouched wilderness.
- Subsistence hunting, trapping, and fishing dominate much of the local economy.
- Northern Yukon Park and the area's spectacular scenery - attractive to tourists from around the world.

Climate Change

British Columbia

- Many regions and sectors of British Columbia will experience increasing water shortages and increasing competition among water uses (e.g. hydroelectricity, irrigation, communities, recreation and in-stream flow needs), with implications for transborder agreements.
- The increasing frequency and intensity of extreme weather and related natural hazards will impact critical infrastructure, affecting communities, industries and the environment.
- British Columbia's forests, forest industry and forest-dependent communities are particularly vulnerable to climate-related risks, including pest infestations and fire.

- Climate change will exacerbate existing stresses on British Columbia's fisheries. The vulnerability of Pacific salmon fisheries is heightened by the unique social, economic and ecological significance of these species.
- British Columbia's agricultural sector faces both positive and negative impacts from climate change, with more frequent and sustained drought being the greatest risk.

From ***Impacts to Adaptation: Canada in a Changing Climate*** **Report**

Yukon

- Climate: Yukon climate is now warming rapidly and more change is projected
- Melt and Thaw: Permafrost is thawing; glaciers are receding and sea ice is melting.
- Water: Climate change is affecting and will continue to affect the hydrologic regime.
- Vegetation: Vegetation zones are shifting, fire risk is up, forests are more vulnerable to insect infestations
- Wildlife: Animal species' habitat, ranges, and diversity are changing.
- Food: Climate change negatively impacts First Nations traditional food security. Agriculture is a potential opportunity
- Hazards and Infrastructure: The major climate change hazards in Yukon are flood, wildfire, and damage to infrastructure from thawing permafrost and/or extreme precipitation. Roads, buildings, and infrastructure built without the future climate in mind are vulnerable.
- Traditional Knowledge: TK is an important way to understand climate change, which complements the scientific approach.
- Causes and Responses: Climate change is human caused. Yukon is responding both to the impacts of climate change and to reduce emissions.
- Importance of the North: Climate change in the North is a major driver of global change.

From ***Yukon Climate Change Indicators and Key Findings 2015 Report***

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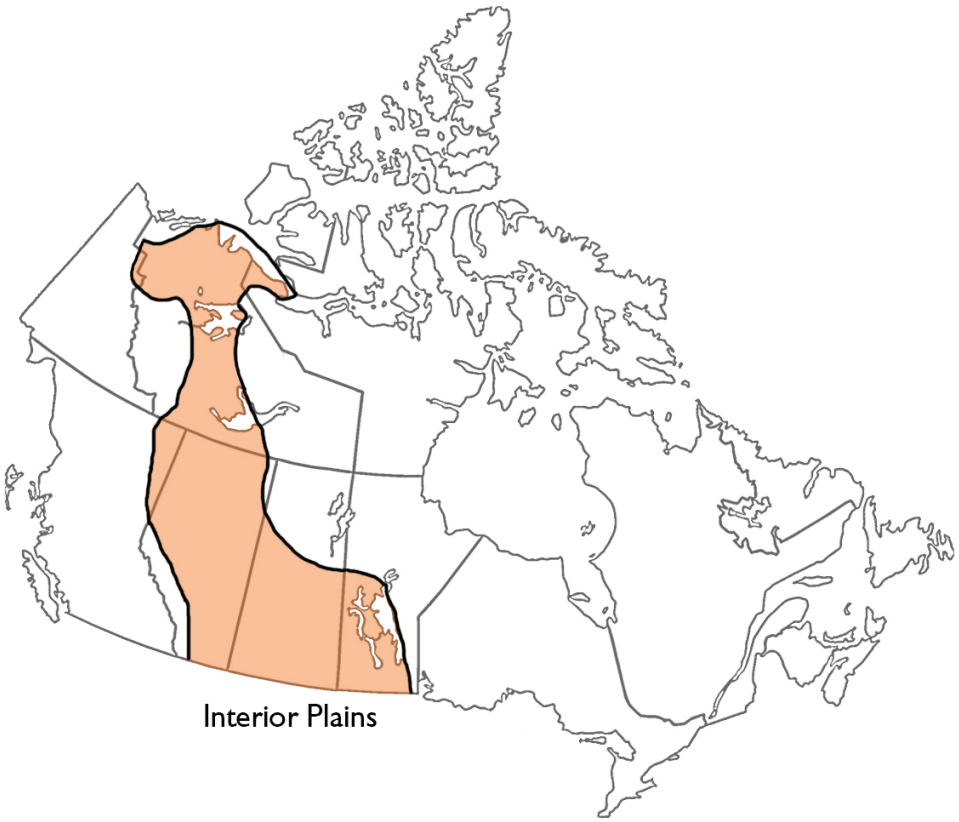
Interior Plains At-a-Glance

- Provincial Areas: Small northeastern corner of British Columbia, *most of Alberta and Saskatchewan*, southwestern part of Manitoba, extends north through the Northwest Territories to the Arctic Ocean.
- Mostly flat elevation
- Southern areas more populated, towns/cities situated near water sources as climate generally dry
- Agriculture - Grain/Farming/Livestock, Resources –Mining, Fuel products esp. oil/gas, Forestry
- Ecozones: *Prairies, Boreal Plains, Taiga Plains*
- Prairies area= From Rocky Mountains in AB to Red River Valley in Manitoba, reaching across southern third of prairie provinces: "Breadbasket of Canada", "Land of Open Skies"
- Boreal Plains – Low lying valleys & plains across mid portions of Manitoba and Saskatchewan & continuing through almost 2/3 of Alberta – Forestry predominates
- Taiga Plains – almost 90% in NWT, contains most of the NWT two "great" lakes, Great Slave and Great Bear, sub-arctic climate
- Climate Change Risks – water scarcity, pests, fire, flooding, biodiversity, infrastructure & economic concerns



Ecozones

Prairies, Boreal Plains, Taiga Plains

Landforms and Climate

Prairies

- Large tracts of flat to rolling plains
- Most of the major rivers have their origin in the Rockies
- Subhumid to semi-arid climate, cold winters, short/warm summers
- Although dry, arctic air predominates in winter, periodic chinooks bring spring-like conditions to southern Alberta
- Water deficit typical but annual precipitation is extremely variable, high winds

Boreal Plains

- The climate of the Boreal Plains Ecozone is determined by its location in the heart of North America. The Rocky Mountains to the west block moisture-bearing winds from the Pacific. The result is short, warm summers and long, cold winters.
- Continental glaciation flattened the landscape and left behind a variety of glacial deposits consisting almost entirely of undulating and level to gently rolling plains dotted with small lakes. Later larger lakes developed from glacial meltwater, creating extensive deltas and dunes

Taiga Plains

- Low-lying plains centred on Canada's largest river, the Mackenzie, and its many tributaries
- Approximately 90% of the Taiga Plains is located in the western Northwest Territories, with small extensions into northeastern British Columbia and northern Alberta.
- Contains most of the Northwest Territories' two "great" lakes, Great Slave and Great Bear,
- The subarctic climate is characterized by short, cool summers and long, cold winters. Precipitation is low to moderate

Wildlife

Prairies

- Intermittent sloughs/ponds on plains offer major breeding, staging, and nesting grounds for migratory waterfowl
- River valleys offer sheltered habitats important to wildlife, especially during the harsh winters.
- Black-tailed Prairie Dog, Short-horned Lizard and Western Rattlesnake. Manitoba - Black Bear, Moose, Sharp-tailed Grouse, Beaver, Red Fox.
- Considering its area and population, the Prairies Ecozone has a disproportionate number of threatened and endangered wildlife species. At least four vertebrate species -- the Plains Grizzly, Swift Fox, Black-footed Ferret, and Greater Prairie Chicken -- have

disappeared from the area. The Peregrine Falcon, Mountain Plover, Eskimo Curlew, Piping Plover, Burrowing Owl, and Whooping Crane are all endangered.
- By replacing natural grasslands with crops, draining wetlands, and destabilizing natural chemical balances in the soil with pesticides, the number and range of wildlife species has changed dramatically.

Boreal Plains

- Human activities have divided the original ecosystems of the Boreal Plains into fragments resulting in diminished wildlife habitats
- Wetlands form an essential part of wildlife habitat, often surviving forest fires to provide refuge and initial browsing lands for wildlife. River levees also provide productive and sheltered areas, especially during harsh winters. Floodplains and associated marshes form unique waterfowl and Muskrat habitat. Bogs, with their ground and tree lichens, are the main habitat for Woodland Caribou.
- The most prominent local species include Timber Wolf, Black Bear, Moose, Woodland Caribou, Mule Deer, Elk, and Beaver.

Taiga Plains

- Moose, Caribou from the Porcupine Herd, Woodland Caribou, Wolf, Red Fox, Snowshoe Hare, Lynx, Black Bear, Marten, Mink, Ermine, Wolverine, River Otter, Porcupine, Muskrat, Red Squirrel, Beaver, and Northern Red-backed Vole, Wood Bison
- Spring/Summer: Red-throated Loon (in the northernmost part), Ring-necked Duck, Greater Scaup, Canvasback, Sharp-tailed Grouse, Hawk Owl, Northern Shrike, and Fox Sparrow, Bald Eagle, Peregrine Falcon, and Osprey
- Year-round bird species adapted to long, cold winters include the Common Raven, Sharp-tailed Grouse, Gray Jay, Common Redpoll, and Willow Ptarmigan.
- Lake Trout, Lake and Mountain Whitefish, Arctic Cisco, Longnose Sucker, Arctic Grayling, Dolly Varden, Burbot, Walleye, and Northern Pike are among the many fish species able to thrive in the Taiga Plain's cold, nutrient-poor lakes and rivers.

Plants

Prairies

- Shift from grassland to cropland in the Prairies has increased losses of organic matter and plant nutrients from the soil.
- The Short-grass Prairie occupies the driest southerly arc of the region, where brown and dark brown soils are dominant. The northern edge of the ecozone is dotted with groves of Trembling Aspen and Balsam Poplar and characterized by black Chernozemic soils. The most productive soils in the region are the black, dark grey, and dark brown soils of the Aspen Parkland and the Tall-grass and Mixed-grass Prairie.
- Lakes and wetland areas are rich in vegetation
- Virtually every major natural water system has been extensively modified and developed for hydro and thermal power generation, irrigation, flood protection, and water management. Agriculture and urbanization have cut the number of wetlands in half.

Boreal Plains

- Nearly half of the Boreal Plains is occupied by productive forest land
- Pressure is mounting to find methods to log without causing irreversible damage to the environment.
- White and Black Spruce, Balsam Fir, Jack Pine and Tamarack in some peatlands. Of the broadleaf trees, Aspen and Poplar are the most common, and Birch exists in some areas. Fire, the most powerful influence on the forest, determines distribution and growth rates. also affected by native insect pests and disease

Taiga Plains

- Plant communities are relatively simple, dominated by a few species well-adapted to poor soil conditions and the harsh subarctic climate
- Tree species of the northern taiga forest, or "land of little sticks," include Black Spruce, White Spruce, Jack Pine, Tamarack, Paper Birch, Trembling Aspen, and Balsam Poplar
- Forest fires that destroy several thousand hectares of trees are not uncommon in this ecozone

Human Activities/Industries

Prairies

- The major population centres are Calgary, Edmonton, Saskatoon, Regina and Winnipeg
- The economic structure of the ecozone reflects a dependence on the primary industries of agriculture, mining, and gas and oil extraction
- Only 15 field crops (grain, oilseeds, and pulses) and even fewer forage crops occupy more than 95% of the cropped area.
- Beef and dairy cattle, swine, horses, chickens, and turkeys are the primary domesticated animals.
- Other industries: Processing food, wood, metals, chemicals, and petrochemicals

Boreal Plains

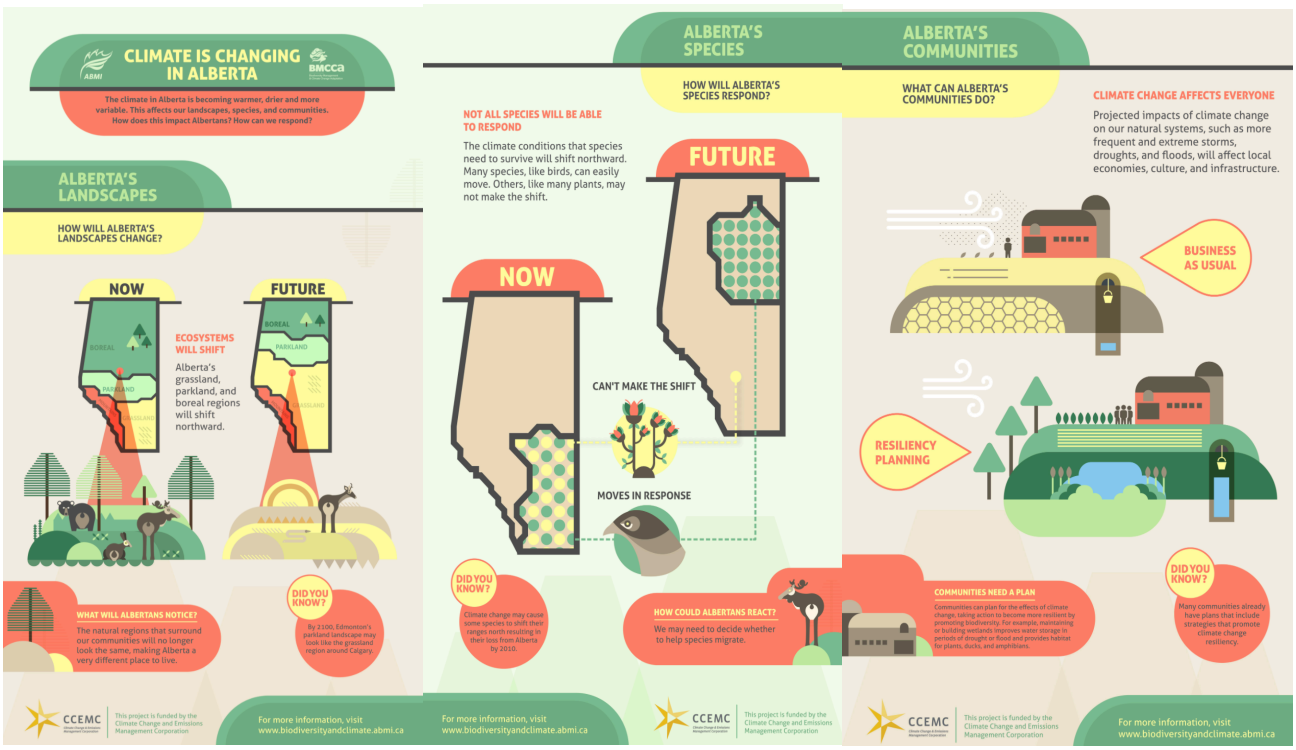
- Most recent major development is the increased use of forests
- The economic structure of the ecozone reflects a relatively high dependence on the service sector, which employs 65% of the labour force, and the primary industries
- Natural resources harvesting. Forestry predominates, along with agriculture, oil and gas development, hydro-electric power generation, fisheries and mining.

Taiga Plains

- Relatively few areas in the Taiga Plains are dominated by human activity. Much of the local economy is based on subsistence hunting, trapping, and fishing. However, the economy does include a small number of industrial activities such as mining, petroleum extraction, and, in recent years, forestry.

Climate Change

Prairie Provinces



Check out link below for full sized graphics

- Increases in water scarcity represent the most serious climate risk in the Prairie Provinces.
- Ecosystems will be impacted by shifts in bioclimate, changes in fire and insect disturbances, stressed aquatic habitats and the introduction of non-native species, with implications for livelihoods and economies dependent on ecological services.
- The Prairies are losing some advantages of a cold winter. Cold winters limit pests and diseases, facilitate winter operations in the forestry and energy sectors, and provide access to remote communities through the use of winter roads.
- Communities dependent on agriculture and forestry are highly sensitive to climate variability and extremes. Drought, which can have associated economic impacts of billions of dollars, wildfire and severe floods are projected to occur more frequently in future.
- Adaptive capacity, though high, is unevenly distributed, resulting in differing levels of vulnerability within the region.
- Although adaptation processes are not well understood, institutions and civil society will play a key role in mobilizing adaptive capacity by building on several recent examples of initiatives that enhance resilience.

From *Impacts to Adaptation: Canada in a Changing Climate 2008*

Alberta/Saskatchewan/Manitoba Resources:

https://www.alberta.ca/climate-change-alberta.aspx

http://biodiversityandclimate.abmi.ca/about-climate-change/ (Source of AB graphics above)

https://www.saskatchewan.ca/business/environmental-protection-and-sustainability/a-made-in-saskatchewan-climate-change-strategy

www.gov.mb.ca/climateandgreenplan

(See also "Canadian Shield" section for overview of climate issues in Manitoba)

Northwest Territories

- Changes to climate and weather
- Thawing permafrost
- Changes to water quality and quantity
- Changes to forests and tundra vegetation
- Changes to wildlife, freshwater fish and marine mammals
- Human health: Potential negative impacts on physical human health, food security and mental, social and cultural well-being, public safety
- Potentially new opportunities for growing local food
- Culture and heritage impacts
- Infrastructure issues

From *2030 Climate Change Strategic Framework*

Sources:

https://www.thecanadianencyclopedia.ca/en/article/physiographic-regions
http://ecozones.ca/english/zone/index.html
https://www.nrcan.gc.ca/impacts-adaptation-canada-changing-climate/10253
https://www.enr.gov.nt.ca/sites/enr/files/resources/128climate_change_strategic_framework_web.pdf

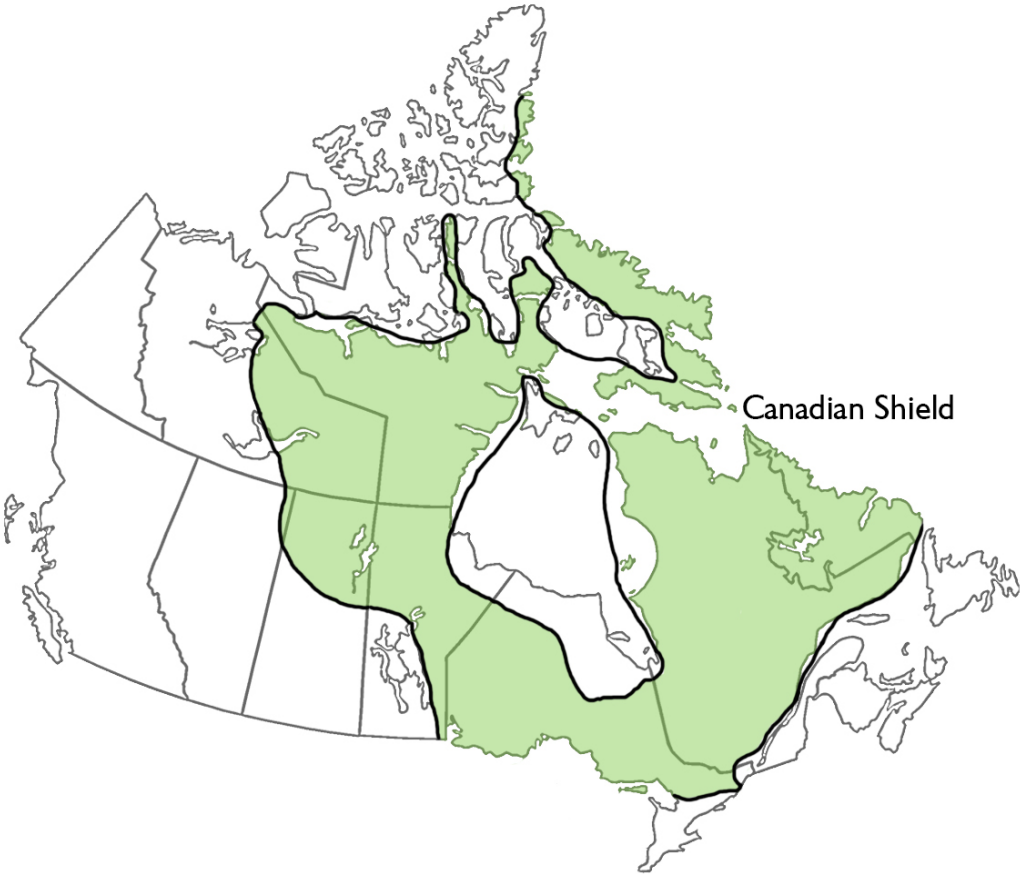
For more info visit:

CCRN
Changing Cold Regions Network

http://www.ccrnetwork.ca/outputs/information-products/docs/Environmental_Change_in_Western_Canada.pdf

Canadian Shield At-a-Glance

- Provincial Areas: Northwest Territories, *Nunavut, *Quebec, Saskatchewan, Manitoba, *Ontario, Newfoundland and Labrador (Labrador only), Tiny NE corner of Alberta
- Covers about half of Canada, made up of very old rock that was mountains millions of years ago
- Shield has only a thin layer of soil that supports a boreal forest of spruce, fir, tamarack and pine.
- Very few people live in the northern, heavily forested part of the Canadian Shield as the soil is poor and the climate is quite cold
- Storehouse of minerals, including gold, silver, zinc, copper and uranium
- Hydro-electricity, forestry, tourism, recreation
- Ecozones: *Boreal Shield, Taiga Shield, Southern Arctic, NW Atlantic Marine*
- Boreal Shield home to animals renowned as emblems of Canada's north woods: Beaver, Moose, Woodland Caribou, Wolf and Black Bear
- Climate Change – increased extreme weather/natural disaster risk, health issue: heat-related illnesses, smog, ecological changes, water shortages, climate-related infrastructure issues



Ecozones

Boreal Shield, Taiga Shield, Southern Arctic, Northwest Atlantic Marine

Landforms and Climate

Boreal Shield

- Canadian Shield rock forms the nucleus of the North American continent
- What once may have been a towering mountain chain is today a massive rolling plain of ancient bedrock
- Most Shield rocks were formed well over a billion years earlier, during the very first chapter of the planet's history known as the Precambrian era
- Long cold winters and short warm summers.

Taiga Shield

- "Taiga" refers to the northern edge of the boreal coniferous forest
- The world's oldest rocks are found on the Taiga Shield in the Slave Geological Province north of Great Slave Lake
- This story of geological creation and change is plainly recorded in exposed bedrock and surface deposits of the Taiga Shield. Volcanic rocks testify to the earliest eruptions of lava that created the Earth's crust as we know it.
- The Taiga Shield Ecozone experiences considerable variation in daylight over the course of a year. Areas north of the Arctic Circle endure at least one day in which the sun never rises and at least one in which it never sets.
- The subarctic climate is characterized by short, cool summers and long, cold winters.

Southern Arctic

- Sprawling shrublands, wet sedge meadows, and cold, clear lakes. Superimposed on this pattern are the fascinating shapes and textures created by intense frost action in the soil.
- Permafrost occurs continuously throughout Ecozone- acts as a dam that stops the downward flow of water, consequently soils are often waterlogged or frozen.
- Repeated freezing and thawing of these soils creates interesting features on the surface, including cell-like polygons, bulging hummocks, and bare mud boils where the soil is so active that no plants can take root.
- Intense frost heaving often splits apart the underlying bedrock and forces large angular "boulders" to the surface.
- Summers are short (about four months), cool, and moist, whereas winters are long and extremely cold.

Wildlife

Boreal Shield

- Each spring hundreds of thousands of ducks, loons, geese and swan
- Characteristic mammals of this ecozone are Woodland Caribou, White-tailed Deer, Moose, Black Bear, Wolf, Lynx, Snowshoe Hare, Fisher, Marten and Striped Skunk
- Many wetlands, ponds, rivers and lakes provide important habitats for Beaver, Muskrat and Mink.
- Atlantic marine environment, typical mammals include Grey, Harp and Hooded seals and Sperm, Killer, Atlantic Pilot, Fin and Blue whales.

Taiga Shield

- Explosive return of ducks, loons, geese, and swans during the spring migration
- Abundant water attracts hundreds of thousands of birds
- Ecological crossroads between two very different ecosystems -- the boreal and the arctic
- Barren-ground Caribou migration, Mice, Voles, Shrews, Weasels, Canids, Grizzly Bear and Arctic Fox, make regular visits
- Lake Trout, Lake Whitefish, Arctic Grayling, Burbot, and Northern Pike.

Southern Arctic

- Low biological productivity, a short growing season, and extremely cold, long winters impose severe demands on wildlife in the Southern Arctic.
- Food chains are relatively short and changes in the abundance of one species may profoundly affect another species. (For instance, a cold, late spring drastically reduces the nesting success of Canada Geese. This causes trouble for Arctic Fox, which depends heavily on egg predation at this time of year.)
- Close to a million caribou migrate south each year
- Flocks of migrating ducks, loons, geese, and swans
- The Barren-ground Black Bear is common throughout Northern Quebec. Moose are also present, particularly along the treeline to the south.
- Polar Bears roam the coastal areas during the summer and venture onto the growing pack ice as winter sets in.

Plants

Boreal Shield

- Cool temperatures, a short growing season, frequent forest fires, and acidic soils challenge plant life here
- Area is forested by a few highly adaptable trees, such as Black Spruce, White Spruce, Jack Pine and Balsam Fir.
- Broadleaf trees in South Paper Birch, Trembling Aspen and Poplar
- Forests are mixed with innumerable bogs, marshes and other wetlands (some converted to cranberry and blueberry farms)

Taiga Shield

- Cool temperatures, a short growing season, frequent forest fires, and thin, acidic soils covering permafrost are among the many challenges faced by plants in this ecozone
- Open, stunted forests with few highly adaptable tree species such as Black Spruce and Jack Pine.
- Innumerable bogs and other wetlands, scattered stands of Paper Birch and Trembling Aspen, and bare rock outcrops, colourful lichens and ground-hugging shrubs.
- Forest fires create a patchwork of plant communities that vary widely in species composition and age
- Permafrost is another major influence, especially in low areas where the soggy ground or active layer above the permafrost regularly freezes and thaws. As trees grow in these ever-shifting soils, they often tip in random directions, giving the impression of a "drunken forest."

Southern Arctic

- Low precipitation and extremely low winter temperatures are among the factors that discourage tree growth
- Blowing of cold, dry winds and the presence of permafrost also restrict plant growth
- Low shrubs such as Willow, Shrub Birch, and Labrador Tea are well adapted to these conditions.
- Mats of lichens, mosses, and ground-hugging shrubs such as Mountain Cranberry and Least Willow.
- Berry picking in autumn when blueberries, cranberries, and bearberries are often found in great abundance.

Human Activities/Industries

Boreal Shield

- Water Flow alteration and mercury contamination from hydro dams and associated river diversions, acidification from mine tailings and smelter emissions, and sedimentation and stream disruptions from extensive logging activities – consequences of industrial development
- Boreal forest - fire suppression, insect control, clear-cutting and single-species tree farming are widespread.
- Mining, forestry, hydro generation and fisheries are all important contributors to the Canadian economy
- Wildlife habitat, tourism, recreation

Taiga Shield

- Coastal settlements were established in the eastern Taiga Shield during the fur trade and whaling eras. The location of more recent communities, including Yellowknife in the Northwest Territories, Uranium City in Saskatchewan, and Churchill Falls and Labrador City in Labrador, reflects the location of ore bodies or hydro-electric potential
- Even largest towns, such as Yellowknife and Labrador City, surrounded by wilderness.

- Quebec portion has several thousand kilometres of roads for logging, mining, and other uses
- Zone contains two of Canada's three largest hydro developments
- The largest mineral rush in Canadian history started in 1991 following the discovery of diamonds in the Slave Geological Province in the Northwest Territories.
- Uranium mining is conducted in northern Saskatchewan, gold is extracted near Yellowknife, and iron is mined in Quebec and Labrador.
- Subsistence hunting, trapping, and fishing still practised widely.

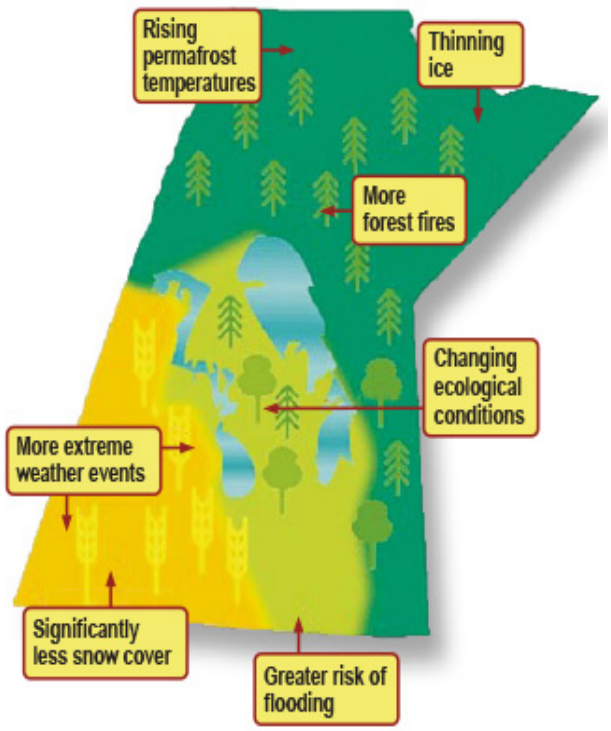
Southern Arctic

- One of the most sparsely populated areas of the world
- Rankin Inlet is the largest centre
- Majority of population is Inuit
- Mixture of traditional and cash economies
- Much of the local population depends on subsistence hunting, trapping, and fishing
- Residents are also involved in mining, oil and gas development, construction, services, and government activities.
- Rich in mineral and hydrocarbon resources

See also *Northwest Atlantic Marine*:
http://ecozones.ca/english/zone/NorthwestAtlantic/index.html

Climate Change

Manitoba



https://www.gov.mb.ca/climateandgreenplan/

- Manitoba's central location in North America and our northerly latitude mean it will face earlier and more severe changes to the climate than many other parts of the world
- Warmer and wetter winters and longer, warmer and drier summers
- Extreme weather, such as heat waves, droughts, floods and intense storms, will likely become more common & affect both our economy and local environment
- Warmer winters will degrade ice roads making it harder to transport supplies to northern communities
- Extreme weather events causing home and commercial business damage could raise insurance costs and government spending on disaster relief

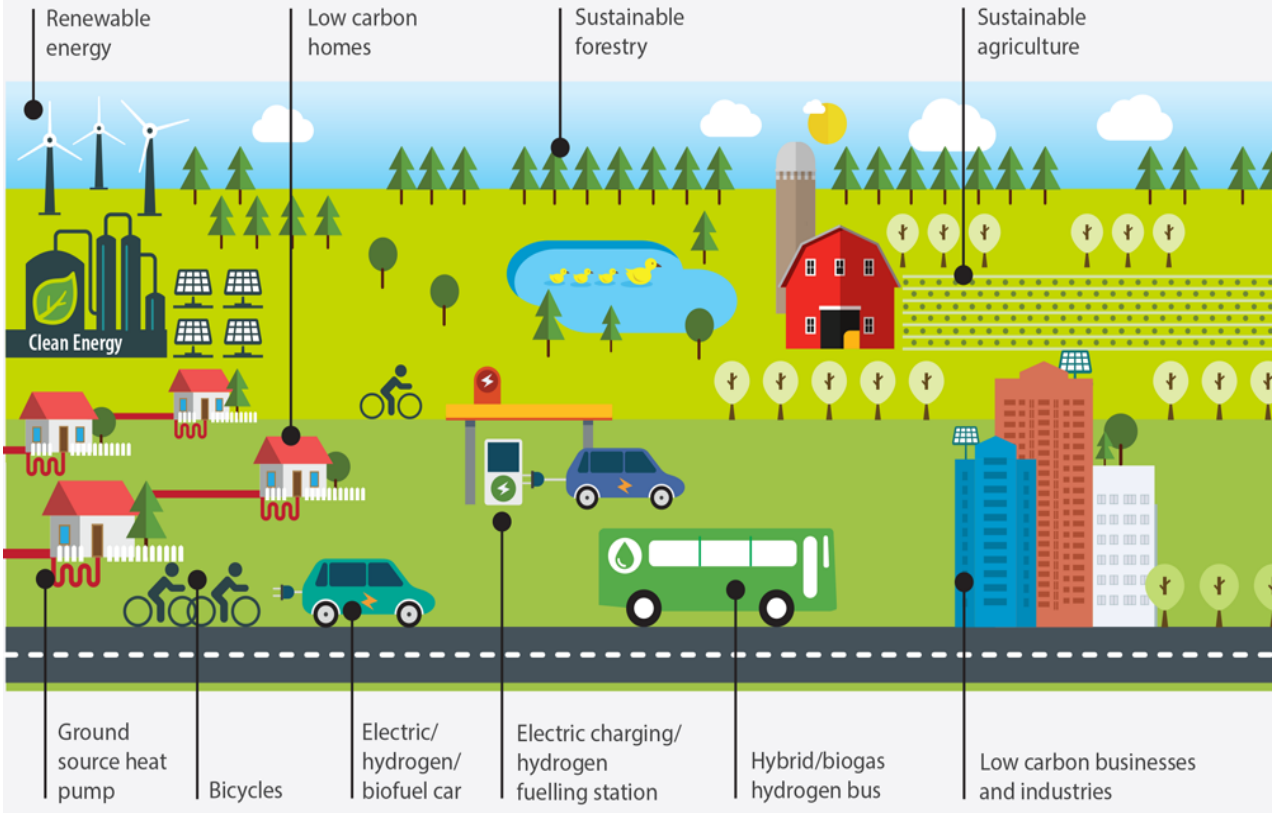
(See also "Interior Plains" for info on SW Manitoba & "Hudson Bay Lowlands" for NE)

Ontario

- Climate-related disruptions to critical infrastructure, including water treatment and distribution systems, energy generation and transmission, and transportation have occurred throughout the province and are likely to become increasingly frequent in future.
- Water shortages have been documented in southern regions of the province, and are projected to become more frequent as summer temperatures and evaporation rates increase.
- Climate-related events, such as extreme weather, heat waves, smog episodes and ecological changes that support the spread of vector-borne diseases, all present risks to the health of Ontario residents.
- Remote and resource-based communities have been severely affected by climate-related events that have caused repeated evacuations, disrupted vital transportation links and stressed forest-based economies. The impacts are expected to increase in future.
- Ontario's ecosystems are currently stressed by the combined influence of changing climate, human activities and natural disturbances.
- Ontario has a strong capacity to adapt to climate change; however, this capacity is not uniform across the region and between sectors.

From Impacts to Adaptation: Canada in a Changing Climate 2008

(See also “Hudson Bay Lowlands” section for more info about climate change issues in Ontario)



https://www.ontario.ca/page/climate-change-strategy

Quebec

- Generally, the climate will grow warmer over the entire territory of Québec, more dramatically in winter than in summer, and more in the North than the South.
- More abundant precipitation is expected in winter and in Nord-du-Québec.
- Climate change will result in extreme weather events (winter storms, violent winds, torrential rains, etc.) becoming more frequent and more intense sometimes lead to flooding, erosion, landslides
- Hotter and more frequent heat waves
- Vulnerability of sectors dependent on natural resources and climate agriculture, forestry, hydroelectricity production, mining and raw materials transformation Impacts of climate change on the vitality of enterprises (infrastructures, supply and distribution chains, operations, profitability, customer traffic and employee absenteeism)
- Emergence of new business opportunities (ie. products or services to ease the adaptation to climate)
- Permafrost degradation in Nord-du-Québec
- Floods, droughts and freeze-thaw cycles in southern Québec
- Species adaptation uncertain, Destabilization of ecosystems
- Conservation and protection of our water and aquatic ecosystems are therefore of capital importance.

From: ***Quebec in Action: Greener by 2020***

Labrador

See “Appalachian Region” notes to follow for info on Newfoundland and Labrador and visit:

https://www.turnbackthetide.ca/impacts-of-climate-change/index.shtml

Northwest Territories

See “Interior Plains” section above for info on Climate Change in NWT and visit the link below to review ***NWT Climate Change Impacts and Adaptation Report***

https://www.enr.gov.nt.ca/sites/enr/files/reports/nwt_climate_change_impacts_and_adaptation_report.pdf

Northwest Territories

Nunavut

- Declining thickness and extent of sea, river and lake ice
- Warmer temperatures
- Changes in vegetation and wildlife: new species are being observed (moving further north), and well-known species are being observed in new areas
- Changes in the permafrost regime and hydrology of the tundra
- Increased frequency and intensity of extreme weather events
- Rising sea levels in certain places
- Melting and shrinking glaciers
- Elders are reporting the same changes as scientists
- For centuries, Inuit have maintained a close relationship with ice (*siku*), land (*nuna*), sky (*qilak*), and wildlife (*uumajut*). Rapid environmental changes will continue to affect Inuit culture and the well-being of all Nunavummiut.
- Heritage and special places in Nunavut are being affected by permafrost degradation and increased coastal erosion caused by the late freezing of sea ice
- Impacts of food security
- Diseases that can be transmitted from animals to humans (scientists call them "zoonotic diseases") are expected to rise as temperatures warm

(See also "Arctic Lands" section for more info about northern areas of Nunavut)

For more info on Climate change in Nunavut, visit:

NUNAVUT CLIMATE CHANGE CENTRE

Sources:

https://www.thecanadianencyclopedia.ca/en/article/physiographic-regions

http://ecozones.ca/english/zone/index.html

https://www.gov.mb.ca/climateandgreenplan/

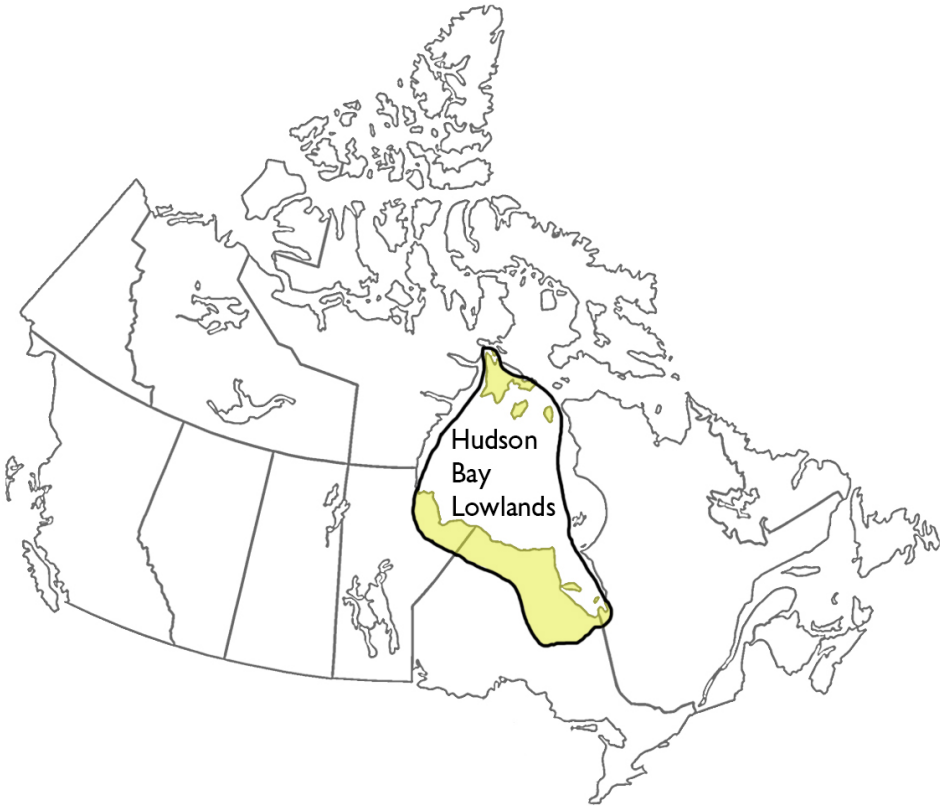
https://www.ontario.ca/page/climate-change

http://www.environnement.gouv.qc.ca/changementsclimatiques/strategie-adaptation-en.htm

https://www.climatechangenunavut.ca/en

Hudson Bay Lowlands At-a-Glance

- Provincial Areas: Largely in upper Ontario, NE section of Manitoba, tiny extension into Quebec.
- Wetland area of Canada that covers about 320,000 square km on the southern shores of Hudson Bay and James Bay, surrounded by the Canadian Shield
- Very few populated areas - the only permanent settlements are small villages, trading posts and ports such as Churchill and Moosonee
- Part of a sedimentary basin that extends beneath Hudson Bay/James Bay
- Ecozone: *Hudson Plains* - Low plain locked in permafrost and characterized by marshes, peat and ponds. Also smaller *Southern Artic* area
- Much of the hydroelectric potential of the area develops at the point where powerful rivers surge out of the Shield on to the lowlands.
- The bay played crucial role in the early development of Canada - direct route to the fur resources
- Climate depends largely on the water surface variances with seasons
- Crustaceans, cod/halibut/salmon, walrus, dolphins, killer whales, seals, 200 species of birds (ducks, geese, swans, sandpipers…)
- Climate Change – Altering sea ice, used by everyone from polar bears to people – higher air temperatures, large implications for terrestrial and aquatic ecosystems



Ecozones

**Hudson Plains mainly, Small section of Southern Arctic, Arctic Archipelago Marine Zone*

Hudson Plains

Landforms and Climate

- Churchill in northern Manitoba represents the approximate western edge of the Hudson Plain and it extends about 1 300 kilometres east to just beyond Fort Rupert in Quebec. To the north, the plains shoulder the waters of Hudson Bay and James Bay.
- Flat terrain, impervious soil and poor drainage have promoted the development of wetlands
- Largest coextensive wetland on the planet
- Web-like or polygon patterns in organic soils are typical of northern wetlands.
- Widespread permafrost, Frozen organic soil
- Hudson Bay moderates the temperature of the lowlands during summer but the effect diminishes in winter when the bay is ice-covered
- Temperatures throughout the year tend to be colder near the coast and warmer inland. Summers are cool and brief.

Wildlife

- Greatest numbers and variety of wildlife in summer
- Migrating, nesting Snow Geese, Canada Goose
- Willow Ptarmigan, Spruce Grouse, Snow Owl, and Raven year-round
- Osprey, Gyrfalcon, Duck Hawk and Peregrine Falcon
- Small mammals - Muskrat, Ermine, Weasel, Marten and Wolverine.
- Some Woodland Caribou, Moose, Black Bear and Timber Wolves, Canada Lynx, Snowshoe Hare, Striped Skunk
- Closer to the coast - Polar Bear, Arctic Fox.
- Marine mammals - Walrus, Bearded, Ringed and Harbour seals, Beluga Whale and the rare Bowhead whales.
- Famous for clouds of insects

Plants

- Wet areas are dominated by tussocks of sedge, Cottongrass and Sphagnum Moss. Dwarf Birch, Willow shrubs.
- Drier sites, shrubby and the low-lying Lapland Rosebay, Crowberry, Blueberry and Cloudberry take hold.
- Herbs - Arctic Aven, Purple and Prickly Saxifrage, and Lousewart
- Taiga area - White Spruce dominate drier areas, while low stands of Willow, Black Spruce and Tamarack are common on wetter and more exposed sites.
- The low taiga areas are similar to the high boreal forests

Human Activities/Industries

- Human activities have strong historical roots (Henry Hudson expedition, later fur trade)
- Settlements of Churchill and Moosonee are perhaps the most recognized
- Except for largely coastal villages, the area is almost unpopulated
- Tourism, fishing, hunting, and trapping provide the main economic base.
- Polar Bear Provincial Park draws many tourists

(See also *Southern Arctic* in Canadian Shield section)

Arctic Archipelago Marine Zone Overview

- One of the most unusual marine ecozones
- Marine area comprised of a patchwork of interconnecting bays, fjords, channels, straits, sounds and gulf
- Important but threatened pods of the Beluga Whale spend their summers along the west coast of Hudson Bay
- The largest population of Polar Bears in Canada builds dens along the coast of Hudson Bay near Churchill, Manitoba

Climate Change

- The Hudson Bay Lowlands, began warming in the mid-1990s — unlike other parts of the Arctic and sub-Arctic, which started heating up decades before
- Lowlands were protected from the effects of climate change by the bottleneck of ice in the bay that kept the surrounding region cold
- Reached a tipping point 15 years ago and has warmed on average by about three degrees
- Lake tests show much less ice cover, warmer water and temperatures in the lake are stratifying.
- Mass die-offs of brook char — a sport fish — because of the rising temperatures
- Changes in water chemistry, changes the food web. Some ponds will totally disappear. Some of the wetlands will dry up - chain reaction of events
- Environmental repercussions of climate change are of global significance, influencing the huge store of carbon in the region's extensive peatlands, the world's southern-most polar bear population that depends upon Hudson Bay sea ice and permafrost for survival, and native communities who rely on this landscape for sustenance.

Sources:

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St. Lawrence Lowlands At-a-Glance

- Provincial Areas: Southern Ontario & Quebec
- A plain along the St. Lawrence River between Québec City in the east and Brockville, Ontario, in the west, including the Ottawa River valley west to Renfrew, Ontario.
- Smallest land region yet one of the most highly populated areas of Canada (big cities ie. Toronto, Ottawa, Montreal, Quebec City)
- Ecozone: *Mixedwood Plains*
- Canada's major deciduous forests located here (beech, hickory, maple, oak and walnut trees)
- Major manufacturing centre due to accessible location to US markets
- Fertile agricultural land, dairy farms
- Freshwater resources from four of the Great Lakes -- Superior, Huron, Erie, and Ontario
- Outflow of the St. Lawrence is the greatest of any river in Canada
- Climate Change: Urban development has led to environmental degradation, increased waves in Gulf, increased temps=heat waves, air pollution, allergies, forest fire risk, waterborne pathogens, infrastructure damage from flooding

Ecozone

Mixedwood Plains

Landforms and Climate

- Extensive system of waterways, including the St. Lawrence River and the Great Lakes, combines with surrounding rich fertile soils to create one of the most attractive and productive ecozones
- Nearly level to gently rolling plains of most of zone with some striking features such as Niagara Escarpment from Niagara Falls to the northern tip of the Bruce Peninsula and Manitoulin Island.
- Abundant freshwater resources, including four of the Great Lakes -- Superior, Huron, Erie, and Ontario -- and the St. Lawrence River from Kingston to Quebec City.
- Outflow of the St. Lawrence is the greatest of any river in Canada
- Rivers and lakes occupy roughly 42% of the ecozone's total surface cover
- Climate produces relatively warm summers and cool winters moderated by surrounding water bodies

Wildlife

- St. Lawrence River and its marine habitats support a diverse collection of aquatic species, including Atlantic Tomcod, Northern Pike, baleen whales and the endangered Beluga Whale
- Numerous bird species, including the Cardinal, Green Heron, and Carolina Wren, are unique to the Mixedwood Plains
- Forests and grasslands support a wide variety of terrestrial organisms in the Mixedwood Plains. Characteristic mammals include White-tailed Deer, Black Bear, eastern Cottontail, and Grey and Black Squirrels. Foxes and wolves make appearances outside urban settings, while coastal wetlands and tributaries provide crucial habitat for beaver and muskrat.

Plants

- Tracks of forest once blanketed most of the Mixedwood Plains but centuries of agriculture, logging, and urbanization in particular, fragmented the landscape into isolated pockets of forest.
- Even though the Mixedwood Plains represent Canada's smallest terrestrial ecozone, they contain over half the nation's endangered and threatened species
- Today’s forest ecosystems - wildflowers and shrubs such Trilliums, Clover, Black-eyed Susans, Goldenrod, and Wild Raspberry
- Successional species such as Staghorn Sumac, Highbush Cranberry, Red-osier Dogwood, and Willo
- Native and exotic plants, such as cattails, water lilies, sedges, and Purple Loosestrife, can be found in wetlands

Human Activities/Industries

- Human activities in the Mixedwood Plains Ecozone, both past and present, are associated with urbanization
- Most densely populated ecozone in the country (Toronto, Montreal, Ottawa, and Quebec City)
- Significant service and manufacturing industries - Oil refineries, power-line corridors and industrial parks
- Fertile soils and a relatively mild climate have created excellent agricultural land - fruit orchards and vineyards (Niagra), Corn, soybeans, and specialty crops such as tobacco and vegetables (Southern Ontario)
- Hog, dairy, and beef livestock production
- Tourism and recreation, cottages, marinas, resorts

Climate Change

- Melting sea ice and warming waters in places like the Gulf of the St. Lawrence, James Bay and the eastern part of Hudson Bay will impact marine ecosystems in those regions
- Waves are also predicted to get worse around the Gulf of the St. Lawrence related to lack of sea ice
- Oxygen levels in the Gulf have also already been found to be decreasing
- Temperatures in the southern part of Quebec have increased on average by one degree Celsius since 1950 and that's expected to continue to increase over the coming decades
- Temp increases result in heat waves and air pollution, as well as an increase in the length of hay fever season for allergy sufferers
- Risk of more forest fires
- Ticks carrying Lyme disease, West Nile virus spreading quickly through both Quebec and Ontario carrier is able to survive farther and farther north
- Warmer water temperatures in Lake Ontario may allow new waterborne pathogens to move northward or existing ones to flourish, fewer fish species
- Infrastructure damage concern in both Ontario and Quebec due to seasonal and flash flooding
- Escalating demands on energy infrastructure as heat waves hit the region will also contribute to the risk of blackouts

(See also Ontario and Quebec climate notes in "Canadian Shield" section)

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Appalachian At-a-Glance

- Provincial Areas: Southeastern Quebec (Gaspé region) and all of the Atlantic Provinces (Nova Scotia, Prince Edward Island, New Brunswick, Newfoundland ~~and Labrador~~) Also known as "Atlantic Region"
- Appalachian Mountains - ancient chain on island of Newfoundland and Labrador that stretches south to the US
- Most populated along the coast among hundreds of bays & harbours
- Hilly land, steep & rock coastlines, many forests
- Farmland, fisheries, pulp & paper, tourism/recreation
- Asbestos deposits (Quebec), Coal & gypsum mining (NB), copper, lead, zinc (NB & NFLD), Oil (ie. Hibernia Oil Field)
- Ecozones: *Atlantic Maritime, Atlantic Marine* - critical terrestrial, freshwater, and marine environments
- Climate Change - thinning sea ice, intense waves, rising sea levels – coastal flooding, warmer/saltier oceans – less oxygen, effect on fish populations

Ecozones

Atlantic Maritime, Atlantic Marine

Landforms and Climate

Atlantic Maritime

- Cluster of peninsulas and islands which form the northeastern end of the Appalachian mountain chain that runs from Newfoundland to Alabama
- Coastal lowlands of the Northumberland Plain accommodate the greater share of the population and agricultural activities
- Numerous lakes, rugged regions of igneous rock, such as volcanics and granite, which are covered by a thin layer of soil.
- Thousands offshore islands lagoons and extensive marshes ring Nova Scotia.
- Red sandstone cliffs and hard volcanic rocks in the Bay of Fundy
- Proximity of the Atlantic ocean creates a moderate, cool, and moist maritime climate
- During late spring and early summer, the mixing of the cold Labrador Current and the warm Gulf Stream produces frequent banks of sea fog over coastal area

Atlantic Marine

- Defined by deep water
- Begins in the Davis Strait, follows the Labrador Shelf south around the Flemish Cap seamount, takes in the Grand Banks, and comes ashore at the northeastern tip of Newfoundland's Avalon Peninsula.
- Inshore boundary encompasses all of Newfoundland's south coast and Nova Scotia's east coast, and extends into the Bay of Fundy and south to the Gulf of Maine.
- Icebergs, 90% of their mass underwater, are not uncommon and have been feared by mariners for centuries. Sailors named the stretch of ocean from Greenland to the southern coast of Newfoundland "Iceberg Alley."
- Generally temperate due to the influence of the massive Gulf Stream
- Off Newfoundland, mixing of the warm currents from the south and the Labrador Current from the north produces some of the most famously dense fog banks on the planet.

Wildlife

Atlantic Maritime

- Kelp and seaweed along rocky coasts provide shelter and food for various marine communities of mussels and crab
- Gulf is well-known for its scallop, mackerel, groundfish, and herring fisheries
- Seals, dolphins, porpoises and Black Guillemots are among the higher predators within the ecozone.
- Both seal- and whale-watching are popular tourist attractions.
- Rivers draining the area are vital for the commercially important Atlantic Salmon and other ocean fish that return to inland streams to spawn

- Lakes and shaded waterways within forests supply habitat for herons, loons, and freshwater ducks, while osprey and eagles nest in tall trees.
- Canada Goose, Blue-winged Teal, Ring-necked Duck, and 31 other bird species breed exclusively in the unique freshwater habitats of the Atlantic region.
- Terrestrial mammals include Black Bear, Bobcat, Snowshoe Hare, Northern Flying Squirrel, and White-tailed Deer, moose herds

Atlantic Marine

- Grand Banks are among the most biologically productive marine areas in the world
- Confluence of the Labrador Current and the Gulf Stream, and the tidal mixing of the water column on the shallows of the continental shelf = ideal feeding and spawning conditions for thousands of species.
- Benthic, or bottom-dwelling, communities are rich with invertebrates, such as barnacles, sea stars, crabs, lobster, sponges, scallops, clams and jellyfish
- Common fish populations historically included Northern Cod, Redfish, Herring, Silver Hake, and the now-famous Greenland Halibut, or turbot
- Harbour and Grey Seals, Harbour Porpoises, and dolphins.
- Several species of whale are indigenous to or migrate through the ecozone, including the Northern Bottlenose, Blue, Pilot, Beluga, Fin, Minke, and Humpback Whale.
- Significant proportions of the North American or world populations of seabirds live within the ecozone
- Estuaries, where fresh river waters mix with saline sea water, are productive habitats that serve as nursery areas for juvenile fish and the planktonic larvae of mollusks, crustaceans, and other invertebrates.

Plants

Atlantic Maritime

- Centuries of forestry, agriculture, and natural disturbances have left few pockets of old-growth forest
- Today, forests are predominantly secondary and tertiary growth on old clear-cuts and abandoned farms
- Third most forested ecozone
- Moss, lichen, ferns, and heathers are typical of swampy areas and rocky barrens

Atlantic Marine

- Phytoplankton tare first link in the food chain
- Marine plants such as seaweeds and kelp are prolific, especially in intertidal zones
- Salt marshes, Tidal wetlands are home to the highly salt-resistant Saltmarsh Cord Grass and Marsh Meadow Grass

Human Activities/Industries

Atlantic Maritime

- No single resource has influenced socio-economic development in the Atlantic Maritime Ecozone more than fish
- Collapse of the groundfish industry is the result of a diminishing resource base and severe environmental pressure
- Aquaculture, or fish farming,
- A relatively short, cool growing season and mediocre soils have hampered farming in many regions
- Forestry and tourism contribute significantly to the ecozone's economy

Atlantic Marine

- Fishing for other species such as lobster, shrimp, and crab still provides a livelihood for some families
- Aquaculture
- Offshore oil and gas production

Climate Change

- **Coastlines** - infrastructure is located in vulnerable areas, sensitive to extreme and more frequent weather events
- **Fresh water** - increased demand for water and increased competition, greater risk of salt contamination from rising sea levels, pollution from runoff caused by heavy rains and snow, and parasites drawn to warmer water temperatures.
- **Business** – Challenges: protecting public and private infrastructure and making climate sensitive industries, like forestry, resilient to climate variability and extremes, Opportunities: warmer conditions may present opportunities for industries such as tourism and agriculture

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