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CURRENT ENVIRONMENTAL ISSUE

STUDY RESOURCES PART B

Roots and Resiliency: Fostering Forest Stewardship in a Canopy of Change

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Current Environmental Issue

Part B

Roots and Resiliency: Fostering Forest Stewardship in a Canopy of Change

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Current Environmental Issue Study Resources - Part B

Key Topic #1: Climate Change Impacts in Alberta Forests

1. Differentiate the key characteristics of the six different forest ecozones of Alberta and identify how each ecozone is expected to shift with climate change.
2. Identify the causes of population decline for Alberta's endangered tree species and describe current recovery efforts.
3. Explain how changes in the frequency and severity of ecosystem disturbances (wildfire, drought, etc.) will impact Alberta's forests.

Study Resources

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VIDEO - Alberta Tomorrow: Natural Landscapes

https://www.youtube.com/watch?v=Lx94jZ9ZSBY

Alberta Tomorrow: Natural Landscapes

Whitebark and limber pine recovery

Threats and recovery actions for Alberta's two endangered tree species.

Overview

Alberta has 2 endangered tree species: whitebark pine (*Pinus albicaulis*) and limber pine (*Pinus flexilis*). These species are endangered because they have been declining rapidly across their ranges. They grow slowly, only starting to produce cones around age 40 (limber pine) and 50 (whitebark pine).

Reversing their decline is a long-term commitment. Without healthy populations of these keystone trees, their ecosystems would no longer provide the habitat and values that animals and people depend on, including:

- slope stabilization
- a rich source of food for birds
- bears and small mammals
- headwater streamflow control
- subalpine tree island formation
- windswept scenic beauty

The Bird Pines

Sustaining and conserving these trees means focusing on more than just the tree itself. Whitebark and limber pine both depend on the Clark's nutcracker, a bird in the jay family, to reproduce.

Figure 1: Clark's Nutcracker

Eons of co-evolution driven by the nutcracker's role in seed dispersal have led to the whitebark and limber pines' both producing very large, wingless seeds with heavy seed coats. While these characteristics render the trees completely reliant on the nutcracker to open its cones and disperse ripe seed, they provide crucial support for seed development after germination and help the seeds establish in areas with little soil and nutrients.

The nutcracker pecks the cones open, extracts the seeds (which are very high in protein and fat) and caches them in the ground with its beak. The nutcracker can store about 100 seeds at a time in a special throat pouch. Each bird plants about 100,000 seeds and digs up about 30,000 seeds each year, from memorized locations, as its main source of food. Surviving seeds grow into seedlings.

Unlike those of the whitebark pine, limber pine cones open, but only seeds cached by nutcrackers germinate and grow into trees.

Species Threats

Four main threats affect these species. Reversing or lessening the damage caused by these threats is key to their recovery.

White pine blister rust

The threat:

White pine blister rust (*Cronartium ribicola*) is a deadly human-introduced fungus from Asia that affects 5-needle pine trees and has spread through North America for over a century. The fungus needs both 5-needle pine trees (primary host) and currant bushes (alternate host) to complete its life cycle, although it does infect some other plants. Efforts to eradicate the rust by removing these alternate host plants have failed. The fungus infects needles and grows into the main stem where it cuts off vital water and nutrients, killing the tree. When a large tree is infected, it may take years to die. When the crown starts to die cone production stops and its key ecological function is lost.

Figure 2: White pine blister rust

Recovery actions:

Rare 5-needle pine trees have been found with natural tolerance or resistance to the disease. These trees must be tested to prove their seedlings are inheriting disease resistance, a process that takes 7 years in a controlled facility, or longer in the field. Seeds from these special trees are collected and used for restoration. Cuttings collected from these trees, called scion, are grafted to make copies of the resistant trees for gene conservation. Scion from mature trees keeps its physiological maturity, so these grafted scion can produce seeds decades earlier than waiting for seedlings to mature conventionally. Grafts are planted in genetic archives called clone banks, preserving extra copies of the original trees. They are also planted in seed orchards, similar to a fruit orchard but managed to produce abundant seed crops.

Mountain pine beetle

The threat:

Recent mountain pine beetle (*Dendroctonus ponderosae*) outbreaks have killed far more trees than in the past, and spread into higher elevation forests. Beetle populations have expanded outside their historic range due to recent fall, winter, and spring temperatures being too mild to kill overwintering larvae. Extensive mature pine forests allow the mountain pine beetle the opportunity to spread widely.

Recovery actions:

Plant-derived compounds can protect valuable blister rust resistant trees from mountain pine beetle attack. One such compound, vebenone, sends out scnets that mimic a fully attacked tree’s chemical signals, which helps repel attacking beetles. Others, such as green-leaf volatiles, send signals to insects disguising the tree as a type that is not a host for beetles. Landscapes can also be managed to reduce the chance of beetle attack by changing the composition of species and age classes, and by removing trees recently attacked by beetles that contain overwintering larvae.

Wildfire suppression and succession

The threat:

Whitebark and limber pine trees have thin bark, making them vulnerable to fire. But regeneration of these slow-growing pines can also benefit from open habitat created by fire. Fire suppression promotes shade tolerant species like Engelmann spruce and subalpine fir, which form dense stands that hinder whitebark and limber pine growth.

Recovery actions:

Identified rust-resistant trees are identified as high-value resources and protected from fire by the Alberta government’s Wildfire Management Branch. Some areas benefit from wildfires or prescribed fire through reducing fuel buildup and creating open caching sites for Clark’s nutcrackers.

Climate change

The threat:

Whitebark pine and limber pine live at the environmental limits of tree growth. Warming is moving species higher in elevation and latitude – whitebark pine may be at risk of being forced off mountaintops as species shift upwards. Moving northwards is another option that has been evaluated but, if suitable habitat is already occupied by other species, whitebark pine is a poor competitor. Planting these pines in novel habitats (often called assisted migration) can only succeed if there is enough high-quality alternate food to sustain Clark's nutcracker populations for decades until the migrated pine populations mature. No habitat in Canada appears to meet these conditions. Conversely, climate models predict limber pine will benefit from more suitable habitat and favourable climates, especially in lower sites.

Recovery actions:

Studies that use climate and habitat models, test assisted migration and establish provenance trials to observe how seedlings originating from different populations grow in different environments are providing information on management options for these species as their habitat changes. This research is useful for assessing the appropriateness of certain seed sources for restoration planting. Slow growth and centuries-long life spans show they have adapted and grown under a wide range of conditions.

Climate Change and Alberta's Forests

An Information and Discussion Paper of Predicted Implications

H. F. Cerezke
Forest Health Section, Forestry Division Alberta Sustainable Resource Development, January 2009

Tree species and distribution predictions: Climate change projections beyond the 2020's for the prairie provinces indicate that climate variability and risk of extreme disturbance events, particularly drought, will be the most important threats imposed on forest ecosystems in Alberta. Other disturbance events (fire, insects, diseases, storms, etc.) predicted to increase will also be important. Increased water scarcity will impact the growth of tree species, their survival, productivity and distribution, especially at the southern boundary of the boreal forest where drought stress will be a main cause of tree decline contributing to regeneration failure, reduced growth and survival, and crown dieback. In contrast, growth and survival of conifers are predicted to increase at higher elevations in southwestern Alberta. Drier conditions are also forecast for much of the central and northern boreal forest. In response, tree species in general are expected to shift northward and to higher elevations, causing reductions in the ranges of boreal species. Engelmann spruce, subalpine fir and lodgepole pine may move to higher elevations, while alpine larch and whitebark pine may find suitable habitat by shifting northward; their distributions at higher elevations may be reduced. Many of the important commercial conifer species are expected to lose a portion of their currently suitable habitat, raising concerns that the present provincial forest land base will decrease. Aspen forests in the southern boreal region particularly are expected to decline, shift northward, and suffer reduced productivity due to periods of drought and recurring insect defoliation. Some tree species such as Douglas-fir, ponderosa pine, western larch, Scots pine and Siberian larch may gain new suitable habitat in western Alberta.

Ecosystem and biodiversity predictions: Warming temperatures and projected increased evapotranspiration rates will impact the forest hydrology of wetland/peatland ecosystems by lowering the water table, favoring increased aerobic conditions, and increasing the rate of decomposition of accumulated dead organic plant materials. This will likely decrease the overall carbon storage and result in increased CO_2 and CH_4 releases in the atmosphere. The drying of some wetland/peatland areas, however, may create new habitat for white spruce, birch and aspen, replacing typical wetland inhabiting species such as willow, black spruce and tamarack.

Climate change is expected to affect the composition, structure and function of forest ecosystems by impacting their fundamental qualities, which include competition of species and succession, water use, nutrient cycling, disturbance regimes, and productivity. Responses to temperature change and increased CO_2concentrations will vary within and among ecosystems in magnitude and direction, and forest ecosystems will be changed or modified in predictable and unpredictable ways. Impacts of climate change on forest biodiversity could be both positive and negative, even though overall diversity of ecosystems is predicted to decrease. Some species extinctions and reduced biodiversity will result, mainly from land-use changes, deforestation, and forest fragmentation.

Forest productivity predictions: Predictions of forest growth and productivity impacts due to climate change are somewhat unclear, but are likely to be positive in many situations due to lengthening of the growing season, increased soil and air temperatures, nitrogen deposition and nutrient cycling, more frost-free days, and the possibility of some CO_2 fertilization effects. However, growth and productivity will also be negative in some situations because of increased disturbance events, reduced moisture availability, and air quality impacts such as O_3. The current general trend of net primary productivity in boreal temperate forests across North America is increasing but the continued long-term trend in future years is unclear. Forests in western Canada may persist in a carbon flux situation, shifting from one of sink to source, depending upon the frequency, duration and extent of forest disturbance events. In general, growth, survival and productivity of white spruce are predicted to decline in the central and northern parts of Alberta within the next 25-30 years. Site index and productivity of lodgepole pine forests in the foothills region have been increasing, but it is unclear whether these changes are attributed to improved management practices, to climate change influences, or to both. Provenance trials of conifers in Alberta have demonstrated that increased productivity is possible if more optimal climatic environments can be identified to allow realization of their genetic growth potential. Periods of drought stress and predicted increases in insect defoliator outbreaks could severely impact the growth, productivity, and health of aspen stands in the Boreal and Parkland zones.

GHG emission predictions: Atmospheric concentrations of GHGs (CO_2 , CH_4, N_2 and tropospheric O_3) and their effects on tree growth and physiology have been reviewed. Numerous experiments have examined CO_2 concentrations of 475-600 ppm or parts per million (i.e., about 2x current atmospheric levels projected to occur by 2050 or 2100) and its effects on tree species. These effects, though highly variable, have ranged from increased ecosystem productivity to enhanced growth of tree structures, changes in wood anatomy, enhanced reproductive fitness, increased foliage nitrogen concentration, to an altering of the sensitivity of trees, making them more prone to the damaging impacts of O_3. Increased tropospheric O_3, on the other hand, is a growing air pollutant and a threat to forests in the northern hemisphere. Current concentrations range between 20 and 45 ppb (parts per billion), but are increasing, and concentrations >70 ppb appear to be detrimental to tree growth and health. High O_3 concentrations have been linked to reduced tree growth and productivity, a reduction in forest carbon sequestration, decreased nitrogen mineralization in the soil, and interactions with CO_2 levels that alter the susceptibility of trees to insect and disease species.

Forests are important sources of N_2O where it is produced in soils as an intermediate or end product from the biological nitrification and denitrification processes. At present, only about 7.5% of the total CH_4 emissions to the atmosphere is known to be contributed by forest ecosystems. The boreal forest has been reported as both a sink and a net source of CH_4 partly because emissions can vary seasonally due to land-use, soil temperatures and water table levels.

Forest disturbance predictions: Forest disturbances can be both human-caused (e.g., harvesting) and natural, including fire, drought, storms, insect and disease outbreaks, landslides and floods. Future forest fire disturbances are predicted to be more frequent, burn over larger areas and with increased severity. Besides killing trees and creating patches and fragmentation over the landscape, fires interrupt the process of forest biomass accumulation, shift the direction of forest succession, release GHGs to the atmosphere, cause a shift in carbon fluxes, and a shift to a younger stand age class structure. Increased variability in weather systems is likely to result in more frequent and severe storms, periods of drought, areas of windthrow, and result in increased tree damages, dieback and mortality. Fire disturbances will interact with drought-stressed trees, decreased soil moisture, and increased insect/pathogen activity. Increased water scarcity leading to drought conditions is predicted to be the most serious climate risk for Alberta, impacting all ecosystem functions. Changes in temperature and precipitation will affect the life histories, dispersion, reproduction and population dynamics of forest insect species and the infection and epidemiology of tree pathogens. Species likely to be especially influenced favorably by climate change include the mountain pine beetle, spruce beetle, spruce budworm, wood borers, root diseases and stem cankers. There will also be increased risks of other minor pests as well as risks of new pests and invasive alien species, and a likely increase in freeze-thaw injuries to trees.

Forest genetics predictions: Tree species may respond to climate change in one of three ways: by genetic adaptation, migration or extinction (Aitken et al. 2008). Those with relatively narrow variability, poor dispersal capabilities, or those occupying a limited range are most prone to extinction, especially in montane and alpine habitats. Genetic variation and the ability to adapt to environmental changes will be the most important criteria for survival. However, the maintenance of genetic diversity in species may be challenged by the shifting of tree distributions and forest habitat fragmentation. Tree species with wide natural ranges exhibit high genetic variation and therefore have a better chance of survival in a changing climate. The potential to migrate with a changing climate will differ for each species and will depend upon dispersal efficiency, suitable new habitats available, and available corridors for movement. Some species may require human assistance. Knowledge of climate factors affecting genetic differentiation will be essential for matching seedling populations to appropriate planting sites.

Invasive species predictions: Invasive or alien species not native to Alberta may include insects, pathogens or plants, many of which can often detrimentally affect all attributes of forest ecosystems. Invasive species such as white pine blister rust or mountain pine beetle kill or weaken trees, and alter the ecology, function and value of forest ecosystems. Increased human access, changes in land-use patterns, forest fragmentation and forest disturbance events all provide increased opportunities for invasive species to become established. Once invaded, their ultimate range may be largely determined by climate and human activities, and climate change will likely amplify their rate of spread, survival and competitiveness. There are numerous aspects of increasing temperatures, elevated CO_2 levels and precipitation changes that may give non-native alien species advantages over native species for successful establishment and survival.

Forest health predictions: The sustainable management of Alberta's forest resources under changing climate regimes will be challenged to maintain forests in a healthy condition and in carbon balance. Climate change threatens to increase forest disturbance events and to impact forest succession patterns such as in post-mountain pine beetle outbreak areas. As well, in areas of the Boreal and Parkland zones, drought, fire, insects, pathogens, and storm events will increasingly influence ecological succession changes in aspen and mixedwood forests. Increased forest disturbance events will reduce mature and overmature forests and shift them to younger age class structures. This will have the effect of decreasing the incidence of insect and pathogen species associated with mature trees and forests (e.g., bark beetles, wood borers, defoliators, root and stem rots and stem cankers), while increasing opportunities for pests attracted to young stands (e.g., needle cast and stem rust diseases, leader and root-collar weevils, and Armillaria root rot). Damages caused by abiotic influences are also expected to be more frequent and severe and include moisture deficiencies, freeze-thaw events and hail. Storm damages are forecast to be more severe and frequent, and will result in more frequent blowdown of mature forests with subsequent interaction with insects and fire. Although many of these impacts of climate change may be decades away, there is uncertainty in the magnitude and timing of future changes. Detection of climate change effects will require the implementation of a comprehensive inventory, monitoring and assessment system to detect and evaluate the vulnerabilities of the provincial forest resources to climate change. Such a system will be essential to developing adaptation strategies and mitigation measures.

NCF-Envirothon 2025 Alberta
Current Environmental Issue Study Resources - Part B

Key Topic #2: Forest Health Issues Facing the Boreal Forest

4. Identify the key characteristics of invasive forest pests and explain how they spread in Alberta's forests.
    a. Asian Longhorn Beetle
    b. Spongy Moth
    c. Emerald Ash Borer
    d. Satin Moth
5. Explain how current and future changes in climate impact the spread of invasive pests such as the Mountain pine beetle.
6. Identify why common forest disease prevalence in Alberta could increase with climate change.
7. Analyze common harvesting methods utilized in the boreal forest and explain how climate change may impact these techniques.
8. Explain how recreation in the boreal forest of Alberta can impact forest health and resilience.

Study Resources

Resource Title	Source	Located on Page
Asian Longhorn Beetle, Spongy Moth, and Satin Moth	*Natural Resources Canada, 2024*	14
Emerald Ash Borer	*City of Edmonton, 2024*	19
Climate Change Could be a Mixed Bag for Mountain Pine Beetles	*University of Alberta, 2024*	20
Review of Insect and Disease Challenges to Alberta Coniferous Forests	*Forest Management Branch, 2013*	21
Harvesting in the Boreal Forest, *VIDEO*	*Natural Resources Canada, 2011*	28
The Importance of Forest Sector Adaptation to Climate Change	*Canadian Forestry Services, 2008*	29
Understanding and managing the interaction of impacts from nature-based recreation and climate change	*Royal Swedish Academy of Sciences, 2020*	33

Asian Longhorn Beetle

The Asian longhorned beetle (*Anoplophora glabripennis*) is native to China and the Korean peninsula.

In Canada, it mainly attacks maple, but also many other tree species such as poplar, birch, willow and elm. It has no natural enemies in Canada and has not been found outside of Ontario.

Impacts

The Asian longhorned beetle can affect ecology, economic activities, urban landscapes as well as tourism and recreation industries.

- The loss of maple trees could affect Canada's multi-million dollar maple syrup industry.
- The loss of hardwoods could affect Canada's forest industry through the loss of billions of dollars in wood products.
- The loss of hardwoods could affect cultural, spiritual and/or economic values of Indigenous people.
- The loss of hardwoods could impact the tourism and recreation industries by affecting tree canopy tourism for "fall-colour tours".
- The Asian longhorned beetle could have a significant, negative ecological impact if eradication measures are not effective.

CFS scientific research

The Canadian Forest Service (CFS) has learned much about the Asian longhorned beetle under the leadership of its Great Lakes Forestry Centre (GLFC) scientists:

Cross Section of a maple tree trunk damaged by Asian Longhorn Beetle.

- Its life cycle (from egg to emerging adult) lasts from one to three years.
- Adult beetles emerge by chewing their way out of trunk and branches, leaving large round holes (6-14 mm in diameter).
- Adult beetles feed on foliage for a few weeks, female beetles then chew grooves into the bark to lay single eggs that hatch within two weeks.
- Large scale surveys designed to detect signs of damage caused by Asian longhorned beetles are conducted mainly during the winter months, when trees have no leaves.

Spongy Moth

The spongy moth (*Lymantria dispar dispar*) is an invasive pest that can destroy trees by eating their leaves. It is found in Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island. The spongy moth has been detected in British Columbia, Alberta, Saskatchewan and Manitoba, although introductions of the insect have been detected and eradicated.

Identification:

Adult

Male moths are much smaller than females and have a wing span of 35 to 40 mm. Females have a wingspan of 55 to 70 mm. Males are brown whereas females are mainly white. Both sexes have a dark, crescent-shaped mark on the forewing. Both sexes also have pectinate antennae, however the males have longer branches that give their antennae a more feathery appearance.

Figure 1. Larger and mainly white female (top). Smaller and mainly

Larva

The first (3 mm) and third (7 mm) instars are black with long hairs; the second instar (5 mm) is brown with short hairs. Instars 4, 5 and 6 are similar to each other and may be light to dark gray with flecks of yellow. They have long hairs that may be dark or golden and have 2 rows of tubercles along the back. Normally 5 pairs of blue tubercles are followed by 6 pairs of red, however variations are known to occur including all 11 pairs of tubercles being blue.

Figure 2. *Lymantria dispar dispar* larva. Note 5 pairs of blue tubercles are followed by 6 pairs of red.

Egg

Ovoid egg masses are covered with tan coloured hairs from the female's abdomen. They eventually become sun bleached with age. Egg masses are approximately 30 to 60 mm long and 20 to 30 mm wide and may contain 100 to 1000 eggs. Spent egg masses have pin sized holes caused by emerging larvae.

Figure 3. Defoliation by early instar *Lymantria dispar dispar* larvae.

Host trees: *Quercus* (main host), *Acer, Alnus, Betula, Crataegus, Fagus, Malus, Populus, Prunus, Salix, Tilia* and many other tree and shrub species.

Location of infestation within the tree: Larvae feed on foliage within the crown.

Host condition: Healthy trees.

Distribution: Europe, northern Africa, eastern Canada and northeastern USA.

Signs and symptoms: Typically near their pupation sites, female moths lay egg masses on tree bark, branches and other protected places including rock piles, lawn furniture, bird houses, piles of wood, beneath logs, underneath recreational vehicles or equipment, etc.

Early instar larvae excavate small holes in leaves and feed gregariously. As the larvae grow they make larger holes and they also consume the leaf margin. Final instar larvae will consume the entire leaf. At high populations, larvae can strip all leaves from a tree. At low populations, feeding may be barely noticeable and larvae may be difficult to find since they prefer to rest in dark locations under bark flaps, stones, litter on the ground, etc. Larvae seek sheltered places to pupate. Pupae may be found attached by silken thread to branches, tree trunks, rocks, forest debris, buildings or fences. During outbreaks large amounts of frass may fall from defoliated trees. When food is scarce, larvae will also feed on unripe tissues of annual shoots, flowers and buds.

One year of defoliation may not kill a healthy tree. Severe defoliation can reduce tree growth and predispose trees to attack from other insects and diseases. Four successive years of defoliation can cause mortality, especially in weakened or stressed trees.

Satin Moth

Distribution

Satin Moth

The satin moth was introduced into North America from Europe. It was first detected near Boston, Massachusetts, and in British Columbia in 1920. In the eastern part of the continent, the species is currently distributed from Newfoundland through eastern Canada and the northeastern United States to Ontario. In the west, it is distributed from British Columbia to northern California. In 1994, an infestation of the satin moth was detected in Edmonton and St. Albert, Alberta. In British Columbia it has spread to Vancouver Island and throughout the southern and central interior.

Damage, symptoms and biology

Satin moth larvae feed on all species of poplar and willow, but prefer ornamental varieties of poplar. There are also a few reports of this species feeding on oaks, crabapple and Saskatoon berries in British Columbia. Although it is mainly a pest of planted trees, the satin moth has also attacked natural stands of poplar and willow throughout Canada.

The first signs of damage become noticeable in mid- to late May when overwintered larvae commence feeding on leaves. As feeding progresses, larvae consume whole leaves except for the major veins. This causes the foliage on trees to look thin. Damage is most conspicuous after mid-June, when late-instar larvae consume entire new leaves except the petioles and larger veins. In late summer the newly hatched larvae skeletonize the leaves; in severe infestations leaves turn brown and drop. Repeated severe defoliation has resulted in top-kill and some tree mortality. Rolled leaves containing pupae and silk webbing on boles and branches, and occasionally larval skins, are indicative of satin moth infestations. Larvae usually molt on the undersides of branches, leaving visible cast skins there. Feeding is completed by late June or early July, and larvae construct conspicuous loosely woven silken cocoons in rolled leaves, on twigs, or in bark crevices, in which they pupate. The next generation of larvae, which commences feeding in August, skeletonizes leaves but causes little damage. If it is too late in the season to observe live mature larvae and pupae, satin moth infestations are apparent from the presence of rolled leaves containing pupal cases or empty larval skins, and silken webbing on bales and branches.

Adult satin moths appear in July and August. Their wings are satiny white and have no markings and the wingspan is 24-47 mm. The stout, black bodies show through the dense covering of white hairs. After mating, females lay eggs in batches of up to 400 on leaves and sometimes on branches and trunks. Eggs are light green, flat, and laid in oval masses of 150-200 eggs covered with a glistening, white secretion. When eggs hatch after about 2 weeks, young larvae move to the leaves, which they skeletonize as they develop through two instars. Second-instar larvae seek out hibernation sites on the trunk or branches of a host tree, and molt after spinning silken coverings (hibernacula) that are usually covered with bark particles, mosses, or lichens. After overwintering, these larvae emerge in mid-May and commence feeding on newly flushed leaves.

Larval feeding continues until late June or early July. There are seven to eight larval instars. Larvae are 35-45 mm long when full grown. The basic body colour is a grayish-brown, and the head and back are dark. There is one row of large, oblong white or pale-yellow patches along the middle of the dorsal surface and two subdorsal yellowish lines. The two lateral and two subdorsal rows of orange tubercles have tufts of long brownish hairs attached to them. Mature larvae spin silken cocoons in the leaves in which they pupate. Pupae are shiny black, 15-22 mm long, and have tufts of yellowish hairs. Moths emerge from pupae after about 10 days to complete the 1-year life cycle.

Other Information

Satin moths are capable of completely defoliating trees. Severe defoliation in several consecutive years results in reduced radial growth of stems, branch mortality, and some tree mortality. The impact of defoliation can be more severe on trees already stressed by other factors such as drought, and trees weakened by defoliation can be attacked by other opportunistic insects and fungi. The aesthetic value of ornamental trees can also be seriously affected by this insect. The migration of larvae from completely defoliated trees in residential areas can cause a public nuisance.

There is no practical way of preventing access of satin moths to trees. To help trees to better withstand defoliation, keep them healthy by watering the roots in the fall before frost sets in, applying a suitable fertilizer each spring, and watering them during prolonged dry periods in the summer.

In North America, the satin moth has many natural enemies, including parasitic wasps, flies, mites, predatory birds and beetles, and a polyhedrosis virus. Parasitism by flies and wasps often contributes to population collapse; however, preliminary observations indicate very low mortality by natural enemies in the Edmonton area. It is anticipated that natural enemies will be imported from British Columbia for release in Alberta to help control satin moths.

Emerald Ash Borer


Adult Emerald Ash Borer

The emerald ash borer (*Agrilus planipennis*) is a deceptively attractive beetle. They are bright, metallic green insects and roughly twice the size of a grain of rice, 8.5 -14 mm long and 3.1 -3.4 mm wide. They start life in an egg only 1 mm long. The newly hatched larva can grow to 32 mm long over a year or two of development. They chew their way through the cambium layer of a living tree's bark and create a zigzag tunnel behind it that prevents the flow of nutrients through the tree's bark in that area. When many larvae chew enough of these tunnels, the tree can be entirely girdled and will quickly die. The larvae overwinter before pupating in the spring and emerge as adults about 3 weeks later. The adult beetles create a "D"-shaped hole as they emerge from the tree. Adults feed on the leaves and soon fly to find mates to begin the cycle anew.

The Problem

The emerald ash borer is a tremendously damaging invasive pest. In its native range of eastern Asia, it seems to be a minor pest, here in North America, it has proven to be a relentless killer of ash trees.

This beetle is harmful for three reasons:

1. It has no effective native enemies in North America
2. It attacks and kills healthy trees
3. Alberta's native ash have very little resistance to it

While woodpeckers will eat the larvae, they are not fast or efficient enough to curtail the spread of established beetle populations. Infested trees usually show dieback or yellowing of their canopies and sucker growth, followed by peeling bark and finally death in as little as 1-3 years.

Approximately 99% of ash trees in an infested region die within 6 years of initial beetle arrival. Emerald ash borer was first found in Canada in 2002 in Windsor, Ontario. Since then, it has spread to most of the St. Lawrence region despite best efforts to destroy or contain its spread. The presence of the borer was confirmed in Winnipeg in 2017, and in Vancouver in 2024. Similar infestations have taken hold in much of the USA, and the beetle is expected to continue to expand its range. The transportation of wood products, especially firewood, is a major factor in this spread.

While there is no native ash forest in Alberta, many of the inventoried boulevard and open space trees in cities are ash. Ash trees are also found on private property. If left unchecked, emerald ash borer could cause untold costs to our quality of life and local infrastructure as beetle-damaged trees fall apart with little provocation, damaging houses, vehicles and citizens alike.

UNIVERSITY OF ALBERTA

Climate change could be a mixed bag for mountain pine beetles

Higher levels of greenhouse gases may have both positive and negative effects on the invasive insects, new research shows.

April 09, 2024, By Bev Betkowski

Researcher Rashaduz Zaman has provided new insight into how the mountain pine beetle and its relationship with beneficial fungi are influenced by climate change. (Photo: Getty Images)

Climate change is hampering mountain pine beetle reproduction but also appears to slightly benefit the invasive insect in other ways, new University of Alberta research shows.

The mixed scenario provides “a deeper understanding of dynamics that are crucial to building effective forest management and conservation strategies in the face of ongoing environmental changes,” says Rashaduz Zaman, who led the study, working toward a PhD in forest biology and management from the Faculty of Agricultural, Life & Environmental Sciences.

The study — the first to show specifically how the mountain pine beetle is affected by elevated levels of two greenhouse gases, carbon dioxide and ozone — provides new insight into how the insect and its relationship with beneficial fungi are influenced by climate change.

The findings signal a mix of potentially positive and negative implications for the beetle.

More CO2, more beetles?

On an apparent upside for the insect — but detrimental for the lodgepole forests it attacks — lab experiments showed that exposure to higher levels of carbon dioxide accelerated the beetle’s typical one-year cycle of egg-laying, hatching and maturing by at least five days, which could in turn lead to more rapid population growth and higher infestation rates.

The finding could potentially aid in creating better management strategies against the beetle’s invasion of boreal forests, says Zaman.

The beetle invades trees both near and far, but because accelerated development could make the insect larger, it would be able to fly farther, making it more difficult to pinpoint and manage far-flung infestation sites.

“This insight is crucial for mountain pine beetle management because it suggests that areas with clusters of attacked trees nearby, resulting from short-distance dispersal, may be more manageable from a control perspective,” Zaman notes. “Concentrating control efforts in these relatively small areas could be more effective in containing infestations and preventing their spread to new locations. Forest managers and policy-makers can tailor their management strategies to target specific areas more efficiently.”

As well, the researchers were surprised to find that despite the beetle’s reduced reproduction rates, within a single generation, the higher ozone exposure also provided a better ability to survive against a parasitic fungus that usually kills the insect.

“Brood beetles demonstrated normal behaviour despite the environmental challenges that affected their parents, which could be due to an increased response from defense-related genes,” Zaman suggests.

Experiments conducted under less humid, drier conditions — which are expected to come with climate change — also altered saprophytic fungi, a type that is usually harmful because it outcompetes the beetle’s beneficial fungi. But lower humidity flipped that equation, providing beneficial fungi for the beetle broods to feed on, Zaman notes.

“This could ultimately benefit the beetles, with a higher likelihood of reproduction success and range expansion.”

Ozone may impair reproduction

There were also detrimental effects for the beetle, the research showed. Exposure to higher levels of ozone reduced the insect’s ability to deposit its larvae in the tree bark, meaning fewer eggs were laid. The production of pheromones — airborne chemical signals the beetles use to communicate in numbers large enough for mating and reproduction — was also altered.

That means their ability to mate could be impaired, Zaman says.

When exposed to high levels of ozone, the insects produced about 10 broods per log, compared with 100 broods produced in more ambient conditions. As well, the research showed that elevated levels of the two greenhouse gases affected the growth of the beneficial fungi the beetle carries with it to trees. Such fungi perform valuable services for the insect, including providing minerals and nutrients.

While some of the species showed enhanced growth from higher exposure to the greenhouse gases, others declined.

“That means changes in the growth rate of these symbiotic fungi may cause irregularities in the normal functioning of the beetle’s life cycle and invasion strategy.”

Overall, the study shows just how complex the effects of climate change are for the beetle and its beneficial fungal partners, says U of A forest entomologist Nadir Erbilgin, who supervised the study.

“While both are affected by changing environmental conditions, the effects aren’t uniform between them, which makes it difficult to understand the dynamics for predicting and managing the impacts of climate change on forest ecosystems.”

Having a better handle on those dynamics could help improve strategies for managing the mountain pine beetle, such as monitoring programs, scientific modelling and genetic research, he adds, noting that his lab is further exploring several of those aspects and also plans to conduct studies spanning more of the insect’s broad geographical range.

“All of this knowledge can help scientists, policy-makers and conservationists work towards more targeted, effective strategies for mitigating mountain pine beetle outbreaks to minimize the damage to forests.”

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4.2 Review of Potential Climate Change Effects on Insects and Diseases

For insects generally, temperature is the single most important abiotic factor, directly influencing insect behavior, development, survival, distribution and reproduction. Predictions of insect life stage development are most often calculated on the basis of accumulated degree-days from a base temperature and a biofix point (Petzoldt and Seaman 2005; Dukes *et al.* 2009). Therefore, an increase in temperature could speed up development time as well as increase the number of generations per season for some insect species. Changes in moisture and CO_2 may also be an important consideration for insect behavior and development (Petzoldt and Seaman 2005). Warmer winter temperatures may increase overwinter survival, influence diapause, change generation time, and contribute to rapid population build up to epidemics for some species. On the other hand, decreased snow cover could increase exposure to cold temperature and lead to higher overwinter mortality (Ayres and Lombardero 2000; Bale *et al.* 2002; Battisti 2008; Moore and Allard 2008; Dukes *et al.* 2009; Hicke *et al.* 2011).

The magnitude of impacts of temperature on insects will differ among species, depending upon habitat conditions, life history, interactions with other organisms and tree hosts, and the ability to adapt to environmental changes (Moore and Allard 2008). Some species unable to adapt could be driven to extinction, while some other species not known to be present or present in a significant amount, may expand their populations. Insect physiology is highly sensitive to temperature, and thus a warming climate could accelerate feeding activity and movement, including dispersal, and thereby influence population dynamics through changes in fecundity, generation time, dispersal and survival. There are growing examples of insect distributions extending farther north and to higher elevations due to a warming climate (Carroll *et al.* 2004; Battisti 2008; Moore and Allard 2008; Dukes *et al.* 2009; Bentz *et al.* 2010).

Temperature change may influence the synchrony of insect life cycle development dependent upon phenological development of host trees as well as with natural predatory and parasitic species, thus adding to the complexity of predicting species survival and population change (Battisti 2008; Moore and Allard 2008; Dukes *et al.* 2009). For example, population synchrony is important to insure mass attack on host trees by several bark beetle species (Hicke *et al.* 2011).

There are fewer studies of the effects of precipitation on insects than with temperature. Excess moisture is often detrimental to insect life stages and may contribute to mortality by drowning, washing off foliage, or by interfering with feeding, mating and dispersal behaviors. Precipitation changes may also indirectly affect insects by influencing their predators and parasites and other mutualist feeders (Petzoldt and Seaman 2005; Moore and Allard 2008). Precipitation may have a profound effect on the health of the trees and their resistance mechanisms that protect against both insect and pathogen attacks. Changes in both temperature and moisture or drought have been associated with insect and pathogen outbreaks (Hicke *et al.* 2011; Jactel *et al.* 2012).

The effects of CO_2 on insect pests generally operate indirectly by affecting changes in host trees. Higher atmospheric CO_2 levels result in improved growth rates and water use efficiency of many plant and tree species. The increased growth results in lower nitrogen concentrations in trees as the carbon:nitrogen ratios rise. This results in reduced nutritional value for feeding insects (Moore and Allard 2008). Some insects may respond by feeding more. Increased CO_2 levels may alter plant structures such as increased leaf area and leaf thickness, alter defensive chemicals, influence palatability, or modify nutritional properties (Battisti 2008; Petzoldt and Seaman 2005; Moore and Allard 2008; Peltonen *et al.* 2010; Pinkard *et al.* 2011). For different groups of herbivorous insects, Battisti (2008) noted that defoliators generally increased leaf consumption by about 30 per cent in response to elevated CO_2 levels, whereas leaf miners consumed at a lower rate, and phloem–sucking insects such as aphids appeared to benefit considerably from elevated CO_2, since they grew larger in a shorter time frame (Petzoldt and Seaman 2005; Moore and Allard 2008). In a 9-year experiment reported by Pinkard *et al.* (2011) examining plant-insect interactions under elevated CO_2, there was reduced abundance of leaf miners. This was attributed to increased mortality from natural enemies and from greater ingestion of tannins. Phloem feeders in general appear to be the main guild of insects that show increased development and reproduction under elevated CO_2 (Pinkard *et al.* 2011).

The effects of biotic disturbances, including forest pest disturbances, on forest carbon cycling were reviewed for North American forests (Hicke *et al.* 2011). The review examined major insect and pathogen disturbance species that cause significant damage across large areas of forests; their interactions with other disturbance agents, and documented the influence of insects and pathogens on carbon cycling. They concluded that these large biotic disturbances impact several aspects of carbon cycling through damages resulting in reduced tree productivity, growth reductions and mortality. Consequently, there is decreased primary productivity and excess dead organic material, with the end result of a forest switching from a carbon sink to a source. Important factors involved include the number of affected trees, type of disturbance agent (e.g., growth reducer or tree killer), and duration of attack. Since both forest insect and disease pests are strongly influenced by climate and weather, future warming is likely to increase the severity and extent of pest outbreaks (Hicke *et al.* 2011; Pinkard *et al.* 2011).

Overviews of potential climate change effects on tree pathogens include reviews by Ayres and Lombardero (2000); Boland *et al.* (2004); Petzoldt and Seaman (2005); Desprez-Loustau *et al.* (2006); Parker *et al.* (2006); Moore and Allard (2008); Dukes *et al.* (2009); Kliejunas *et al.* (2009); Hicke *et al.* (2011), Kliejunas (2011) and Sturrock *et al.* (2011). Forest pathogens are taxonomically a diverse group and include fungi, bacteria, phytoplasmas, viruses, nematodes and parasitic higher plants (Hicke *et al.* 2011; Sturrock *et al.* 2011). Fungal pathogens are the most common cause of forest diseases and are primarily in the phyla Basidiomycetes and Ascomycetes (Hicke *et al.* 2011). Most of the important functional groups of fungal pathogens affecting trees include bark and stem cankers, foliar pathogens such as needle casts and rusts, root diseases that infect mostly underground, rust fungi that infect stems and cones, wood decays and stains, and parasitic vascular plants such as dwarf mistletoe (Kliejunas *et al.* 2009; Hicke *et al.* 2011; Sturrock *et al.* 2011).

The two most important environmental factors affecting the development of plant disease epidemics are temperature and moisture. Other contributing factors are atmospheric CO_2 and O_3 concentrations, nitrogen deposition, ultraviolet radiation, and insects that weaken trees or act as vector carriers of fungal spores (Boland *et al.* 2004; Dukes *et al.* 2009).

Several authors stress the fact that predictions and uncertainty are two major concerns for assessing future response and the impact of forest pathogens, and that pathogens could respond negatively or positively under the influence of climate change (Boland *et al.* 2004; Desprez-Loustau *et al.* 2006; La Porta *et al.* 2008; Dukes *et al.* 2009; Kliejunas *et al.* 2009; Sturrock *et al.* 2011). This is because climate change will affect the geographic distribution of vegetation types, ecosystem processes such as primary production, and the distribution and abundance of individual tree species and other plants. Interactions between plant species and host-pathogen interaction systems are complex and may be altered in different ways. For example, rising temperature and CO_2 will impact various functions such as seasonal phenology, biochemistry, photosynthesis, and other physiological traits. Climate warming will also act directly on fungal pathosystems that are already present in a forest and will favor the emergence of new diseases because of distributional range and temporal activity; community structure of pathogens will be modified (Desprez-Loustau *et al.* 2006; La Porta *et al.* 2008). Global climate change is ultimately expressed at the microclimate level; i.e., the level at which plant pathogens infect their hosts, reproduce, and disperse (Kliejunas *et al.* 2009; Sturrock *et al.* 2011). Although there is great uncertainty as to how specific forest pathogens will respond, some general predictions can be made (Kliejunas *et al.* 2009; Sturrock *et al.* 2011):

- Climate change will affect the pathogen, the host plant and the interaction between them, resulting in changes in disease epidemiology and disease impact;
- Changes in interactions between biotic and abiotic stresses may represent the most significant drivers of disease outbreaks;

- Changes in temperature and precipitation will influence changes in distribution of host and disease organisms, allowing them to expand their latitudinal and elevational ranges;
- Pathogens that especially affect water-stressed trees are likely to have an increased impact on forests in regions where precipitation is reduced;
- The ability of pathogens to adapt to new climatic conditions faster than their long-lived tree hosts will likely increase their potential role as disturbance agents;
- Most pathogens will be able to migrate to locations where climate is suitable for their survival and reproduction at a faster rate than tree species;
- Climate change will affect the life cycles and synchronicity of many tree species and pathogens that could effect changes in the distribution and phenology of events such as bud break, spore release and activity of insects that serve as vectors of pathogens;
- Climate change may facilitate invasion by new non-native pathogenic species, resulting in new epidemics;
- Many pathogens currently are limited by cool winter temperatures: rising winter temperature could favor increased overwinter survival of pathogens and disease severity.

In addition to the above predictions, Sturrock *et al.* (2011) predict that under a climate change scenario of warmer and drier future conditions, diseases that are caused by pathogens directly affected by climate (e.g., dothiostroma needle blight) will have a reduced or unchanged impact on their hosts, but will have an increased impact under a scenario of warmer and moister conditions. For pathogens indirectly affected by climate such as Armillaria root disease, and for tree decline diseases in general, these authors predict an increased impact on hosts if the climate scenario is warmer and drier, and a reduced or unchanged impact under warmer and wetter conditions. Many of the most important forest diseases such as root rot diseases, stem diseases, and decline diseases require a stressed host before infection or disease expression occurs (Hogg and Bernier 2005; La Porta *et al.* 2008). Additionally, from their analysis of the literature, Desprez-Loustau *et al.* (2006) noted that most published studies referred to a positive association between drought and disease that applied to both broadleaf and coniferous trees.

Rising temperatures, moisture and pH can favor soil-inhabiting pathogens that cause root rots; all of these variables will influence pathogen growth and reproduction. Floods, drought, increased mean winter temperature and seasonal shifts in precipitation pattern may trigger epidemics of some pathogens. Moisture is essential for many pathogens in determining survival and sporulation, while the duration, frequency and timing of rain events during the winter play a key role in inoculation production (Kliejunas *et al.* 2009; Sturrock *et al* 2011). Rust diseases such as white pine blister rust require high humidity conditions for basidiospore germination and pine needle infection, and at temperatures below 20° C.

Pathogens that are indirectly affected by climate may often be associated with drought-stressed trees. Disease types associated with drought generally include canker/dieback (e.g., Hypoxylon canker of aspen) diseases as well as some rusts. Obligate parasitic pathogens such as rusts and mildews do not appear to be positively associated with drought (Desprez-Loustau *et al.* 2006; Sturrock *et al.* 2011).

Increased atmospheric CO_2 concentrations can impact both the host tree and pathogens in multiple ways. Responses to elevated levels of CO_2 may vary between species. The elevated CO_2 concentrations can affect changes in plant structure such as increased leaf area and thickness, greater amount of foliage, leaf waxes, and larger diameter stems and branches. The increased growth rate of foliage could result in denser canopies with higher humidity that favors some pathogens. Also, longer periods of high humidity conditions resulting from more frequent and extreme precipitation events could enhance pathogen environments.

Increased leaf growth from elevated CO_2 levels could result in lower plant decomposition rates that could increase crop residues on which disease organisms overwinter, resulting in higher inoculum levels in the following spring (Petzoldt and Seaman 2005). Other observations have suggested that elevated CO_2 levels could affect host-pathogen interactions by initially delaying the establishment of a pathogen and by causing increased fecundity of pathogens (Boland *et al.* 2004; Dukes *et al.* 2009; Pinkard *et al.* 2011). On the other hand, increases in water use efficiency of host trees exposed to elevated CO_2 levels may improve plant water status, and thereby reduce susceptibility to root and stem pathogens (Pinkard *et al.* 2011).

VIDEO - Harvesting in the Boreal Forest

https://www.youtube.com/watch?v=2OA7FB2vrMo

Harvesting in the boreal forest

The Importance of Forest Sector Adaptation to Climate Change

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Information Report NOR-X-416E

What Are the Expected Future Impacts on Canada's Forest Sector?

Timber Supply

The impacts of climate change on the forest will affect both biophysical and economic aspects of the timber supply in Canada in a wide variety of ways, with the magnitude and type of effect in any given region dependent on the climate change in that region. There will be effects on the quality and quantity of timber and the quantity and location of salvage. Table 6 displays a summary assessment of some of the impacts of climate change by forest region now and in the near term (2011–2040), medium term (2041–2070), and long term (2071–2100).

Most of the wood that will be harvested in Canada over the next 50 to 100 years will come from trees that are already growing or from those that will be planted in the next decade, with minimal consideration of climate change impacts. Some areas there will be an increase in forest productivity owing to climate change, whereas in other areas there will be a decrease. Thus, a gradual warming of the climate may enhance the long-term supply of timber in some areas. This perspective, however, fails to take into account the impacts of natural disturbances. Wildfires, insect infestations, and drought will increase in many regions of the country, resulting in short-term increases in the supply of salvage material, which in turn will translate into medium- to long-term decreases in overall timber supply through the impacts of disturbances on certain age classes of trees. Any improvements in productivity resulting from enhanced growth because of climate change will probably not be able to offset the productivity that will be lost because of increased natural disturbances (Kurz et al. 1995). For this reason, Kurz et al. (2007) suggested that the carbon stocks in Canada's boreal forest are very likely to decline as a result of climate change.

Although these authors did not look at timber supply, their results can be extrapolated to suggest that timber supplies will probably also decline. Further complicating this picture in the longer term, bioclimatic zones and the tree line will shift north, allowing southern species to expand their ranges north. This will have an impact on ecosystems in general and future wood supply flows in particular. In the very long term, the species mix of forests will change as a result of forest competition and succession, which in turn will change the species composition of fiber supply, with implications for products and markets. This shift in species mix may increase growth rates in some areas and may allow the introduction of faster growing species, eventually increasing timber supply. Faster growing hardwoods, for example, may do better (Spittlehouse 2005) under climate change than they do at present in many regions. This trend will affect not only forest management decisions for existing forests (e.g., thinning) but also planning for future forests in terms of species selection.

A warming trend in areas east of the Prairies increases the likelihood of drought, fire, disease, and more severe outbreaks of pests, notably the eastern spruce budworm, (Choristoneura) fumiferana (Clemens), depending on the impacts of climate change on complex prey– predator relations. However, this increase in natural disturbances could be partially offset by increases in growth rates accompanying higher atmospheric CO2 levels, higher temperatures, a longer growing season, and increases in precipitation in some areas of northeastern Ontario and western Quebec, which could significantly increase productivity and timber supply in those areas (Colombo and Buse 1998). The net effect of these impacts is difficult to predict (as described in section 2.1.2). In northwestern Ontario, in contrast, an increased incidence of drought and severe disturbances could have serious consequences for the timber supply. A predicted reduction in precipitation in this area could trigger severe pest outbreaks and forest fires (Colombo and Buse 1998). Similar effects, although perhaps less severe, may also occur in southern Ontario.

The impacts of climate change on timber supply are expected to be greatest in the short and medium term in the Boreal West region because of increased disturbance regimes (fire, pests) and drought. Increases in forest, grassland, and crop productivity as a result of higher temperatures and higher atmospheric CO2 concentrations could therefore be limited or offset by decreases in productivity because of reduced available soil moisture, and dry soil is more susceptible to degradation. Both the quantity and quality of fiber supply from aspen are expected to decline in the southern Boreal West region owing to increasing impacts of drought, insects, and fungal pathogens. The zone of greatest aspen productivity is likely to move northward (or upward) into more remote areas, posing challenges for the industry in terms of timber access and transportation costs.

In British Columbia, a large increase in the amount of salvage material as a result of outbreaks of the mountain pine beetle has translated into an increase in supply in the short term, but in the medium to long term such outbreaks are expected to negatively affect timber supply because large amounts of timber are killed earlier in the timber's growth cycle than it would otherwise have been harvested. Large-scale outbreaks of pests such as the mountain pine beetle and spruce beetle are expected to persist and expand with continued warming. The spread of the mountain pine beetle is a growing concern east of British Columbia, especially in Alberta, with localized infestations already occurring east of the Rockies. There is particular concern that the beetle infestation, which until now has been confined mostly to lodgepole pine forests, could migrate to jack pine stands in the boreal forest (Johnston et al. 2006; Carroll et al. 2007), which extends across the northern Prairies and eastward across Canada, causing supply effects similar to those currently being experienced in the Montane region of British Columbia.

All of these factors combined will directly affect the variability of timber supply, the costs of mitigation and adaptation, and the nature of adaptation responses and will have downstream implications for mill operations, in terms of both cost and capacity, and their location. Table 7 shows how various impacts of climate change are expected to affect the quantity and quality of timber supply in Canada and international supply and demand in the future.

Table 8. Qualitative assessment of the scale of impact of climate change on forestry operations, by forest region

Period	Atlantic–Mixedwood	Boreal East	Boreal West	Montane	Pacific	Canada
Now	NC	-	-	---	NC	--
Near-term (2011–2040)	NC	-	--	-	NC	-
Medium-term (2041–2070)	+	-	-	+	-	-
Long-term (2071–2100)	+	-	-	+	-	-

NC = no change observed/expected. Scale of impact is indicated as follows. Positive: + low, ++ moderate, +++ high. Negative: - low, -- moderate, --- high.

Forestry Operations

Climate change will affect forestry operations and practices such as the timing of harvesting and road building. Table 8 displays a summary assessment of some of these impacts by forest region now and in the near term (2011–2040), medium term (2041–2070), and long term (2071–2100).The discussion below provides the basis for this assessment.

In response to increased winter-kill and insect-caused weakness and because of forest managers' desire to reduce forests' susceptibility to insects and fire, there will probably be an increase in selective logging, thinning, and fuel management. In response to more frequent and intensive drought (e.g., in western boreal forests), harvesting levels could be reduced and practices altered to intensify thinning and increase spacing, thus reducing water stress.

In general terms, northern regions are likely to face a series of impacts quite different from those in the rest of Canada. Changes in the length and climate of the seasons will affect harvesting practices. The length of the snow season and snow depth are very likely to decrease in most of Canada. Melting permafrost is expected to become an increasingly important issue, because the resulting softer ground will affect access (and potentially site quality). Shorter, warmer winters will reduce the life and usefulness of winter roads, which will also cause access problems and increase infrastructure costs. A decrease in winter harvesting because of these problems, along with increasingly restricted summer harvesting owing to increases in fire danger, will mean a shorter harvesting period, potentially reduced harvest, and, more importantly, significant increases in wood costs. Changes in the timing and volume of peak flow in streams (e.g., increased runoff) may cause road failures and affect other infrastructure such as buildings, which will in turn also affect the practices used to build roads and other infrastructure and the associated costs.

Water shortages are projected to become more frequent as summer temperatures and evaporation rates increase, negatively affecting irrigation and processing costs. Drought conditions also increase the risk of other natural disturbances such as fires or insect infestations.

Large natural disturbances, such as the mountain pine beetle infestation or increases in fire activity, have the potential to create a large amount of material that needs to be salvaged if value is to be derived from the dead timber. This increase in salvage material, in turn, creates a host of challenges for infrastructure and forest management, including difficulties in accessing fallen timber, problems with industrial capacity to process the increased volume, transportation issues for moving the large volume of dead or processed timber, and market-access problems during high supply periods.

Current manufacturing technologies for pulp and wood products may not be optimal given the changes in the timber supply that are expected in the future (in terms of salvage, species changes, timing, and quality) (Spittlehouse 2005; Ogden and Innes).

An increase in the use of salvage material will also reduce average fiber quality. Moreover, an increased reliance on lower quality fiber has implications for the products that can be produced and the markets for those products and will also increase the costs associated with processing. For example, some mills in British Columbia have had to install new equipment to process harder, drier salvage timber killed by the mountain pine beetle, as they can no longer assume that logs will cut nicely. Moreover, the shelf life of salvaged timber is proving to be shorter than originally anticipated, which has affected the amount that can be economically salvaged. Decision-makers who are considering investing in increased mill capacity to process a greater supply of salvage material will have to consider the longer term availability of a suitable timber supply to determine if such investments are worthwhile. Such temporal issues will pose some of the greatest challenges to our ability to adapt effectively to climate change.

In the longer term, changes in productivity and species mix will affect harvesting, processing, and planting practices by affecting rotation ages, species selection, wood quality, wood volume, size of logs, and infrastructure development. Any increases in supply in northern areas, for example, will necessitate an associated increase in processing equipment and transportation routes.

Moreover, international yield models indicate that climate change might increase global timber production, driving down global prices and affecting supply and demand flows in international and regional markets (Kirilenko and Sedjo 2007). This will create both market opportunities and market dangers for sellers and buyers alike, particularly in emerging markets such as biomass energy. Industry participants who recognize these changes early will be most likely to benefit from changing climate and market conditions.

Understanding and managing the interactions of impacts from nature-based recreation and climate change

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Introduction

Parks and protected areas (PPAs) such as national parks, wilderness areas, and nature reserves are essential to species conservation while simultaneously providing nature-based tourism and recreation activities that are enjoyed by hundreds of millions of people worldwide (Balmford et al. 2015). This "dual mandate" to protect habitat critical for conservation and allow people to access PPAs to experience nature has often been described as a significant management challenge (Hammitt et al. 2015). Even in PPAs that are highly managed, non-consumptive recreation and tourism (i.e., photographing wildlife, hiking, mountain biking, camping, etc.) often result in ecological disturbance. Recent reviews in this field of study, often called recreation ecology (e.g., Monz et al. 2010, 2013; Hammitt et al. 2015; Sumanapala and Wolf 2019), generally suggest that ecological responses to recreation disturbance are often highly influenced by human factors such as use type and behavior, but also depend on the ecosystem and species that are affected. For example, trampling disturbance from activities such as hiking can result in reduced vegetation cover and a shift in species composition toward ruderal species (Cole and Monz 2002; Ballantyne and Pickering 2015; Pickering and Barros 2015), but spatial confinement of intense recreation disturbance often limits the disturbance to acceptable levels (Cole et al. 2008; Hammitt et al. 2015). Broadly, recreation and tourism activities often result in vegetation disturbance and soil erosion and, depending on the activity, may impact other ecosystem properties via air and water pollution, noise, wildlife disturbance, and associated feedbacks (Monz et al. 2013; Hammitt et al. 2015; Buxton et al. 2017; Gutzwiller et al. 2017).

Historically, nature-based tourism and recreation most often have been concentrated in only some parts of PPAs, but this may be changing due to increasing demand, combined with new technologies that increase access to and within protected areas. A good example of this phenomenon is winter recreation—it has become easier for people to access remote terrain via improvements in ski technology, more capable snowmobiles, and in some cases via helicopter (Olson et al. 2017). Similarly, the spread of e-mountain bikes and other ridable technology is allowing easier access farther from park entrances. These trends, combined with the increasing use and availability of communication technology and social media to publicize new and unique experiences, suggest a broadening of the spatial scale and an increase in intensity of recreation use.

These trends of increased use and associated disturbance are co-occurring with a rapidly changing climate. Climate change is already having significant impacts on a range of ecosystems popular for nature-based recreation and tourism. These include Arctic and alpine ecosystems (e.g., Ernakovich et al. 2014; Verrall and Pickering 2020), forests (e.g., Dale et al. 2001), deserts (Bachelet et al. 2016), and river and lake ecosystems (Hunt et al. 2016). New disturbance regimes may emerge as climate change not only alters the frequency, intensity, duration, and timing of wildfire and drought, but also enhances the spread of many invasive species including weeds, feral animals, and pathogens (Schoennagel et al. 2004).

The “Grand Challenges”: Identifying knowledge gaps

Existing ecological knowledge suggests that disturbance from nature-based tourism and recreation and climate are likely to interact in ways that alter both visitor behavior and biophysical conditions. For example, outdoor recreation and tourism are expected to shift to higher elevations and latitudes as the climate warms and the season for snow- and ice-free recreational activities such as hiking, kayaking, climbing, and biking lengthens in higher altitude regions (Fisichelli et al. 2015; Hewer and Gough 2018; Koutroulis et al. 2018). Likewise, park visitation has been found to increase with warmer temperatures until a threshold of approximately 25 °C, after which visitation declines (Fisichelli et al. 2015). Changing rainfall, increased frequency of extreme events such as flooding, storms, drought, and wildfires, and an earlier spring season also can influence the timing of recreation and tourism activities.

Depending on their landscape and regional context, some PPAs will be more exposed to recreation-climate interaction effects than others. PPAs within moderate driving distances of major human populations may experience additional recreation disturbances as populations increase (Hansen and DeFries 2007), while visitation is often limited when PPAs are distant from urban areas (Norman et al. 2019). Concomitant changes in land use in areas adjacent to PPAs can reduce habitat amount and connectivity for native species. Loss of habitat usually leads to declines in populations and loss of physical or functional connectivity, and may reduce dispersal pathways that would enable species to track suitable climate spaces over time (Hannah 2015). If such changes occur near protected areas, species’ populations in those areas may become less functional as source populations for PPAs, and populations inside the protected areas themselves may consequently decline (Hansen and DeFries 2007) and become more vulnerable to recreation and climate stresses.

Higher latitudes and elevations are already experiencing significant climate change (Hansen et al. 2010; Brusca et al. 2013). PPAs in these places may therefore face greater climate impacts than those at lower latitudes and elevations. Some species at extreme latitudes and elevations have already been adversely affected (Grebmeier et al. 2006; Hannah 2015; Verrall and Pickering 2020), and protected areas may lose species as suitable climate spaces shift beyond present park boundaries (Peters and Darling 1985; Heller and Zavaleta 2009). Climate warming has caused significant upslope shifts in the distributions of many organisms (Chen et al. 2011). Some montane plant species have exhibited upslope shifts in their lower or upper elevation limits in response to warmer and drier conditions (Brusca et al. 2013). Therefore, it is especially likely that in protected areas at higher latitudes and elevations, recreation disturbance has the potential to exacerbate the effects of climate-induced stress.

Species level interactions: Animals

In tourism and recreation, animal species can act either as attractions, as victims, or as threats (Buckley 2019). As attractions, they may be either a primary or secondary component of a nature-based experience. As victims, animal species and populations may suffer from a wide range of recreation impacts and disturbances. These may affect habitat, foraging and energetics, social interactions and reproduction, migration, seasonality, and diurnal activity patterns (Steven et al. 2011). As threats, animal species may act either directly on individual humans, or as vectors for pathogens.

For animal species that may be suffering population declines from climate change, additional impacts from tourism and recreation may accelerate this effect. Similarly, for species experiencing impacts from recreation and tourism, the effects of climate change can exacerbate such impacts. For example, climate change may reduce the geographical range of a species, and recreation may increase disturbance within that range. If disturbance affects reproduction or migration, the consequences can be amplified accordingly.

Species level interactions: Vegetation

Nature-based tourism and recreation are increasingly recognized as having a wide range of effects on plants and plant communities (Barros et al. 2015) and in many cases are one of the most common threats to plants already at risk of extinction (Wraith and Pickering 2017). Climate change also is rapidly altering the distribution of plant species and communities and is the most important threat globally to natural ecosystems (Díaz et al. 2019). Although specific research is sparse, there are important straightforward interactions; e.g., well-documented impacts such as those showing trampling on vegetation has greater impact when conditions are warmer (Monz et al. 1996). Other interactions are more complex, reflecting the interplay between climate, tourists, and management. We illustrate some of the links and complexities with specific examples including weeds, feral animals, fires and trampling.

Non-native invasive species are one of the major threats to biodiversity globally and a major management challenge in PPAs (Pickering and Mount 2010). With warming conditions, range expansions are likely for many invasive plants, including into areas of high conservation value (Shrestha and Shrestha 2019). As people act as unintentional vectors for a wide diversity of weed seeds (Ansong and Pickering 2014), those visiting remote areas can inadvertently introduce new species into areas where climatic conditions used to be unfavorable, amplifying the rate of biological invasions.

Non-native animals such as horses, mules and donkeys are often used by park visitors and/or valued by them, but they can damage vegetation and waterways (Pickering et al. 2010). With warmer conditions resulting in a capacity to access more remote areas, there is likely to be pressure from tourists and operators to use these forms of transport more often, further damaging fragile ecosystems, particularly in mountain regions. In some cases, tourists see feral animals in PPAs as attractive, despite well-documented damage to vegetation and soils (Robertson et al. 2019). With climate warming, damage to vegetation from these and other feral animals is increasing, but control options are sometimes limited due to these animals' perceived value (Williams 2019).

A major effect of hotter and drier conditions is increased wildfire. An emerging body of research is beginning to examine the consequences of altered fire regimes on tourism and recreation (e.g., Otrachshenko and Nunes 2019). Some of these fires extend into plant communities that previously rarely burned, including rainforest and high-altitude plant communities. Visitation to these areas soon after the fires can cause further damage, with impacts from activities as simple as trampling being greater post-fire (Growcock et al. 2004).

People and nature

Nature-based tourism and recreation are likely to be more susceptible to weather changes and extreme events than other activities. Activities are more likely to be weather-dependent if they occur in locations with less infrastructure, rely on human-powered transportation, occur in expansive topography, and require extensive planning—all characteristics of dispersed and backcountry recreation activities (Verbos and Brownlee 2017). The consequences of increased temperatures depend on whether warming will make weather more clement or more extreme. Temperature effects do not appear to be influenced by the origin of the visitors, as people who live in different climates tend to have the same climate preferences for leisure activities (Lise and Tol 2002). Recreation demand is highest on sunny days, and when springtime temperatures are unusually warm, but demand decreases on the hottest days (Dwyer 1988). We might expect, then, that rising temperatures would result in a shift of use away from the hottest times of year while increasing use during the spring and fall. Such changes could have negative feedbacks for plant and animal species. Effects of springtime vegetation trampling, if it occurs at summer rates, would likely have greater impact on plant populations if it occurs when individuals are smaller and have less well-developed root systems and stem structures, or when soils are wetter. Similarly, recreation use could have greater negative impacts on wildlife if it increases during breeding and early rearing of young animals.

Also unknown is the extent to which visitors will be willing to alter their behaviors to mitigate climate change impacts. A variety of climate change adaptation strategies are available to land managers, including alterations to the setting, educational programs, and changes in visitor access to sensitive resources (O'Toole et al. 2019). A scenario-planning exercise in Jasper National Park, Canada, found that a majority of visitors would support climate change adaptation strategies that limited visitation as long as opportunities were not foreclosed entirely (Weber et al. 2019). Further research is needed to understand the climate-change contexts and climate-adaptation strategies that are more likely to result in visitor behavior change that could offset negative impacts.

The path forward: study designs and approaches to inform management

Climate change is a worldwide phenomenon that individual managers cannot influence by themselves; hence, most efforts to protect natural systems against climate change involve minimizing the impacts of other ongoing threats (loss of habitat amount and connectivity, spread of invasive species, etc.) that can be managed in some situations (Hannah 2015). The rationale is that a species will have a better chance of persisting in the face of climate change if it has, for example, more habitat that is connected across landscapes and regions, and if it experiences fewer adverse effects (competition, predation) from invasive species. Fortunately, recreation disturbance in protected areas is a threat that *can* be managed, and this situation provides opportunities to implement some control of the impacts. At present, virtually nothing is known about the prevalence (temporal and spatial) and severity of such interaction effects, or the recreation variables (type, frequency, seasonal timing, etc.) that may be involved. Without this information, little direction on how to preclude or reduce climate-recreation interaction effects can be provided to managers.

2025 NCF-Envirothon Alberta

Current Environmental Issue Study Resources - Part B

Key Topic #3: Indigenous Knowledge Systems and relation in Alberta's forests

9. Describe how Indigenous people and communities live with, care for, and rely on the forested areas.
10. Explain the promise and premise to the numbered treaties of Alberta, as well as the long-term effects of these treaties.
11. Truth and Reconciliation reflects more than understanding; describe what actions can be made to reflect reconciliation in relation to forest management and protection.
12. Explore how Indigenous Knowledge Systems are being adopted for natural lands improvement and stewardship, such as Traditional Fire Keeping.
13. Identify traditional practices of Indigenous people and how they elevate forest stewardship.

Study Resources

Learning the Grammar of Animacy

Excerpts from Braiding Sweetgrass

European languages often assign gender to nouns, but Potawatomi does not divide the world into masculine and feminine. Nouns and verbs both are animate and inanimate. You hear a person with a word that is completely different from the one with which you hear an airplane. Pronouns, articles, plurals, demonstratives, verbs—all those syntactical bits I never could keep straight in high school English are all aligned in Potawatomi to provide different ways to speak of the living world and the lifeless one. Different verb forms, different plurals, different everything apply depending on whether what you are speaking of is alive.

No wonder there are only nine speakers left! I try, but the complexity makes my head hurt and my ear can barely distinguish between words that mean completely different things. One teacher reassures us that this will come with practice, but another elder concedes that these close similarities are inherent in the language. As Stewart King, a knowledge keeper and great teacher, reminds us, the Creator meant for us to laugh, so humor is deliberately built into the syntax. Even a small slip of the tongue can convert "We need more firewood" to "Take off your clothes." In fact, I learned that the mystical word *Puhpowee* is used not only for mushrooms, but also for certain other shafts that rise mysteriously in the night.

My sister's gift to me one Christmas was a set of magnetic tiles for the refrigerator in Ojibwe, or Anishinabemowin, a language closely related to Potawatomi. I spread them out on my kitchen table looking for familiar words, but the more I looked, the more worried I got. Among the hundred or more tiles, there was but a single word that I recognized: *megwech*, thank you. The small feeling of accomplishment from months of study evaporated in a moment.

I remember paging through the Ojibwe dictionary she sent, trying to decipher the tiles, but the spellings didn't always match and the print was too small and there are way too many variations on a single word and I was feeling that this was just way too hard. The threads in my brain knotted and the harder I tried, the tighter they became. Pages blurred and my eyes settled on a word—a verb, of course: "to be a Saturday." *Pfft!* I threw down the book. Since when is *Saturday* a verb? Everyone knows it's a noun. I grabbed the dictionary and flipped more pages and all kinds of things seemed to be verbs: "to be a hill," "to be red," "to be a long sandy stretch of beach," and then my finger rested on *wiikwegamaa:* "to be a bay." "Ridiculous!" I ranted in my head. "There is no reason to make it so complicated. No wonder no one speaks it. A cumbersome language, impossible to learn, and more than that, it's all wrong. A bay is most definitely a person, place, or thing—a noun and not a verb." I was ready to give up. I'd learned a few words, done my duty to the language that was taken from my grandfather. Oh, the ghosts of the missionaries in the boarding schools must have been rubbing their hands in glee at my frustration. "She's going to surrender," they said.

And then I swear I heard the zap of synapses firing. An electric current sizzled down my arm and through my finger, and practically scorched the page where that one word lay. In that moment I could smell the water of the bay, watch it rock against the shore and hear it sift onto the sand. A bay is a noun only if water is *dead*. When *bay* is a noun, it is defined by humans, trapped between its shores and contained by the word. But the verb *wiikwegamaa*—to *be* a bay—releases the water from bondage and lets it live. "To be a bay" holds the wonder that, for this moment, the living water has decided to shelter itself between these shores, conversing with cedar roots and a flock of baby mergansers. Because it could do otherwise—become a stream or an ocean or a waterfall, and there are verbs for that, too. To be a hill, to be a sandy beach, to be a Saturday, all are possible verbs in a world where everything is alive. Water, land, and even a day, the language a mirror for seeing the animacy of the world, the life that pulses through all things, through pines and nuthatches and mushrooms. *This* is the language I hear in the woods; this is the language that lets us speak of what wells up all around us. And the vestiges of boarding schools, the soap-wielding missionary wraiths, hang their heads in defeat.

This is the grammar of animacy. Imagine seeing your grandmother standing at the stove in her apron and then saying of her, "Look, it is making soup. It has gray hair." We might snicker at such a mistake, but we also recoil from it. In English, we never refer to a member of our family, or indeed to any person, as *it*. That would be a profound act of disrespect. *It* robs a person of selfhood and kinship, reducing a person to a mere thing. So it is that in Potawatomi and most other indigenous languages, we use the same words to address the living world as we use for our family. Because they are our family.

To whom does our language extend the grammar of animacy? Naturally, plants and animals are animate, but as I learn, I am discovering that the Potawatomi understanding of what it means to be animate diverges from the list of attributes of living beings we all learned in Biology 101. In Potawatomi 101, rocks are animate, as are mountains and water and fire and places. Beings that are imbued with spirit, our sacred medicines, our songs, drums, and even stories, are all animate. The list of the inanimate seems to be smaller, filled with objects that are made by people. Of an inanimate being, like a table, we say, *"What* is it?" And we answer *Dopwen yewe*. Table it is. But of apple, we must say, *"Who* is that being?" And reply *Mshimin yawe*. Apple that being is.

Yawe—the animate *to be*. I am, you are, s/he is. To speak of those possessed with life and spirit we must say *yawe*. By what linguistic confluence do Yahweh of the Old Testament and *yawe* of the New World both fall from the mouths of the reverent? Isn't this just what it means, to be, to have the breath of life within, to be the offspring of Creation? The language reminds us, in every sentence, of our kinship with all of the animate world.

English doesn't give us many tools for incorporating respect for animacy. In English, you are either a human or a thing. Our grammar boxes us in by the choice of reducing a nonhuman being to an *it*, or it must be gendered, inappropriately, as a *he* or a *she*. Where are our words for the simple existence of another living being? Where is our *yawe?* My friend Michael Nelson, an ethicist who thinks a great deal about moral inclusion, told me about a woman he knows, a field biologist whose work is among other-than-humans. Most of her companions are not two-legged, and so her language has shifted to accommodate her relationships. She kneels along the trail to inspect a set of moose tracks, saying, "Someone's already been this way this morning."

"Someone is in my hat," she says, shaking out a deerfly. Someone, not something.

When I am in the woods with my students, teaching them the gifts of plants and how to call them by name, I try to be mindful of my language, to be bilingual between the lexicon of science and the grammar of animacy. Although they still have to learn scientific roles and Latin names, I hope I am also teaching them to know the world as a neighborhood of nonhuman residents, to know that, as ecotheologian Thomas Berry has written, "we must say of the universe that it is a communion of subjects, not a collection of objects."

One afternoon, I sat with my field ecology students by a *wiikwegamaa* and shared this idea of animate language. One young man, Andy, splashing his feet in the clear water, asked the big question. "Wait a second," he said as he wrapped his mind around this linguistic distinction, "doesn't this mean that speaking English, thinking in English, somehow gives us permission to disrespect nature? By denying everyone else the right to be persons? Wouldn't things be different if nothing was an *it?*"

Swept away with the idea, he said it felt like an awakening to him. More like a remembering, I think. The animacy of the world is something we already know, but the language of animacy teeters on extinction—not just for Native peoples, but for everyone. Our toddlers speak of plants and animals as if they were people, extending to them self and intention and compassion—until we teach them not to. We quickly retrain them and make them forget. When we tell them that the tree is not a *who*, but an *it*, we make that maple an object; we put a barrier between us, absolving ourselves of moral responsibility and opening the door to exploitation. Saying *it* makes a living land into "natural resources." If a maple is an *it*, we can take up the chain saw. If a maple is a *her*, we think twice.

Another student countered Andy's argument. "But we can't say *he* or *she*. That would be anthropomorphism." They are well-schooled biologists who have been instructed, in no uncertain terms, never to ascribe human characteristics to a study object, to another species. It's a cardinal sin that leads to a loss of objectivity. Carla pointed out that "it's also disrespectful to the animals. We shouldn't project our perceptions onto them. They have their own ways—they're not just people in furry costumes." Andy countered, "But just because we don't think of them as humans doesn't mean they aren't beings. Isn't it even more disrespectful to assume that we're the only species that counts as 'persons'?" The arrogance of English is that the only way to be animate, to be worthy of respect and moral concern, is to be a human.

A language teacher I know explained that grammar is just the way we chart relationships in language. Maybe it also reflects our relationships with each other. Maybe a grammar of animacy could lead us to whole new ways of living in the world, other species a sovereign people, a world with a democracy of species, not a tyranny of one—with moral responsibility to water and wolves, and with a legal system that recognizes the standing of other species. It's all in the pronouns.

Andy is right. Learning the grammar of animacy could well be a restraint on our mindless exploitation of land. But there is more to it. I have heard our elders give advice like "You should go among the standing people" or "Go spend some time with those Beaver people." They remind us of the capacity of others as our teachers, as holders of knowledge, as guides. Imagine walking through a richly inhabited world of Birch people, Bear people, Rock people, beings we think of and therefore speak of as persons worthy of our respect, of inclusion in a peopled world. We Americans are reluctant to learn a foreign language of our own species, let alone another species. But imagine the possibilities. Imagine the access we would have to different perspectives, the things we might see through other eyes, the wisdom that surrounds us. We don't have to figure out everything by ourselves: there are intelligences other than our own, teachers all around us. Imagine how much less lonely the world would be.

Every word I learn comes with a breath of gratitude for our elders who have kept this language alive and passed along its poetry. I still struggle mightily with verbs, can hardly speak at all, and I'm still most adept with only kindergarten vocabulary. But I like that in the morning I can go for my walk around the meadow greeting neighbors by name. When Crow caws at me from the hedgerow, I can call back *Mno gizhget andushukwe!* I can brush my hand over the soft grasses and murmur *Bozho mishkos*. It's a small thing, but it makes me happy.

I'm not advocating that we all learn Potawatomi or Hopi or Seminole, even if we could. Immigrants came to these shores bearing a legacy of languages, all to be cherished. But to become native to this place, if we are to survive here, and our neighbors too, our work is to learn to speak the grammar of animacy, so that we might truly be at home.

I remember the words of Bill Tall Bull, a Cheyenne elder. As a young person, I spoke to him with a heavy heart, lamenting that I had no native language with which to speak to the plants and the places that I love. "They love to hear the old language," he said, "it's true." "But," he said, with fingers on his lips, "You don't have to speak it here." "If you speak it here," he said, patting his chest, "They will hear you."

Albertans' Love of the Eastern Slopes is in our DNA

Excerpts from Streams of Consequence: Dispatches from the Conservation World

ALBERTANS' LOVE OF THE EASTERN SLOPES IS IN OUR DNA

In the early 1970s, on a university field trip to the coal strip mines of BC's Elk Valley, a small group of us listened in disbelief to a mining engineer's description of how the company was in the process of levelling one of the mountains. Somewhat in shock at his cavalier attitude, we asked if this was wise environmentally, ethically and, perhaps in the back of our minds, morally. His response was equally shocking. "Look around," he said. "We have so many mountains in BC, we won't miss one."

From the perspective of pure pragmatism, he had a point: BC has a lot of mountain landscapes – in his mind, a surplus of them. But Alberta doesn't. Our share of the Rocky Mountains – the Eastern Slopes and foothills – is meagre by comparison. They start as a sliver in the southwest corner of the province and widen considerably to the north, forming an elongated triangle. In contrast to the abundantly watered province of BC, we rely heavily on our Eastern Slopes, especially as the source of water for most Albertans.

For at least 70 years, Albertans have smugly prided ourselves on delivering oil to the nation and the continent. In the hype over oil, some might have forgotten that our Eastern Slopes have been the source of water, delivered to three provinces, for millennia.

Maybe our reverence for the Eastern Slopes started before Alberta was a province, with federal bureaucrats like William Pearce and J.B. Harkin. They ensured that most of the Eastern Slopes was set aside from settlement – for national parks, as game reserves, for watershed protection and as a timber source. A 1911 report by the Department of the Interior describes the Eastern Slopes as "a timbered area lying alongside of a prairie country hundreds of miles in extent…form[ing] the watershed for the river systems which water the great plains to the east, where water supply is practically the only limit to anticipated settlement and development."

These early policy decisions set the Eastern Slopes, as publicly managed and protected "commons," out of bounds for privatization. Without this, we could have ended up with a checkerboard of land ownership and an inability to manage that part of the province on a landscape basis. This sense of the "commons" began to percolate in the minds of Albertans, many of whom finally realized that these are special landscapes.

We Albertans often scoff at the initiatives of what we perceive as an eastern federal government, but watershed protection through "forest reserves" was one of this nation's great and (hopefully) enduring ideas. The Eastern Slopes Policy of the 1970s cemented in the minds and psyches of Albertans that these landscapes were important and had to be protected and stewarded, and that their maintenance was a matter of public trust.

Whether through history, experience or osmosis, Albertans have come to view the Eastern Slopes as sacrosanct, a landscape dedicated to the public good. However, growing awareness about the cumulative effects of land uses has led to simmering concern about unsustainable, industrial-scale clear-cut logging; significant environmental issues with existing coal mines; and worrisome levels of recreation, especially unregulated off-highway vehicle use and random camping.

The additional concerns about coal mines – with more mountaintops blasted off, stream valleys filled with overburden, water contamination, and loss of biodiversity and recreation opportunities – have galvanized Albertans. Why? Because they see that the future of these iconic landscapes is at stake. For many, this is a personal attack on something held dear.

Beyond the cerebral concerns of Albertans about the Eastern Slopes – water contamination, recreational losses, pushing wild species to the brink – there are visceral ones, not so easily articulated.

On a clear day the Eastern Slopes are within sight for many Albertans, and every day, they are within reach of all Albertans, in spirit if not in reality. Looking down on this landscape from above, we can see the mountains as a naked and serene backbone of twisted and tortured rock. Forests of conifer cling to the slopes and spread in an ever-widening band over the rounded foothills. In the southwestern corner, the transition is abrupt – from naked rock to forest to rolling fescue grasslands, in just a few kilometres.

The mountains, looming above a green foreground of foothills, have a superb clarity, even at great distance. They stand as sentinels in our busy world, a backdrop, maybe a backrest, for our emotions and dreams.

In the glare of a winter's day, there is satisfaction in seeing the snowpack build on them. Throughout the summer, I watch apprehensively as that white frosting disappears and stream flows diminish. Throughout the year, the clouds boil over the peaks of the Livingstone and Front ranges and up the Continental Divide, parsimoniously offering what moisture is left over after the BC mountains have milked them strenuously. We live in a rain shadow, which means dry, arid and parched for southern Alberta and drought-prone for the remainder of the province.

The winds pushing the clouds strike a chord, a momentary hum through the pine and spruce boughs, rising to a roar over mountain summits, racing down canyon slopes over exposed grasslands. The resinous fragrance of a hot pine forest is moderated by the sharp coolness of a streamside band of old-growth and immense spruce. This is a place that can remind us we are not far from our own origins.

When Albertans travel to or even think about the Eastern Slopes, we pass from the developed, the civilized, the tamed and the known to another place, one of unknowns, the unexplored, the intangible and maybe the mystical.

As a kid, I could look west from our farmhouse, over the Medicine River valley west of Red Deer, to the foothills and the "shining" mountains, so named by Anthony Henday some 200 years earlier. That country, within sight but beyond my grasp, was the real wild in my mind. It rivalled the mysteries of the Serengeti, the Amazon basin, the Himalayas and other geographies of a child's imagination.

Many Albertans can't travel to such exotic locations, but we can go to the province's backyard – the Eastern Slopes. Few things take on the prominence and are as important as a person's backyard and clean drinking water. Meddle and tinker with either (let alone both) and the consequences aren't trivial.

Albertans view the Eastern Slopes as our backyard. In that shared backyard is an opportunity to relax, explore and escape the developed world. Places in the Eastern Slopes can take on mythical properties as we search for personal space in shaded forest, amid mountain backdrops with the plunge of clear streams and rivers. This is where we find possibilities, peace and personal rewards.

We drink from the Eastern Slopes, we restore ourselves in them, they form a metaphorical border and backbone. They are our wild, our inspiration, and they are a place where we can see ourselves clearly as part of the environment, not separate from it. Why does this place called the Eastern Slopes evoke such emotions? Because there are memories of our fleeting presence there, of cherished activities, and, regrettably, there is also the trauma of some of the scars we have inflicted on it.

Many of us still seek passage beyond that gradient of the developed world and recreate exploratory journeys, mostly on weekends westward to our headwaters. Maybe we're like salmon, looking for our natal stream and a chance to be reborn. An older cohort of Albertans clinched their affinity with hunting and fishing trips. Newer generations camp, explore, hike, cross-country ski and birdwatch with an expanded scale of environmental sensibilities.

In a world increasingly mechanized, digitized, electrified and programmed, this is a place where we can escape to something more elemental, where our stone-age brains can better cope and find release. The simple act of building a fire restores an atavistic skill. The Eastern Slopes lavish us with many gifts, a few of them being peace, relaxation, purpose, strength, inspiration, challenge, reward and worship.

Sacred may be a strong word to apply to the Eastern Slopes, in the face of utilitarian views and users. But to Indigenous Peoples and others, *sacred* describes a place of ceremony, of medicinal plants and connection with cultural roots. Robin Wall Kimmerer, author of *Braiding Sweetgrass,* describes it this way:

> Being naturalized to place means to live as if this is the land that feeds you, as if these are the streams from which you drink, that build your body and fill your spirit. To become naturalized is to know that your ancestors lie in this ground. Here you will give your gifts and meet your responsibilities. To become naturalized is to live as if your children's future matters, to take care of the land as if our lives and the lives of all our relatives depend on it. Because they do.

With the imminence of more coal mining, many Albertans have been jolted out of complacency about the Eastern Slopes. They've started to remember things they didn't know they had forgotten. Fundamental things, like where their water comes from – clean, clear and refreshing. It could be the memory of where they caught their first fish, a trout, which conjured up a place of quiet, of space, and reverence. Instead of a situation where we work over a place, the Eastern Slopes work on us.

Maybe some have taken a closer look at our coat of arms, with the bordering mountains and the green foothills that seem intact, but they harbour a suspicion that the picture hides an alternate reality. Others have consulted Google Earth and seen the devastation, the fitful black purgatory of coal mining next to us in BC, and wondered, Is this our future?

No government should overlook or misjudge the sentiments of Albertans and our deep-seated appreciation of the Eastern Slopes. Anything that throws open the Eastern Slopes to destructive and unsustainable exploitation represents a serious violation of the public's trust and a failure to properly steward these landscapes for the public good. The cumulative economic aspirations, the growing recreational pressures and the accumulated scars show that we cannot take the Eastern Slopes for granted any longer.

Land held in common gives Albertans something to fight for collectively; there is strength and conviction in the crowd over individual, political and corporate desires. The Eastern

Slopes are a gift from previous generations that creates an ongoing relationship and responsibility. There is only one way to thank those prescient individuals with foresight for this gift: let's not squander it on some short-sighted, short-term, get-rich-quick liquidation scheme.

The Eastern Slopes that Albertans want and need can't exist alongside deals shrouded in secrecy, bounded by an out-of-step economic ideology and an agenda rife with obfuscation and disingenuous spin. Much is at stake here, as we have seen in the reaction of many Albertans to the spectre of coal mines, industrial-scale clear-cut logging and rampant off-highway vehicle use.

There is a crying need to return to legitimate, evidence-based and nonpartisan land-use planning. Like a kettle boiling, the scream of cumulative land uses threatens the integrity and ideal of the Eastern Slopes. These landscapes cannot persist without limits set on the human footprint.

The stewardship objectives and desires of Albertans for the Eastern Slopes are still clear after nearly a century. It's part of our DNA. Albertans' message is loud, clear and unequivocal: we do not support the squandering of the integrity of the Eastern Slopes for a pocketful of economic mumbles.

The Mindful Harvest

Excerpts from 'Held by the Land: A Guide to Indigenous Plants for Wellness

The Mindful Harvest

What is harvesting? When I use the word, I mean the act of going out on the land and taking plant foods, medicines, and materials from either wild or cultivated plant populations. Harvesting can look different depending on the plant. You may need clippers, a shovel, gloves, a basket.

What is a mindful harvest? It is a framework grounded in respect, reciprocity, and responsibility to plant relatives, and is foundational to being in good relationship with plants. Plants and the land have agency. They have their own spirits, names, interconnections, needs, and power. Being mindful with plants and with ourselves while observing, identifying, cultivating, and harvesting them is part of upholding our side of the relationships between people and plants.

Before I Harvest

My lived experience as an Indigenous woman, along with what my elders and cultural teachers have shared with me, has led me to ask myself questions before I set out to harvest. These questions come from a place of developing a humble self-awareness grounded in gratitude for the gifts of nature. They rely on an inherent understanding that I am relying on the generosity of the botanical relations that I am approaching, and that if I am not carrying myself in a good way, I will not receive their gifts. For a gift to be a gift, it must be offered and not taken without permission. To prepare myself for harvesting, I ask myself the following questions:

- Am I in a good frame of mind and heart?
- Have I asked for permission from the local Indigenous community?
- Am I prepared for my harvest?
- Am I harvesting in a good area, free from contaminants?
- Do I know how to spread out my harvest so that I leave enough for non-human life and for the plants to thrive and regenerate?

Asking Permission from the Local Indigenous Community

The practice of giving a territorial acknowledgment, or naming the Indigenous lands you are on, has become a much more common and expected protocol when holding events or activities on Indigenous lands. Though this practice is important, it does not stand alone. It requires associated action to hold true meaning. One way to do this is to consider what activities one can do to support local Indigenous communities. One action we can all take is to learn whose traditional territory we live on. If we are wanting to harvest, we can ask permission and become familiar with culturally important areas we shouldn't harvest in. We can also ask if there is a way to give back. Is there a youth group that might want to come out harvesting? Is there an elders group that could benefit from you sharing your harvest? Perhaps you should not harvest a certain plant, and instead look at growing it yourself or sourcing it from a native plant nursery. I ask permission when I am outside my home territory, especially if I am harvesting a culturally important plant food or medicine. This ensures that I am considering the people from that land before my own harvesting desires.

Preparing for a Harvest

Follow the steps below before setting out to harvest:

1. Familiarize yourself with how to identify the plant, when it is ready for harvest, and what a sustainable harvest looks like. Ask, "How do I give back to this plant and to the land where it grows?"
2. Plan for how to process the plant once you have harvested it. A strong teaching is not to take too much and to be sure to use all that you harvest.
3. Do you have the proper equipment to harvest this plant? Please see the guidelines on the next pages for a list of materials you may want to collect.

Plant Harvesting and Cultivating Materials

Before you head out into the garden or forest, consider what you may need from the following lists:

PLANT IDENTIFICATION

Must-Haves:

- Selection of plant field guides that have clear photographs, taxonomic identification keys, and other important information on habitat and timing of planting/cultivating/harvesting.

Good-to-Haves:

- Plant press for making herbarium pressings to aid in identification and to record areas where particular plants are found growing.
- Magnifying lens or loupe for closer inspection of small plant parts for identification purposes.
- Soft measuring tape if you would like to verify identification measurements in field guides.

PLANT HARVESTING EQUIPMENT

Must-Haves:

- Good harvesting basket or breathable bag. Baskets are one of my obsessions for good reason! They allow for airflow, come in many different shapes and sizes, and are structured enough to create some protection for delicate plant materials. They are also multipurpose, as they can carry your field guide and snacks.
- Drying rack with good airflow and a suitable surface for securely drying plants. You can make your own from window screens or purchase herb-drying racks from garden stores.

Good-to-Haves:

- Gloves for harvesting plants with thorns, stinging hairs, or phototoxic compounds (naturally occurring chemicals in plants that react with sunlight to cause a skin reaction).
- Clippers for cutting through larger woody stems or plants that have stinging hairs, such as stinging nettle.

- Sturdy harvesting knife that you can store safely and that you don't mind getting dirty.
- Digging stick if you have access to one; these traditional tools are very helpful for digging precisely and carefully without disturbing other plant roots.

SAFETY EQUIPMENT

Must-Haves:

- First aid kit stocked for remote settings.
- Bear spray if in areas where bears live.
- Means of communication other than cell phone if out of range (satellite phone, radio).
- Trip plan that can be left with someone at home so they know where you are going and when you plan to return; this is especially important if you are going further afield to harvest.
- Extra layers and rain gear for changing weather.
- Water and food.

PLANT CULTIVATION MATERIALS

Must-Haves:

- Seeds or plant starters from your local native plant nursery, or seeds you have collected.
- Pots, raised beds, or garden beds. Many native plants thrive in containers and pots; growing your own plants helps take harvesting pressure off wild plant populations and also creates habitat and food in your garden for wildlife such as birds and insects. This also may allow you to save seeds or share starts with local Indigenous communities.

Good-to-Haves:

- Gardening gloves.
- Seed markers to record where you are planting seeds.
- Gardening book or resources to help you prepare your soils and plant native plants in

ideal conditions.

Knowing Your Harvest Sites

Finding places to harvest plants can take some time and exploration. Once you have permission and know what plant you are intending to harvest, you can set out to find those special places on the land to build relationships with plants and eventually harvest them. This may be a site in your own garden, that of a friend or family member, or a community garden. Considering alternatives to wild harvesting is a way of sustainable harvesting. When exploring harvest sites, you can look for signs that the area is far away from potential sources of contamination such as major roads, power lines, industrial sites, and dog parks. If you are planning to dry your plants, it is important to select your harvest areas carefully. You don't want to wash leaves, flowers, bark, or any plant part you are going to be drying, as adding extra water to delicate petals, leaves, or shoots can increase the chances of mold and rancidity when storing and utilizing the botanicals later. Know the cultural significance of areas in your region and be respectful. Take care not to harvest in traditional harvesting grounds, and not to harvest plant species that are endangered, rare, or spiritually significant, as you need to have training and cultural context to safely and respectfully utilize such botanicals.

Spreading Out Your Harvest and Leaving Enough Behind

The ways you spread out your harvest will depend on if you are harvesting shoots, leaves, flowers, roots, or bark. Remember, a key sustainable harvesting practice is to not take too much; don't take the first plant you encounter or the last of a particular plant. Overharvesting is a real concern and has a detrimental impact on wild plant populations. Plants such as stinging nettle, wild leeks, and ostrich fern fiddleheads have all been put under great pressure due to their popularity with wild food foragers, chefs, and related businesses. Medicinal and spiritual plants such as white sage, palo santo, and the yew tree have faced severe (and in some cases ongoing) pressures due to popularization and commercialization. When botanicals become popularized without any cultural context of lived experience, it is frighteningly easy for humans to quickly overburden or exploit culturally important plants to the brink of extinction, and certainly to inhibit the access of cultural groups who rely on the plant for ancestral health and wellness practices.

Understanding the life cycle of a plant can help inform you how to spread out your harvest sustainably. Again, remember not to take the first plant you happen upon, don't take more than you need or can use, certainly don't take more than half a stand of a plant, and be sure to make an offering and give back to the plant or the land in any way you can. For example, when I harvest wild rose petals, I'm careful to leave two to three petals on each rose flower so that pollinators can still land upon it. With plants that reroot themselves, such as willow and devil's club, cuttings can be planted in the place of the plant you harvested. Spreading root segments from plants such as camas and rice root while you harvest will enhance their reproduction, and saving or spreading seeds will

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ensure culturally important plants come back year after year.

While I Harvest

The following teachings in relation to harvesting have been shared with me by elders and family members over the years. I offer them here as a starting place for you to consider your own teachings or traditions:

1 Introduce myself to the plant.

2 Share my intention to harvest the plant in a mindful and respectful way.

3 Ask permission to harvest and listen to the response.

4 Make an offering to the plant.

5 Enact reciprocity toward the plant; this could be to replant part of the plant, spread its seeds, grow the plant in my garden, and plant more plants in its place.

Introducing Myself and Sharing My Intention

I've been taught to introduce myself in my Indigenous language so that the ancestors can understand me. This is an act that is personal to me and that I carry out even when I'm outside of my home territory, as it feels meaningful to ground my mindful presence in my cultural language. As a child, I witnessed my elders and relatives in conversation with non-human life—my great-uncle speaking to the plants in his garden, my father speaking to the deer he just harvested, my great-aunt speaking to the medicines she prepared—so it doesn't feel unfamiliar to now be practicing speaking with plants and teaching my children to do so. Taking the time and care to introduce yourself to a plant is a way of showing respect, and it also acknowledges your intentions. Making the time to do this can cue a deeper awareness of the surrounding area and give you time to observe if the plant looks healthy and plentiful. Are there signs of other recent harvests? Are you near or in a culturally significant site?

During my introduction, I also share my intentions: to be respectful, to listen, to be grateful, and to utilize all that I harvest to create food, medicine, or material that carries with it love and honor for the plant itself.

Making an Offering and Enacting Reciprocity

Making an offering is a personal act that can and should be grounded in your own cultural or personal practices and beliefs. This is an act that embodies reciprocity and can be informed by your own relationship with the plant you are harvesting. When I harvest, I introduce myself, make an offering of tobacco, and share my intention with the plant. I don't take too much, and I give back by replanting part of the plant or growing it in my garden as a way of reducing the harvesting pressure on wild plant populations. This is an opportunity to invite ceremony and ritual into building your relationships with plants. I don't mean you should appropriate or borrow ceremony; rather, connect to your own traditions or cultural practices or explore practical ways to contribute to sustainably harvesting and rebuilding wild plant populations. If you don't know your traditions or cultural practices, this may be an opportunity to seek out a family or community member and ask them. Many unexpected things can come when we take these kinds of risks and opportunities.

Asking Permission and Listening to the Answer: Teachings from Ch'átyaý for a Mindful Harvest

I have had experiences in my life linked to learning from ch'átyaý (devil's club) as a teacher. The first was a few years ago when I was teaching an ethnobotany course on Haida Gwaii at the Kay Llnagaay heritage center in Skidegate as a visitor on Haida territory. I was co-instructing the course with a Haida teacher, which was important to me as an Indigenous instructor from another territory. The day before the course started, I went for a walk on a trail close to Skidegate. Excited and wanting to bring some plants into the classroom with me on the first day, I set out to respectfully harvest from a handful of culturally important plants. I had salmonberry, cedar, lichen, and ch'átyaý in mind. I had brought my tobacco to make an offering to the plants as I introduced myself to them, told them where I am from, and what my intention was in harvesting from them. I located the first three plants fairly quickly and felt confident harvesting a small amount as the stands were thriving in and around the forest area I was hiking in. I kept coming across wet depressions in the forest where ch'átyaý should have been growing, yet there wasn't a plant in sight. As I made my way further up the trail, I puzzled at the lack of ch'átyaý growing in the area. Then a feeling came over me as if someone gently tapped my elbow, and it was clear: the message I was hearing was I was not invited to harvest this plant here.

When I received this message, I thanked the forest and the carrier of the message and turned to hike back down to the trail to bring the other plants home and put them in water for the class the following day. I had only taken a few steps when I saw a large ch'átyaý plant out of the corner of my eye, growing just in the place I would have expected it to grow. I looked beyond and saw a handful of other plants scattered throughout the forest understory. It felt undeniable in that moment that, knowing my intention to harvest it, the plant had hidden itself from me. Once I had received the message that the answer was no, it revealed itself.

Now, my logical brain started explaining the coincidence; it told me that sometimes the trail looks different on the way down, and perhaps I was so focused on certain areas that I missed the places that the scarce single plants were growing. But I knew this wasn't the case. I felt it. When I asked my Haida co-instructor about the state of ch'átyaý on the islands, she told me it was declining rapidly due to over-browsing from introduced deer, and that people were feeling sadness at seeing this important medicine decline. She reaffirmed that it was a good thing I didn't harvest any. I learned two lessons there. As a visitor in an area, it is so important to not only ask permission from the plants, but also from the Indigenous stewards of the land. I knew this! And I felt foolish having not taken that step, so that was one reminder. But I also learned what it feels like to ask permission to harvest and to be told NO.

Video - Treaties with Indigenous peoples in Canada

[Treaties with Indigenous peoples in Canada, explained | CBC Kids News]

Forestry and Reconciliation: Focus on BC

February 10, 2016

Indigenous Relations (https://www.ictinc.ca/blog/topic/indigenous-relations) Reconciliation (https://www.ictinc.ca/blog/topic/reconciliation) Forestry (https://www.ictinc.ca/blog/topic/forestry)

Since the Truth and Reconciliation Commission released its summary report containing 94 Calls- to-Action we have written a series of articles on what various organizations can do towards reconciliation (//www.ictinc.ca/blog/truth-and-reconciliation-commission-calls-to-action?hsLang=en). We have articles on what local governments (//www.ictinc.ca/blog/first-nations-and-local-government-reconciliation?hsLang=en), municipalities (//www.ictinc.ca/blog/indigenous-reconciliation-and-municipalities-some-calls-to-action?hsLang=en), dioceses (//www.ictinc.ca/blog/reconciliation-and-the-bc-anglican-diocese?hsLang=en) and schools (//www.ictinc.ca/blog/24-tips-on-creating-culturally-inclusive-schools?hsLang=en)are implementing or could implement to reset their relationship with Indigenous people. In this article, we visit the forestry and reconciliation. We provide an overview and then focus on British Columbia as BC is historically the biggest producer of forest products and its forestry/Indigenous relations have progressed since the infamous "War in the Woods" era.

So, first some background basics. Indigenous-forestry relations fall under both the federal government (controlling and directing issues related to Indigenous Peoples) and provincial and territorial governments. The management and use of forests, on the other hand, is primarily a provincial and territorial responsibility with those governments holding management authority over forest resources on most public lands. Private companies apply to provincial/territorial authorities for permission to conduct logging and production activities.

> The majority of all lands in Canada are held by governments in the name of the monarch and are often called Crown Lands.* About 89% of Canada's land area (8,886,356 km^2) is Crown Land, which may either be federal (41%) or provincial (48%); the remaining 11% is privately owned. In BC, 94% of the land is provincial crown land while 1% is federal crown land, including reserves, defence lands and federal harbours; 5% is privately owned. [1]
>
> *Although in places Aboriginal Title represents an encumbrance on the Crown's title so I would recommend avoiding the use of Crown Lands in conversation to avoid triggering intense debate.

The majority of Indigenous communities are in or closely associated with forests, and about 1.4 million hectares (3.46 million acres) of reserve (//www.ictinc.ca/blog/8-first-nation-reserve-faqs?hsLang=en) lands across the country are suitable for resource uses such as forestry, hunting, trapping, fishing (//www.ictinc.ca/blog/first-nations-salmon-fisheries?hsLang=en) and gathering herbs and medicinal plants. For many Indigenous communities, having recognized rights and a role in forestry has come at the high cost of lengthy legal battles, boycotts, barricades and negotiations. Including Indigenous Peoples in forestry plans is considered by some companies a hindrance, an inconvenience and an additional cost. Provincial governments sometimes find themselves caught in the middle trying to uphold treaty (//www.ictinc.ca/blog/10-treaty-facts?hsLang=en)rights and meeting obligations to forestry companies and local economies dependent on forestry.

> Since the 1960s, Aboriginal peoples have sought both greater recognition of their rights and increased autonomy, through political negotiations, public protests and legal challenges. This includes seeking recognition of their rights to forestlands already allocated to forestry companies, a situation that involves both the federal government (responsible for Indians) and provincial authorities (responsible for lands and forests)." [2] The situation has improved though. "Collectively, First Nations now hold approximately 10.4% of the national wood supply, an increase of 7.5 million m3 or 64% in volume from our last report in 2007, and a 140% increase since our first report in 2003.[3]

- Read:
  First Nations Forestry (//www.ictinc.ca/blog/corby-lamb-first-nations-forestry?hsLang=en) for an interesting business model.

The British Columbia example

BC is the most important timber producer in the country, with 51.74 million hectares of timber-productive lands. There are 198 First Nation communities in the province and Indigenous forest lands (mainly reserves) cover approximately 198,000 hectares.

British Columbia has been renowned for the quality of its timber and forest products since Europeans first visited in the late 1700s. By the time BC entered confederation in 1871, the province was recognized globally for the superior quality of its timber. But long before then these same forests were crucial to the First Peoples who had inhabited the land since time immemorial. Forests are the source of cultural traditions, spiritual knowledge, traditional foods and revenue. Early logging practices did not factor in sustainability, the environment, Indigenous relationship to the land (//www.ictinc.ca/blog/first-nation-relationship-to-the-land?hsLang=en) or the traditional and cultural significance (//www.ictinc.ca/blog/sacred-cedar?hsLang=en) of the forests to First Peoples - the rate that the forests were being logged and ecosystems destroyed with no regard for Indigenous values, beliefs or traditional knowledge (//www.ictinc.ca/blog/owns-tek?hsLang=en) caused great concern amongst Indigenous Peoples, and others, in the province.

Wars in the Woods

The relationship between Indigenous Peoples and the forestry sector in BC over logging practices is underscored by a few noteworthy confrontations - Meares Island, Haida Gwaii, South Moresby and Stein Valley - some of which have garnered worldwide attention, and not the good kind.

The Meares Island Case 1985 (//www.ictinc.ca/blog/meares-island-case-ongoing?hsLang=en), which has been described as a David and Goliath calibre confrontation, involved members of the Nuu-chah-nulth First Nation and other protesters taking on the Province of British Columbia over logging rights on Meares Island. The case was adjourned by agreement of all parties.

In the Haida decision (//www.ictinc.ca/blog/haida-case?hsLang=en) of 2004, a unanimous Supreme Court of Canada set out the basic principles applicable to the duty to consult and clarified that the duty to consult and accommodate rests with the Crown. The judge ruled that third parties, such as a forestry company, could not be held liable for the failure of the Crown to consult and accommodate, but did not absolutely absolve the company of responsibility to protect Aboriginal and treaty rights.

The Meares Island confrontation is seen as a turning point in that it was the first time Aboriginal title was considered important enough to justify an injunction against logging. The Meares Island case also led to the formation of the province's Ministry of Native Affairs (which has since evolved into the Ministry of Aboriginal Relations and Reconciliation) whose first minister was Frank Calder (//www.ictinc.ca/blog/frank-calder-the-man-who-moved-the-mountain?hsLang=en), Canada's first Indigenous cabinet minister.

There has been a significant shift in forestry operations and forestry-Indigenous relations since those dark days of disregard for Indigenous rights and environmental protection. According to the January 2015 BC Forest Industry: Economic Impact Study prepared by MNP LLP:

> The forest industry is a world leader in sustainable forest management. BC has more land certified to internationally recognised sustainability standards than any other jurisdiction in the world. This certification has helped to differentiate products originating from BC forests as being environmentally sustainable products.
>
> The forest industry includes First Nations participation. Since 2002, the Ministry of Forests, Lands and Natural Resource Operations has signed forest tenure agreements with 175 of the 203 First Nations in BC. These agreements provide $324 million in resource revenue-sharing and access to 63.2 million cubic metres of timber.

A provincial governmental policy development requires strength of claim assessment:

> Almost all of BC forest land has overlapping claims by various First Nations. A strength of claim assessment has become necessary since the Tsilhqot'in decision (//www.ictinc.ca/blog/forestry-after-tsilhqotin?hsLang=en) and consists of right and title assessment for every application and block on Crown land. Because the strength of claim is highly subjective it not yet used in Forest Consultation and Revenue Sharing Agreements.
>
> Under the Forest and Range Practices Act, forest professionals are also responsible for the management of cultural heritage features at the site level, during planning (identification of features), layout (field identification of features) and harvest (no-harvest or site alteration permits in areas with identified features). [4]

Additionally, all Registered Professional Foresters practicing in the province are required to conduct a self-assessment that includes a fairly comprehensive set of Indigenous relations requirements. We have copied Statements 7 and 8 of the Self-Assessment Guide in their entirety because we think they provide a good template for Indigenous relations for all resource sectors. We are also extremely honoured to have our Training (//www.ictinc.ca/training?hsLang=en) included as a recommendation.

> In order to carry out my job responsibilities I have adequate knowledge about Aboriginal peoples, their culture and Aboriginal rights and title interests, and concerns with forest land and resource use.
>
> In order to have adequate knowledge, you should be competent with respect to all of the following Aboriginal competency statements which are applicable to your job. If improvement is needed with respect to any one of these statements, it must be addressed in your Professional Development Plan.
>
> 1. I have a working knowledge of the implications of court decisions pertaining to Aboriginal rights and title such as Calder; Sparrow; Delgamuukw; Haida and Tsilhqot'in (found in Why Treaties?); Guerin (found in Primer on the Recent Law Affecting Aboriginal People); and Rio Tinto Alcan.
>
> Links are provided to give summaries about these important court decisions. You are encouraged to research more information about these decisions if they pertain to your work.
>
> These decisions relate to Aboriginal rights and title, duties to consult and accommodate Aboriginal interests and the Crown's fiduciary responsibility with respect to Aboriginal relationships.
>
> 2. I am aware of the reasons why BC and Canada are attempting to work with First Nations and
>
> Aboriginal groups on treaty rights and treaty related measures and why BC has to enact an Aboriginal interim measures policy until such time as treaties are settled dealing with consultation, accommodation and reconciliation of any infringement on an Aboriginal right or title.
>
> ABCFP Self-Assessment Guide 8
>
> This is related to the above statement where the legal decisions provide some reasons for treaties and Aboriginal interim measures policies. The Why Treaties? document is from the BC Treaty Commission and it explains the need for treaties. Until treaties are finalized, it is important to know how interim measures can be initiated so consultation, accommodation and reconciliation of any infringement on an Aboriginal right or title can be addressed.
>
> This awareness requires an effective relationship and communication with local Aboriginal communities. Once this happens you will better be able to obtain knowledge about how Aboriginal cultural and spiritual interests will be affected by your or your client's or employer's actions.
>
> 3. I have an effective relationship with appropriate Aboriginal communities.
>
> An effective relationship with an Aboriginal community means*:
>
> - You have an ability to communicate with the whole Aboriginal community, not just council members or elected and hereditary chiefs;
> - You receive positive responses to your communication efforts;
> - You are involved with local Aboriginal community events;
> - Presentations to local Aboriginal communities are met with friendly dialogue;
> - You have demonstrated knowledge about local Aboriginal culture, issues and concerns;
> - Aboriginal community members respect your integrity;
> - You don't impose timelines on projects; and
> - You are able to work out solutions with the whole Aboriginal community.(*this is a good start but is a partial list)

4. I have a basic awareness of the various distinct Aboriginal groups and First Nations that exist within my operating areas. This includes governance models pertaining to the land and resources within traditional territories (e.g. from the hierarchical, matrilineal societies and governance models that exist in coastal areas to the more egalitarian societies in the interior and northern parts of BC). This includes knowledge of traditional territories and their overlap within your interest area and all the Aboriginal communities affected by your interest area. Knowledge of the governance models within the various First Nations of your interest area will enable you to communicate more effectively.

5. I am able to effectively communicate directly or indirectly with Aboriginal peoples.

See above

6. I am aware of the impacts on Aboriginal communities and culture as a result of my employer's, client's or my own actions when I carry out my job responsibilities.

This awareness requires an effective relationship and communication with local Aboriginal communities. Once this happens you will better be able to obtain knowledge about how Aboriginal cultural and spiritual interests will be affected by your or your client's or employer's actions.

If improvement is needed with respect to any one of the above Aboriginal competency statements, members are strongly encouraged to register for the online workshop entitled **Working Effectively with Indigenous Peoples®** provided by **Indigenous Corporate Training Inc**. This workshop can be recorded in your self assessment professional development plan and is a first step in understanding BC Aboriginal issues." [5] emphasis added

In terms of Urban Forestry, the provincial government, the private sector and Canim Lake Band, are working together to replant forests affected by the Mountain Pine Beetle.

Canim Lake Band lands that are either Indian Reserve Land or part of their forestry lands have also been invested by the Mountain Pine Beetle epidemic and the forestry recession. There was at one point recently, very little money in the Bands' forestry department to afford tree planting in areas that needed restoration. Through a partnership with a well-known silvicultural contractor and facilitator, a now three year old tree planting program was created that has built a silviculture work force in the community. These projects benefited the Canim Lake Band youth that are becoming tree planters. The Band supports the project by allocating resources in several ways: first, their forestry department finds the land, collects the surveys and then sources and allocates tree species to be planted in these units based on Ministry of Forest standards. Second, the Band's Human Resource liaison works with silviculture contractor to hire a local Canim Band crew that will work with contractor's seasoned planters and staff. Lastly, the Community provides the base of work force for the planting. [6]

What actions can the forestry sector take toward reconciliation?

In 2010 Canada included its signature on the **United Nations Declaration on the Rights of Indigenous Peoples** (//www.ictinc.ca/united-nations-declaration-on-the-rights-of-indigenous-peoples-snapshot?hsLang=en) (UNDec). Industry should become familiar with and recognize opportunities to support the Articles of UNDec that specifically promote the role and responsibility of Indigenous peoples in the management of land:

> **Article 25** seeks to maintain and strengthen distinct spiritual relationships with traditional lands, territories, waters and coastal seas to uphold responsibilities to future generations.
>
> **Article 26** articulates a right to lands and resources on those lands including ownership, use, development and control. This article also states that governments must give legal recognition and protection to these lands and resources, guided by respectful engagement with the customs, traditions and land tenure systems of the Indigenous people concerned.
>
> **Article 27** restores the right to restitution for land that has been confiscated, occupied or damaged.
>
> **Article 29** addresses the right to conservation and protection of the land's productive capacity. This article precludes the storage of hazardous waste and promotes the use of land in the restoration of the health of Indigenous peoples. [7]
>
> **Article 31** covers the right to maintain, control, protect and develop cultural heritage, cultural expression and the manifestations of Indigenous science and technology including human and genetic resources.

The Truth and Reconciliation Commission Calls-to-Action (//www.ictinc.ca/blog/truth-and-reconciliation-commission-calls-to-action?hsLang=en) includes one for corporate Canada and sets some pretty clear guidelines for the corporate sector to follow:

> **92**. We call upon the corporate sector in Canada to adopt the *United Nations Declaration on the Rights of Indigenous Peoples* as a reconciliation framework and to apply its principles, norms, and standards to corporate policy and core operational activities involving Indigenous peoples and their lands and resources. This would include, but not be limited to, the following:
>
> i. Commit to meaningful consultation, building respectful relationships, and obtaining the free, prior, and informed consent of Indigenous peoples before proceeding with economic development projects.
>
> ii. Ensure that Aboriginal peoples have equitable access to jobs, training, and education opportunities in the corporate sector, and that Aboriginal communities gain long-term sustainable benefits from economic development projects.
>
> iii. Provide education for management and staff on the history of Aboriginal peoples, including the history and legacy of residential schools, the United Nations Declaration on the Rights of Indigenous Peoples, Treaties and Aboriginal rights, Indigenous law, and Aboriginal–Crown relations. This will require skills based training in intercultural competency, conflict resolution, human rights, and anti-racism. [8]

Forests have been incredibly important to Indigenous Peoples since time immemorial. Forests have also been incredibly important to the development of Canada and continue to be, with respect to market variables, an important economic driver for the economy in certain regions of the county. While there may be great opportunity to improve relations between the forestry sector and Indigenous Peoples, British Columbia - the province that has the most to gain and the most to lose with its Indigenous relations - has made significant improvements. *The Self-Assessment Guide for Registered Professional Foresters in BC* is an example of an association that has conducted intensive consultation in order to develop a comprehensive set of Indigenous relations guidelines and kudos to them.

[1] Wikipedia

[2] Sustainable Forest Management Network, Collaboration Between Aboriginal Peoples and the Canadian forest Industry: a dynamic relationship

[3] National Aboriginal Forestry Association (NAFA) 3rd report, 2015 First Nation-held Forest Tenure in Canada 2015

[4] BC Forest Professional May-June 2015

[5] ABCPF Self Assessment Guide

[6] Canadian Urban Forest Network: A Snapshot of Urban Forestry Activities in British Columbia

[7] United Nations Declaration on the Rights of Indigenous Peoples

[8]Truth and Reconciliation Commission Calls to Action

Featured photo: Wah'nah'juss Hilth'hooiss (Meares Island). Photo: Blue Pixel Design

Cultural Burning - Cultural Burning & Prescribed Fire and Video

What is Cultural Burning?

Cultural Burning is a practice that has existed for millennia. It holds different meanings for different Indigenous communities but is often defined as the controlled application of fire on the landscape to achieve specific cultural objectives.

These burns are typically implemented at low intensity, with guidance from an Elder or Fire Knowledge Keeper, often in collaboration with inter-ministry partners. Common objectives for cultural burning include but are not limited to cultural and language preservation, fuel mitigation, food and medicinal plant revitalization, and habitat enhancement.

In many Indigenous cultures in Canada, fire is a sacred and powerful element that can help on landscapes and in ceremony.

Indigenous communities have in many ways been leading wildland fire mitigation and prevention in Canada since time immemorial, relying on local Indigenous knowledge systems. Indigenous communities have various current and emerging fire stewardship practices in support of cultural revitalization, resilience and pride, and (emergency) preparedness.

Quote from page 4, Blazing the Trail

A Conversation with Fire Keepers

Filmed in Merritt BC, Rory Colwell, Fuel Management Superintendent, BC Wildfire Service, discusses the practice of cultural burning with two members of the Interior Salish Fire Keepers Society, Harry Spahan (Nlaka’pamux Nation) and Joe Gilchrist (Skeetchestn Indian Band).

* Watch the 9 min video at https://prescribedfire.ca/cultural-burning/ *(this video is the only video on this website that is a part of the Study Resources)* or with Vimeo at https://vimeo.com/732214833

9. ALL HANDS ON DECK

In 2014, two First Nations in northeast British Columbia faced a dilemma. Caribou herds that had sustained their people for many thousands of years were perilously close to local extinction. The last surviving member of the Burnt Pine herd had tumbled into a coal exploration pit and died, unable to climb out. Fracking wells, resource roads, clear-cuts, mines, pipelines, and hydro dams and reservoirs had fractured the landscape, decimating caribou herds once so large that Elders remembered the animals as "like bugs on the landscape." "There's an argument that caribou are one of these creatures that are just doomed for extinction," said West Moberly First Nations Chief Roland Willson. "They'll just fade out. But what's happening here is man-made."

Over and over, the nations asked the BC government to step in to help recover herds that historically provided Indigenous People with meat, tools, warm clothing, and materials for shelter. Five out of six herds left in the region were at immediate risk of winking out, yet the government did nothing. It continued to hand out permits and approvals to companies destroying caribou habitat, ignoring the cumulative impacts as new industrial development invariably took precedence over caribou recovery. Willson didn't have anything against industrial development; he sat on numerous resource boards, including the BC First Nations Energy and Mining Council. He sought to find a balance that would protect caribou and other wildlife.

Together with neighbouring Saulteau First Nations, Willson's nation hashed out a plan to save a herd named Klinse-Za, after a sacred mountain. They would launch their own recovery strategy, one that put caribou first. Working with a wildlife research company, the nations constructed the first of two pens on the top of a mountain in the herd's range, planning to capture pregnant caribou and keep them safe until their calves were sturdy enough to stand a greater chance of surviving in the wild. The pen enclosed alpine meadows flanked by forests, the habitat female caribou sought out to give birth. Two electric fences encircled the enclosure to thwart wolves and other predators.

Early each March, biologists climbed into helicopters to search for pregnant female caribou in the snow-covered mountains. Strapped to the chopper and balancing on a skid, they caught the caribou in an open area using a netgun. Instead of a bullet, it fired a net. The helicopter landed nearby, and biologists and a veterinarian jumped out. The vet sprayed medetomidine, a sedative, into the caribou's nostrils and placed a thermometer in her rectum. If the caribou's temperature reached forty-one degrees Celsius, a sign of potentially fatal distress called capture myopathy, they peeled off the net and aborted the mission.

The team blindfolded the caribou, strapped her hooves, and eased her into a custom-made vinyl body bag. Calmly, so as not to alarm their nervy passenger, four team members hoisted 120 kilograms of muscle, fur, and antlers into the helicopter for a short flight. One biologist held up the caribou's head so she didn't aspirate her stomach contents en route to a marshalling spot near the top of a mountain in BC's Peace Region. From there, still trussed and bagged, the caribou travelled the final distance to the pen in a snowmobile skimmer.

"It's kind of crazy," said biologist and Saulteau First Nations member Julian Napoleon. "We have a big team of folks. We've got biologists, we've got veterinarians, we've got community members from

Saulteau and West Moberly. We've got three helicopters for the bulk of the capture days. Once a caribou is shot with that gun, everything has to happen very fast to ensure that it's subjected to the least amount of stress possible."

At the pen, the team weighed the animal, scooped her poop to send to a lab for testing, drew three vials of blood to test for pregnancy and pathogens, plucked a clump of hair with rubber gloves for DNA testing, and ran a portable ultrasound over her rump to measure body fat. They recorded the length of the caribou's legs, chest, and back, parted her milky-brown coat to check for ticks, and injected a "health shot" of vitamins and deworming medication before leaving the groggy animal to struggle to her feet. For the first few weeks, before transitioning to pellets, they fed captive females hair lichens, handpicked by volunteers, kept fresh in soccer ball nets next to a tiny wooden cabin where Indigenous guardians took two-week shifts, keeping watch.

Once all the calves were at least one month old, the guardians opened the pen and the caribou wandered back into the wild, tracked by radio telemetry. The average cost for each caribou born in captivity was about $125,000.[1] Nine years after the nations launched the penning project, the Klinse-Za herd had grown from 16 animals to 101, and other potential penning projects in Alberta and BC were studying the endeavour in the hopes of emulating its success.

Many other promising initiatives are underway across Canada as individuals and communities forge their own plans to protect at-risk species. Near Grande Cache, Alberta, west of Edmonton, the Aseniwuche Winewak Nation runs a stewardship program called Caribou Patrol. Guardians help migrating woodland caribou cross Highway 40 without being hit by passing vehicles, especially if caribou stop to lick road salt or graze beside the busy roadway. In Ontario, "plover lovers" rise early in the morning to prevent tourists and locals heading to the beach from trampling the nests of the tiny bird, whose chicks resemble pieces of popcorn with legs.[2] On Vancouver Island, an association of wetland stewards built an underpass to assist frogs, toads, salamanders, and newts who cross a busy highway during migrations to and from breeding grounds. The project is called SPLAT, an acronym for the Society for the Prevention of Little Amphibian Tragedies.

In southern Ontario, more than four thousand gardeners planted "Canada's biggest wildlife garden." They joined an initiative, championed by the non-profit group Carolinian Canada in partnership with the World Wildlife Fund, to sow native plants, restoring habitat for hundreds of rare and at-risk species, including pollinators, and helping to heal the land in the spirit and practice of reconciliation with Indigenous Peoples. In Nova Scotia, conservation biologist Sean Brillant and his team at the Canadian Wildlife Federation helped pioneer ropeless crab and lobster fishing gear in Canada to protect North Atlantic right whales, one of the world's most endangered large whales. Ship collisions and entanglement in fishing gear gravely threatened the shrinking population, and fewer than 350 North Atlantic right whales remained. Instead of traditional gear, fishers use remote controls to bring buoys up from the seafloor to the ocean's surface so they can retrieve their traps.

In New Brunswick, an entrepreneur named Cornel Ceapa embarked on an unusual plan to help save endangered sturgeon. Ceapa, the owner and operator of Acadian Sturgeon and Caviar, has a quota to harvest 350 Atlantic sturgeon each year for caviar and meat and to raise shortnose and Atlantic sturgeon on two land-based farms. He also has a special export permit to sell his products outside the country, because Canada is a signatory to the Convention on International Trade in Endangered Species of Wild Flora and Fauna (known by its acronym, CITES). Some might frown at the idea of capturing and breeding such species for consumption, but Ceapa,

Video - Since Time Immemorial": How Indigenous People Are Reviving Traditional Stewardship

["Since Time Immemorial": How Indigenous People Are Reviving Traditional Stewardship]

"Since Time Immemorial": How Indigenous People Are Reviving Traditional Stewardship

Humans
Bringers of Balance
Shapers of the land and waters

When I use the terms *balance* or *balancer* to describe the role of humans in ecosystems, it is important to recognize that this is not the type of balance that has been debated over the history of ecology, which tends to be synonymous with *equilibrium*. *Balance* in the context of this work is a somewhat failed attempt to anglicize that which is an expressed sentiment of an Indigenous understanding of our role with our Earth. It is not something that required objectification within our own languages as it is the very pulse of our existence. Balance in this case is not a static condition; it acknowledges and accepts the dynamic nature of our ecosystems. It honours the past, present, and future. It recognizes and accepts that we cannot fully comprehend the complex number of and nature of the relationships within our ecosystems. It does not profess control over those systems. Instead, it puts forward a sentiment of responsibility to shape ecosystems into ways of being that meet the needs of our relations (animals, insects, fish, humans) and are consistent with community values. In essence, our role as balancers of ecosystems is a humbly accepted leadership role given to us by Creator.

The concept of balance in ecology has been debated throughout its history in scientific study. At the turn of the nineteenth century, American ecologist F. E. Clements had proposed a dynamic ecology which replaced the previous static descriptive work before him.[42] Then came ideas of equilibrium and stability, the "classical" or "equilibrium" paradigm, which persisted until the 1970s.[43] This paradigm fed the idea, in conservation and in the wider environmental movement, that there was a "balance in nature," easily upset by inappropriate human action. That equilibrium is naturalized as a "pre-disturbance" state—that is, the state of balance that existed prior to the disturbance of human activity.[44]

Fear not. Enter the ecologist. A hero cast by the conservation movement, who would, "external to natural processes, spanner in hand…put the balance right" when human action upset the machine.[45] As W. M. Adams puts it, "the scientific ideas and practices of conservation of this time were concerned precisely with establishing or recovering control, both over human impacts on nature (in stopping habitat loss) and over nature itself (in habitat management)."[46] While this was a role that recognized human responsibility to ecosystems, it differs entirely from the role of humans in the ecosystem in an Indigenous worldview. The ecologist is placed in a godlike position, above the ecosystem as external master fixer, the engineer of nature.[47] An Indigenous worldview, on the other hand, casts us as an equal part of the ecosystem; a leader meant to shape the system over time according to the values and needs of the ecological communities. This was not a single person's role to fulfill; the human community simply, as Elder Luschiim put it, "lived it."

Meanwhile, we exist in an ecology that is run by those who do not "live it" and yet we yield to their "expertise." Ecological restoration has taken scientific understanding to create rules for ecological restoration such that it can be executed in a cookie-cutter fashion.

If we are to allow an Indigenous ecology to take root once more, we must ensure that we can work together to create our collective garden. This comes in sharing a relational language. One that puts relationship in focus. One that ensures we are accountable for every decision made. One that centres our values and community needs. One that values wisdom. At this critical juncture it is as though, to me, we are all standing in front of a canvas with a mission to create a vision for the future that heals the planet. If we are to all pick up a paintbrush, we need to be able to communicate. If we want the art to look different from the status quo, we cannot work from the same old palette using the same old techniques we used before.

I have been told by Kwakwa̱ka̱'wakw and Coast Salish friends that there was once a distinct language on the waters of the Salish Sea: the language of the fishermen. Fishing and managing the resource required the collaborative and cooperative efforts of those coming together on the water with their distinct languages and cultural identities. It was here where, when possible, political differences were set aside. Communication was key and a unique language was created to accomplish that. When I learned of this, I could not help but wonder, What about a common language for those caring for and stewarding lands?

This question resonated in my mind as I sat with Elders trying to figure out how to apply an Indigenous ecology. After they shared knowledge with me about some plants and how some important medicines seemed to be disappearing from certain areas, I said, "Well, what do we do?" I waited for their answer, but instead I was met with an uncomfortable silence, then a shared expression of, "You are here to tell us." It is important to understand the significance of this. I have been taught that with Elders, I best listen and not talk much. I had been told before that it wasn't up to Elders to tell me what to do. They were there simply to share what they knew. Here I was again, holding knowledges and being reminded it's up to my generation to determine what to do with them.

Sitting in a new-found and scary leadership role among my Elders, I reflected that we had known of the declining populations of these medicines for a long time. Typical assumptions were made about what was causing this and actions were taken based on those assumptions. Assumptions and actions that were confined by the language of modern ecology and that, despite years of efforts, did not appear to be saving these medicines. Scientific language was keeping us from what we needed. The question of how we move forward applying a relational, Indigenous worldview to ecology suddenly seemed less daunting. A relational terminology would help us to move forward. The language of the land stewards. So began a deep dive into modern Eden ecological terminology and more meaningful discussion with Elders, knowledge keepers, and many of my colleagues whose work included restoration to begin the reclamation of having a distinct language for such an important responsibility.

The canvas of a modern Eden ecology is called an "ecological restoration plan." A term for what is often used to direct ecological restoration projects, and one which I had never given a second thought to. Until now. Their common format and contents are a dead giveaway of how far they are from the canvas of an Indigenous ecology. These plans will describe the target area geographically and perhaps describe the reason that the area to be restored was degraded. Many have generalized stated goals such as "restoration of the natural environment," "removal of invasive species," and planting "native species." These are well-intentioned documents and I have helped to write many of them. However, having now committed to a relational lens, when considering these plans I am taken aback by just how impersonal they are. Frankly, I am embarrassed to have participated in their creation. At the same time, I know that my friends and colleagues and I engaged in this kind of work with the best of intentions. We did not realize that the prescriptive and yet unspecific nature of these plans and the language used within them were largely incongruent with their intent to bring healing to the land.

Most of these plans made no mention of Indigenous knowledge up until more recent years. If they did, they certainly made no mention of a relational worldview, the very foundation of our knowledges. There was often no mention of the history of the land, or the origins of the very systems targeted for remediation. Where Indigenous communities were mentioned, it would only be as a stakeholder. Most of these documents lack specificity in their statement of goals. It is apparent now why we have strayed so far from truly being effective in healing the land—the more we have leaned on natural and applied sciences to substantiate ecology as a field of study, the further we are from the artful balance of an Indigenous ecology. The efforts of legitimizing an inherently relational practice using Western notions of science created terminology that fulfills its purpose in maintaining the facade of objectivity. We keep expecting a different result using the same language.

> *We are all different. We have different histories. Different families. Different experiences. Different support networks. Different roles to play. So do the trees. So do the fish. So do the birds. So do the plants.*

The power of language is not to be underestimated. Simple changes in our language can completely change our perceptions, our ways of thinking and knowing, and our actions. A new language will help us to consciously transition toward an Indigenous ecology. It will provide the freedom we need to shift into the relational worldview.

I thought it would be difficult to depart from the language of modern Eden ecology. It is the very language I have used to describe and conduct my own work; it's also the language I used when communicating and promoting environmental awareness initiatives to the public and government. But I was wrong—the transition felt easy for me. Liberating, in fact.

What is it about this change in terminology that makes such a difference? The language of the application of modern Eden ecology is transactional and the language of an Indigenous ecology is reciprocal. Simply put, Eden ecology is business and Indigenous ecology is personal.

Many unhealthy relationships could be described as transactional, and these kinds of relationships allow for short-term exchanges. In ecological restoration, we often find "this for that" guiding our work instead of finding a path that honours our mutual dependence. Such transactional relationships make inequities possible; the characteristics of these relationships are not congruent with the spirit of ecological stewardship, yet somehow we find ourselves operating in this way and accepting it as our reality. It is evident in our language, approaches, compromises, and funding models. I believe that by consciously moving away from transactional language, we will quickly find ourselves resting upon the relational foundation of an Indigenous ecology, and at last realize the consistent, long-term successes we have been longing for.

To develop terminology that will help us to apply an Indigenous ecology, I consulted friends and

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colleagues involved in ecological restoration; this included staff at environmental nonprofit organizations, academics involved in various aspects of the field, and government staff (Indigenous and other). They were open to my ideas and shared their own. This collaboration, along with my review of ecological restoration plans from across North America, resulted in a list of commonly used terms from modern ecology. From this list, we identified and discussed the words that reflected transactional relationships, and those that presented the greatest opportunity to shift worldviews by replacing them with relational terminology. This exercise was not intended to change the entirety of commonly used vocabulary of ecological restoration—it was about finding those words or phrases that would provide a new circle of understanding. The beginning of developing a new language where people from all walks can come together united by values and work to bring healing to our lands.

This list is simply a beginning. I don't assert it to be *the* way but simply a start that I hope shows that words matter and have transformative power. I am asking you to be part of the creation of this language as part of our journey around the medicine wheel together, and consider how we might live an Indigenous ecology. Let us be reminded of its principles.

An Indigenous ecology:

- Rests upon a foundation of relationality.
- Is accountable to all relations.
- Is dependent upon humans fulfilling their role and responsibilities as balancers of the ecosystem.
- Embraces all relations equally.
- Is based upon reciprocity.
- Is focused on relationships.
- Does not objectify our relations.
- Is free from categorization, labelling, and dichotomies.
- Is respectful of all worldviews and their knowledges.
- Acknowledges the history of relationships with land and relations.
- Accepts all forms of knowledge acquisition.
- Embraces uncertainty.
- Adapts as it needs to whether it be over time or within a specific context.
- Is pragmatic.

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Restoration is defined by the *Canadian Oxford Dictionary* as "the act of returning something to a former owner, place, or condition."[48] Stephanie Mills defined it as "the art and science of repairing damaged ecosystems to the greatest possible degree of historical authenticity."[49] This definition refers to damage caused by some sort of disturbance, such as development, pollution, deforestation, and perhaps an often-forgotten reason: loss of human relationship. It mentions repair according to historical authenticity, but, At what point in time? and Whose version of history? For me, this calls into question whether *restoration* is the right term for what we are trying to do.

Restoration implies that we are putting something back to the way it was. It was often the stated goal on many of the funding applications I wrote in my work with environmental nonprofit organizations. Having embraced Indigenous ecology now, I can see that "restoration" stated as a goal is too general, speaking only to the intention of the work. An intention that fails to acknowledge both the dynamic nature of our planet and the legacy of the relationships my ancestors had with the land. The term *restoration* can limit the scope of our actions by its very definition, casting us solely in the role of fixers. It creates the context for work with goals based on aesthetic notions of a non-existent natural state. It allows us to forget ourselves, the human relations, in the ecological equation, and creates an impersonal dynamic, one only between fixer and project.

The definition of this Indigenous ecology that I feel summarizes all of what I have learned on my research journey around the medicine wheel is *Relationally guided healing of our lands, waters, and relations through intentional shaping of ecosystems by humans to bring a desired balance that meets the fluid needs of communities while respecting and honouring our mutual dependence through reciprocity.*

We need to replace *ecological restoration* with terminology that reflects this definition and is powerful enough to bring awareness to, and encourage the shift toward, Indigenous ecology. We need a term that can bridge our worldviews.

There are several definitions that can be found for the verb *to heal*. The *Merriam-Webster Dictionary* defines it as "to make sound or whole; to cause an undesirable condition to be overcome; the process in which a bad situation or painful emotion ends or improves; and finally, the process of becoming well again."[50] While the definitions of *to restore* and *to heal* may seem similar, there is a fundamental difference in their connotation. *To heal* does not imply an automatic intention to return something to a particular state. I see these definitions of *healing* as offering greater flexibility and scope, and, most importantly, offering a feeling of hope through caring actions. We are not limited by a predetermined notion to putting anything back the way it was. It allows us to respond to the needs of the relations of the day and determine the appropriate balance for the relation or place.

I began suggesting to friends working and volunteering in the field of ecological restoration to begin using the word *healing* in place of the word *restoration*. It has been a well-received change. A good friend of mine who has worked in the field for almost

2025 NCF-Envirothon Alberta

Current Environmental Issue Study Resources - Part B

Key Topic #4: Forest Management Policy in Alberta

14. Describe how forest resources are allocated for industry in Alberta (Forestry Management Areas, Quotas, and Permits) and which Operating Ground Rules each allocation holder is required to follow.

15. Explain the duty to consult in planning forest management activities and what this process entails.

16. Explain how natural disturbances impact forest-based industries in Alberta in terms of their Annual Allowable Cut (AAC).

17. Identify how natural and forested areas are protected, physically and legislatively, in Alberta and how these areas contribute to forest resilience and stewardship.

18. Describe how Alberta assesses fire risk in forested communities.

Study Resources

Resource Title	**Source**	**Located on Page**
Forest Management Planning	*Government of Alberta, 2024*	68
Impacts of Wildfire Burned Areas on Annual Allowable Cuts	*Government of Alberta, 2021*	71
Protected Areas	*SAPAA, 2023*	75
Alberta Parks and Protected Areas Provincial Map	*Government of Alberta, 2024*	79
Alberta Wildfire-mapping Tool points our where communities are at risk, *VIDEO*	*Global News, 2023*	80

Forest management planning

Alberta has strict standards for sustainable forest management.

Overview

Forests, one of Alberta's most important resources, provide many benefits to society. The Alberta government is committed to ensuring that Alberta has strong, healthy forests for future generations to enjoy.

Alberta supports the principles of sustainable forest management and responsible stewardship. Forest management planning is essential to sustainable forest management in Alberta.

Forest management planning does not include protected areas. This planning only provides direction for forest management activities and does not involve public land and resources for non-forestry uses. All commercial timber dispositions carry out forest management planning to varying degrees, depending on the type of forest tenure.

Regulation

Under the authority of the *Forests Act*, Alberta has developed strict standards for forest management planning. Each type of forest management planning document has specific requirements.

Alberta Forest Management Planning Standard:

The government must approve all plans regarding forest management in Alberta. The Alberta Forest Management Planning Standard (the Standard) and its annexes, interpretive bulletins and updates comprise the standard for preparing and implementing Forest Management Plans (FMP) in Alberta. These standards ensure consistent, thorough plan submissions.

Timber dispositions

Once a timber disposition is allocated, an extensive planning process is used to ensure sustainability before any trees are harvested. These plans must be approved by the Government of Alberta after consultation with the public, First Nations, and other stakeholders.

Planning documents

There are 3 key forest management planning documents:

1. Annual Operating Plan (AOP)

Annual operating plans describe in detail the harvesting and road building activities proposed for the current year. Annual operating plans must also include details regarding reforestation and fire control plan.

2. General Development Plan (GDP)

General development plans project activities for the next 5 years. These documents include a forecast of the areas scheduled for harvest. They also provide details regarding road requirements and fish and wildlife issues within the planning area. General development plans are intended to guide the integration of activities among different operators.

3. Forest Management Plan (FMP)

A forest management plan turns sustainable forest management commitments into action in the field. This plan summarizes the current state of the forest, as well as the values, objectives, indicators and targets of sustainable forest management developed through consultation with the public, First Nations and other stakeholders. Forest management plans are prepared by Forest Management Agreement (FMA) holders and, in non-FMA Forest Management Units, by the provincial government.

Industry Ground Rules

The Alberta Timber Harvest Planning and Operating Ground Rules provide direction to forest companies and government for planning, implementing and monitoring timber harvesting operations on timber disposition areas in Alberta.

Stewardship Report

Stewardship reports describe the monitoring program and how well the objectives of the forest management plan are met. Stewardship reports are required every 5 years.

Public and Indigenous Engagement

Members of the general public and Indigenous communities have opportunities to be involved during forest management planning. FMA holders are required to follow the Government of Alberta's Indigenous Consultation Policies and Guidelines, as well as consult with the general public during the development of forest management plans. Indigenous communities are also consulted on the general development plans. As well, the general development plans, final harvest plans and annual operating plans are made available for public review on an annual basis.

Public consultation can include:

- public advisory committees
- town hall meetings
- open houses within the community
- presentations
- information on the forest tenure holder's website

Updates to consultation process support

As of August 12, 2024, Indigenous consultation process administration and support for relevant activities approved under the *Forests Act* and *Forest and Prairie Protection Act* is now provided to proponents directly by the Ministry of Indigenous Relations' Aboriginal Consultation Office (ACO). Proponents submit their new assessment applications and associated documents directly to the ACO through the ACO's Digital Service (ACO DS).

Additionally, the Information Sharing and Exploring Concerns for Forestry Planning and Operations has been developed to provide relevant forestry specific guidance and direction to proponents. This document will be used in association with the Government of Alberta's Proponent Guide to First Nations and Metis Settlements Consultation Procedures (current version).

Strategic land use plans

From time to time, Alberta prepares strategic land use plans such as Regional Sustainable Development Strategies or the Land-use Framework, regional plans that address the integration of resource uses. Existing land use plans take precedence over forest management plans (FMPs) and provide strategic direction that shall be honoured in the FMPs. The direction may be through zoning, which limits activities in various zones, or by setting values, objectives, indicators or targets to be implemented.

Where strategic land use plans are approved after an FMP has been approved, Alberta and the organization shall discuss implementation of the strategic land use plan, and Alberta may require the FMP to be amended.

Enhanced forest management

Enhanced forest management is improvements in forest growth resulting from thinning, fertilizing, tree improvement or drainage. These enhancements can be considered during the forest management planning process.

Impacts of Wildfire Burned Areas on Annual Allowable Cuts

Government of Alberta

2021

Purpose

Wildfires can affect an annual allowable cut (AAC) at two possible points in the forest management planning cycle:

1. During the Forest Management Plan (FMP) implementation phase, where wildfires may trigger the requirement for an AAC impact assessment[1]; and/or
2. During FMP development, where recently burned areas have historically been excluded from the contributing landbase for purposes of AAC determination.

This Directive provides updates to Alberta Forest Management Planning Standard (AFMPS) requirements for incorporating wildfire impacts into AAC determination, including:

- Requirements for AAC impact assessments following wildfire, including a choice of two discretionary methods that may be used as an alternate to the default method;
- FMP development requirements that apply when including wildfire-burned areas in the contributing landbase for purposes of AAC determination; and
- The approaches that an organization may use to include wildfire-burned areas in the contributing landbase, either as part of an AAC impact assessment or during FMP development.

Policy Context

This Directive is enabled by Section 14(2) of the ***Forests Act***.

The Directive replaces those portions of AFMPS Annex 1, Appendix B not already superseded by Directives 2007-01 and 2014-01. The Directive also provides updates to AFMPS Annex 1, Section 5.9.6.ii and Appendix A, Section 1.0.

Procedures

1. Overview

Context: The AAC for a Forest Management Unit (FMU), determined through the forest management planning process, is calculated based on harvest levels that do not directly account for stochastic natural events such as wildfire. If natural disturbance events occur during the FMP implementation phase, AACs must be adjusted to ensure that sustainable harvest levels are maintained. When an organization subsequently commences development of a new FMP, those disturbances must be correctly represented in timber supply analysis (TSA) in order to set a new sustainable AAC for that FMU.

The general process for incorporating wildfire impacts on AACs is as follows:

1.1. When wildfires occur during the FMP implementation phase and the cumulative area impacted by wildfire exceeds 2.5 per cent of the contributing landbase for that FMU, an assessment to determine the impact on the AAC is required ("AAC impact assessment"). If the impact is assessed to be greater than 2.5 per cent of the current approved AAC, the AAC must be adjusted for that FMU according to the rules outlined AFMPS Annex 1, Appendix A[2].

1.2. The default ("baseline") method for AAC impact assessment is an area-based method in which the per cent AAC impact is equal to the per cent of the contributing landbase that is burned, i.e., the entire burned area is deleted from the contributing landbase. Organizations may request to use one of two discretionary methods in order to mitigate AAC impacts. These are:

i. Adjusted area-based method: Allows an organization to return some of the burned area to the contributing landbase in order to reduce the total area deleted and reduce the corresponding AAC impact.

ii. TSA-based method: Allows an organization to return additional burned areas to the contributing landbase in a more sophisticated manner, allowing for the AAC impact assessment to recognize the contribution of post-wildfire regeneration and growth.

1.3. During FMP development, wildfire-burned areas may be returned to the contributing landbase using the same suite of options available for TSA-based AAC impact assessments, until such time as an approved forest inventory[3] shows the area as reforested.

The processes are described in detail in the following sections.

2. Annual Allowable Cut Impact Assessments

Context: An AAC impact assessment is intended solely to determine the impact of wildfires on the AAC when wildfires occur during the implementation phase of an FMP. As such, the assessment is constrained to wildfires that have occurred since the last FMP[4] and associated events that have occurred within those wildfire boundaries since the wildfire event (e.g. salvage harvest and/or changes to reforestation obligations within burned areas).

The process for impact assessments is as follows:

2.1. Alberta will undertake photo interpretation of wildfire boundaries and classification of delineated polygons into burn classes. Upon completion, Alberta will calculate a preliminary AAC impact using the baseline area-based adjustment method to determine the per cent impact on the AAC. The per cent impact of wildfire will be calculated to two decimal places using the following equation:

$$\% \, Impact = \frac{Contributing\ Landbase\ Area\ After\ Wildfire - \ FMP\ Contributing\ Landbase\ Area}{FMP\ Contributing\ Landbase\ Area} * 100$$

In cases where the approved AAC established in the FMP approval decision has already been adjusted (e.g. to account for landbase removals), the FMP contributing landbase area used in the calculation will be the approved contributing landbase area minus the area of previous removals.

2.2. If the cumulative per cent area impacted by wildfire[5] has exceeded the 2.5 per cent threshold, Alberta will notify the organization of the preliminary AAC impact assessment calculation. Depending on fire size, a preliminary notification to the organization may occur prior to finalizing photo interpretation of wildfire boundaries.

2.3. Organizations may subsequently request to use one of two discretionary (optional) methods as listed in Sections 2.3.i or 2.3.ii. In order to do so, the organization must submit a written request for approval via email to the Director, Forest Resource Management Section. Requests must specify the discretionary method to be used and the proposed date for submission of additional information. Discretionary methods are as follows:

i. Adjusted area-based method: The organization will provide Alberta with supplemental spatial information that will be used to reduce the area deleted from the contributing landbase under the baseline method. Previously harvested openings with reforestation obligations that meet the requirements outlined in Appendix 1 are eligible under this approach[6,7]. Alberta will then update the per cent impact calculation as described in Section 2.2.

ii. Timber supply analysis-based method: The organization will undertake a forecasting-based analysis to determine the per cent impact, subject to additional approval and technical requirements listed in Appendix 2. Appendix 1 specifies the conditions under which additional wildfire-burned areas may be returned to the contributing landbase. The organization will submit the results of analysis to Alberta for review and approval according to the submission requirements specified in the Appendix 2.

iii. If the organization does not request to use an alternate method, fails to submit the information required under Section 2.3.i or 2.3.ii by the agreed-upon date, or approval is not granted under Section 2.3.b, the method specified under Section 2.1 will apply.

2.4. Alberta will then determine whether an AAC adjustment ("AAC update") for the FMU is required. If the impact is greater than 2.5 per cent of the current approved AAC, the AAC must be updated for each FMU according to the methods outlined in AFMPS Annex 1, Appendix A, with the following additional clarifications:

   i. The updated AAC will be effective May 1 of the timber year of the wildfire in which the 2.5 per cent threshold was exceeded.

   ii. The per cent adjustment will be applied to the currently approved AAC(s), regardless of whether they are based on even flow or accelerated harvest assumptions, or whether they have previously been adjusted (e.g. to account for landbase removals).

   iii. Secondary volumes will be adjusted by the per cent difference applied to the corresponding primary AAC, i.e. the secondary coniferous AAC will be adjusted by the per cent impact calculated based on the primary deciduous volume and the secondary deciduous AAC will be adjusted by the per cent difference for primary coniferous volume.

2.5. No modifications to the spatial harvest sequence (SHS) are required as part of the AAC impact assessment process. However, depending on the magnitude of wildfire impacts on the current SHS or other non-timber values, a wildfire event may trigger other policy instruments (e.g., compartment assessment).

3. Forest Management Plan Development

Context: This Directive replaces the current direction for treatment of wildfire-burned areas during FMP development under the AFMPS. Section 4 and Appendix 1 of this Directive provide updated direction on which areas may be included in the contributing landbase. This section outlines requirements that will apply during FMP development and are considered supplemental to the AFMPS.

An organization must:

3.1. Include burned areas in the contributing landbase according to the criteria outlined under Appendix 1 and order for inclusion in Appendix 1, Figure 1. Certain approaches listed in this Appendix are optional.

3.2. Meet any applicable approval requirements specified in Appendix 1, Section A1.5. (Additional Requirements for Return to Contributing Landbase) prior to development of the classified landbase.

3.3. Where post-wildfire transition assumptions are employed:

   i. Undertake a sensitivity analysis as per AFMPS Annex 1, Section 5.6.iii: Sensitivity of Long-Term Forecasts to Yield Projections in order to quantify the risk associated with including these areas in the contributing landbase. The sensitivity analysis must compare the harvest levels with and without the post-wildfire transition areas in the contributing landbase.

3.4. Where any of the optional methods are employed (lightly burned areas, post-wildfire surveys or post-harvest transition assumptions):

   i. The FMP landbase submission must include relevant pre-wildfire AVI and/or ARIS attributes (e.g. for AVI, those listed in Annex 1, s. 3.9.2) and must also include derived landbase attributes assigned based on pre-wildfire attributes, including at a minimum, in/out of the contributing landbase, stand type (e.g., natural/managed), pre-wildfire yield stratum and pre-wildfire stand age, as per AFMPS Annex 1, s. 3.10.x.

4. Returning Wildfire-Burned Areas to the Contributing Landbase

Context: Wildfire-burned areas are considered non-forested until shown to be in an acceptable reforested condition in a subsequent FMP through an approved post-wildfire inventory. This section outlines the exceptions under which non-forested, wildfire-burned areas may be included in the contributing landbase prior to showing as reforested in an approved inventory as part of either an AAC impact assessment or during FMP development.

The following areas may be returned to the contributing landbase depending on the approach being employed. Further details on the approaches for return to the contributing landbase, including associated requirements and restrictions on use, are described in Appendix 1.

4.1. Previously harvested openings: Openings or portions of openings for which reforestation obligations have been retained or assumed after wildfire according to the rules in Directive 2014-01. Managed stand yields apply. Examples are areas where:

   i. Reforestation activities were not yet complete at the time of wildfire;

   ii. A post-wildfire assessment has deemed the area "capable of meeting its regenerated yield and stand structure projection"; and/or

   iii. Reforestation obligations have or will be assumed, e.g. via the Wildfire Reclamation Program (WRP).

4.2. Salvage harvest with reforestation obligations: Areas that have been salvage harvested after wildfire or are scheduled for salvage harvest as part of an approved salvage plan[8]. Managed stand yields apply.

4.3. Lightly burned natural stands: Areas with a burn class of 1 (1-25 per cent fire killed) that were of natural origin prior to wildfire[9]. Natural stand yields apply, with a reduction of 25 per cent to account for wildfire losses[10].

4.4. Post-wildfire surveys: Areas that show an acceptable reforested condition based on a survey acceptable to Alberta. Two approaches are recommended[11]:

   i. Photo-based Surveys: Protocols derived from the Reforestation Standard of Alberta (RSA) aerial stratification standards, with photo capture and interpretation as per RSA performance survey specifications and revised rulesets to facilitate delineation of new linework. Natural stand yields apply.

   ii. Reconnaissance Surveys: Protocols derived from RSA establishment survey protocols, retaining pre-fire polygons to facilitate surveys, and recording total per cent poorly stocked area for each polygon in order to adjust to yield estimates. Natural stand yields apply, adjusted to account for average per cent poorly stocked area by FMP yield stratum.

4.5. Post-wildfire transition assumptions: Areas assumed to regenerate naturally after fire using transition assumptions and a conservative approach to mitigate risk; further details are provided in Section A1.5.3. Reduced natural stand yields apply.

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1 An AAC impact assessment is required when the cumulative impact of wildfire on the contributing landbase exceeds 2.5 per cent.

2 Plus additional clarification as provided in Section 2.4 of this Directive.

3 Approved by the Executive Director, Forest Stewardship and Trade Branch under Directive 97-12 and Alberta Vegetation Inventory Standards Version 2.1.1.

4 Wildfires that have occurred since the date of the input layer used in the approved FMP's classified landbase.

5 Defined as the total area of the contributing landbase burned by wildfire since the date of the wildfire input layer used in the approved FMP's classified landbase.

6 Area-based methods are a relatively simple method for assessing the impacts of wildfire. While the methods are accurate at predicting the impact of landbase *deletions* on the AAC, they are unable to reflect the AAC impacts dues to landbase *changes* i.e. from standing timber to a young regenerating stand condition. If an organization wishes to recognize the contribution to the AAC from reforestation after wildfire, use of the TSA- based AAC impact assessment approach is recommended.

7 Spatial boundaries for all supplemental datasets must meet the spatial requirements of the AFMPS and be clipped to the wildfire boundaries. Attributes must include, at a minimum, ARIS opening number, fire number, fire year, and burn class.

8 Approved as part of an Annual Operating Plan under Section 3.6 of the Operating Ground Rules.

9 Applies to natural stands only; the assessment of lightly burned managed stands and determination of their eligibility for inclusion in the contributing landbase is addressed under Directive 2014-01.

10 Organizations may propose an alternate estimate of yield impacts based on information collected from burned stands; see Section A1.5.1.

11 Organizations may propose alternate survey methods; see Section A1.5.2.

Protected Areas

Alberta's protected areas can be owned by different levels of government, private citizens, and land trusts. Within Alberta, three legislative frameworks provide this protection: the Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act, Parks Act, and the Willmore Wilderness Act. The following sets of land classifications start with Natural Areas – the particular focus of SAPAA.

The next set of classes also fall under the mandate of the Government of Alberta with the final set of protected areas being managed by municipal governments, land trusts and other entities that manage protected areas, including private citizens.

- Natural Areas and Crown Reservations
- Wildernesses, Reserves & Willmore Wilderness Area
- Rangelands and Recreational Areas
- Provincial Parks
- National and County/Municipal Parks and Land Trusts
- List and Map of Protected Areas
- 1997 Definitions of Protected Areas

Natural Areas and Crown Reservations

Their purpose is: Protection, Education and Recreation; they have Development Restrictions

Natural Areas

- Natural areas preserve and protect sites of local significance while providing opportunities for low-impact recreation and nature appreciation activities.
- They include natural and near-natural landscapes of regional and local importance for nature-based recreation and heritage appreciation.
- They are typically quite small (with notable exceptions).
- Most natural areas have no facilities. Facilities that do exist are minimal, consisting mainly of parking areas and trails.
- There are 138 order-in-council (OC) designated Natural Areas in Alberta.

Crown Reservations

Several Natural Areas have not been designated by an order-in-council but have either a Protective Notation (PNT; 100 sites) or Consultative Notation (CNT; 6 sites) on the lands.

- PNTs, or reservations, are placed by public agencies in consultation with the public land manager. They identify land and resources that are managed to achieve particular land use or conservation objectives.
- PNTs identify the agency that has placed the reservation, show allowable land uses and

may give management guidelines for integrating different uses on the land.

- Restrictions on land use are based on the characteristics of the land itself. These include soil, vegetation and surface materials and drainage.
- Local and regional factors such as fish and wildlife requirements or timber regeneration and access also receive consideration.
- CNTS are used to “flag” an interest in the land (e.g., administrative, planning or land inventory process) by a particular agency. They don’t place restrictions on land use, but alert potential applicants to the agency’s concern.

Wilderness, Reserves & Willmore

Highest Level of Protection

Wilderness Areas

- Wilderness areas preserve and protect natural heritage while providing opportunities for non-consumptive, nature-based outdoor recreation.
- Alberta’s three wilderness areas are among the most strictly protected areas in Canada. No developments of any kind are permitted.
- Wilderness areas provide limited opportunities for nature-based recreation such as backcountry hiking, wildlife viewing and mountain climbing.
- Travel in wilderness areas is by foot only. Hunting, fishing and the use of horses are not permitted.
- Collecting, destroying and removing plant and animal material, fossils and other objects of geological, ethnological, historical and scientific interest are prohibited.

Ecological Reserves

- Ecological reserves preserve and protect natural heritage in an undisturbed state for scientific research and education.
- They contain representative, rare and fragile landscapes, plants, animals and geological features. Their primary intent is strict preservation of natural ecosystems, habitats and features and associated biodiversity.
- Ecological reserves serve as outdoor laboratories and classrooms for scientific studies related to the natural environment.
- Public access to ecological reserves is by foot only. Public roads and other facilities do not normally exist and will not be developed.
- Most ecological reserves are open to the public for low-impact activities such as photography and wildlife viewing.

Willmore Wilderness Area

- Willmore is unique in that it has its own legislation outside of the seven Alberta parks system classifications.

- Established in 1959 and is managed under its own legislation, the Willmore Wilderness Park Act. At 4,597 square kilometres, Willmore is the second largest park in the Alberta parks system.
- It contains excellent habitat for mountain goats, bighorn sheep, grizzly bear, mountain caribou, cougars and wolves.
- The windswept front ranges in the eastern parts are also critical winter habitat for ungulates. Management of Willmore Wilderness Park is similar in intent to Wildland Provincial Parks.

Provincial Recreational Areas

- Established under the Provincial Parks Act to support outdoor recreation and tourism by providing access to lakes, rivers, reservoirs and adjacent Crown land, thereby playing a significant role in the management of these adjacent lands and waters.
- Provincial Recreation Areas support a range of outdoor activities in natural, modified and man-made settings; some areas are intensively developed while others remain largely undeveloped.

Provincial Parks

Recreation and Preservation

Designated under the Provincial Parks Act, there are 89 Provincial Parks, 44 Wildland Provincial Parks, 233 Provincial Recreation Areas and 10 Section 7 Lands in Alberta.

Provincial Parks

- Play a key role in preserving Alberta's natural heritage.
- They support outdoor recreation, heritage tourism and natural heritage appreciation activities that depend on and are compatible with the natural environment.
- Provincial parks protect both natural and cultural landscapes and features.
- Provincial parks are distinguished from Wildland Provincial Parks by the greater range of facilities and the extent of road access.
- They offer a variety of outdoor recreation opportunities and support facilities that promote appreciation of natural and cultural heritage.
- Interpretive and educational programs are offered in some Provincial Parks to enhance visitor understanding and appreciation of and respect for Alberta's natural heritage.

Wildland Provincial Parks

- Established to preserve and protect natural heritage and provide opportunities for backcountry recreation.
- Wildland provincial parks are large, undeveloped natural landscapes that retain their primeval character.
- Trails and primitive backcountry campsites are provided in some wildland parks to minimize visitor impacts on natural heritage values.

- Some provide significant opportunities for eco-tourism and adventure activities such as backpacking, backcountry camping, wildlife viewing, mountain climbing and trail riding.
- Designated trails for off-highway vehicle riding and snowmobiling are provided in some Wildland Provincial Parks.

National and County/Municipal Parks and Land Trusts

Nationally and Locally Protected Areas

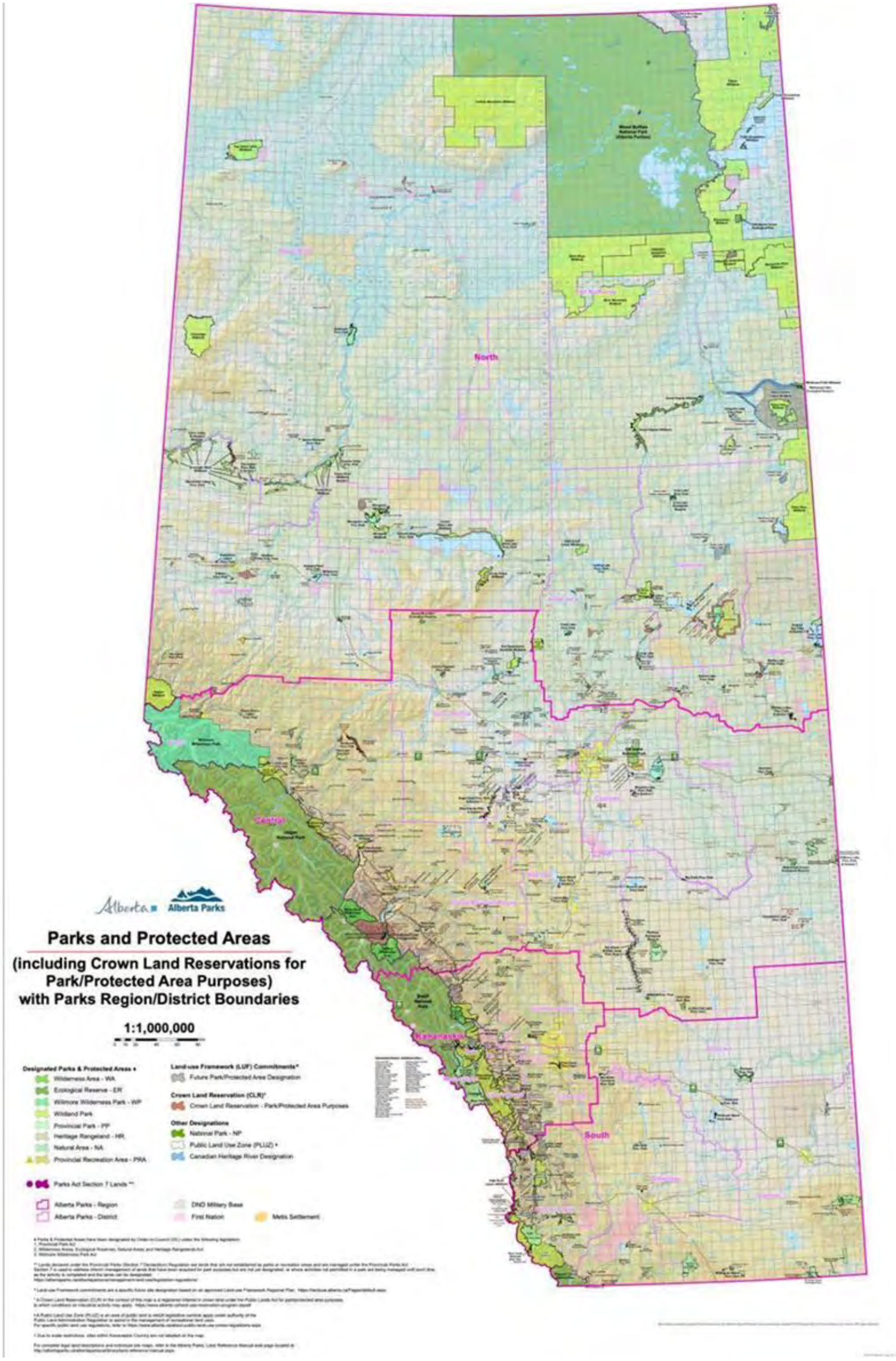
National Parks

Alberta is home to 5 National Parks. Banff, Jasper and Waterton Lakes are mountain parks. In addition, Elk Island is located east of Edmonton and Wood Buffalo lies in the Northeast of the Province.

Land Trusts

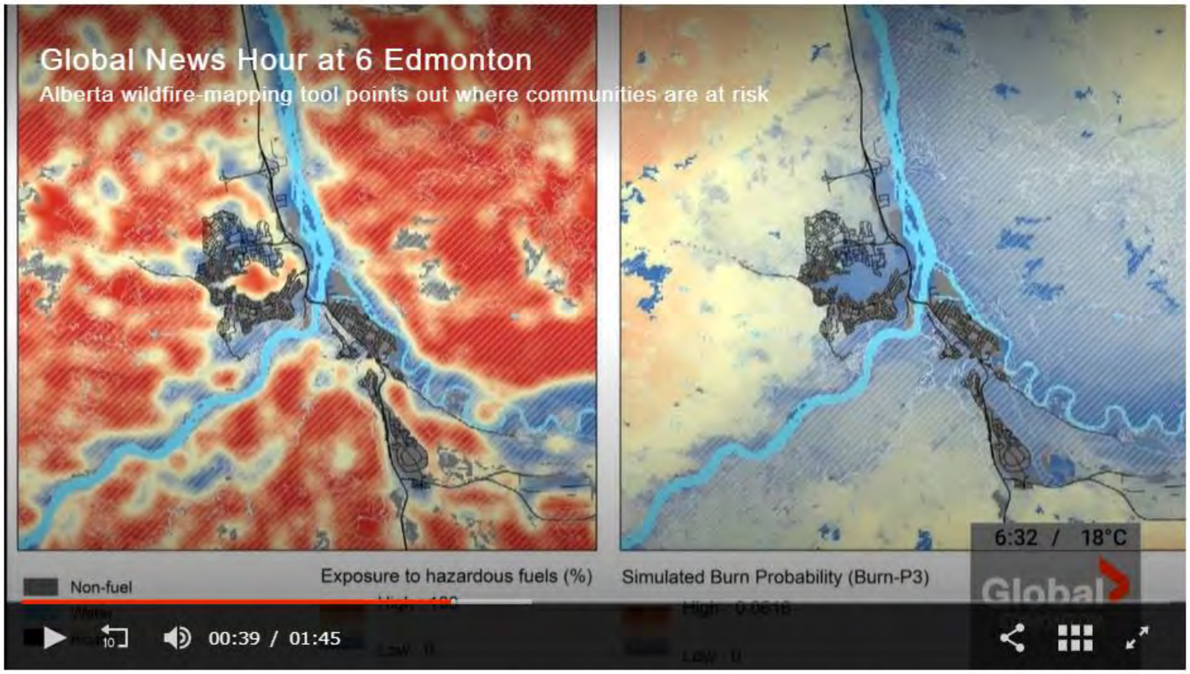
A land trust is owned by an organization set up to ensure the area remains protected. Often the land is sold or donated to the trust by the original owner or their estate.

Alberta Parks and Protected Areas Provincial Map



VIDEO - Alberta wildfire-mapping tool points out where communities are at risk

https://globalnews.ca/news/9753941/alberta-wildfire-mapping-tool-fuel-spread-communities/



Wildland fire researchers are using fuel sources to map out where fires could spread and which communities are most vulnerable. As Emily Mertz explains, they hope it leads to planning and mitigation. – Jun 15, 2023