The State of
British Columbia's Forests
Third Edition

BRITISH COLUMBIA
The Best Place on Earth

Ministry of
Forests, Mines and Lands

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To request more detailed information or send comments about this report, contact:

Forest Practices and Investment Branch, B.C. Ministry of Forests, Mines and Lands

Email: Forests.ForestPracticesBranchOffice@gov.bc.ca
Phone: (250) 387-1946
Fax: (250) 387-2136
Mailing address:
Forest Practices and Investment Branch
Ministry of Forests, Mines and Lands
PO Box 9513 Stn Prov Govt
Victoria, BC, Canada V8W 9C2

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Introduction and Overviews

Summary

This document is the sustainable forest management report for British Columbia (B.C.). Sustainable forest management (SFM) is concerned with maintaining the long-term health of forest ecosystems while providing environmental, economic, and social opportunities for present and future generations.[1] Through national and international agreements, the set of topics and statistics (called *indicators*) to include in an SFM report have been identified.[2] Jurisdictions around the world monitor, assess, and report on SFM in conformance with these agreements. The content of *The State of British Columbia's Forests* was guided by these agreements and is consistent with State of the Forest reports from major forest jurisdictions around the world.[3]

The purpose of this report is two-fold:

i. to provide information on the condition of British Columbia's forest and range resources, and the environmental, social, and economic values associated with these resources; and
ii. to provide an assessment of that information.

In this report, detailed information and assessments are provided for 91 indicators, grouped into 24 topic areas. In the section below, key findings are summarized by eight central themes for SFM reporting that are widely used around the world. The majority of the data in this summary and throughout the report is current to 2008. In a few cases, data from 2009 is presented, and in other cases, only older data is available.

Extent of forest resources

British Columbia contains vast and diverse forests and rangelands. Almost 60% (55 million hectares) of B.C.'s 95 million hectares is classified as forest land. This estimate of forest area is less than some previous estimates due to a change in inventory methods, not a change in on-the-ground conditions. Provincial forests contain a rich mix of tree species and stand ages growing on a wide range of ecosystems. Most of B.C.'s forests (83%) are dominated by conifers. Lodgepole pine, spruce, true fir, hemlock, and Douglas-fir are the most common forest types. Forests over 140 years old exist in all 16 biogeoclimatic zones and cover 23 million hectares (41% of B.C.'s forests).

Overall, less than 3% of B.C.'s original forest has been converted to human (non-forest) use. However, in three smaller, warmer ecological zones—CDF (Coastal Douglas-fir), BG (Bunchgrass), and PP (Ponderosa Pine)—the proportion converted to human use (e.g., agriculture, reservoirs, and urban) is much greater, and conservation concerns have emerged. Currently, the annual rate of forest land conversion in the province is very low. Roughly 34 million hectares of public land is classified as rangeland and 80% of it is forested.

Biological diversity

Ecosystem diversity

British Columbia's vast and diverse forests and rangelands sustain a high level of biological diversity. Protected areas play a central role in conserving biological diversity. The area of protected forests (primarily federal and provincial parks) has increased many times over since the 1950s. Protected areas now include 7.6 million hectares (14%) of B.C.'s forests (with some of the newest protected areas not included in this total). The forests in protected areas span a wide range of forest ages, composition, ecological conditions, and geographic location. With 41% of protected forests over 140 years old, older forests are well represented in B.C.'s network of protected areas. In addition to areas strictly protected, millions of hectares have some special management designation that limits resource development to varying degrees. These areas include old-growth management areas, riparian reserves, wildlife habitat areas, visually sensitive areas, areas around recreation and cultural features, environmentally sensitive areas, and community watersheds. When all areas that are uneconomic or severely constrained to harvest are totalled, the current estimate is that roughly one-half of B.C.'s forest lands will never be harvested.

Species diversity

British Columbia has a rich diversity of species. About 33% (1,345) of the plant and animal species in B.C. (vascular plants and non-marine vertebrates) rely on forests for some portion of their life cycle. Of these forest-associated species, 35% are known to use old-growth forests. Most of B.C.'s forest-associated species have healthy populations, but 116 species (vascular plants and vertebrates) are red-listed (i.e., extirpated, endangered, or threatened) by the B.C. Conservation Data Centre. A variety of actions are taken to protect threatened and endangered species, including the identification and special management of areas of critical habitat. As of 2008, 1,251 locations, totalling 7.2 million hectares, had been formally designated as wildlife habitat area or ungulate winter range.

Genetic diversity

B.C.'s forests are genetically diverse, with 49 native tree species growing in a wide range of environmental conditions. In B.C., through protected areas, gene conservation sites, and careful management of tree seed production in seed orchards, the genetic resources of trees are considered fairly well conserved. Among seedlings planted in harvested areas, the level of genetic variation is similar to that among seedlings regenerating naturally. Since the 1980s, the proportion of harvested area reforested by natural regeneration has declined, and the proportion regenerated by planting has increased. Since the 1990s, planted seedlings derive increasingly from seed produced in tree seed orchards where parent trees are bred to improve tree growth, quality, and health.

Forest productivity

Land base and growing stock

B.C.'s forests contain enormous volumes of timber (roughly 11 billion cubic metres). Spruce, lodgepole pine, and hemlock account for 61% of the growing stock. Approximately one-half of this timber is located on land available for harvesting. The public forest land on which timber harvesting is both feasible and permitted is termed the timber harvesting land base (THLB). The THLB totals 22 million hectares in B.C., relatively unchanged since 1996. An additional 2 million hectares of private forest land is suitable for timber harvesting. In the B.C. Interior, a massive outbreak of the mountain pine beetle is killing much of the mature lodgepole pine. By 2008, an estimated 620 million cubic metres of lodgepole pine had been killed.

Harvest

The amount of timber harvested annually in B.C. increased greatly over the last century until the mid-1980s and has fluctuated since then. Peak annual harvests of 90 million cubic metres were reached in both 1987 and 2005. Since 2007, as the U.S. housing market collapsed and a global economic downturn took hold, timber harvesting has declined significantly. Over the last 10 years, the timber harvest on public land averaged 69 million cubic metres per year. About 96% of this harvest came from the province's timber supply areas and tree farm licences. From private land, an average 9 million cubic metres per year were harvested over this period.

Recently, in response to the mountain pine beetle outbreak, temporary increases in the allowable harvest levels were authorized on many public forests. Over the next decade, available timber supply and allowable harvest levels are forecast to decline in many forest management units in the B.C. Interior. By 2025, the provincial timber supply is forecast at 50–60 million cubic metres per year for several decades. Over the long term, timber supply is expected to recover. On B.C.'s public forest land, the long-term sustainable harvest level is currently estimated at 70 million cubic metres per year.

The area harvested each year translates to 0.4% of the forest area in B.C. and 0.8% of the forest area that is suitable for harvesting.

Silviculture

Since 1990, the area harvested on public forest land averaged 180,000 hectares per year. On average, an estimated additional 20,000 hectares are harvested each year on private forest land. Until the mid-1990s, most areas were clearcut, but today variable retention and clearcutting with reserves are the dominant silvicultural systems used in the province. Areas harvested but inadequately reforested accumulated in the 1970s and 1980s. These areas were greatly reduced through a large rehabilitation program in the 1990s. Today, all harvested areas are legally required to be reforested, and reforestation success rates are very high. However, wildfires and the mountain pine beetle are generating some new areas that are not sufficiently stocked. Planting with select seed, spacing (juvenile thinning), fertilizing, and pruning are common silvicultural treatments, although the area treated annually has varied greatly through time.

Crown rangelands provide 60% of the province's total annual livestock forage requirement.

Forest health

Over the last decade, lodgepole pine trees throughout vast areas in the B.C. Interior have been killed by a massive outbreak of the mountain pine beetle.

Historically, B.C.'s forests were periodically disturbed and renewed by the actions of fire, insects, disease, and other disturbance agents. Over the last decade, lodgepole pine trees throughout vast areas in the B.C. Interior have been killed by a massive outbreak of the mountain pine beetle. At the peak of the outbreak in 2007, over 10 million hectares were under attack. In total, the current outbreak had spread over 14 million hectares by 2008 and killed roughly one-half of the mature pine in B.C. The forest area disturbed by the beetle greatly exceeds the area disturbed by harvest, fire, and all other factors totalled over many years. Climate change and fire suppression may have helped create favourable conditions for this outbreak which is of a size unprecedented in the historical record.

Other native insects and diseases create locally significant damage in various locations across B.C. Over the last 30 years in B.C., the number of wildfires averaged 2,300 per year and the area burned averaged 67,500 hectares per year. Climate change may alter conditions in ways that contribute to an increase in fire and pest damage in forests and a reduction in forest health and vitality. Ground-level ozone and acid deposition, significant problems in some countries, are below damaging levels in B.C.'s forests.

Over many years, non-native (alien invasive) insects, plants, and plant diseases have been introduced into B.C.'s forests and rangelands. Current estimates for the number of forest-associated exotic species that have established in B.C. are 124 insect species, 144 plant species, and 6 plant diseases. Gypsy moth, knapweed, and white pine blister rust are among the more prominent of the alien invasive species. Alien invasive plant species are estimated to occur on 145,000 hectares of Crown forest and rangeland in B.C. In the BG, PP, and IDF (Interior Douglas-fir) biogeoclimatic zones, invasive plant species occur on over 100,000 hectares. The establishment and spread of certain exotic species has been successfully controlled by a variety of treatments. A small fraction (approximately 0.01%) of the area reforested each year is planted to non-native tree species, primarily hybrid poplars.

Invasive plant species have established on some rangelands, decreasing the quality and quantity of forage, with negative economic impacts. Two-thirds of rangeland sites are considered to be in good or fair condition. In the dry forest ecosystems of the B.C. Interior, tree ingrowth has altered tree species composition and density, reducing range values and stressing stands. Some areas have been restored to a more ecologically appropriate state.

Soil and water resources

Less is known about soil and water resources than is known about the forest's timber resources. However, the available data suggest that forest and range activities are generally conserving and not degrading soil and water resources. Improvements in forestry operations have resulted in a steady decrease in the road area required for timber harvesting. The percent of harvested area taken up by roads has declined since the 1990s and currently averages 3.5%. The frequency of enforcement action for excessive soil disturbance during forest operations has sharply declined since the mid-1990s.

In recent years, water quality and riparian habitats in harvested areas have been thoroughly monitored. Detailed assessments at 1,202 sites found most (94%) forest roads have low to moderate potential to deliver sediment to a stream. Detailed assessments of 1,022 streams within harvested areas found 87% in proper functioning condition. Recent examinations of forest roads have found that some stream crossings create a barrier to fish passage and remedial actions are underway.

Contribution to global carbon cycles

Vast amounts of carbon are stored in B.C.'s forests. From 1990 to 2002, B.C.'s forests were a carbon "sink," providing a net uptake of carbon dioxide (CO_2). Large wildfires in 2003 and 2004 and the mountain pine beetle epidemic have resulted in B.C. forests becoming a net emitter of CO_2 (i.e., a "source") since the year 2002. In 2007, B.C.'s forests released the equivalent of 40–60 million tonnes of CO_2 into the atmosphere. B.C.'s forests are projected to return to being a net sink after 2020. Reforestation and other forest management investments that increase growth can increase the amount of CO_2 absorbed by forests. Over the last 10 years, the amount of carbon in the living biomass pool in B.C.'s forests has declined while the amount in the deadwood and forest floor pool has increased, driven by the beetle epidemic. Deforestation, a significant contributor to greenhouse gas (GHG) emissions globally, is much less significant in B.C. About 6,200 hectares of forest land is converted to non-forest use per year, contributing an estimated 4% of B.C.'s total GHG emissions.

When trees are harvested in B.C., roughly one-half of the removed volume is turned into long-lived products such as lumber. Because much of wood is carbon, forest products manufacture in B.C. puts 25–30 million tonnes of CO_2 into storage in long-lived wood products each year. GHG emissions are further reduced when these wood products are used in place of fossil fuel intensive alternatives such as concrete and steel. GHG emissions from fossil fuel use in the forest sector account for 6% of overall provincial emissions. Forest sector GHG emissions from fossil fuel use were 1.8 million tonnes CO_2 in 2006, down from 4 million tonnes in 1990. By replacing fossil fuels with the burning of wood residue, B.C.'s pulp and paper producers have reduced their GHG emissions to roughly one-third of their 1990 levels.

Socio-economic benefits and impacts

Production of wood products

Growth in the forest sector contributed to much of B.C.'s economic development in the 1800s and 1900s. B.C. forest products include lumber, pulp and paper, panels, and a multitude of value-added wood products. Today, B.C.'s forest sector accounts for 4% of direct provincial GDP (gross domestic product), and every cubic metre harvested contributes an average of $126 to the provincial economy. The current global economic downturn has greatly depressed demand (and prices) for forest products. Lumber consumption in the United States, B.C.'s largest market, declined 51% since 2005. U.S. housing starts in 2009 totalled 558,000, down 73% from the 2005 peak of over 2 million. Lumber prices (i.e., the SPF 2x4 price) fell to a 40-year low in 2009. Demand and price declines have dragged down forest products production and exports. Lumber production in 2009 declined 19% from 2008. After averaging $14.7 billion per year from 1996 to 2004, the value of forest product exports from B.C. declined to $7.6 billion in 2009. B.C.'s lumber exports to China have increased greatly in recent years, rising from 175 million board feet in 2006 to 1.6 billion board feet in 2009.

Employment and communities

In 2007, forest sector jobs (direct and indirect) accounted for about 7% of employment in B.C. Over the last 24 months, extremely difficult economic conditions have resulted in thousands of temporary and permanent job losses in the sector. Overall, since the 1980s, employment in the forest sector has slowly declined, while the province's economy has grown and diversified. Although provincial dependence on the forest sector has decreased, many rural communities are still highly dependent. Many communities obtain a high proportion of their income from timber-based industries. These communities, many of them in the Central Interior, are vulnerable to downturns in timber product markets and the impacts of the current mountain pine beetle epidemic. In 2005, roughly 8% of provincial total labour income was derived from the forest sector. Jobs in the forest sector pay well; the average income in forest-based industries is 12% greater than in other industries. Since the 1970s, the annual number of injuries and fatalities in the forest sector has gradually declined. Open burning, forest products production, and residential wood combustion emit fine particulate matter into the air. Exposure to fine particulates (i.e., particles less than 2.5 micrometres) has been linked to respiratory health problems in humans. Large forest fires near communities can result in fine particulate matter exceeding the recommended air quality thresholds.

Recreation, tourism, and rangelands

B.C.'s varied environment provides a wide range of forest recreation opportunities. The province's extensive road network provides access to these opportunities. As the amount of road in B.C.'s forests has increased over time, the area available for roadless recreation experiences has decreased. Undeveloped and minimally roaded watersheds covered an estimated 84% of B.C. in 1982, 62% in 2008, and are projected to cover 53% in 2021. The recreation infrastructure within B.C.'s public forests includes 1,650 campgrounds (totalling 23,000 campsites) and 20,000 kilometres of trails. Seventy million user-days of forest recreation are estimated to occur each year. Expenditures on forest recreation contribute $2.2 billion to provincial GDP each year. To conserve the scenic beauty of B.C.'s landscapes, visually sensitive areas in B.C. have been mapped, visual quality objectives have been legally established, and detailed evaluations are conducted to continuously improve policy and practices. The beef cattle and guide outfitting industries that rely on B.C.'s forest and rangelands make a significant contribution to local economies. The value of forage grazed on Crown land is estimated at $17–30 million per year. This forage helps support B.C.'s beef cattle industry, which contributed $252 million to the B.C. economy in 2007.

Distribution of benefits

Some 94% of B.C. is owned by the Province of British Columbia. Timber harvesting rights are issued to a wide variety of private interests through licences that confer varying rights and responsibilities. Since 1999, the proportion of timber allocated through large, long-term licences has declined and the proportion allocated through smaller, short-term licences has increased. The largest 10 operators have 44% of the harvesting rights, a proportion relatively stable since 1975. The involvement of First Nations people in the forest-based economy has increased in recent years and is expected to grow further. Since 2002, the Province has entered into interim measures agreements with 158 First Nations to provide access to 39 million cubic metres of timber and over $230 million in forest revenues. Many initiatives are underway to address First Nations interests in forest management.

Legal, institutional, and policy framework supporting SFM

British Columbia's forest law is designed to support sustainable forest management. The province's legal framework includes requirements specified in law, compliance and enforcement activities, public reporting by the independent Forest Practices Board, and systematic monitoring and assessment of the law's effectiveness. In 2007/08, the government undertook 16,000 inspections of forest operations to assure compliance with the law. To mitigate minor problems, 2,200 corrective actions were taken. In response to more serious problems, a total of 461 enforcement actions were taken. Monitoring and effectiveness evaluations contribute to the continuous improvement of forest policy and practices.

The proportion of B.C. subject to a consensus-based land use plan has increased steadily since 1993 and now totals 86% of the provincial land base. A strong knowledge and database, and a pool of skilled workers, support sustainable forest management in B.C. The province maintains a multitude of forest and range resource inventories, though some are less current than others. A diverse research community provides new knowledge to help existing and emerging challenges in forest management. From 1992 to 2006, investments in forest research averaged $74 million per year.

Forest certification led by non-government organizations complements the governance provided by B.C.'s legal framework. British Columbia's forest industry has pursued forest certification to maintain access to markets and demonstrate the province's high quality of forest management. Since 1999, the area that is

SFM certified has increased greatly and now totals 54 million hectares. In B.C., CSA (Canadian Standards Association) and SFI (Sustainable Forest Initiative) certification is much more common than FSC (Forest Stewardship Council) certification. Rates of SFM certification are higher among the holders of large tenures than among the holders of small tenures.

Fast Facts

Ecosystem diversity

- Area of British Columbia: 95 million hectares
- Extent of B.C.'s forests: 55 million hectares, almost 60% of B.C. (plus an additional 3.7 million hectares with stunted or scattered trees)
- Original forest converted to human use: < 3%
- Original forest in CDF, BG, and PP biogeoclimatic zones converted to human use: 46%, 18%, and 16%, respectively
- Forests dominated by conifers: 83% of the forested area of B.C.
- Five most common forest types: forests dominated by lodgepole pine, spruces, true firs, hemlocks, and Douglas-fir
- Forest in the coastal and interior regions: 32% and 68% of B.C.'s forest, respectively
- Extent of forests over 140 years old: 22.6 million hectares (41% of B.C.'s forests)
- Biogeoclimatic ecological classification (BEC) zone with least forest over 140 years old: CDF (16% of the forested area in the CDF is over 140 years old)

Protected forests

- Protected areas (primarily federal and provincial parks) in B.C. in 2008: 14.1 million hectares, 14.8% of the gross provincial area
- Forest in protected areas: 7.6 million hectares, 14% of B.C.'s forests
- Forest in protected areas in 1991, 2002, and 2008: 2.5, 5.7, and 7.6 million hectares, respectively
- Range among biogeoclimatic zones in the percent of the forest that is in a protected area: 7–25%
- Forests dominated by conifers in protected areas: 89%
- Five most common forest types in protected areas: forests dominated by spruces, lodgepole pine, true firs, hemlocks, and western redcedar
- Number of ecosections with less than 1% of their forest area protected in 1991, 2002, and 2008: 78, 25, and 15, respectively
- Forests 141–250 years old in protected areas: 2.9 million hectares, 13% of all forest in this age class
- Forests over 250 years old in protected areas: 1.6 million hectares, 23% of all forest in this age class

Ecosystem dynamics

- Average annual area disturbed by wildfire and timber harvest, 1960–2007: 254,000 hectares per year

- At its peak in 2007, area under attack by the mountain pine beetle: 10 million hectares
- Predicted trend to 2050 in the proportion of forests over 80 years old on the THLB and non-THLB: stable and increasing, respectively
- Trends in the amount of carbon in the soil, live biomass, and deadwood biomass pools in B.C.'s forests: stable, declining, and increasing, respectively
- Percent of B.C. in undeveloped and minimally roaded watersheds in 1982, 2008, and 2021: 84%, 62%, and 53%, respectively
- Biogeoclimatic zones with greatest road density (in descending order): CDF, PP, BG, and IDF

Species diversity

- Percent of the plant and animal species in B.C. (vascular plants and non-marine vertebrates) that rely on forests for some portion of their life cycle: 33% (1,345 species)
- Percent of the forest-associated vascular plant and animal species that are known to use old-growth forests: 35% (473 species)
- Percent of forest-associated vascular plant and animal species that are red-listed (i.e., extirpated, endangered, or threatened) by the B.C. Conservation Data Centre: 8.6% (116 species)
- Number of locations and total area formally designated as wildlife habitat area or ungulate winter range by 2008: 1,251 locations, totalling 7.2 million hectares

Exotic species

- Number of forest-associated, exotic insect, plant, and plant disease species that have established in B.C.: 124 insect species, 144 plant species, and 6 plant diseases
- Some prominent examples of exotic species in B.C.: gypsy moth, knapweed, and white pine blister rust
- Crown forest and rangeland with invasive alien plant species: 145,000 hectares
- Crown forest and rangeland sites treated to control exotic species: 3,809 sites treated in 2008
- Percent of the area reforested each year that is planted to non-native tree species, primarily hybrid poplars: 0.01%

Genetic diversity

- Number of native tree species in B.C.: 49
- Fraction of the genetic diversity in natural populations that is contained in seedlots produced in tree seed orchards: a minimum of 98%
- Since the 1980s, the proportion of harvested area reforested solely by natural regeneration: declining
- Since the 1980s, the proportion of harvested area reforested by planting: increasing
- Since the 1990s, the proportion of planted seedlings derived from seed produced in tree seed orchards: increasing

Soil

- The percent of harvested area taken up by roads, landings, and other permanent access structures in mid-1990s and in 2008: 4.6% and 3.5%, respectively
- Since the mid-1990s, the number of soil disturbance enforcement actions taken each year: sharply declined

Water

- Percent of forest road stream crossings with low to moderate potential to deliver sediment to a stream: 94%
- Percent of riparian areas within cutblocks that are in one of three classes of proper functioning condition: 87%
- Total length of road in B.C. in 1988 and 2005: 387,000 and 702,574 kilometres, respectively
- Total number of stream crossings in B.C. in 2005: 488,674

Air

- Average number of wildfires and area burned annually (1960–2008): 2,300 fires and 67,500 hectares burned per year
- Top three sources of fine particulate emissions: open burning, forest products production, and residential wood combustion
- Levels of ground-level ozone and acid deposition: below damaging levels in B.C.'s forests

Forest carbon and greenhouse gases

- Trend in net carbon flux from B.C.'s forests, 1990–2009: carbon sink from 1990 to 2003 and carbon source from 2004 to 2009
- Proportion of the carbon removed from the forest through harvesting that is turned into long-lived forest products like lumber: roughly 50%
- Carbon stored in B.C.'s annual production of lumber and plywood: 25–30 million tonnes CO_2e (equivalent carbon dioxide)
- GHG emissions from fossil fuel use in the forest sector in 1990 and 2006: 4.0 million tonnes CO_2e and 1.8 million tonnes CO_2e, respectively
- Current deforestation rate in B.C.: 6,200 hectares of forest land converted to another use each year

Ownership and timber harvest rights

- Percent of the land in the province that is publicly owned (either federal or provincial): 95%
- Percent of allowable annual cut (AAC) allocated through large, long-term licences in 1999 and 2009: 75% and 52%, respectively
- Volume and percent of tenured volume held by the largest 10 operators in 2008: 38 million cubic metres, 44% of tenured volume

Timber production forests

- Extent of public forest land on which timber harvesting is both feasible and permitted (termed the timber harvesting land base, THLB): 22 million hectares, largely unchanged since 1996
- Amount of timber in B.C.'s forests: 11 billion cubic metres, with roughly one-half available for harvest
- Share of the growing stock contributed by spruce, lodgepole pine, and hemlock: 61%
- Extent of the current mountain pine beetle (MPB) outbreak in 2008: 14.5 million hectares in the B.C. Interior
- Volume of lodgepole pine killed in current MPB outbreak to 2008: 620 million cubic metres
- Percent of mature lodgepole pine predicted killed by 2015: 70%

Timber harvest

- Average annual timber harvest on public land, 1998–2008: 69 million cubic metres per year
- Average annual timber harvest on private land, 1998–2008: estimated at 9 million cubic metres per year
- Percent of the public land harvest that comes from the province's timber supply areas and tree farm licences: 96%
- Provincial AAC in the 1990s and in 2009: 72 million cubic metres per year and 88 million cubic metres per year, respectively
- Forecast timber supply, 2025–2075: 55 million cubic metres per year
- Long-term sustainable harvest level on B.C.'s public forest land: currently estimated at 70 million cubic metres per year

Silviculture

- Average area harvested on public forest land, 1990–2008: 180,000 hectares per year (0.8% of the THLB and 0.3% of the total forest area of the province)
- Average area harvested on private land, 1983-2007: 20,000 hectares per year
- On public land, percent of area harvested by clearcutting in 1970–1999 and 2000–2007: 87% and 44%, respectively
- Status of reforestation following harvest: harvested areas are legally required to be reforested, and reforestation success rates are very high
- Cumulative area of public forest land spaced, pruned, fertilized, or planted with select seed, 1976–2007: 1.6 million hectares

Rangeland

- Crown land under range tenure: 34 million hectares
- BEC zones containing range tenure: 15 of the 16 zones
- Percent of total annual livestock forage requirement that is provided by grazing on Crown rangeland: 60%
- Fraction of assessed rangeland sites in good or fair condition: two-thirds

- Current extent of invasive plant species in the BG, PP, and IDF zones: over 100,000 hectares
- Since 2006, hectares of dry interior forest rehabilitated with ecological restoration treatments: 7,331 hectares
- Value of forage grazed by livestock on Crown land: $17–30 million per year

Recreation, tourism, and visual quality

- Percent of B.C. providing roadless recreation opportunity in 1994 and 2005: 56% and 31%, respectively
- Campsites on public land: 23,000 campsites in 1,650 campgrounds
- Trails on public land: 20,000 kilometres of trails
- Percent of non-residents that were "very satisfied" with their outdoor activities while on an overnight trip to B.C.: 75%
- User-days of forest recreation in B.C. each year: 70 million
- Contribution to provincial GDP from expenditures on forest recreation: $2.2 billion each year
- Extent of visually sensitive area in B.C.: 14.6 million hectares
- Area with established visual quality objectives: 10.5 million hectares

Forest products and the economy

- Change in U.S. housing starts from 2005 to 2009: down 73%
- SPF 2x4 price (U.S.$) in early 2009: $130 per thousand board feet, lowest price in 40 years
- Percent of economic activity in the province in 2009 attributed to the forest sector: 4%
- Average contribution to provincial GDP from each cubic metre of timber harvested: $126
- Annual value of B.C.'s forest products exports in 1996–2004 and in 2009: $14.7 billion and $7.6 billion, respectively
- Forest products exports as a percent of B.C.'s total exports: 30%

Jobs and communities

- Percent of jobs in B.C. attributable to the forest sector (direct and indirect) in 2008: 7%
- Direct forest-based employment in 2008: 64,800 jobs
- Percent of total labour income in B.C. from forest-based jobs (direct and indirect): 8.2% in 2005
- Average income earned in forest-based industries: 12% higher than the all-industry average
- Areas obtaining 20–48% of their basic income from the timber and tourism industries: 25 of the 63 local areas in B.C.
- Trend in the annual number of injuries and fatalities in the forest sector: declining since the 1970s

First Nations involvement

- In 2008, number of First Nations with Forestry Agreements that provide both a share of timber harvesting revenue and timber volume: 145
- Timber and forest revenue made available to First Nations through interim measures agreements since 2002: 39 million cubic metres of timber and $230 million in forest revenues
- Percent of First Nations population at Stage 4 of treaty process (negotiation of an agreement in principle) in 1995 and 2008: 6% and 48%, respectively

Public involvement

- Percent of B.C. under a consensus-based land use plan in 1996 and 2008: 26% and 86%, respectively
- Percent of public that describes themselves as "satisfied" with the quality of forest management in B.C. in 2006 and 2009: 56% and 37%, respectively

Law

- Ministry of Forests and Range (MFR) Compliance & Enforcement inspections, corrective actions, and enforcement actions in 2007/08: 16,000 inspections, 2,200 corrective actions, and 461 enforcement actions
- Amount of bridges, cutblocks, and road maintenance audited by Forest Practices Board from 1995 to 2008: 3,309 bridges, 8,029 cutblocks, and 43,657 kilometres of road maintenance

Management capacity

- Average return on capital employed (ROCE) of the 11 largest Canadian forest products companies in 2007 and 2008: 0% and –5%, respectively
- Registered members in the Association of BC Forest Professionals in 1997 and 2008: 3,733 and 5,450, respectively

Knowledge

- Percent of B.C. covered in MFR's spatial, forest cover inventory: 90%
- Percent of B.C. re-inventoried to the modern Vegetation Resources Inventory (VRI) standard: 26%
- Average annual investment in forest research in B.C., 1992–2006: $74 million

Certification

- SFM-certified area in B.C.: estimated at 54 million hectares
- Rank (by both area and volume certified, in descending order) of the SFM certifications in B.C.: CSA, SFI, FSC
- Rates of SFM certification among holders of large tenures and small tenures: much greater among holders of large tenures

About This Report

Purpose

The purpose of this report is two-fold:

i. to provide information on the condition of British Columbia's forest and range resources, and the environmental, social, and economic values associated with these resources; and
ii. to provide an assessment of that information.

Content

The introductory section of this report includes a summary of the report; a discussion of B.C.'s forests and rangelands and their use, conservation, and protection; and a brief section on climate change.

Indicators of sustainable forest management form the main body of this report. The selected indicators are based on those found in national level SFM criteria and indicators (C&I) frameworks, and on issues of particular significance to British Columbia. The presentation of each indicator opens with a question relevant to sustainable forest management in B.C. Then, a statistic or map is provided (the indicator) that addresses the question. The indicator write-up concludes with additional information and a discussion of the issue.

Indicators are organized into 24 broad topic areas. For each topic, the report contains several indicators. Each topic section ends with a summary and assessment of the topic.

The appendices contain a variety of supplementary material, including a list of abbreviations, glossary of terms, and the Montréal Process and Canadian Council of Forest Minister's SFM C&I sets. Endnotes provide references and more detailed explanations for technically inclined readers.

Methods

The vast subject area covered by this report was divided into 24 smaller, more manageable topic areas. For each, a topic area leader was selected. These leaders, drawn from both within and outside government, prepared the drafts of each report section (see Appendix 1).

Through a series of consultation cycles, the project team engaged a wide range of interested parties in broad discussions and reviews of the questions, indicators, and assessments. A group of over 130 advisors provided data, review comments, and other contributions. These contributors are listed in Appendix 1.

Several factors were weighed in selecting the final set of indicators. The ideal indicators: (1) are consistent with the Montréal Process and CCFM C&I frameworks and State of the Forest reports from other jurisdictions worldwide, (2) reflect SFM issues of concern in B.C., (3) are easy to get the data for, (4) are quantitative statistics from good quality data available in long time series, and (5) are understandable and relevant to readers. The questions and indicators presented in this report represent a best fit at this time to this set of ideal characteristics.

In the case of indicators of the state of a nation's economy, it took many years of study, trial-and-error, and debate for a widely accepted indicator set to emerge that provided a reliable picture of the key features of the economy. Similarly, the small set of indicators of human health widely used to provide a preliminary characterization of condition (e.g., heart rate, blood pressure, body temperature) evolved over centuries of advances in medical knowledge and measurement capability. Compared to economic indicators, human health indicators, and indicators in many other fields, the development of provincial-scale indicators of sustainable forest management is in its infancy. As science, measurement capability, and public issues evolve, these indicators will also evolve. As a result, improvements in future editions of the report are likely.

Most national and provincial SFM reports group their indicators into a small number of primary elements of SFM—and then provide summarizing comments on each primary SFM element. This grouping facilitates higher level, broader comment and interpretation.

Reports following the Montréal Process C&I framework recognize seven high-level elements of SFM: (1) biological diversity, (2) productive capacity of forest ecosystems, (3) forest ecosystem health and vitality, (4) soil and water resources; (5) forest contribution to global carbon cycles, (6) socio-economic benefits; and (7) legal, policy, and institutional framework. Reports following the Canadian Council of Forest Ministers C&I framework recognize six overarching elements: (1) biological diversity, (2) ecosystem condition and productivity, (3) soil and water, (4) global ecological cycles, (5) economic and social benefits, and (6) society's responsibility. Reports following a framework endorsed by the United Nations recognize seven SFM elements: (1) extent of forest resources, (2) biological diversity, (3) forest health and vitality, (4) productive functions of forests, (5) protective functions of forests, (6) socio-economic functions, and (7) legal, policy, and institutional framework.[1]

Based on a comparison of the topics and indicators associated with the SFM elements from these three schemes, we identified the following eight elements of SFM against which we report: (1) extent of forest resources, (2) biological diversity, (3) forest productivity, (4) forest health, (5) soil and water resources, (6) contribution to global carbon cycles, (7) socio-economic benefits and impacts, and (8) legal, institutional, and policy framework supporting SFM.

Each indicator was reviewed to determine the SFM element to which it was most relevant. The information from all of the indicators associated with an SFM element was synthesized to generate summary statements for the SFM element.

SFM Interpretations and Actions

The text under each indicator includes additional statistics and some explanation of the information but no assessment and interpretation. This is intended to enable readers to make their own assessments. At the end of the section for each topic, a brief summary and some assessment is offered.

This report does not describe or assess the Ministry's activities, goals, targets, or performance, because these are covered in the Ministry's service plans and annual reports. Similarly, it does not examine the activities or performance of individual forest companies. Information about these can be found elsewhere.

Changes and Updates from the Second Edition

The completion of all topic areas is the most significant change to the report since the second edition. The second edition provided indicator data for 12 of the 24 topic areas. In this third edition, all topic areas are complete. For those topic areas addressed in the second edition, data and text have been updated for this third edition.

In previous editions, the 24 report sections that provide data on the state of B.C.'s forests were referred to as indicators. In the third edition, these chapters are referred to as topics or topic areas, with each topic comprising several indicators. In the second edition, entire chapters were designated as relating to one of the social, environmental, economic, or governance domains. Results were then summarized by these four domains. In this third edition, this classification is replaced with one based on eight primary elements of SFM (see Methods, above) and results are summarized by these eight main components of SFM.

A section on climate change was added to the introduction to acknowledge its importance to the conservation, use, and protection of forest and range resources, and the challenges climate change will pose to monitoring, assessing, and reporting on SFM. Relative to the second edition, many indicators were improved based on reader feedback from the second edition, additional consultations in advance of the third edition, and other improvement efforts by the Project Team.

Only a few of the maps linked to the web version of the second edition were updated for this third edition. Several appendices were removed or greatly simplified. HTML links were replaced with full URLs in the endnotes.
Terms such as "forest" that have a technical meaning specific to this report are listed in the appendix glossary. They are underlined the first time they occur within each indicator.

Accountability

The information presented in this report was collected from a variety of sources, each accountable for the quality of the data it provided. Any errors in the presentation or interpretation of those data are, of course, the responsibility of the authors of this report.

Indicators of sustainable forest management cover a scope that is broader than the direct accountabilities of any individual government agency or company. While each organization is accountable for specific aspects of forest management, no one organization is necessarily wholly accountable for the states and trends shown by the indicators.

Turning Assessment into Action

An important goal of this report is to inform the ongoing development of forest policy and management.

Readers are encouraged to take action in two ways:

i. provide feedback to help improve the content, presentation, and overall usefulness of future editions of the report (please see contact information on the inside front cover); and
ii. engage in informed, constructive discussion about the future management of British Columbia's forests.

Actions that support progress in achieving sustainable forest management will benefit all British Columbians.

British Columbia's Forests and Society: An Overview

It seems clear beyond possibility of argument that any given generation of men can have only a lease, not ownership, of the earth; and one essential term of the lease is that the earth be handed on to the next generation with unimpaired potentialities.

Roderick Haig-Brown (British Columbia conservationist and winner of a Governor General's Award. Measure of the Year, 1950. Toronto: Collins)

The Forests

At 95 million hectares, British Columbia is larger than any European country except Russia, about four times the size of the United Kingdom, and larger than the combined areas of the states of Washington, Oregon, and California.

About two-thirds of the province is forested (Figure I-1). This makes the province, on a global scale, as important as many forest nations.

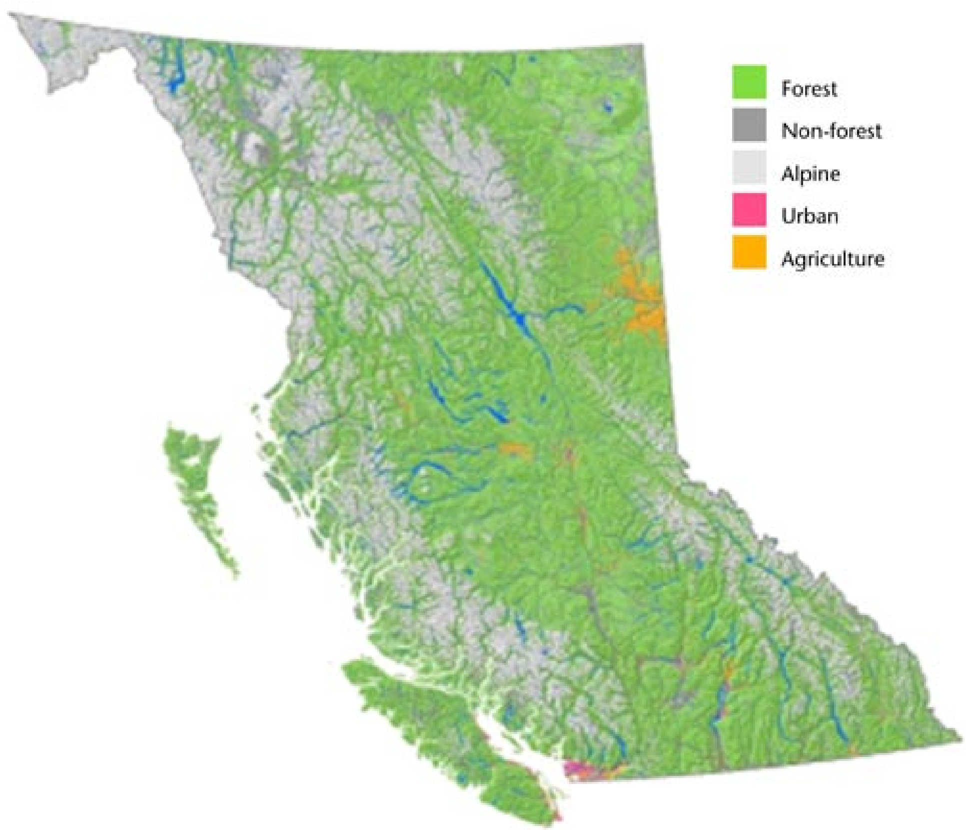


Figure I-1. Forest and other land types in British Columbia.

British Columbia Is Ecologically Diverse

The province's mountainous terrain creates a range of distinct climatic zones. Along the Pacific coast, temperatures are mild and rainfall is abundant. The Interior Plateau, lying in the rain shadow of the Coast Mountains, has a dry continental climate. The northeast, which is part of North America's Great Central Plains, has an extreme continental climate with very cold winters.

This variety of climates, combined with the extensive and varied terrain, has resulted in a complex pattern of many distinct ecosystems. Among them are grasslands, oak parklands, temperate rain forests, dry pine forests, desert-like steppes, boreal black spruce muskegs, tundra, and alpine meadows.

The many ecosystems have made British Columbia home to a great diversity of flora and fauna—in fact, a greater diversity than any other province in Canada. Three-quarters of Canada's mammal species are found in the province, 24 of which occur only in British Columbia. Some 162 species of birds that breed in British Columbia breed nowhere else in Canada.[1]

The Society

British Columbia has been inhabited for about 10,000 years. When Spanish and British explorers first reached the province's coast in the late 1700s, they found thriving First Nations societies and cultures. Trading posts sprang up throughout the province during the early 1800s, soon giving way to more established towns and cities as settlers arrived in the new British colony from Europe, the United States, Asia, and elsewhere.

Before the arrival of Europeans, about 40% of Canada's Aboriginal population lived within the area that became British Columbia. Their population was probably over 80,000, but introduced diseases resulted in severe losses.

The Population Is Concentrated in Urban Centres in the Southwest

The province's total population expanded from 33,000 in 1867 to over 4.4 million in 2008 (see Figure I-2). About half of the population now lives in the province's southwest corner (the Lower Mainland), in Vancouver, Surrey, and other communities making up Metro Vancouver.

Another 30% lives on Vancouver Island (mainly in Victoria and Nanaimo) or in the Southern Interior's Thompson-Okanagan region (Kelowna and Kamloops). The remaining 20% live primarily in smaller rural communities throughout the province.

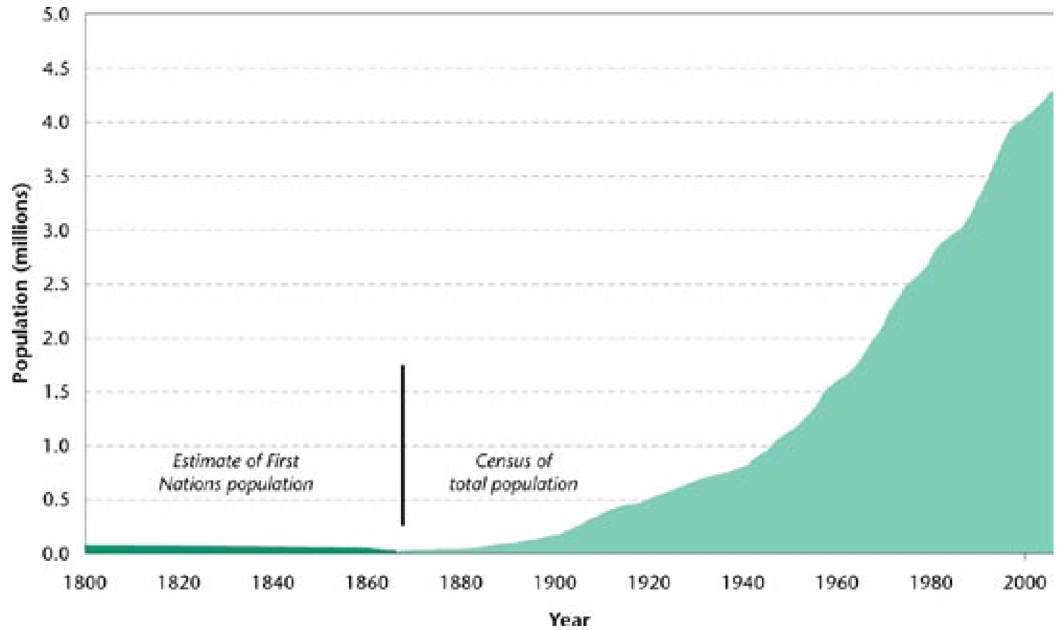


Figure I-2. *Population of British Columbia, 1800–2006.*[2]

The growing population has exerted considerable pressure on British Columbia's natural resources, including timber, water, fish, wildlife, range, wilderness, and others. This has often resulted in competing demands and conflicting public expectations for the use of forest resources (e.g., ecosystem and watershed protection vs. jobs and other economic benefits). It has also led to increasing risks of wildfires in the wildland/urban interface.

Forestry Is an Important Industry

For thousands of years, aboriginal people depended on the forest for shelter, food, clothing, tools, and medicine. The first European settlers also came to rely on the forest—primarily for timber, using the wood to construct buildings, ships, and even roads and railway trestles. Industries and communities grew up around timber harvesting and processing, producing logs, lumber, pulp, paper, and other products for export and domestic use. Recognition of the value of non-timber forest products and services, such as drinking water and wilderness recreation, is well established and growing.

Today, all communities in British Columbia, urban and rural, continue to have significant cultural, recreational, and economic connections with the province's forests.

Timber-based industries, generally referred to as the forest sector, continue to be the foundation of British Columbia's economy, accounting for 7% of employment and 15% of all economic activity when indirect and induced economic activity are included. Although its significance has declined as the economy has matured and diversified over the past few decades, the forest sector remains the most important employer in many rural communities.

Sustainable Forest Management Is Vital to British Columbians

With about 95% of the province in public ownership, the British Columbia government manages the land in the public interest, balancing many environmental, economic, and social issues.

The government and people of the province have many years of experience in developing and using tools and processes to enable balanced consideration of environmental, economic, and social values. The Protected Areas Strategy, Land and Resource Management Planning, the Forestry Revitalization Plan, and the requirements of the *Forest and Range Practices Act* are just a few of the major initiatives during the past decade that support sustainable forest management.

British Columbians, along with buyers of the province's forest products and tourists who come to see its great outdoors, have an interest in the sustainability of the province's forests because their continuing use and enjoyment of the forests depend on the province's progress in achieving sustainable forest management.

Forest Management in British Columbia: An Overview

Let us think how long is ninety years. What has happened to stable countries in the last ninety years? . . . Human habits have changed equally drastically. Wireless communication, the internal-combustion engine, the aeroplane, atomic fission and fusion, plastics and man-made fibres have been invented . . . The per capita use of lumber has dropped by over 50 per cent. Who shall say what further changes will affect the value of the crop by the end of the rotation the Licensee is now starting?

H.R. MacMillan (first Chief Forester of the British Columbia Forest Service and prominent forest industrialist. 1956 Sloan Commission)

Forest management can be described as ongoing iterations of five activities:

1. Define and understand the forest
2. Set goals
3. Plan activities
4. Implement activities
5. Assess results

The five activities provide a useful framework for describing the main elements and evolution of forest management in British Columbia.

Define and Understand the Forest

This includes basic rules of ownership and practices, inventory, and research.

The Ministry of Forests, Mines and Lands (formerly Ministry of Forests and Range) and the Ministry of Natural Resource Operations are the main government agencies responsible for stewardship of the province's public (non-park) forest lands. The province relies on private sector investment to develop B.C.'s forests, creating jobs and revenue, while retaining public ownership to enable conservation measures consistent with public expectations.

The issuance of timber tenures under the *Forest Act* to private forest operators is the key vehicle that establishes rights to forest development and the generation of public revenues through the payment of stumpage. The two main types of long-term tenures issued are area-based tree farm licences (TFLs) and volume-based forest licences (FLs). In addition, short-term timber sale licences (TSLs) facilitate market-based pricing and value-added opportunities. Tenure holders must be compliant with the planning and practices requirements established by the provincial government.

The Ministry of Forests, Mines and Lands manages the forest inventory program for the province's publicly owned forests. The ministry, tenure holders, and other agencies undertake inventories of timber and non-timber values to support forest management.

The provincial government's research program contributes to the scientific basis for many aspects of forest management, including silviculture; growth and yield of managed forests, and conservation of soil, water, and wildlife. The Canadian Forest Service and several universities also play major roles in research. The forest industry often collaborates on research with partners.

Set Goals

The goals of forest management, and the processes for setting goals, have evolved over the past century in British Columbia. The main goals highlighted below in **bold** include desired future forest conditions for values including timber, biodiversity, and cultural heritage resources.

As the forest industry rapidly grew at the beginning of the 20th century, concerns were raised that future timber supplies could be depleted. A royal commission on timber and forestry made recommendations in 1910 that led to the introduction of new timber tenures in the *Forest Act* of 1912 and the establishment of the Forest Service **to protect forests** and **regulate their use**.

By 1940, annual rates of harvest had increased substantially, much of the best timber had been allocated, and natural reforestation was not keeping pace with harvesting. A second royal commission recommended in 1945 that the Province ensure a **sustained yield of timber**. The *Forest Act* was amended in 1947 to regulate harvests with allowable annual cuts (AACs) and help ensure an orderly transition from harvesting old-growth timber to long-term management of second-growth forests. Area-based tenures, later named TFLs, were granted in exchange for private sector commitments to invest in manufacturing facilities and provide long-term forest management, thereby supporting the province's goal of **economic development**.

Improved access and technological advancements led to increasing AACs as the land base economically suitable for forestry expanded, particularly in the province's Interior. The increasing scope of industrial forestry in turn led to concerns about other forest values and uses, such as recreation, water, wildlife, and fish. In 1976, another royal commission recommended an overhaul of timber tenures and policies, and led to the 1979 *Forest Act* and a new *Ministry of Forests Act*. To ensure **integrated resource management** that provides diverse public benefits, the ministry now had to explicitly consider non-timber values in its decisions. A new planning process was introduced, new forest management units called timber supply areas (TSAs) were formed, a new process for determining AACs was established, and a strategic management system was initiated that included periodic publication of provincial information in forest and range resource analyses.

Many forest issues arose as public expectations increased in the 1980s. This led to yet another commission that made recommendations in 1991 on many issues, including land use conflicts, AACs, and forest planning and practices.

In 1992, government initiated consensus-based land use planning processes, involving diverse public interests, **to reduce land use conflicts**. Today, land use plans have been approved for 86% of British Columbia, providing long-term management goals and objectives for public lands. The plans also helped deliver the Province's goal established in the early 1990s **to double protected areas to 12% by the year 2000**.

Also in the early 1990s, the Province re-emphasized the goal of a sustained yield of timber with a new goal of **timely determinations of AACs**. The province's Chief Forester was legally required to make AAC determinations for TFLs and TSAs every five years, taking into account current understanding of the forests, current forest practices, and any approved land use plans.

In response to widespread demands **to improve forest practices**, the *Forest Practices Code of British Columbia Act* came into force in 1995. The Code collected hundreds of varied requirements into one consistent legal framework for planning and practices that applied across the province. This resulted in improvements that were widely noted. However, its complex planning requirements and highly prescriptive approach to forest management led to significant increases in costs to both tenure holders and government.

In 2004, the results-based *Forest and Range Practices Act* (FRPA) replaced the Code. Among its several goals are **to encourage innovation** by reducing the prescriptive aspects of the Code, and **to reduce regulatory costs** by streamlining the planning process and other requirements while **maintaining high environmental standards**. Along with FRPA, legislation governing various resource professionals was amended or introduced **to increase reliance on the judgment of professionals** by clarifying standards of accountability.

Plan Activities

Forest planning typically includes identification of key issues, information, and objectives, development and evaluation of scenarios, and selection of a preferred scenario that is fleshed out to make "the plan." The evolution of forest planning in British Columbia reflected its goal-setting history.

Timber was the predominant forest value up to the mid-1970s, so most forest plans focussed on timber harvesting. The 1947 *Forest Act* set the stage for long-term area-based tenures, now called TFLs, and a requirement for TFL tenure holders to prepare five-year management plans that address long-term timber supply, a 20-year spatial harvesting plan, and investments in forestry activities. These apply to less than 10% of the province's forests.

Following the 1979 *Forest Act*, TFL management plans and a variety of other plans for local areas and specific sites evolved to provide integrated resource management of timber and other forest values, and opportunities for public review and comment.

Beginning in the 1990s, some plans have included more explicit efforts to balance environmental, economic, and social goals to achieve sustainable forest management. Many TFL holders now prepare sustainable forest management plans (SFMPs) to support their application for forest certification, using indicators for resource values and targets to describe desired future forest conditions.

Selected material from these SFMPs is used to meet current TFL management plan content requirements.

Most of the province's forests are in TSAs, for which a timber supply analysis is periodically updated, typically every five years since the early 1990s. The analysis provides a forecast for 200 years or more, taking into account existing land use goals and objectives. There is no legal requirement for long-term plans that address forestry activities and investments needed to achieve desired future forest conditions. That said, many forest tenure holders in TSAs now also voluntarily develop long-term SFMPs in support of forest certification, similar to TFL holders.

On private forest land, which accounts for about 4% of the province's forests, planning is the owner's responsibility. A management commitment is required for some of these lands to maintain a favourable tax classification.

The *Forest Practices Code of British Columbia Act* of 1995 required six levels of forestry plans. Among these, the five-year forest development plan (FDP) was required to be consistent with legal objectives stemming from land use plans. Prescriptive content requirements, including the need to show the location of intended cutblocks and roads, hampered innovation and responsiveness to changing markets. The subjective approval test "that forest resources be adequately managed and conserved" led to disputes that delayed approval and implementation of plans. FDPs were updated every one or two years, leading to significant transaction costs between industry and government as well as a short planning horizon. Although streamlining changes were made with respect to the number of required types of plans, the Code's overall approach to forest planning was viewed as too cumbersome and costly.

For major forest tenure holders, the *Forest and Range Practices Act* of 2004 requires two levels of plans, of which one—the forest stewardship plan (FSP)—is submitted for approval by the provincial government. The FSP identifies forest development units within which development can occur, and must provide measurable results or verifiable strategies consistent with government objectives for various forest values. Government objectives stem from a variety of sources. Some come from land use plans, others are provided or enabled in regulations, and others are grandparented from the Code. The FSP has a five-year term that may be extended to 10 years. Other requirements include consultation with First Nations and providing an opportunity for review and comment by the public and other resource users. Tenure holders must also prepare site plans that identify intended roads, cutblocks, and FSP strategies for the site. The site plans are not approved by government but must be available to the public on request.

Implement Activities

Forestry activities today, such as road building, timber harvesting, reforestation, silvicultural treatments, and forest protection, have long-term implications for future forest conditions, often well beyond the next 50 or 100 years. Forestry activities need to be carried out by tenure holders and government in a manner that is consistent with completed plans, including land use plans, SFMPs, FSPs, and site plans.

Forestry activities have long-term implications for future forest conditions.

Under the *Forest Act*, the provincial government is responsible for issuing tenures, including long-term licence documents such as TFLs and shorter-term road permits and cutting permits, and for determining the stumpage price and other charges that tenure holders must pay. Most forest activities are implemented by tenure holders and contractors working for them. Fire suppression and management of insects and diseases have been the responsibility of the provincial government in partnership with tenure holders.

Before 1987, reforestation of harvested areas on public land was mostly funded by government and carried out by the MFR and some tenure holders. Reforestation efforts lagged under this arrangement, so in 1987, reforestation was made a legal obligation to be funded and carried out by major tenure holders. BC Timber Sales is legally required to reforest areas harvested under TSLs. Areas of public land where timber was burned by wildfire or killed by insects may be reforested by government, based on each situation's merits as an investment of public funds.

Similarly, other silvicultural treatments such as juvenile spacing, fertilizing, pruning, and commercial thinning are based on their merits as an investment of public funds, and may be carried out by government agencies or tenure holders.

Assess Results

Monitoring and assessing forest conditions relative to the desired future forest, and evaluating the effectiveness of management activities in achieving goals, supports a cycle of continuous improvement.

Each of the above activities can be assessed and adjusted based on the assessments. For example:

1. Is available information adequate? Are tenure obligations clear?
2. Are the goals clear and comprehensive?
3. Are plans realistic and adequate for realizing the goals?
4. Did implementation follow the plan and legal requirements?
5. Were the desired results achieved?

Continuous improvement is a fundamental component of modern forest management. Government processes that contribute to continuous improvement include this report, the Ministry's service plans, the Forest and Range Practices Advisory Council, the Forest and Range Evaluation Program, various adaptive management projects, the investigations and audits by the Forest Practices Board, and the Compliance and Enforcement Program.

As discussed, many forest tenure holders in British Columbia either have or are actively pursuing independent third-party forest certification. This involves use of indicators, targets, monitoring, and reporting on attainment of those targets.

The tenure holder's performance is also periodically assessed through independent third-party audits.

Professional associations and academia, often in partnership with government and industry, provide numerous continuing education opportunities to help ensure that resource professionals are aware of their professional obligations, are appropriately qualified to perform key tasks, learn from actions taken, and adapt to change.

Long-term forest management requires inter-generational learning and adaptation to broad changes such as changes in society's values regarding forest resources, changes in global demand for forest products, and increasingly, climate change.

About Sustainable Forest Management

Forestry isn't rocket science. It is much more complicated.

Fred Bunnell (Professor, University of British Columbia)

The Concept

Sustainable forest management is a widely supported goal. Forest practices have addressed aspects of sustainability for centuries, but "sustainable forest management" is a relatively recent concept that explicitly encompasses environmental, economic, and social dimensions. It is more comprehensive than earlier concepts such as "sustained yield of timber."

Sustainable forest management can be viewed as a sector-specific subset of the broader concept of sustainable development, which was first given prominence by the World Commission on Environment and Development, commonly known as the Brundtland Commission. In its 1987 report, *Our Common Future,* the Commission emphasized the interdependence of environmental integrity, economic development, and social security. Specifically, the commission stated:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The concepts of sustainable development and sustainable forest management have gained wide acceptance, even though their exact meaning and the methods for their implementation are often disputed. A variety of graphic models, such as three overlapping circles representing the environment, the economy, and society, are used to illustrate the concepts.

Numerous efforts that support sustainable development and sustainable forest management are being implemented in a variety of ways by governments, communities, and industries.

Definition

This report uses the Canadian Council of Forest Ministers' definition of sustainable forest management:

Management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social and cultural opportunities for present and future generations.

Canadian Council of Forest Ministers. 2008. *A vision for Canada's forests: 2008 and beyond.*

Criteria, Indicators, and Forest Certification

Sustainable forest management gained prominence at the 1992 Earth Summit, or United Nations Conference on Environment and Development (UNCED), in both the Forest Principles and in Chapter 11: Combating Deforestation of the conference's programmes for the 21st century, called Agenda 21.

Two streams of global action followed from UNCED:

1. governments committed themselves to developing and using indicators to define, assess, and promote progress towards sustainable forest management at the national level; and
2. non-government organizations (NGOs)—some of them dissatisfied with government-led efforts to address forestry—developed forest certification systems to promote sustainable forest management at the operational forestry level.

Both streams use indicators to measure or describe aspects of sustainability and their trends. Governments have typically grouped indicators into categories, referred to as criteria of sustainable forest management.

Criteria and indicators have been developed by nine regional groups of nations that contain most of the world's forests. One of these groups, known as the *Montréal Process*, involves 12 nations including Canada. Its goal is to define and promote the conservation and sustainable management of temperate and boreal forests. In 1995, the Montréal Process published its framework of 67 indicators, grouped under seven criteria that address the environment, economy, society, and institutional frameworks that support sustainable forest management. The Montréal Process framework was revised in 1999 and again in 2007. Some of the member countries have published national reports based on these criteria and indicators.

The Canadian Council of Forest Ministers (CCFM) also developed a framework of criteria and indicators to reflect the unique aspects of Canadian forests and values of particular concern to Canadians. This framework of 6 criteria and 83 indicators was also published in 1995. The first full report based on these indicators was published in 2000. A revised framework of 46 indicators was published in 2003 (CCFM 2003 indicators), reflecting experience from use of the framework and advances in scientific knowledge.

This report, The State of British Columbia's Forests (Third Edition), cross-references relevant indicators of the Montréal Process (2007) and CCFM (2003) for the convenience of readers. In the Rangeland chapter, related indicators from the Sustainable Rangelands Roundtable indicator set are noted.[1]

While many governments were developing criteria and indicators, several NGOs and a few nations developed forest certification systems to encourage companies to practice sustainable forestry at the operational level. These systems share many aspects of the governmental criteria and indicators frameworks. Both are based on the concepts of sustainable development: both use indicators to report on progress and trigger appropriate actions, and both share the goal of sustainable forest management.

The two streams of action have interacted in several ways. The use of criteria and indicators has spread from the national level to the operational level, NGOs and governments have advised each other on indicators, and some governments have obtained certification for their forest management. For example, the CCFM's 1995 criteria and indicators were the basis for the Canadian Standards Association's forest certification system published in 1996 and revised in 2002 and 2009. This and other forest certification systems are now used widely in British Columbia, as discussed in the chapter on Certification.

Reporting on Sustainable Forest Management

Reporting on sustainable forest management is challenging.

Sustainable forest management is not just about trees. It involves other plants, as well as wildlife, soil and water, air quality, and greenhouse gases; all economic activities that depend on the forests; the communities that depend on those economic activities; other social and cultural activities and values related to forests; and the legal, institutional, and policy framework that supports sustainable forest management.

For these reasons, the scope of reports on sustainable forest management is typically broader than that of the direct accountabilities of a single government agency or the actions of individual forest industry operators.

Ensuring Relevance and Credibility

The Montréal Process and CCFM criteria and indicators offer a good starting point for selecting relevant indicators for any jurisdiction in Canada since they were developed through consultation with experts on all aspects of sustainable forest management. To be locally relevant, however, reporting must also reflect the unique aspects of the nature, history, and culture of a jurisdiction and its forests.

The credibility of reporting depends on the use of the best science-based information available and the inclusion of both positive and negative findings. Credibility is further supported by identifying knowledge gaps and, where possible, using information from public sources.

Challenges in Reporting

Several factors pose practical challenges to finding and presenting relevant, useful information and data on the indicators. This report attempts to address and balance all of these challenges:

- Cost – The cost of detailed inventories of all forest resources is high, and data may be unavailable.

- Time – Assembling and analyzing extensive datasets to provide meaningful information is time consuming, making presentation of recent information difficult.
- Technical/scientific – Exactly what to measure and how to measure it are the subjects of technical debate, and all of the potential approaches have different technical merits and problems.
- Administrative – Access to information, as well as permission to report on it, is sometimes limited by proprietary concerns (e.g., information related to commercial interests and private land) or the sensitivity of information (e.g., rare ecosystems that might be threatened by vandals or nature lovers if their locations were made public).

Assessing Sustainable Forest Management

Assessing sustainable forest management is difficult because of the complex and intertwined nature of its many aspects. Nonetheless, questions about sustainability need to be asked, and answered, to help inform future actions.

The conditions of forests and societies continually change, as do interactions between the two. Perceptions of what is sustainable or unsustainable change over time.

An indicator may be assessed relative to historical conditions, technical or scientific thresholds, and desired targets. Where these reference values are unknown, unclear, or disputed, meaningful assessment of the indicator is difficult.

Assessment of several indicators collectively is conceptually even more problematic. First, indicators that use different units of measure cannot simply be added together unless they are converted to a common unit. Conversion may be technically problematic or wholly inappropriate. Second, the relationships between indicators are often complex, making interpretation of their interactions unreliable. Third, because the importance of any one indicator relative to another depends on the values and perspective of the assessor, even experts have trouble developing a consensus on overall assessments.

While various approaches have been developed to assess multiple indicators collectively, no one approach is entirely satisfactory.

Climate Change

Climate change significantly complicates the pursuit, monitoring, and assessment of sustainable forest management.

Anticipated climate change suggests that B.C.'s forest types will change during this century.

Even with aggressive action globally to curb greenhouse gas emissions, B.C. can expect warming of 2–3°C by the 2080s.[1] Without aggressive reduction of emissions, B.C. is expected to warm by 3–5°C by the 2080s, with warming continuing for centuries. To put this in perspective, the difference in average annual temperature between the hot, dry climate of Kelowna (in the Southern Interior) and the cool, continental climate of Prince George (in the Central Interior) is 3.7°C. In addition, changes are expected in precipitation and in the frequency and severity of extreme weather.

Modelling of anticipated climate change suggests that B.C.'s forest types will change during this century, and that grasslands will expand considerably into areas that are currently forested. The resilience and condition of the forests will be tested by climate-induced spread of insects, diseases, and invasive species. This will require significant adaptation of not only the forests, but also the industries, communities, and cultural activities that have evolved around the historical state of B.C.'s forests.

While the rate and magnitude of climate change are uncertain, and its biophysical impacts cannot be forecast with certainty, it is clear that anticipated climate change will require new ways of thinking about forest values, forest management, forest industries, forest-dependent communities, and forest governance. Following are some speculations about the future and examples of these new ways of thinking and related current developments.

Forest Values

Warmer winters, receding glaciers, and diminishing snowpacks will likely make water a prized commodity. Forests will become increasingly valued as a water purifier, regulator, and reservoir. Social, economic, and ecological implications will alter current management expectations. Forests will also be increasingly valued for their role in carbon sequestration and storage to mitigate climate change. Changes in the value of carbon, water, and other ecological services might shift the traditional focus on timber production.

Globally, carbon is being traded as a commodity on the Chicago Climate Exchange,[2] European Climate Exchange,[3] and elsewhere. B.C. government emissions are being offset through the Pacific Carbon Trust,[4] for $25 per tonne of carbon dioxide equivalent. Offset protocols have been developed to encourage climate-friendly investments in B.C. forests so that they sequester more carbon.

Forest Management

Science-based forest management is based on empirical observation of past conditions. Climate change will invalidate many of its assumptions and models. Forest professionals will be looking for ways to reduce impacts, foster resilience of ecosystems, industries, and communities, and store more carbon—without the benefit of historical evidence of treatment effectiveness observed in a stable environment.

In B.C., research on climate change and forest responses is underway through the Future Forest Ecosystems Initiative.[5] Integrated assessments are looking at impacts, vulnerabilities, and policies. At the management unit level, Future Forest Strategies[6] provide a forward-looking assessment of potential ecosystem effects and management responses. Work is underway on an inventory strategy, on assessment of silviculture options, and on enhancing carbon budget modelling[7] (in collaboration with the Canadian Forest Service). B.C.'s new Conservation Framework[8] places a priority on monitoring species and ecosystems likely to be sensitive to climate change.

Forest Industries

Changing societal expectations are creating new opportunities such as bioenergy and the use of wood to replace more energy-intensive and polluting materials such as steel and concrete. Seizing these opportunities will require new degrees of flexibility, consultation, and collaboration among industry, government, and various stakeholders.

The Forest Sector Climate Action Steering Committee, a joint government-industry team, has a strategy for climate change action. It articulates a vision for B.C.'s forest sector as a global leader in climate change mitigation and supplier of choice of climate-friendly products and services from the forest. Life cycle assessments[9] being conducted by the Consortium for Research on Renewable Industrial Materials[10] (CORRIM) will quantify carbon and energy flows for harvested wood products and substitutes.

Forest-dependent Communities

Locally, climate change will change the forests that surround communities, and may alter their relationships with the industries that support them. Globally, climate change demands new levels of collaboration among nations to reduce greenhouse gas emissions. In B.C. and elsewhere, communities and nations will seek ways to address climate-induced migration of plants, animals, other organisms, and people.

Work by Beetle Action Coalitions[11] to diversify forest-dependent communities will help them adapt. The BC First Nations Forestry Council[12] and the Forestry Roundtable[13] identified economic opportunities related to managing forests for carbon offset credits.

Forest Governance

Because practices that were sound under a stable climate are starting to give unexpected results, the uncertainties and new risks associated with climate change will likely require rethinking the way government, industry, and professionals share obligations and liabilities. Cascading and cumulative effects will call for land management with more integration across sectors. New governance mechanisms such as eco-service tenures and carbon tenures may be needed.

B.C. has a new offsets regulation[14] under the *Greenhouse Gas Reduction Targets Act*,[15] and is a partner in the Western Climate Initiative[16] to reduce emissions at least cost. B.C. has set a goal of zero net deforestation to minimize conversion of forest land to other land uses and maintain the net area of forest.

Conclusion

Ongoing changes in climate are expected, with no return to a historic "normal" climate (Figure I-3). This has significant implications for the future state of B.C.'s forests. Initial steps are being taken to address related challenges to forest management and the forest industry. More profound changes may occur in societal values, expectations from forests, and adaptation by forest-dependent communities. These changes will pose challenges for the monitoring and assessment of sustainable forest management (SFM). The various SFM criteria and indicator sets will likely need to be revised to address a changing climate. As the guiding C&I sets evolve to accommodate climate change, future editions of The State of British Columbia's Forests will evolve to include the new indicators related to climate change related.

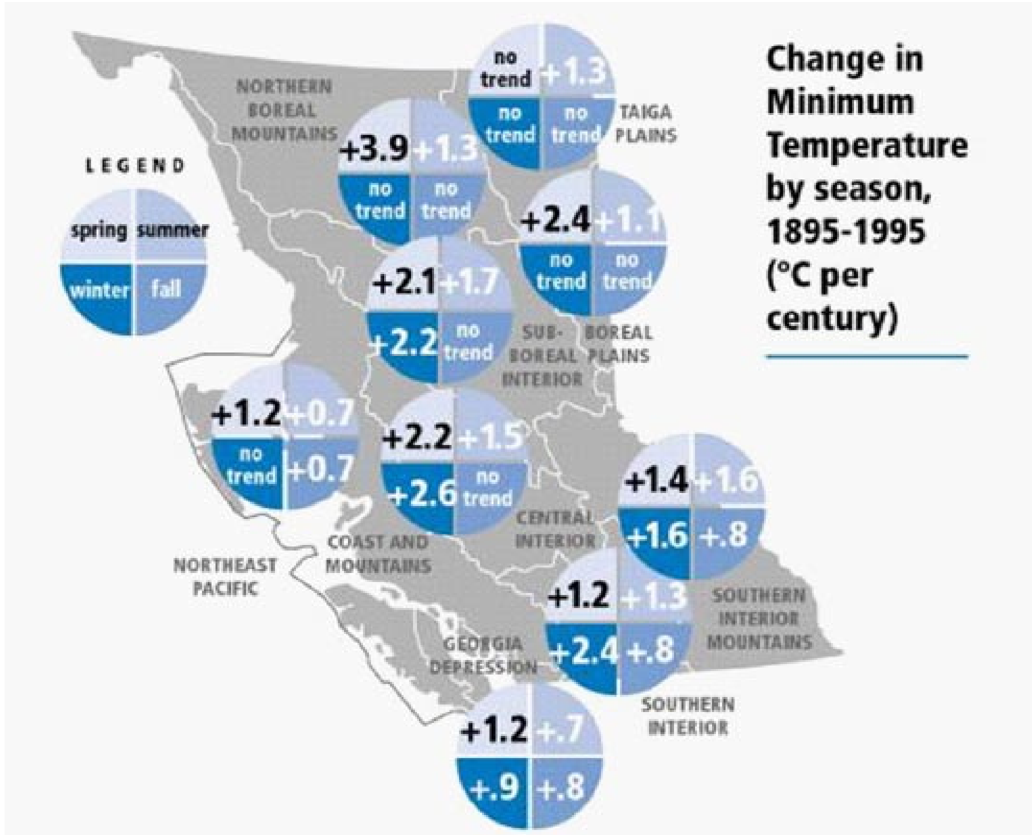
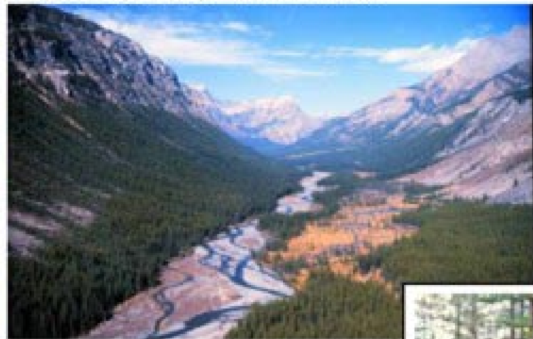


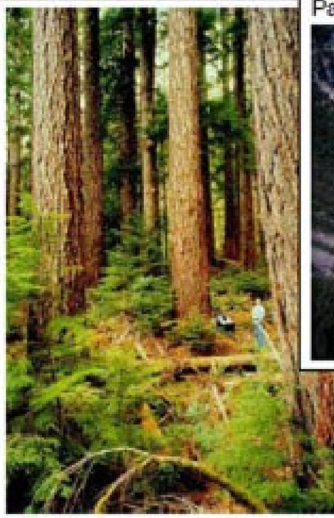
Figure I-3. *Change in minimum temperature from 1895 to 1995, by season across British Columbia.*

1 Ecosystem Diversity

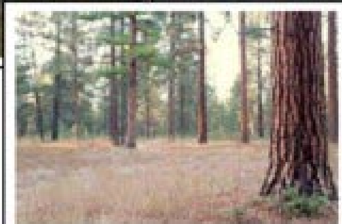
Diverse, well-functioning ecosystems are essential for environmental, economic, and social sustainability.

Palliser River Valley – John Parminter





Coastal forest – Alex Inselberg



Dry open forest – Don Gayton

Why is this important?

Diverse, well-functioning ecosystems are essential for environmental, economic, and social sustainability. Many British Columbians are concerned about land use and preservation of old-growth forests.

Overview

- Ecosystem diversity refers to the variety of ecosystems, their organisms, and the interactions of those with their environment.[1]
- British Columbia is the most biologically diverse province in Canada, and includes parts of six of the world's 30 terrestrial ecoregions.
- Most of this diversity still exists 150 years after the start of European settlement, but development is critically threatening some ecosystems, such as wetlands, grasslands, and Garry oak meadows.
- Forests cover 55 million hectares, or about 60% of B.C.'s 95 million hectares. In the second edition of *The State of British Columbia's Forests*, forest area was estimated at 59 million hectares. The difference results from a change in inventory methods, not a change in on-the-ground conditions. A further 3.7 million hectares are covered with stunted or scattered trees.
- In the Coastal and Interior regions, forests cover 18 and 37 million hectares, respectively.
- Coniferous trees dominate 83% of B.C.'s forests. In descending order, forests dominated by lodgepole pine, spruces, true firs, hemlocks, and Douglas-fir are the five most common forest types.
- Forests over 140 years old exist in all 16 biogeoclimatic zones and cover 22.6 million hectares. Of this area, forests over 250 years old cover 7.1 million hectares.

Questions about ecosystem diversity

1-1: How varied and extensive are B.C.'s ecosystems?
1-2: What are the types and ages of B.C.'s forests?
1-3: How have B.C.'s forests changed over the last half-century?
1-4: How much older forest does B.C. have?
▶ Summary and assessment

Related indicators

- Agricultural and urban development, fires, and logging (see Ecosystem dynamics, Timber harvest, Silviculture) have modified the province's ecosystem diversity to date. Climate change (see Forest carbon and greenhouse gases) may cause extensive further changes.
- Forest ecosystem conditions affect wildlife habitats (see Species diversity), may ameliorate climate change (see Forest carbon and greenhouse gases) and support economic activity (see Forest products and the economy, Jobs and communities).
- Examples of management responses include protected areas (see Protected forests) and ecosystem restoration (see Rangeland).

1-1 How Varied and Extensive Are B.C.'s Ecosystems?

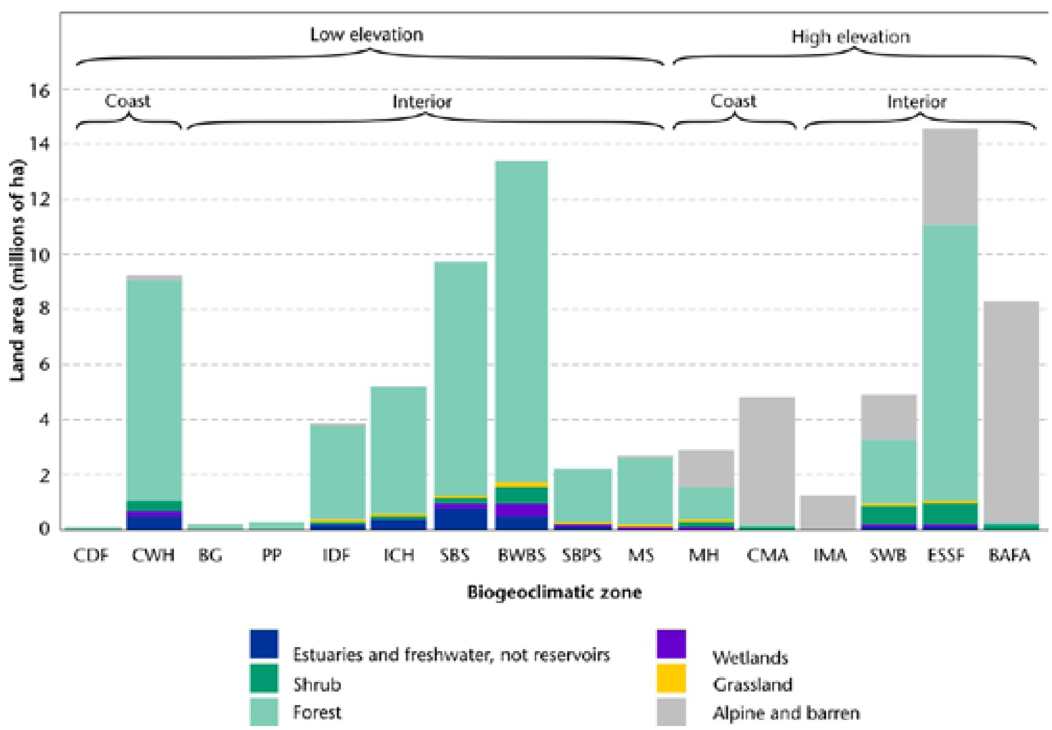


Figure 1-1. Area of province by ecosystem type and biogeoclimatic zone, 2008.

Why is this important?

Human settlement and resource development change the diversity and extent of ecosystems.

State and trend

- B.C.'s maritime and continental climates, combined with its mountainous terrain, have resulted in a wide variety of ecosystems from desert to alpine tundra. They are often grouped under 16 biogeoclimatic zones.[2]
- Forests occur in all 16 zones, dominating in most of them. Varied conditions within each zone have led to diverse forest types.
- Since 1850, ecosystem conversion to agriculture, reservoirs, urban areas, and other land uses has occurred on 2% of the province.[3]
- About 3% of former forests have been converted to other land uses. Only the three smallest, warmest biogeoclimatic zones have had more than 10% of their former forests converted. The Coastal Douglas-fir (CDF) zone has been most affected, with 46% of its former forests now converted.
- Conversion impacts on former grasslands and some former wetlands are greater than those on most former forests, and are endangering some of these ecosystems and the species dependent on them.
- Fire exclusion has resulted in forest encroachment onto former grasslands and ingrowth of more trees in formerly open forests (see Rangeland, 15-4).

Information

- Recent satellite imagery provides reasonably accurate information on the location and extent of major ecosystems and converted ecosystems.
- Estimates of forest encroachment and ingrowth are incomplete.
- B.C. is currently developing a systematic monitoring program across the province to better monitor changes in the forest due to natural and human-related activities.
- References: MFR's BEC, VRI

1-2 What Are the Types and Ages of B.C.'s Forests?

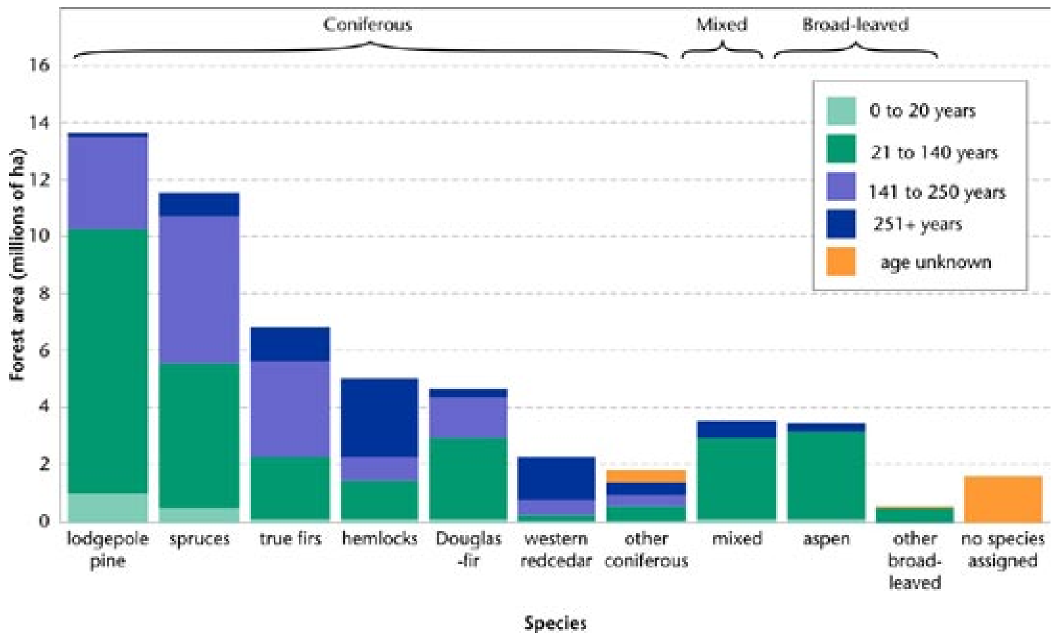


Figure 1-2. Forest area by forest cover type and age class, 2008.

Why is this important?

Different forest types and ages provide specialized habitats for plants and animals, and support a variety of human activities and livelihoods.

State and trend

- Forests cover 55 million hectares, or about 60% of B.C.'s 95 million hectares. A further 3.7 million hectares are other wooded land with woody shrubs, stunted trees, or scattered tree cover.
- Throughout this edition of *The State of British Columbia's Forests*, forest area is defined by the Forest Management Land Base (FMLB) delineated by provincial forest inventory specialists. This more stable and repeatable definition of forest results in a change in the estimated forest area (from 59 million hectares in the previous edition of this report).[4]
- 83% of B.C.'s forests are dominated by coniferous tree species, 7% are mixed, 7% are broad-leaved, and the remaining 3% are regenerating forests with no species assigned. In descending order, the most common forest types are dominated by lodgepole pine, spruces, true firs, hemlocks, and Douglas-fir.[5]
- Many of B.C.'s forests are old: 43% are over 140 years old, including 13% that are over 250 years old. Only 4% of the forests are less than 20 years old.[6]

Information

- Detailed forest cover inventories exist for 96% of the province. The forest cover has been collected and maintained since the 1950s. The inventory is kept current for harvest activity and large fire disturbances. It is projected each year to reflect timber growth. The inventory does not yet account for the epidemic mountain pine beetle losses. Inventories for tree farm licences and private land are mostly not available to government and the public.
- The 1950s inventory and satellite imagery are the only public sources of data for some parks and private land, about 4% of B.C.'s area.
- References: MFR's VRI; MAL's LRDW

1-3 How Have B.C.'s Forests Changed over the Last Half-Century?

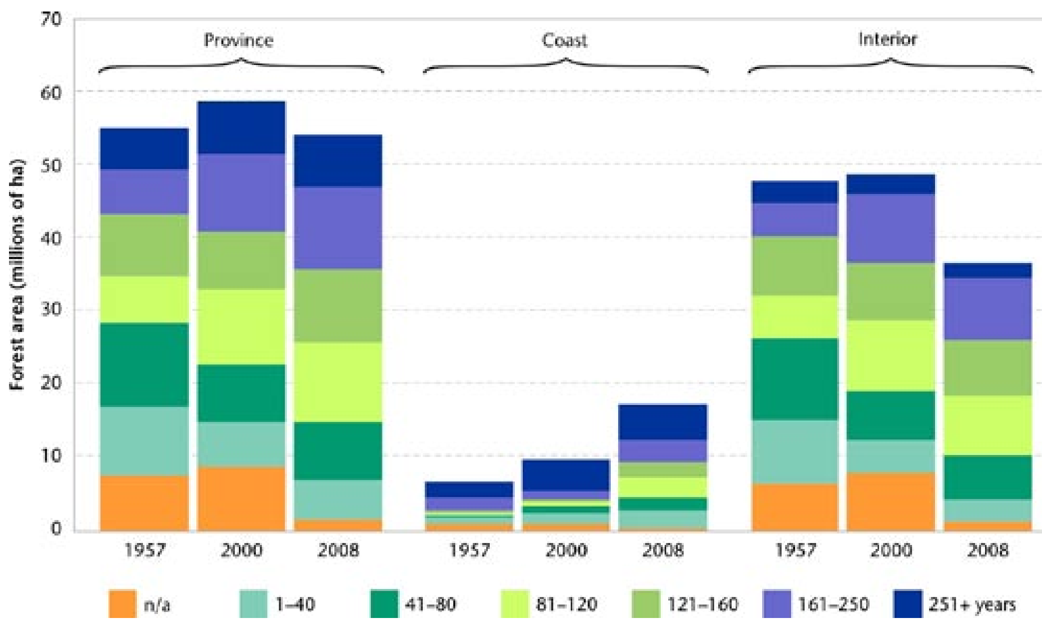


Figure 1-3. Forest area by age class as estimated in 1957, 2000, and 2008.

Why is this important?

Natural disturbances, logging, and land use conversion affect ecosystem processes.

State and trend

- Ecosystem processes in forests depend on the area and distribution of forests, tree species composition, and age.
- The area of forests recorded in forest inventories increased from 1957 to 2000, but it is not known how much of this is due to changes in inventory methods and how much is due to changes in actual forests. From 2000 to 2008, the estimate of forest area declined with the adoption of a new defini-

tion of forest (see FMLB discussion in Indicator 1-2). Current inventories contain much less area with unknown age.
- Changes over time in the delineation of Coast and Interior zones have affected the breakdown of forest area by region. Currently, 68% of B.C.'s forest is in the Interior zone and the remaining 32% is in the Coast Zone.
- Although changes in inventory methods over time limit the reliability of trends, province-wide since 1957 it appears that the area of young forest has decreased and the area of older forest has increased (also see Indicator 3-2). This trend likely varies geographically.[7]
- Forests over 80 years old amount to 72% of the province's forests (72% in the Interior and 73% on the Coast). Railways and settlements led to large areas of forest being burned by accidental fires in the late 1800s. By the 1950s, many of these areas had regrown to become forests under 80 years old. With effective fire suppression over the past 50 years, many of these areas are now over 80 years old.

Information

- Differences between the forest inventories of 1937 and 1957 are largely due to changes in inventory methods, and do not provide reliable trends of changes in forest area, species, or age over this period.
- The 1957, 2000, and 2008 inventories permit reasonably reliable analysis of changes in age distribution but do not support reliable analysis of changes in forest area or species composition.
- References: MFR's VRI

1-4 How Much Older Forest Does B.C. Have?

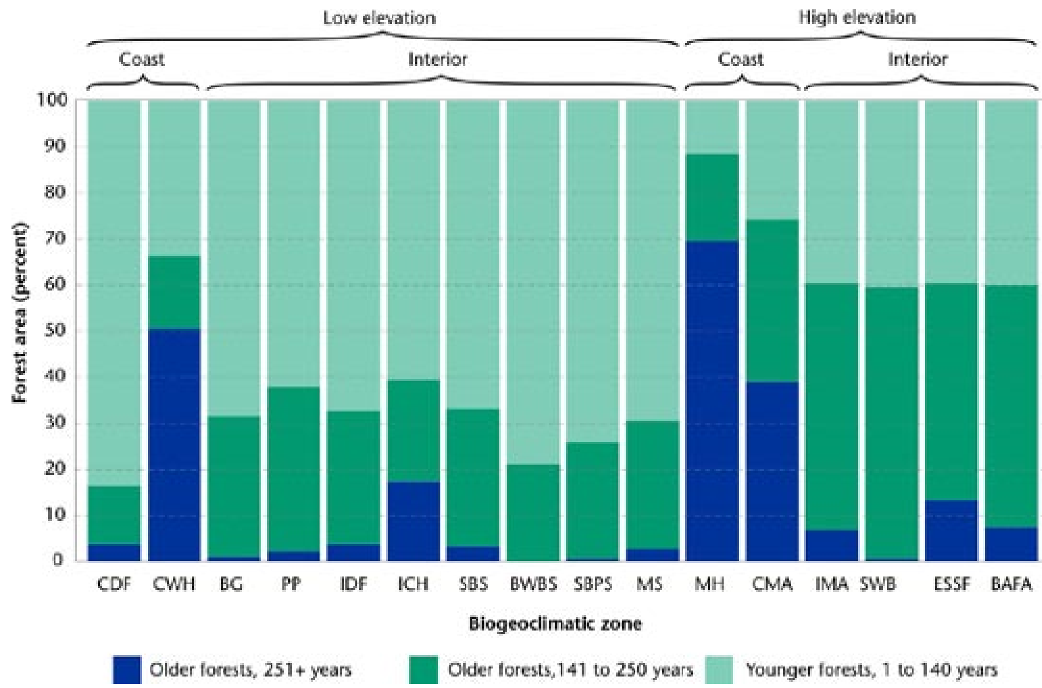


Figure 1-4. In each biogeoclimatic zone, percent of forest area by age class, 2008.

Why is this important?

Older forests provide specialized habitats not found in younger forests.

State and trend

- The dry temperate and boreal ecosystems in the Interior have frequent, natural wildfires that limit the proportion of older forests. The wetter ecosystems in the Coast region and along the Interior mountain ranges have fewer wildfires and higher proportions of older forests.
- Forests over 140 years old exist in all 16 biogeoclimatic zones and cover 22.6 million hectares (41% of B.C.'s forests). Of this area, 7.1 million hectares (13% of B.C.'s forests) are forests over 250 years old.[8]
- These older forests—or old growth—tend to have large trees, standing dead trees, multi-layered canopies with gaps resulting from the deaths of individual trees, and coarse woody debris on the forest floor.
- Substantial proportions of older forests exist in most biogeoclimatic zones that naturally develop them, with the exception of the Coastal Douglas-fir and Interior Douglas-fir zones. Relatively small areas, 4% or less, of the forests in these two zones are over 250 years old, a result of logging and the development of agriculture and settlements.[9]
- Tree height is often ecologically, economically, and culturally important. Trees are over 20 m tall in about 70% of forests over 140 years old and 80% of forests over 250 years old.

Information

- Because the provincial forest is so vast, the age of forest stands is photo estimated from the relative size of trees and from known disturbance events. For forest stands over 250 years old, age is difficult to estimate and often inaccurate in the inventory. While this is less of a concern for volume calculation, it does increase the risk in determining the contribution to old growth.
- References: MFR's VRI

Summary and Assessment

State

B.C.'s varied climates and mountainous terrain have led to expansive forest cover of diverse types and ages—for example, oak parklands, temperate rain forests, dry pine forests, and boreal black spruce muskegs. Most of this diversity still exists 150 years after the start of European settlement. Vast areas of old forest occur in B.C. Permanent conversion to agriculture, reservoirs, urban, and other development has changed 2% of B.C.'s land base and 3% of former forests. However, more of the forest area in the CDF, PP, and BG biogeoclimatic zones has been converted, prompting conservation concerns.

Trend

Further permanent conversion of forest land could be limited by terrain and climate but will likely occur in the ecosystems already stressed by development. Fire suppression over the past 50 years has allowed the area of older forests to increase in parts of the Interior. Forest encroachment onto grasslands and ingrowth of more trees in formerly open forests has also occurred. This partly offsets the conversion of forest land to other uses but threatens the ecological integrity of grasslands and some forest types. Continuation of these trends will strain the ability of several ecosystems to support B.C.'s rich biological heritage.

Information

The diversity of forest ecosystems in B.C. requires diverse management approaches, which in turn require an extensive knowledge base. Biogeoclimatic ecosystem classification data and 1:250,000 maps are used for forest and range management throughout the province, and larger scale maps of site series are available for almost half the province. A broad ecosystem inventory with 1:250,000 maps is used to assess habitat potential. Threatened plant communities and sensitive ecosystems, including forests, are not well documented. A national forest inventory will provide broad overview and trend information on forest cover. Detailed forest cover inventories on 1:20,000 maps exist for 96% of the province, but many are not current to new standards. Current inventories for tree farm licences and private land are not all available to government and the public. Forest cover inventories available in B.C. do not enable reliable analysis of trends in forest area and species composition due to changes in standards. Forest cover information is incomplete in areas where the highest proportions of former older forests have been converted, due to the high proportion of private land in those areas.

2 Protected Forests

B.C.'s protected forests are mostly coniferous.

Kitlope Heritage Conservancy - John Kelson

Why is this important?

Protected forests provide natural habitats for plants and animals, areas for scientific study, and wilderness for recreational, cultural, and spiritual pursuits.

Overview

- Protected forests are forests in strictly protected areas in which development is largely prohibited by law.[1]
- In B.C., forests are strictly protected in provincial parks, ecological reserves, recreation areas, and national parks. These types of protected areas correspond to International Union for Conservation of Nature (IUCN) categories I to III.
- A generally representative 14% of B.C.'s forests are strictly protected.
- Older forests are well represented in protected areas.
- In B.C., the area of protected forest has increased greatly over time.

Questions about protected forests

2-1: Are B.C.'s protected forests representative of its total forests?
2-2: What are the types and ages of B.C.'s protected forests?
2-3: What is the geographic distribution of protected forests?
2-4: How much of B.C.'s older forests is protected?
▶ Summary and assessment

Related indicators

- Logging, public awareness, and environmental activism (see Timber harvest, Public involvement, Law) have influenced the extent and location of protected forests. Their condition is affected by fire, disease, invasive species, climate change, and recreational users (see Ecosystem dynamics; Exotic species; Forest carbon and greenhouse gases; Recreation, tourism, and visual quality).
- The types and condition of protected forests influence habitats for wildlife (see Species diversity) and recreational opportunities (see Recreation, tourism, and visual quality).
- Management responses include planning, facility management, and restoration (see Public involvement; Recreation, tourism, and visual quality; Rangeland).

2-1 Are B.C.'s Protected Forests Representative of Its Total Forests?

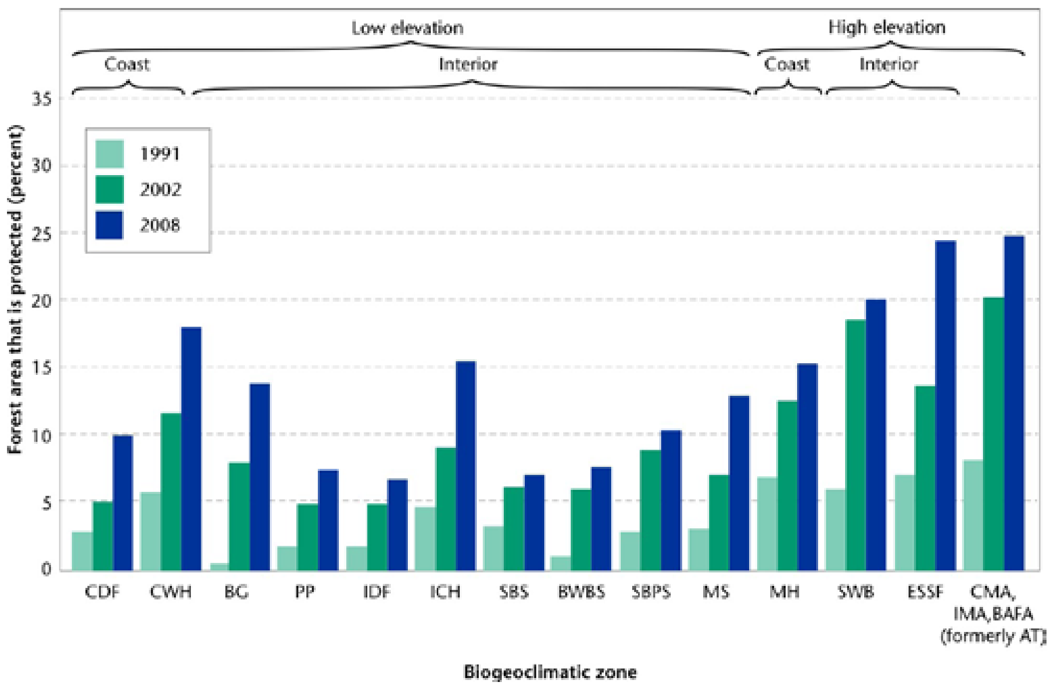


Figure 2-1. *By biogeoclimatic zone, percent of forest area that was protected in 1991, 2002, and 2008.*

Why is this important?

Protection of representative examples of forest ecosystems helps maintain ecological processes and species diversity.

State and trend

- Including forested and non-forested areas, in 2008 protected areas in B.C. totalled 14.1 million hectares, 14.8% of the gross provincial area.[2]
- As new parks and reserves have been designated, the amount of protected area in B.C. has increased greatly over time.[3]
- Forested land within protected areas now totals 7.6 million hectares, 14% of B.C.'s forests.
- Protected forest area was 2.5 million hectares in 1991 and 5.7 million hectares in 2002.
- Low-elevation forests, which account for 75% of all forests in B.C., are represented with 11% protected in 2008. High-elevation forests are represented with 23% protected in 2008.
- In 2008, the proportion of protected forest in each biogeoclimatic zone varied from 7 to 25%.
- The Ponderosa Pine (PP) and Interior Douglas-fir (IDF) zones have lower representation, each with about 7% of forests protected. These zones are the warmest and driest of the forested biogeoclimatic zones; consequent human settlement has limited availability of natural forests for protection.
- In the forested coastal biogeoclimatic zones (CDF, CWH, and MH), 17.6% of the forest is protected. In the forested interior biogeoclimatic zones (BG, PP, IDF, ICH, SBS, BWBS, SBPS, MS, SWB, and ESSF), 13.0% of the forest is protected.

Information

- The above figures are based on areas protected by the national and provincial governments. Regional parks, municipal parks, and private conservation lands provide limited additional areas. A small portion of the increase in protected area from 2002 to 2008 is due to improved data.
- Forest cover was estimated for most of the provincial and national parks in the 1950s. This information represents some of the oldest forest cover information still in use.
- References: MFR Forest Cover Ownership dataset based on the Ministry of Environment (MOE) Resource Registries dataset Tantalis; BC Parks; Parks Canada

2-2 What Are the Types and Ages of B.C.'s Protected Forests?

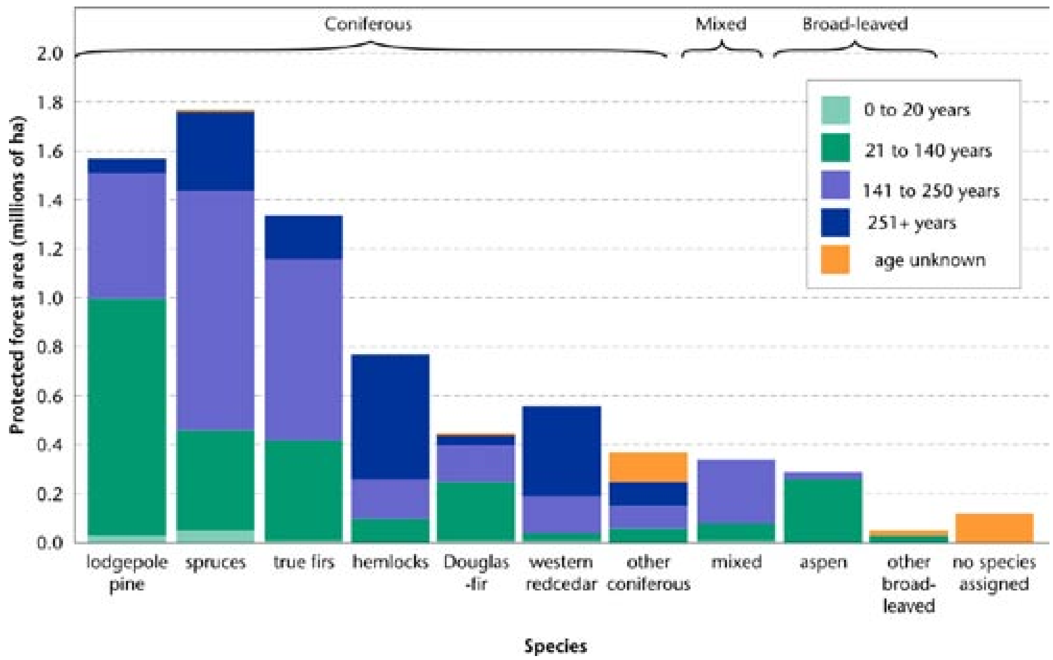


Figure 2-2. Protected forest area by forest cover type and age class, 2008.

Why is this important?

The many specialized habitats of forest-associated species occur in forests of different types and ages.

State and trend

- Like B.C.'s total forests, B.C.'s protected forests are mostly coniferous.
- 89% of the forest in protected areas is classified as a coniferous stand type.
- In descending order, the most common stand types in protected areas are spruce types, lodgepole pine, true firs, hemlocks, and western redcedar.
- The species composition of protected forests is quite representative of the overall forest.
- Very young forests are rare in protected areas. Stands under 20 years old amount to 1% of the total area of protected forest.
- Stands aged 21 to 140 years account for 34% of the forest in protected areas.
- Older forests are the most common in protected areas. 61% of the protected forest is over 140 years old: 40% is 141–250 years old and 21% is over 250 years old.
- Relative to the overall forest, protected areas contain fewer young and mid-aged stands and more older stands.

Information

- Only satellite imagery is available for a few large parks, and data for several parks existing since the 1950s are old and less reliable.
- More recent forest inventories exist for parks established since 1990.
- Variable data quality reduces the reliability of the assessment of the representativeness of protected forests in terms of species and age.
- References: MOE BC Parks; Parks Canada; MFR VRI

2-3 What Is the Geographic Distribution of Protected Forests?

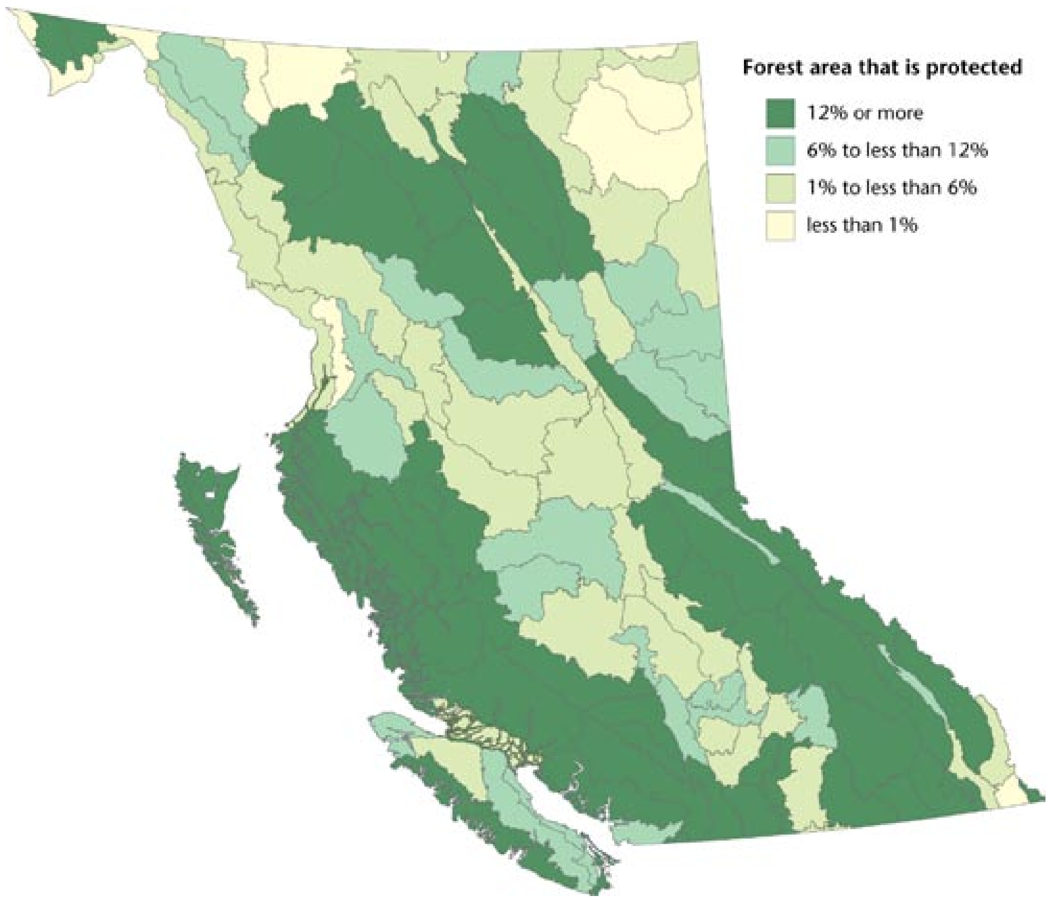


Figure 2-3a. Percent of forest area that is protected by ecosection, 2008.

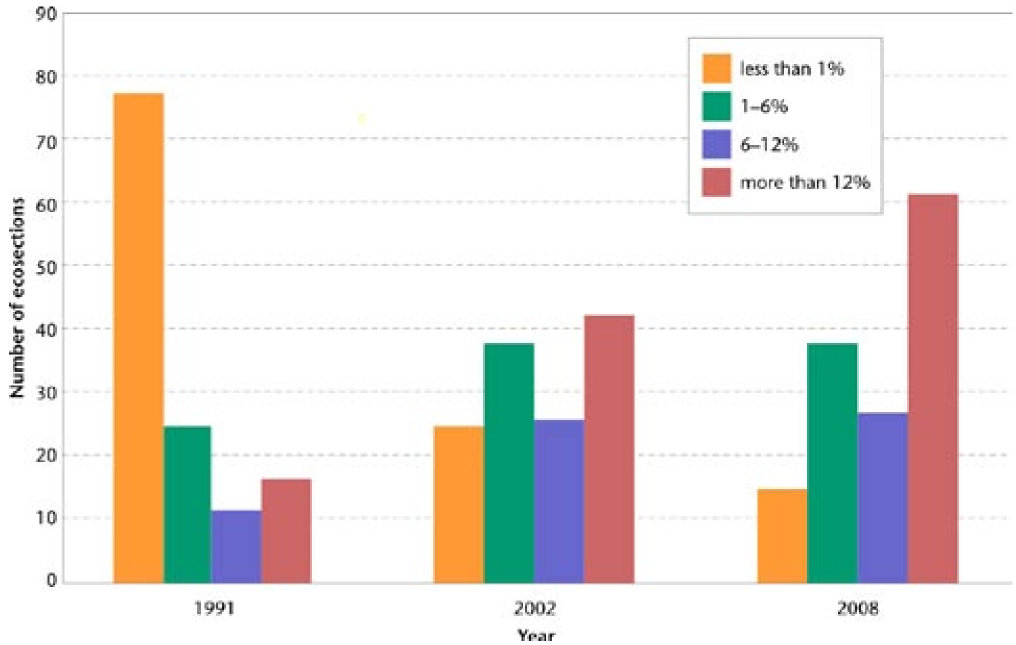


Figure 2-3b. Number of ecosections in four classes of percent of forest protected in 1991, 2002, and 2008.

Why is this important?

The geographic distribution of protected areas reflects society's choices to balance conservation values with economic development opportunities.

State and trend

- Ecological classification into ecosections based on climate and physiography is used for general conservation and wildlife management. Currently, 142 ecosections are recognized in B.C., an increase from the 132 recognized in previous editions of this report.
- Since 1991, both the total area and amount of forest in protected areas has increased greatly.
- The number of ecosections with less than 1% of their forest area protected decreased from 78 in 1991, to 25 in 2002, to 15 in 2008.
- From 2002 to 2008, the area protected increased in 113 of the 142 terrestrial ecosections. The number of ecosections with 12% or more of their forest area protected increased from 43 to 62. The number of ecosections with 6–12% protected increased from 26 to 27. Ecosections with 1–6% protected remained the same at 38. The number of ecosections with less than 1% of their forests protected decreased from 25 to 15.
- A similar analysis is available for forested plus non-forested protected area.[4]
- In some parts of the province, especially along the Coast, protected areas are concentrated in ecosections with high conservation values.

Information

- Ecosections are better suited for analyzing geographic distribution than biogeoclimatic zones.
- Existing data on the areas of total forests and protected forests by ecosection are reliable.
- References: MOE BC Parks; Ecoregions of B.C.

2-4 How Much of B.C.'s Older Forests Is Protected?

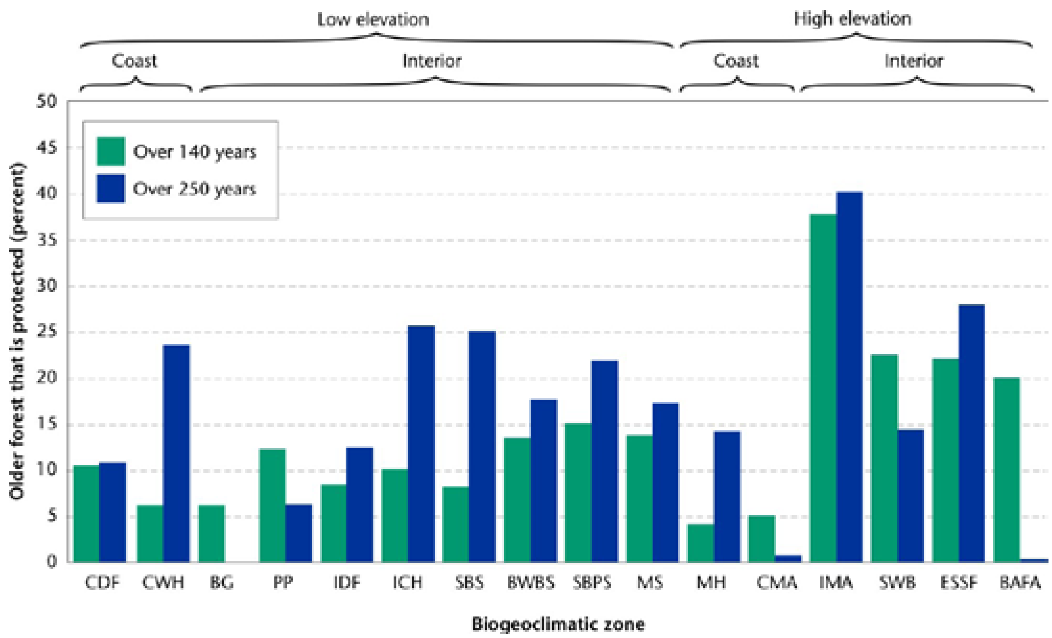


Figure 2-4. Percent of older forest area that is protected, by biogeoclimatic zone, 2008.

Why is this important?

Protection of older forests helps ensure the survival of dependent species and the preservation of other special values. Protection of B.C.'s old-growth forests is a high profile public issue.

State and trend

- Older forests that take hundreds of years to develop provide specialized habitats and numerous economic, social, and spiritual values.
- Figure 2-4 displays both the percent of forest aged 141–250 that is protected and the percent of forest over 250 years that is protected.
- 2.9 million hectares of forest aged 141–250 years old are in protected areas. This equals 13% of B.C.'s forests of this age. Depending on biogeoclimatic zone, the amount of forest aged 141–250 years old that is in a protected area varies from 6 to 38%.

- Of forests over 250 years old, 1.6 million hectares are protected. This equals 23% of B.C.'s forests of this age. Depending on biogeoclimatic zone, the amount of forest over 250 years old that is in a protected area varies from 0 to 40%.
- Relatively few intact old forests remain in the heavily settled Coastal Douglas-Fir (CDF), Ponderosa Pine (PP), and Interior Douglas-Fir (IDF) zones, but 11%, 6%, and 12%, respectively of the forests over 250 years old are protected.
- In low-elevation biogeoclimatic zones, 9% of forests 141–250 years and 24% of forests over 250 years are protected. In high-elevation zones, 20% of forests 140–250 years and 23% of forests over 250 years are protected.
- About 60–65% of the area of protected older forests has trees over 20 m tall. Tall trees provide important ecological niches, and are appreciated for their aesthetic and spiritual values.

Information

- References: MFR VRI

Summary and Assessment

State

Protected areas provide natural habitats for plants and animals, areas for scientific study, and wilderness for a wide variety of recreational, cultural, and spiritual pursuits. About 14% of B.C.'s forests are legally protected and meet the standards for IUCN categories I to III. They are reasonably representative of most of the province's forest ecosystems, with a desirable emphasis on older forests. Their geographic distribution reflects intentional balancing of conservation with economic and social priorities. Maintaining ecological processes and natural habitats is also a priority in forests outside of strictly protected areas. In B.C., large special management zones were estimated to cover 14 million hectares (forest and non-forest) in 2006. Many smaller riparian and other sensitive zones cover additional areas. These areas meet some aspects of IUCN definitions for categories IV to VI because resource development is somewhat constrained. Cumulatively, they provide substantial additional areas that help maintain ecological processes and forest-dependent species.

Trend

The area of protected forests has more than tripled since 1991. Representation of most biogeoclimatic zones has improved, and the geographic distribution of protected forests among ecosections has also improved. Many forest ecosystems still present a wide range of choices for protecting or developing forests. Due to historical development patterns, choices are limited in some of the smaller biogeoclimatic zones, such as the CDF and PP.

Information

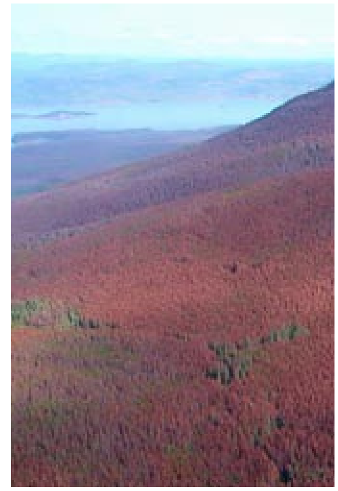
Management of currently protected forests and decisions to protect additional areas depend on information about the forests, their conservation values, and expected benefits and costs of ongoing protection. Detailed biogeoclimatic data and 1:250,000 maps are available for the whole province, including protected areas. The broad ecosystem inventory is also available and may be sufficient for some decisions regarding the selection and management of protected forests. Detailed forest inventories are available for many protected forests, but only the less reliable 1950s inventory and satellite imagery are available for about half of the protected forests.

3 Ecosystem Dynamics

Fire, insects, and diseases are part of the natural dynamics of forest succession.

Wildfire – MFR

Timber harvest – MFR



Mountain pine beetle – Adrian Walton

Altering the dynamics of forest ecosystems may reduce environmental stability and resilience, leading to detrimental economic and social impacts.

Overview

- Ecosystems are dynamic—their non-living elements change, and their living components grow, move about, and die. Despite dramatic changes, ecosystems can be stable and resilient at some scales.[1]
- B.C.'s forest ecosystems have been influenced by fire suppression, conversion to other land uses, timber harvesting, and more recently, accelerated climate change.
- Disturbances are key to ecosystem dynamics. Over the past four decades, harvest and wildfire have disturbed a combined average of 254,000 hectares per year. Over this period, the annual area disturbed by the mountain pine beetle was highly variable, peaking at 10 million hectares in 2007 in the midst of the current outbreak.
- Mortality from the mountain pine beetle is driving an overall decrease in carbon in the live biomass pool and an increase in carbon in the deadwood and forest floor pools. Over the next decades, the average age of forests outside of the timber harvesting land base is expected to increase.
- Road density continues to increase. The area of undeveloped watersheds continues to decrease.

Questions about ecosystem diversity

3-1: What are the main dynamics of disturbance in B.C.'s forests?
3-2: How are the main dynamics changing forest age?
3-3: How are the main dynamics changing forest biomass?
3-4: How fragmented are B.C.'s forest ecosystems?
▶ Summary and assessment

Related indicators

- Ecosystem dynamics are influenced by fire suppression, timber harvesting, reforestation, invasive plants and animals, and climate change (see Timber harvest, Silviculture, Exotic species, Forest carbon and greenhouse gases).
- Changes in ecosystem dynamics can affect wildlife habitat and resource management (see Species diversity, Soil, Water, Forest products and the economy, Jobs and communities).
- Management responses include protected areas (see Protected forests), research to improve our knowledge (see Knowledge, Management capacity), reduced road networks, habitat improvement, ecosystem restoration, and fire management.

3-1 What Are the Main Dynamics of Disturbance in B.C.'s Forests?

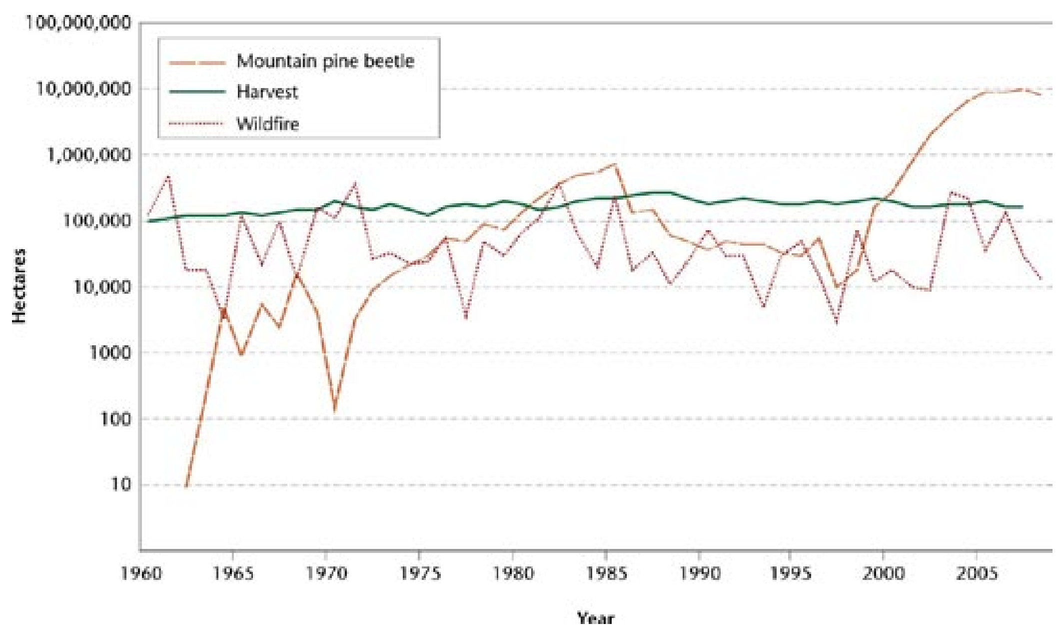


Figure 3-1. *Area disturbed by mountain pine beetle (MPB), harvesting, and wildfire, 1960–2008. For MPB, area shown is hectares under current attack that year.*

Why is this important?

Managing the combined effects of historic and current ecosystem dynamics requires an understanding of their relative importance and interactions.

State and trend

- Fire, insects, and diseases are part of the natural dynamics of forest succession. Humans reduce some disturbances (e.g., through fire suppression) and add other disturbances (e.g., timber harvesting).
- The trend in number of wildfires generally increased from 1960 to 1994 and then decreased. The trend in area burned by wildfires decreased from 1960 to 2002 and then increased. The area disturbed by timber harvests increased steadily to 1988 and has decreased since then. The combined affected area averaged 254,000 hectares annually between 1960 and 2007.
- The current mountain pine beetle epidemic, enabled in part by climate change,[2] increased rapidly after 1997 to peak at over 10 million hectares in 2007 and then declined in 2008 (an area may be disturbed more than once, and harvested and/or burned by wildfire). Previously, the area under attack increased from extremely low levels in 1962 to peak at 750,000 hectares in 1985 and then decreased to 9,725 hectares in 1997. Average yearly area under attack from 1962 to 1997 was 99,600 hectares, and from 1998 to 2008 was 4.5 million hectares.[3]
- Compared to the mountain pine beetle and harvesting, wildfires accounted for a small proportion of the recent area disturbed, averaging 4.5% annually for the 10-year period 1998–2007. Even during the severe 2003 fire season, wildfires accounted for only 5.9% of the area disturbed by these three agents. Between 1962 and 2007, wildfires accounted for an average of 14% of the area disturbed and peaked at 67.6% in 1971 when mountain pine beetle activity was low, harvesting was typical, and the area burned by wildfire was high.
- Insects other than bark beetles primarily reduce growth rates and generally have had lesser impacts on tree mortality.[4]
- Diseases attack tree roots, boles, and foliage. They cause both growth loss and mortality, and impacts are widely dispersed and difficult to reduce. An introduced stem disease, white pine blister rust, has greatly reduced the occurrence of western white pine and whitebark pine. Climate change also enabled an outbreak of a native foliar disease in mature timber.[5]

Information

- Due to the unprecedented size of the current outbreak, the mountain pine beetle is now attacking some younger stands. Future climate change impacts on forest dynamics, including regeneration, growth, and mortality from insects, diseases, and fire are uncertain.
- References: MFR MPB; CFS Disturbances, MPB Initiative

Related international and national indicators

- MP 3.a, 3.b CCFM 2.3

3-2 How Are the Main Dynamics Changing Forest Age?

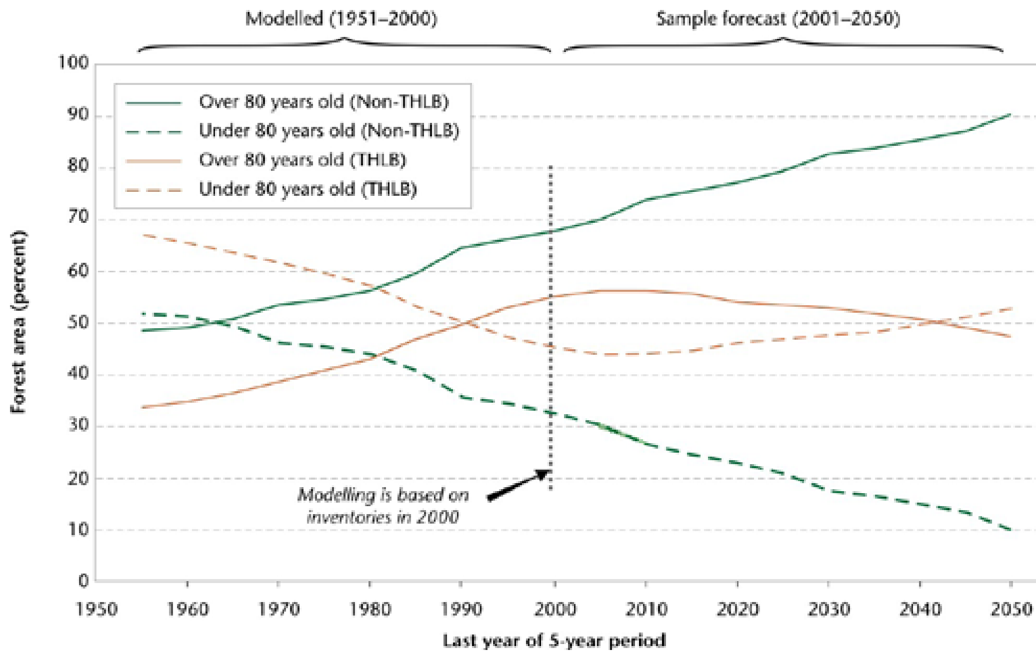


Figure 3-2. *Percent of forest area over and under 80 years of age, THLB and non-THLB, 1950–2050. THLB is the timber harvesting land base.*

Why is this important?

Maintaining a mix of forest ages at the landscape scale supports a variety of habitats for plants and animals through time and enhances the capacity of ecosystems to recover from disturbances.

State and trend

- Fire, insects, and diseases affect forest age structure across the province, but timber harvests affect the age of forests primarily on the timber harvesting land base (THLB).
- From 1951 to 2000, the proportion of forests over 80 years of age increased on both the THLB and the non-THLB (non-commercial and explicitly reserved forests). Effective fire suppression allowed the aging of large areas of lodgepole pine that originated due to wildfires in the late 1800s (see Indicators 1-2 and 1-3).
- Over the next 50 years, a decrease in the proportion of forests over 80 years of age is forecast on the THLB, caused by increased harvesting and mountain pine beetle-caused mortality in pine forests.
- In contrast, ongoing aging is forecast for forests on the non-THLB until 2050, when modelling suggests that 90% of these forests could be over 80 years old. The result will be altered wildlife habitats and susceptibilities to fire, insects, and diseases.

Information

- Past and future forest age structures were modelled with the federal government's national carbon budget model, using forest inventories for 2000.
- The model treated all insect disturbances as partial disturbances—forests with a mix of tree species continue to age after mountain pine beetle kills all the pine. This modelling is inaccurate for pure pine forests if all trees are killed and does not reflect accelerated silvicultural treatments or climate change impacts.
- References: MFR's VRI; CFS's CBM-CFS2
- Related international and national indicators
- MP 1.1.b, 2.a CCFM 1.1.1

3-3 How Are the Main Dynamics Changing Forest Biomass?

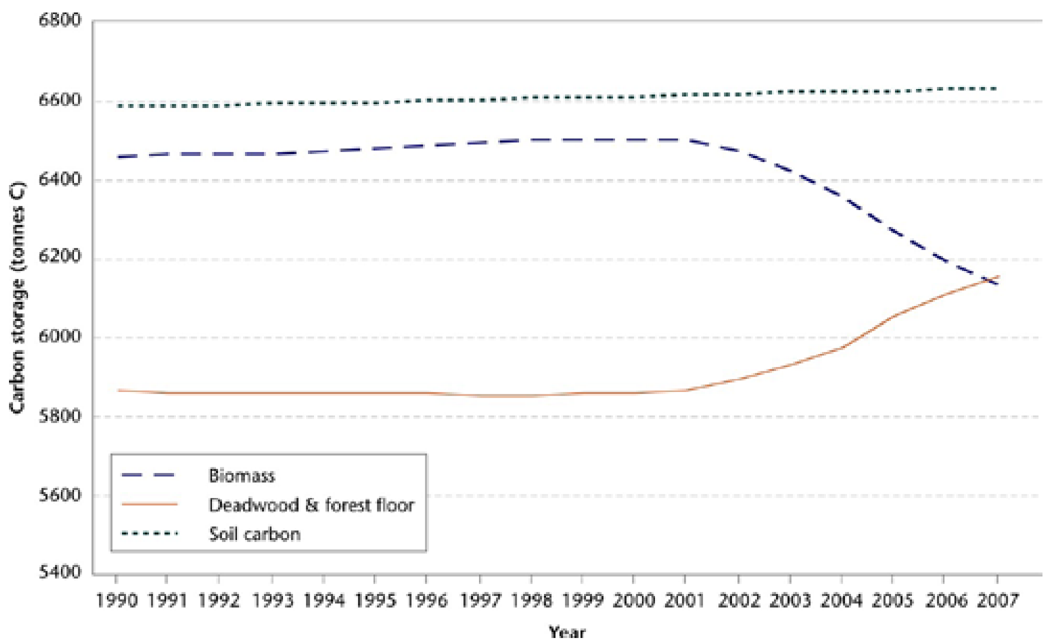


Figure 3-3. Carbon stock in three biomass pools (live biomass, deadwood and forest floor, and soil carbon),1990–2007.

Why is this important?

Changes in forest biomass imply changes in ecosystem function, stability, and resilience.

State and trend

- The quantity of living vegetation in an ecosystem can be expressed as the amount of carbon in above-ground and below-ground biomass. The quantity of dead organic matter is also important.

- In B.C.'s ecosystems, tree biomass amounts to about 34% of total ecosystem carbon, the rest being present in soil, deadwood, the forest floor, and other vegetation. Merchantable parts of trees amount to about 10% of total ecosystem carbon.
- Provincially, the proportion of total ecosystem carbon in the tree biomass pool has declined steadily since 2000 while the proportion in the deadwood and forest floor pool has increased. This is a function of the mountain pine beetle epidemic, wildfires, and associated salvage harvesting.
- Wildfires and harvesting decrease total ecosystem carbon by directly removing carbon from forest ecosystems. Harvests have the biggest impact on total ecosystem carbon.
- Mountain pine beetle and other insects and diseases affect total ecosystem carbon indirectly. They change biomass to dead organic matter with no immediate effect on total ecosystem carbon. This leads to increased carbon release from decomposition, and decreases carbon absorption from the atmosphere.
- The soil carbon pool is exhibiting a slow but steady increase.
- Total ecosystem carbon in B.C.'s forest ecosystems increased from 1951 to 2050 in the scenario used for Indicator 3-2. On the non-THLB, total ecosystem carbon increases 18% from 1951 to 2050 but is relatively stable on the THLB. A decrease of about 5% of total ecosystem carbon from 2000 to 2050 is caused by harvesting replacing older forests with second-growth forests.

Information

- There is considerable uncertainty about climate change impacts on growth and decomposition rates as well as on disturbance regimes. The model may be overestimating carbon increases before 2000.
- Information on the impacts of diseases is limited.
- References: MFR's VRI; CFS's CBM-CFS2

Related international and national indicators

- MP 2.b, 5.a CCFM 2.1, 4.1.2

3-4 How Fragmented Are B.C.'s Forest Ecosystems?

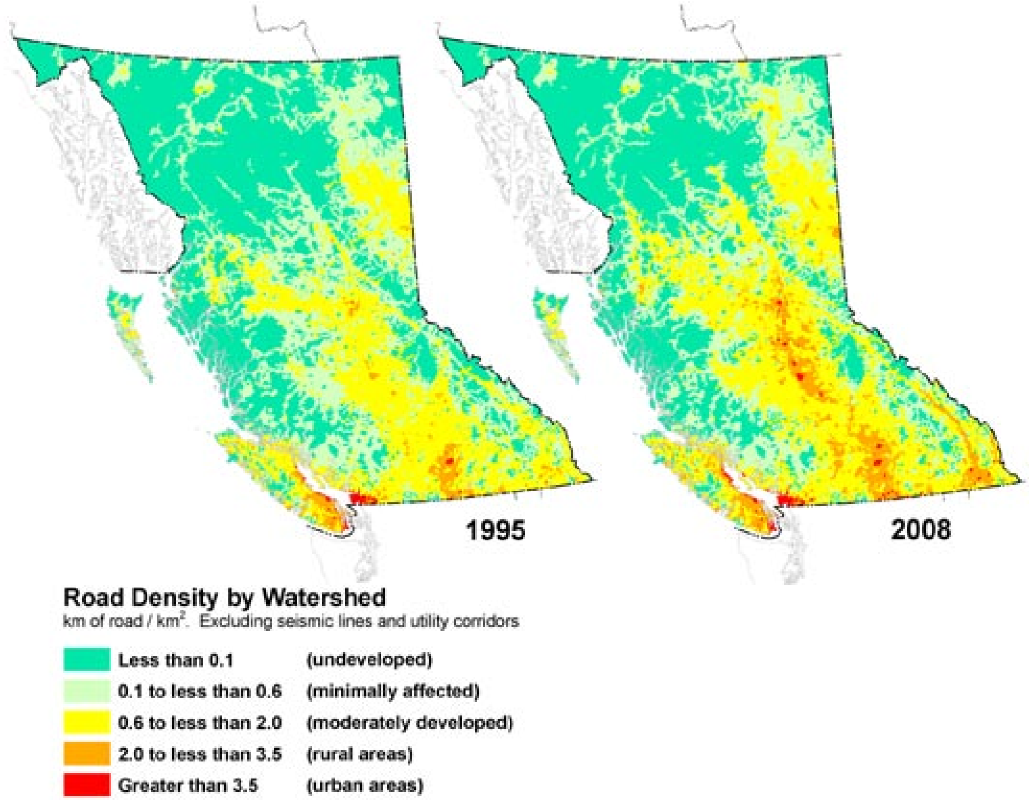


Figure 3-4. Road density by watershed, 1995 and 2008.

Why is this important?

Fragmentation of forests disrupts ecosystem function, reduces habitat quantity and quality, and reduces populations of some species.

State and trend

- Road density is a common indicator of fragmentation and related human activities. Roads can cause a direct loss of habitat, degrade habitat quality, reduce the size of habitat patches, create barriers that isolate populations, reduce habitat use because animals avoid related noise and activity, decrease populations through road kills and increased legal and illegal hunting, and help disperse predators and invasive species.
- The road density categories shown represent areas that are (1) undeveloped, without roads, (2) minimally affected by few roads, (3) moderately developed, (4) rural areas, and (5) urban areas.
- From 1995 to 2008, road density increased in many of B.C.'s watersheds.[6] Road density is highest in the CDF biogeoclimatic zone, followed by the warm, dry Southern Interior zones PP, BG, and IDF.[7]

- Undeveloped watersheds covered an estimated 52% of B.C. in 1982 and 38% in 2008, and will cover an estimated 33% in 2021. Over the long term, 18% of the province is expected to remain undeveloped due to protection status or remoteness.
- Undeveloped and minimally affected watersheds combined covered an estimated 84% of B.C. in 1982, an estimated 62% in 2008, and will cover an estimated 53% in 2021.
- Although access to some remote forest roads has been removed or restricted since 1995, other developments such as seismic lines for oil and gas exploration cause additional fragmentation, especially in northeastern B.C.
- Large areas away from all developments (regardless of watershed locations), called intact areas, are important habitat for wildlife. See related Indicator 16-1.

Information

- Province-wide road data were systematically collected by government in the 1980s, and updated for about 34% of the province during the 1990s. Since then, voluntary contributions from industry have provided updates, but it is not known where road information is complete or incomplete. Accurate estimates of some road parameters are available from statistical sampling (see Indicators 8-3 and 16-1) using the National Forest Inventory photo-plot grid.[8]
- References: MAL's LRDW

Related international and national indicators

- MP 1.1.c CCFM (none)

Summary and Assessment

State

B.C.'s varied forest ecosystems have evolved with disturbance by fire, insects, and diseases. Forest management over the last 50 years has suppressed some of these disturbances and introduced increasing levels of disturbance from timber harvesting, especially in certain ecosystem types. On balance, the amount of forest over 80 years old is greater now, as is total ecosystem carbon. The current epidemic of mountain pine beetle has, however, created an unprecedented level of disturbance in some areas that is impacting aspects of environmental, economic, and social sustainability. Ecosystem fragmentation has increased, but substantial areas still exist that are undeveloped or only minimally affected by roads.

Trend

Fire suppression, timber harvesting, insects, diseases, and climate change are altering ecosystem dynamics across the province. Their combined effects are not easy to anticipate and, as in the case of the mountain pine beetle, can have catastrophic impacts. The changing proportions and geographic distribution of forests over and under 80 years of age can be expected to have various known and currently unknown impacts on ecosystem function. In combination with climate change, this is changing susceptibility to wildfires, insects, diseases, and invasive species. Increasing impacts from these agents can be expected, resulting in increasing levels of ecosystem fragmentation.

Information

Locations of historic wildfires and many insect outbreaks are well documented. Their impacts on timber volumes are less well known, as are the locations and impacts of tree diseases. A detailed and complex model of provincial-level forest ecosystem dynamics is available, and while scientists now know some of the original assumptions were not correct, the model and data are constantly being improved. Systematic, province-wide inventories of roads are not available, so monitoring of ecosystem fragmentation will need to rely on remote sensing (e.g., satellite imagery) or statistical sampling. Climate change is known to be occurring in B.C., but the nature of the change is variable and its likely impact on forest ecosystem dynamics, temporally and spatially, is hard to predict.

4 Species Diversity

Species diversity encompasses the number of species and the distribution of their populations and individuals.

Mountain caribou

Western yew – MFR

Spawning salmon

Why is this important?

Conserving species diversity is a fundamental goal of sustainable forest management. Changes in species diversity can affect ecosystem productivity and stability. Species at risk, especially culturally important species, have a high public profile.

Overview

- Species diversity encompasses the number of species (species richness) and the distribution of their populations and individuals.[1]
- B.C. has high species diversity with more vascular plants than neighbouring provinces and states and more than 70% of Canada's bird species.
- Roughly one-third of the plant and animal species native to B.C. are associated with forest ecosystems.
- Of B.C.'s 1,345 forest-associated plant and animal species, 116 (8.6%) are red-listed.
- Most of B.C.'s forest-associated species have healthy populations. Some populations and distributions are changing, and some are at risk.
- Among the measures taken to protect and assist wildlife, B.C. has zoned 65 areas (6.2 million hectares) as ungulate winter range and 1,186 areas (1.0 million hectares) as wildlife habitat area.

Questions about species diversity

4-1: How many species are forest-associated?
4-2: How many forest-associated species are at risk?
4-3: Are populations of selected forest-associated species changing?
4-4: Are areas managed to provide critical wildlife habitat?
4-5: Are tree species before and after timber harvests similar?
▶ Summary and assessment

Related indicators

- Pressures on species diversity include land use changes, invasive species, fires and fire suppression, logging, human access, and climate change (see Ecosystem diversity; Exotic species; Ecosystem dynamics; Timber harvest; Recreation, tourism, and visual quality; Forest carbon and greenhouse gases).
- Changes in species diversity may affect ecosystem dynamics and functions, economic opportunities, enjoyment of nature, and cultural traditions (see Ecosystem dynamics; Forest products and the economy; Recreation, tourism, and visual quality; First Nations involvement).
- Management responses include protected areas (see Protected forests), other habitat protection tools (e.g., wildlife habitat areas and ungulate winter ranges), species recovery programs, and ecosystem restoration (see Rangeland).

4-1 How Many Species Are Forest-associated?

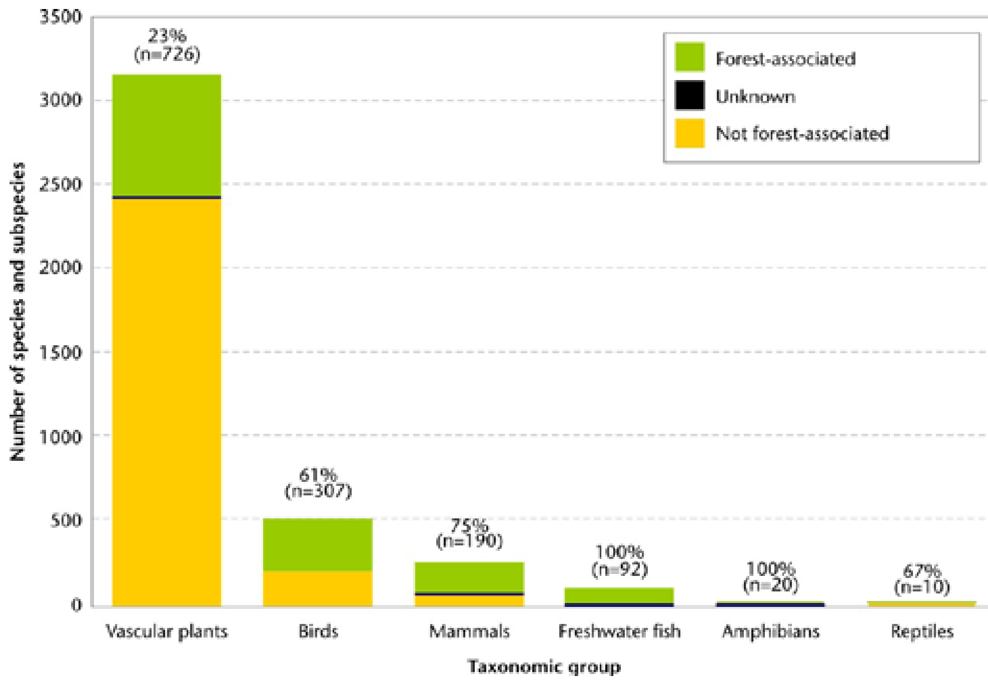


Figure 4-1. *Number of species that are forest-associated and not forest-associated by taxonomic group, 2008 (vascular plant and animal species only). In each taxonomic group, the percent and absolute number of forest-associated species are shown.*

Why is this important?

Forest management changes the habitats that forest-associated species depend upon.

State and trend

- B.C.'s forest ecosystems provide habitats for many plants, vertebrates, invertebrates, lichens, and fungi. A forest-associated species is known to either depend on, or make some use of, forest ecosystems.
- Among B.C.'s 3,148 vascular plant and 887 non-marine vertebrate species, 1,345 (33%) are forest-associated, including 726 vascular plants, 307 birds, 190 mammals, 92 freshwater fish, 20 amphibians, and 10 reptiles.
- Of these forest-associated species, 473 (35%) are known to be associated with old-growth forests.
- Standing or fallen, dead or dying trees (wildlife trees and coarse woody debris) are used for food, nesting habitat, or shelter by 83 birds, 58 mammals, 12 amphibians, and 1 reptile.
- Many streams that support freshwater fish species depend on forested riparian areas and large organic debris in stream channels for channel stability,

erosion control, creation of pools and riffles, shading, and temperature modification.
- See Indicator 4-3 for population trends of selected forest-associated species.

Information

- Extensive information is readily available for some taxonomic groups (e.g., vertebrates and most vascular plants).
- Information is available but incomplete for non-vascular plants, invertebrates, lichens, and fungi.
- The Resources Information Standards Committee (RISC) develops standards for field inventory of plants and animals in British Columbia.
- Relatively few species are regularly and systematically inventoried.
- References: MOE's SEE, IWMS, RISC, CDC; MFR's WTC; UBC's E-Flora BC; NatureServe; Wild BC

Related international and national indicators

- MP 1.2.a CCFM (none)

4-2 How Many Forest-associated Species Are at Risk?

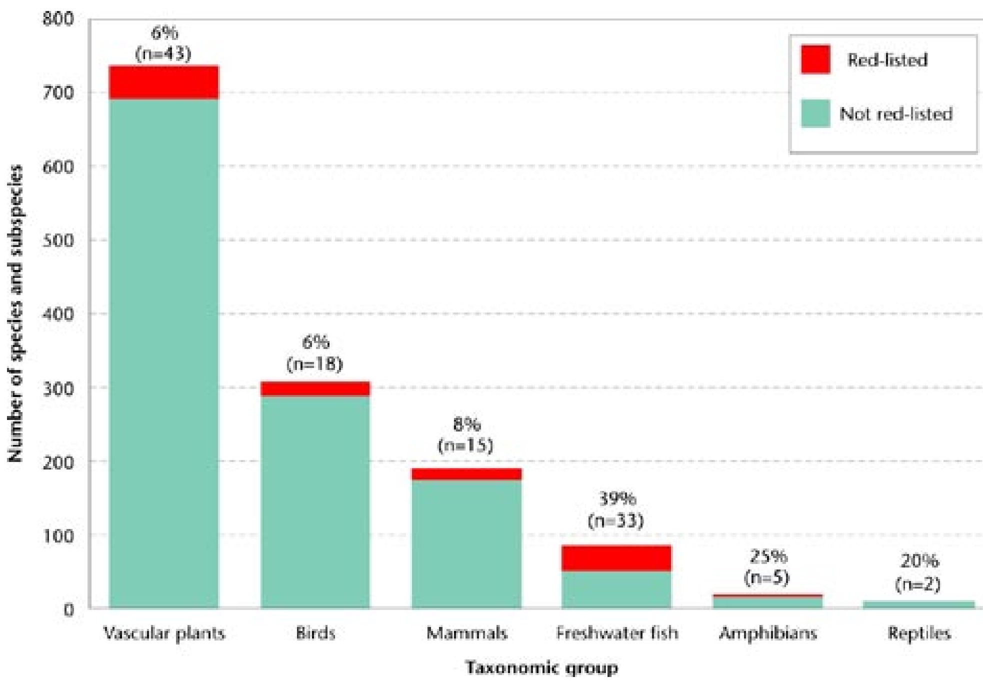


Figure 4-2. *Number of forest-associated species that are red-listed and not red-listed, by taxonomic group, 2008. Vascular plant and animal species only. In each taxonomic group, the percent and absolute number of red-listed species are shown.*

Why is this important?

Local extirpation of species can affect ecosystem processes and economic opportunities. Global extinction of species is irreversible.

State and trend

- Ranking the risk of extinction helps to guide conservation efforts. Various provincial, national, and international lists of species are based on increasing degrees of scientific scrutiny and data to confirm status.
- The B.C. Conservation Data Centre's Red List currently contains 116 (8.6%) of the forest-associated species (vascular plants and vertebrates). This includes 43 vascular plant species, 40 vertebrate species (birds, mammals, amphibians, and reptiles), and 33 freshwater fish species that are extirpated, endangered, or threatened in British Columbia. A further five species are extinct.
- The majority of the forest-associated red-listed species occur in the CWH, CDF, and IDF biogeoclimatic zones. Timber harvesting, agriculture, exotic species, and urbanization are major threats to some of these species.[2]
- Some red-listed species, such as the Northern Goshawk (coastal subspecies *laingi*) and phantom orchid, are naturally rare. Others, such as the White-headed Woodpecker and mountain beaver, are at the northern limits of their natural range and are rare in B.C. but are more abundant outside the province.
- Further investigation is required after a species is red-listed. This may or may not lead to formal designation and explicit management measures.
- The provincial *Forest and Range Practices Act* provides specific habitat protection (e.g., wildlife habitat areas, ungulate winter ranges) for "Identified Wildlife", which currently include 63 vertebrates (species, subspecies, or populations), 5 invertebrate species, 2 plant species, and 15 plant communities.
- The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) currently lists over 55 of B.C.'s forest-associated species as endangered or threatened, with some protection for these species and their residences (e.g., a nest or den) afforded under the federal *Species at Risk Act* (SARA).
- See Indicator 4-3 for population trends of selected forest-associated species.

Information

- Changes in number of species listed and in rankings (greater or lesser risk) do not reliably indicate trends due to factors other than risk status, such as large-scale ecosystem changes or climate change.
- References: MOE's CDC, SEE, IWMS, Recovery Planning; MFR's BEC; Government of Canada's COSEWIC, SAR; NatureServe; IUCN

Related international and national indicators

- MP 1.2.b		CCFM 1.2.1

4-3 Are Populations of Selected Forest-associated Species Changing?

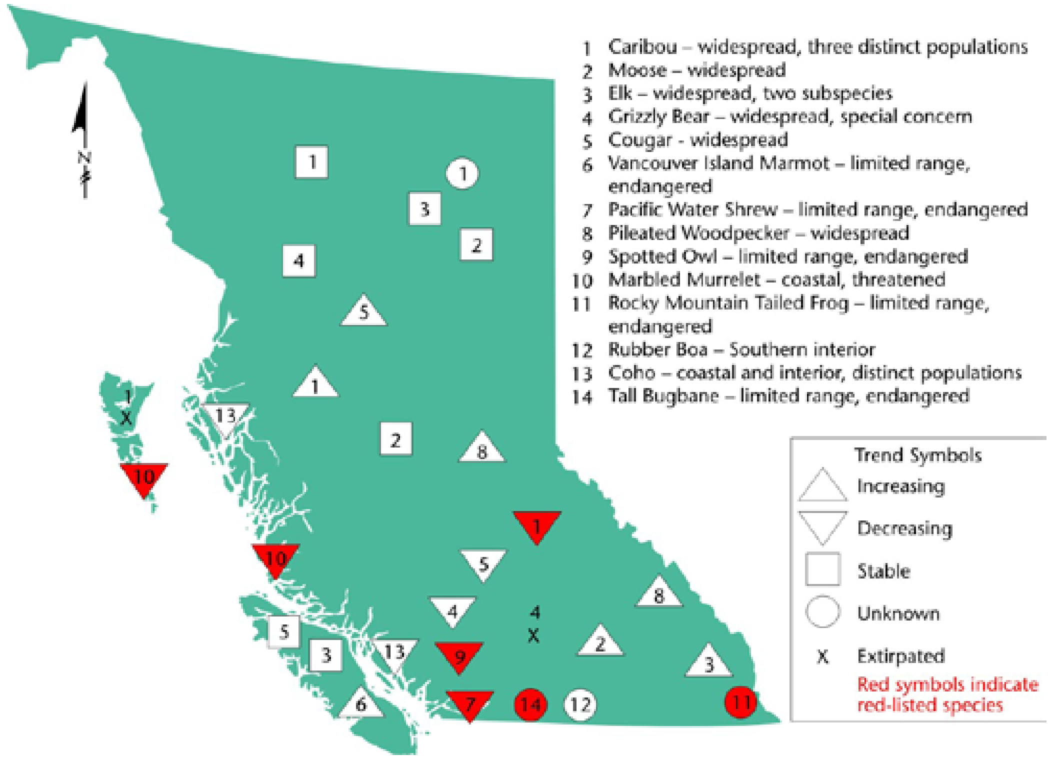


Figure 4-3. *Population trends of some forest-associated species.*

Why is this important?

Changes in populations and ranges may reflect evolutionary change or ecological dysfunction, and can affect economic uses and social traditions.

State and trend

- From a list of 105 species selected for their ecological, economic, or social significance, and to represent a variety of taxonomic groups, 14 species are presented here to illustrate the variety of population trends.
- Among widespread species, caribou, moose, elk, grizzly bear, and cougar have locally varying population trends. Some local populations are increasing or have expanding ranges; others are stable, declining, or at risk, and a few have been extirpated (for example, the Dawson caribou, last observed on the Queen Charlotte Islands in 1908).
- Pileated Woodpeckers appear to be increasing. The tree cavities created by this keystone species are used by other species for nesting, shelter, and feeding.
- Along the Coast, stocks of coho salmon have declining spawning abundance.

- Among rare species with limited ranges, both Vancouver Island marmot and Spotted Owl are endangered. While Spotted Owl populations are decreasing, Vancouver Island marmot populations are increasing as a result of captive breeding and reintroduction efforts.
- Although few or no population trend data exist for many species such as Pacific water shrew, Marbled Murrelet, Rocky Mountain tailed frog, rubber boa, and tall bugbane, their habitat is known to be declining in quantity and quality due to logging, urbanization, and agriculture.

Information

- Population trends are known for relatively few species. Most vascular plant and vertebrate species have not been systematically inventoried.
- References: MOE's SEE, IWMS, CDC, Recovery Planning; Government of Canada's COSEWIC; NatureServe; BBS

Related international and national indicators

- MP 1.3.a, 1.3.b   CCFM 1.2.2, 1.2.3

4-4 Are Areas Managed to Provide Critical Wildlife Habitat?

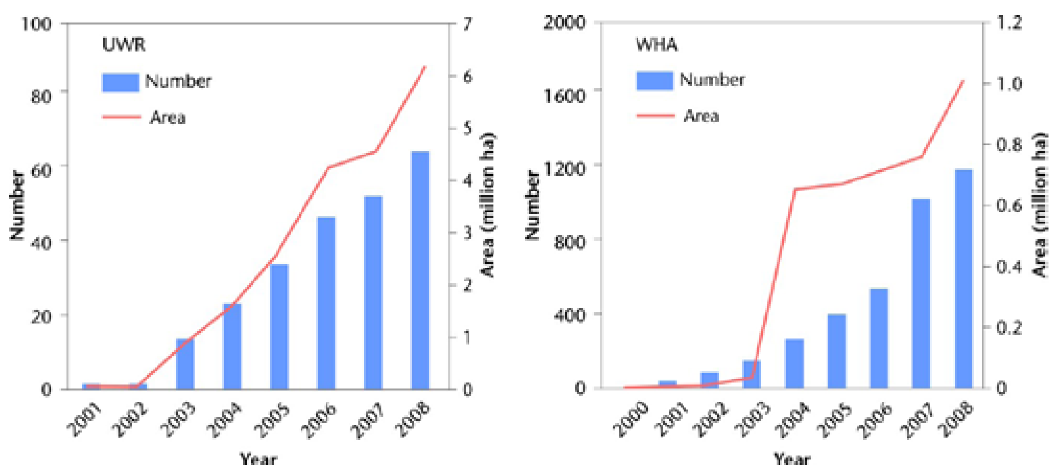


Figure 4-4. *Number and area of legally designated ungulate winter range (UWR) and wildlife habitat area (WHA) special management areas, 2001–2008.*

Why is this important?

One important way to help sustain wildlife populations is to designate areas where the primary management objective is to provide critical habitat.

State and trend

- In B.C., a variety of measures are taken to support wildlife populations, including identifying and specially managing critical wildlife habitat.

- Wildlife habitat areas (WHAs) and ungulate winter ranges (UWRs) are special management areas. To conserve and manage habitat for species at risk, and to provide for the winter habitat requirements of ungulates, the Province can establish WHAs and UWRs, respectively, on Crown lands. By law, forest operations are limited in these areas.
- Since 2001, the number and area of approved WHAs and UWRs have generally increased each year.
- In 2008, 153 WHAs comprising approximately 245,000 hectares of suitable habitat were approved for a variety of species such as caribou, grizzly bear, Marbled Murrelet, Spotted Owl, Williamson's Sapsucker, coastal tailed frog, and western rattlesnake. Also in 2008, 12 UWRs comprising about 1.5 million hectares were approved for ungulates, including mountain goat, caribou, moose, elk, and deer.
- By 2008, a total of 65 UWRs (totalling 6.2 million hectares) and 1,186 WHAs (totalling 1.0 million hectares) had been established in B.C.
- In addition to WHAs and UWRs, a variety of other reserves, retention, and special management areas (e.g., old growth management areas, riparian reserve zones, and wildlife tree retention) protect important habitat.

Information

- Areas with UWR or WHA designation are tracked by MOE.
- References: MOE website[3]

Related international and national indicators

- MP 1.2.c CCFM (none)

4-5 Are Tree Species before and after Timber Harvests Similar?

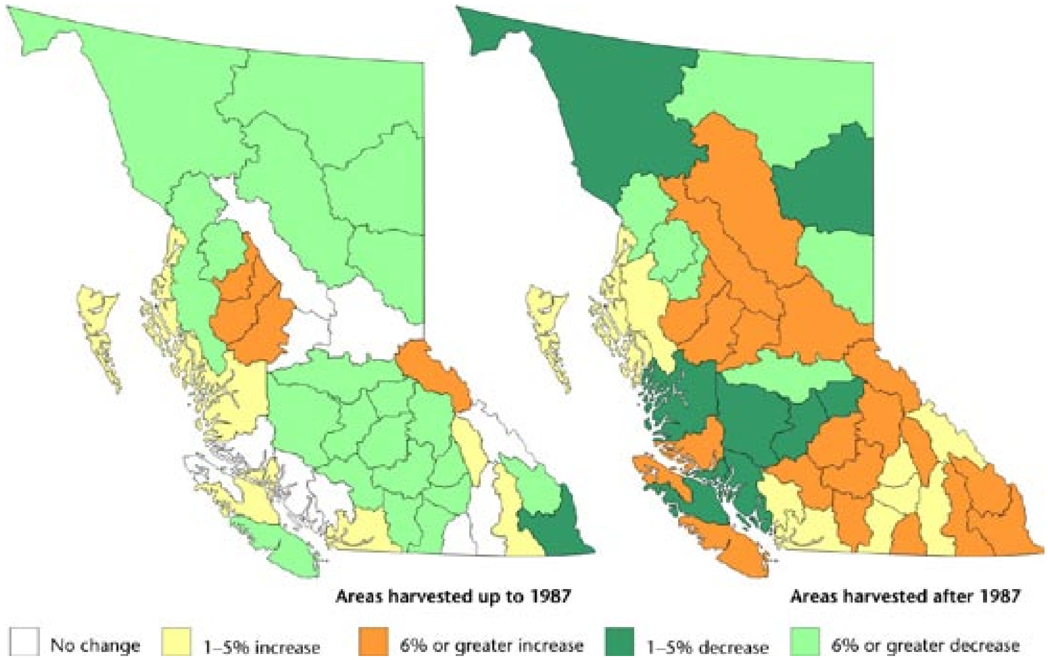


Figure 4-5. *Change in the area dominated by a single tree species, by timber supply area, for areas harvested up to 1987 and after 1987.*

Why is this important?

Reducing the number of tree species may decrease biological diversity and ecosystem resilience. Future biological and economic value of forests may be increased or inadvertently decreased.

State and trend

- Most of B.C.'s forests have a mixture of two or more tree species. About one-quarter to one-third are dominated by a single tree species (such as lodgepole pine, Douglas-fir, or spruce) that accounts for more than 80% of timber volume before harvest.
- The area dominated by one species before timber harvest can change after harvesting and reforestation. Management practices (such as replanting with a single species or herbicide application to control broad-leaved trees) and natural stand dynamics (such as natural ingress and succession) can lead to an increase or decrease in the extent of stands dominated by single species. Partial information suggests that the extent of dominance has changed since 1987.
- In areas harvested up to 1987, coniferous forests with one dominant tree species decreased from 33% before harvest to 25% after harvest. Broad-leaved forests increased from 0% before harvest to 5% after.

- In areas harvested after 1987, coniferous forests with one dominant tree species increased from 25% before harvest to 34% after harvest. Broad-leaved forests increased from 1% before harvest to 4% after.
- Changes in area of predominant species before and after harvest (both time periods combined) include lodgepole pine (35–33%), spruces (29–23%), true firs (3–9%), hemlock (6–4%), Douglas-fir (16–16%), western redcedar (3–2%), and aspen (0–2%). These pre- and post-harvest trends are a function of the harvest profile, species stocking preferences and ecological/site suitability, and landscape-scale disturbance agents (e.g., insects, wildfire).[4]

Information

- Species data before and after harvest are currently available for 57% and 11%, respectively, of the areas harvested from 1970 to 1987 and after 1987.
- Reference: MFR's RESULTS

Related international and national indicators

- MP (none)   CCFM (none)

Summary and Assessment

State

British Columbia has exceptional species diversity, much of it forest-associated. Among the 1,345 forest-associated vascular plant and terrestrial vertebrate species, 116 (8.6%) are red-listed (extirpated, endangered, or threatened). The majority of these species are found in the CWH, CDF, and IDF biogeoclimatic zones. Timber harvesting, agriculture, and urbanization are major threats to some of these species. Maintaining ecosystem representation, including old-growth forests, both in and outside protected areas, will help meet the habitat requirements of a wide range of species (both at risk and not at risk). In addition, reforesting with a mix of tree species will help maintain ecosystem processes and diverse habitats.

Trend

Populations and ranges of some opportunistic species such as white-tailed deer have expanded, while declining habitat quantity and quality has reduced populations of other species (e.g., Williamson's Sapsucker), in some cases putting them at risk. The extinction of five species in the province to date was not related to forestry. Forest management is, however, implicated (along with climate change, urbanization, agricultural development, and activities related to roads and other linear access) in the status of some endangered species. To halt this trend, management responses have increased over the past two decades, and to date include approximately 60 species recovery strategies,[5] captive breeding and reintroduction programs, protected forests (7.6 million ha), protection of other forest habitats, establishment of old growth management areas, and establishment of wildlife habitat areas and ungulate winter ranges (7.2 million ha). Partial data (for 11% of areas harvested) indicate that since 1987, reforestation may be increasing the extent of forests dominated by a single tree species. In some areas, this trend has been stopped (by encouraging mixed species stocking), due to concerns about ecosystem health, resilience, and species diversity.

Information

Taxonomic cataloguing and description of B.C.'s species and their life cycles are extensive for vascular plants and vertebrate species, and less so for non-vascular plants, invertebrates, lichens, and fungi. Populations and population trends are known only for the relatively few species that are regularly and systematically inventoried. Inventories of mosses and lichens are generally lacking. Several sources rank the conservation status of B.C.'s species. Changes in conservation status may be due to changes in knowledge, procedures, inventory effort, and taxonomy, rather than a species' actual population condition; consequently, trends in the number of species at risk should be interpreted with some degree of caution.

5 Exotic Species

As trade between B.C. and its national and international partners increases, so does the risk of introduction of invasive alien species.

Invasive plant herbicide treatment crew

White pine blister rust

Marsh plume thistle

Why is this important?

Invasive alien species pose a significant threat to biodiversity and many social and economic values provided by B.C.'s forest and rangelands.

Overview

- The term "exotic species" refers to organisms that have been introduced from another geographic region to an area outside their natural range.[1]
- Invasive alien species and non-indigenous species fall within the exotic species definition. Exotic species are plants, animals, insects, and micro-organisms that, when introduced outside of their natural range, can spread causing serious and often irreversible damage to native ecosystems.
- Invasive alien species can originate from other continents, from neighbouring countries, or from other ecosystems within Canada.
- British Columbia's physical and ecological diversity provides a wealth of opportunities for invasive alien species to establish, acclimatize, and expand.
- To alleviate the risk of continued or future invasive alien species introductions, effective control measures have to consider the multiple pathways of introduction, early detection networks, rapid response capabilities, inventory information, and multi-jurisdictional containment and control strategies.
- The lack of knowledge on invasive alien species often impedes or slows control measures.
- In B.C., 124 insect, 4 plant disease, and 144 plant invasive alien species associated with forest and rangelands have been identified.

- Over 145,000 hectares of Crown forest and rangeland are infested with invasive alien plant species.
- A variety of measures are taken to control exotic species. In 2008, 3,809 sites on Crown forest and rangeland were treated to control invasive alien plant species.
- The planting of exotic tree species on Crown forest land is tightly regulated and highly constrained. Virtually no exotic forest tree species are planted on Crown forest land.

Questions about exotic species

5-1: How many invasive alien forest and range-associated species are established in British Columbia?
5-2: How much area is occupied by invasive plant infestations in British Columbia?
5-3: What treatments are being done to limit establishment or spread of invasive alien species?
5-4: How many hectares of Crown land have been planted with exotic forest tree species in British Columbia?
▶ Summary and assessment

Related indicators

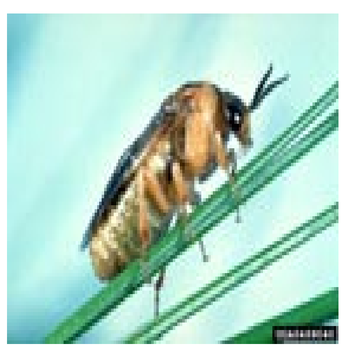
- Many factors can support the introduction and spread of invasive alien species, including land use changes, forest and range activities, tourism and trade (see Recreation, tourism, and visual quality).
- The presence of invasive alien species in British Columbia's forests, forest products, and agricultural products could lead to restrictions on exports (see Forest products and the economy).
- Establishment and spread of invasive plant species may affect ecosystems, species diversity, economic opportunities, enjoyment of nature, and cultural traditions (see Species diversity, Rangeland).

5-1 How Many Invasive Alien Forest and Range-associated Species Are Established in B.C.?

4 Diseases

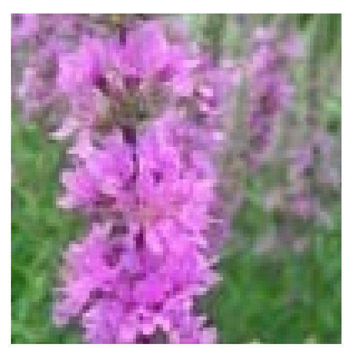
Dogwood anthracnose

124 Insects



Pine saw fly

144 Plants



Purple loosestrife

Why is this indicator important?

Established invasive alien pests (disease, insect, or plant species) threaten populations and habitats of native forest species.

State and trend

- Trade between British Columbia and its national and international partners is increasing, and so is the likelihood of the introduction of invasive alien species.
- Because of the scale at which invasive alien species introductions can occur, the prospect of completely removing them, or even containing them, is very poor.
- Preventing the establishment of new invasive alien species through implementing best management practices, effective early detection activities, and rapid response treatments are the most cost-efficient and effective ways of addressing these species.

Diseases

- There are four established invasive alien forest-associated diseases in British Columbia: *Discula destructive* on dogwood; *Lachnellula willkommii* on larch; *Venturia saliciperda* on willow; and *Cronartium ribicola* on pine.
- White pine blister rust (*Cronartium ribicola)* has caused widespread mortality of western white pine (*Pinus monticola)* and whitebark pine (*Pinus albicaulis)* throughout almost all of their natural populations.
- To maintain viable populations of western white pine, a provincial program to breed blister rust resistant white pine trees is ongoing.

Insects

- There have been 124 established invasive alien insect species identified from forest-associated plants in British Columbia. The extent of their distribution within the province and their impacts are largely unknown.

Plants

- There are 774 alien plant species in British Columbia, 144 of which have proven to be invasive in two or more ecosystems in the province. Sixty invasive alien plant species are listed in the *Forest and Range Practices Act*, the *Weed Control Act*, or both.
- The Inter-Ministry Invasive Plant Working Group and the Invasive Plant Council of British Columbia are developing a ranking protocol and risk assessment framework to define those species that pose the greatest threat in each biogeoclimatic zone.
- The trend in number of invasive alien plant species is increasing; however, historical baseline information is extremely limited.
- Invasive alien plants reduce crop yields by an average of 10–15%, and may reduce native forage production by up to 90% in some areas.

Information

- Information on diseases and insects cover the years 1900 to 1995 and is sourced from the Forest Invasive Alien Species database and document library, Canadian Forest Service; Forest Invasive Alien Species of Canada.
- Information on invasive alien plant species presence in the province is readily available but determination of "invasiveness" is inconsistent.
- The Inter-Ministry Invasive Plant Working Group and the Invasive Plant Council of BC are developing a ranking process to define invasive alien species priorities.
- References: British Columbia Ministry of Forests and Range Invasive Alien Plant Program; Government of Canada's Alien Species Strategy for Canada; E-Flora BC; Flora ID Northwest; Flora of North America; B.C. Conservation Data Centre

Related international and national indicators

- MP 3.a CCFM 1.2.4

5-2 How Much Area is Occupied by Invasive Plant Infestations in B.C.?

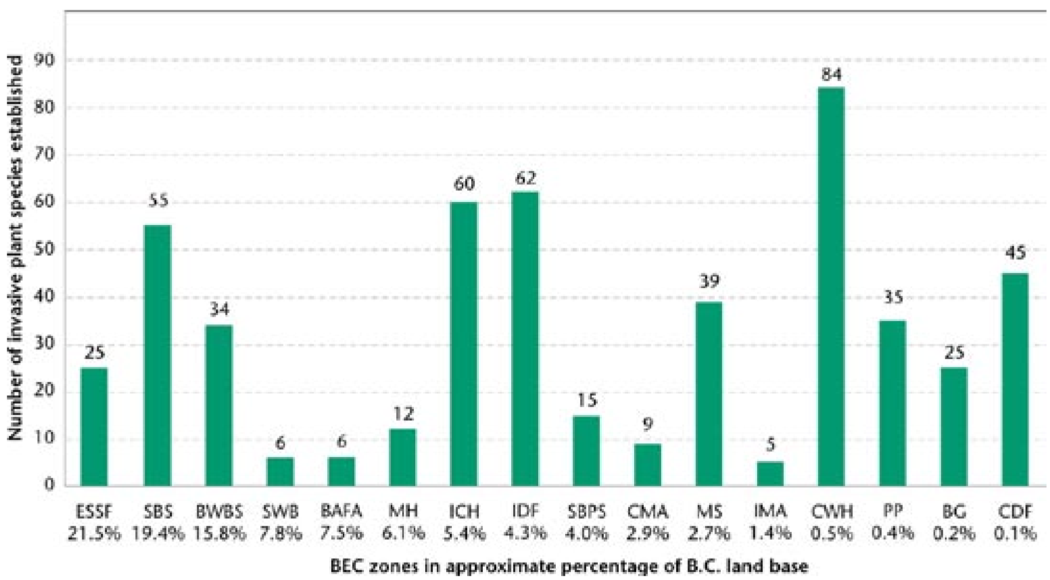


Figure 5-2a. *Number of invasive alien plant species established on Crown land, by biogeoclimatic zone, 2008.*

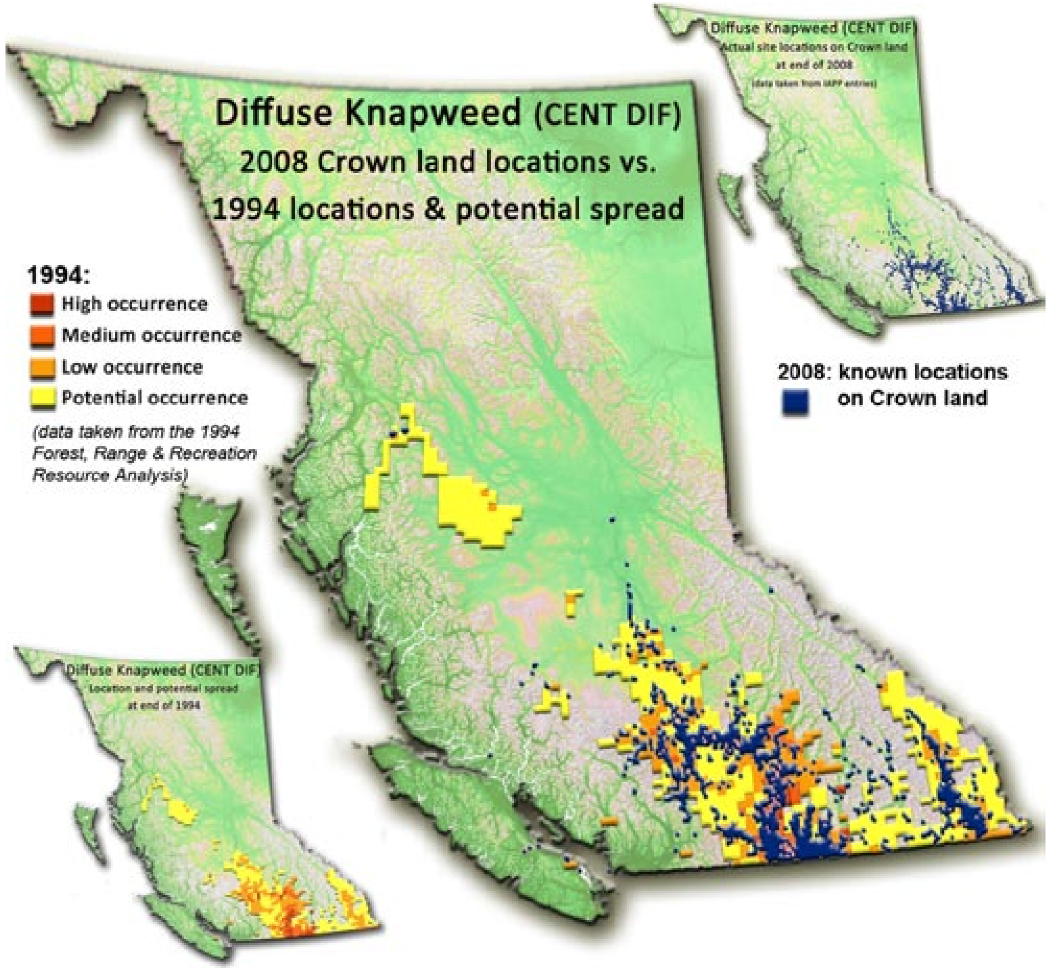


Figure 5-2b. *Occurrence and potential distribution of diffuse knapweed in 1994 and 2008.*

Why is this important?

Invasive alien plant infestations directly impact numerous resource values, including ecosystem diversity and function, species diversity, forage production, recreation, and water.

State and trend

- Invasive alien plant species that are widely distributed in the province will continue to expand to their ecological limits.
- Management objectives are to reduce the rate of expansion of priority invasive alien plant species and the resulting impacts on the environment, economy, and society.
- Tracking invasive alien plant species' population change over time is an indicator of success of containment strategies.
- Over 145,000 hectares of Crown forest and rangeland are currently reported as infested with legislated invasive alien plant species. However, inventory data are not complete for all invasive alien species; therefore, this total is probably conservative.

- Long-term data on the distribution of invasive alien plant species are only available for only five species: diffuse knapweed (*Centaurea diffusa*), spotted knapweed (*Centaurea biebersteinii*), Dalmatian toadflax (*Linaria genistifolia* ssp. *dalmatica*), leafy spurge (*Euphorbia esula*), and hound's-tongue (*Cynoglossum officinale*).
- Over time, the area on which these five species are established has increased. The trend in distribution for these five species is increasing. However, for most of these species, there has been a decrease in plant density as a result of implementing successful biological control measures.

Information

- References: Invasive Alien Plant Program

Related international and national indicators

- MP 3.a CCFM 1.2.4

5-3 What Treatments Are Being Done to Limit Establishment or Spread of Invasive Alien Species?

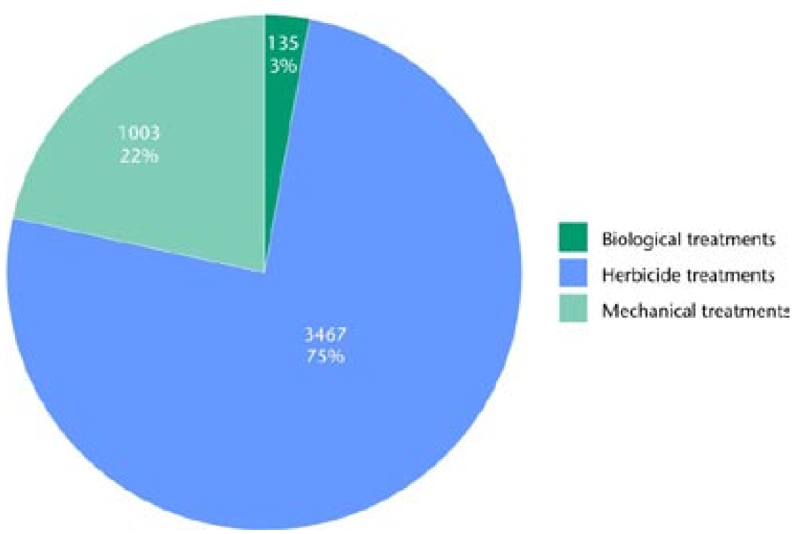


Figure 5-3. *Number of mechanical, herbicide, and biological control treatments on invasive alien plant species on provincial forest and rangeland completed in 2008.*

Why is this important?

Preventing establishment of new invasive alien plant species and containing the spread of those already in the province will reduce long-term impacts on forest and range-associated species, the economy, and human health.

State and trend

- Pest risk analyses are conducted to determine the appropriate preventative phytosanitary measures, methods of pest detection, and rapid response actions. These analyses are conducted collaboratively with federal, provincial, and local agencies.
- Effective and timely treatments minimize the long-term ecological, economic, and societal impacts posed by invasive alien species if left to expand unabated.
- To control problem species, an integrated pest management approach is used, which includes mechanical, manual, cultural, chemical, and biological control measures.
- Ministry of Forests, Mines and Lands implements eradication programs for gypsy moth (*Lymantria dispar*) when moths are detected, and the programs have successfully prevented the establishment of this invasive alien insect species.
- On-ground treatment activity for invasive alien plants steadily improved through 2006. In 2005, partnership approaches and pooling of resources with two invasive plant committees was tested, and this model has now expanded to six regions in the province. Collaborative partnership delivery of invasive plant management activities has furthered success.
- Provincial containment lines were first established in 2005 for two species: marsh plume thistle (*Cirsium palustre*) and field scabious (*Knautia arvensis*). In 2008, survey data and treatment results led to a reduction in the field scabrious containment line and an expansion of the marsh plume thistle containment line. These refinements assist multi-stakeholder planning and ensure future treatment actions are targeting sites that are threatening to spread outside of the containment line.

Information

- Information on all treatments completed targeting invasive alien plant species on Crown land is maintained and available through the Invasive Alien Plant Program application website.
- The database of the Invasive Alien Plant Program is available to any agency with a land management responsibility, including provincial, local, and municipal government, invasive plant committees, and clients. Treatment and planning data entered by partner agencies is available for others to view and consider, facilitating improved coordination of efforts.
- References: Invasive Alien Plant Program; Canadian Food Inspection Agency

Related international and national indicators

- MP (none)   CCFM (none)

5-4 How Many Hectares of Crown Land Have Been Planted with Exotic Forest Tree Species in B.C.?

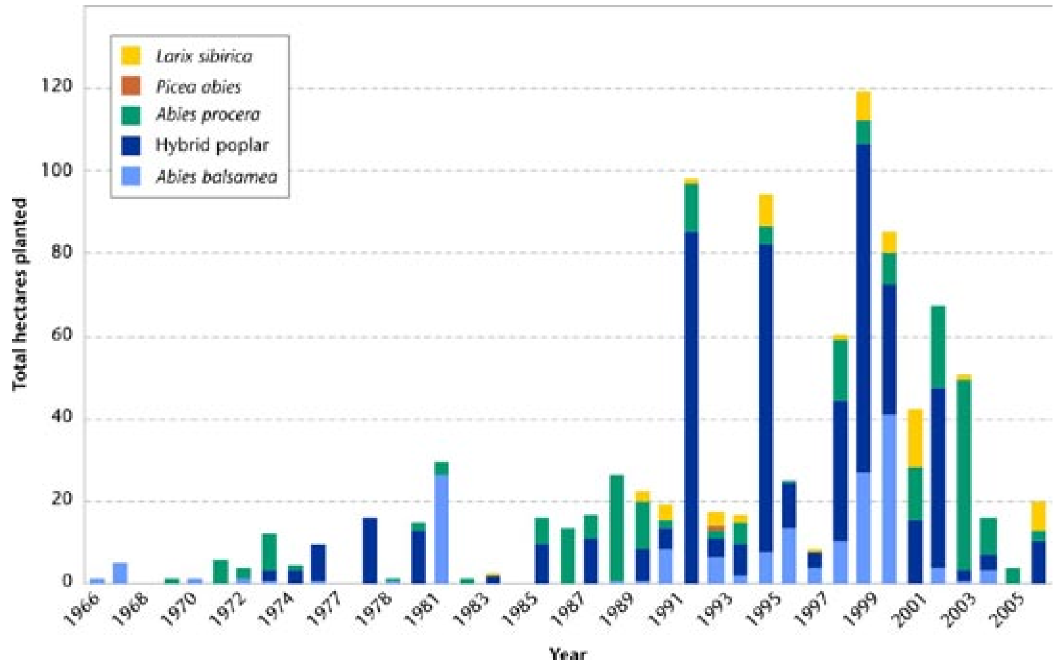


Figure 5-4. *Area of non-indigenous (non-B.C. source) forest tree species planted on Crown land, 1966–2005.*

Why is this important?

Some risk exists that exotic tree species could become invasive or hybridize with closely related indigenous species, leading to disruption of ecosystem processes.

State and trend

- Some fast-growing, non-indigenous tree species may offer benefits such as greater timber production on a smaller land base than indigenous species and may provide better adaptation to future climates. Many small, contained research trials are underway in B.C. to evaluate some of these species.
- The Chief Forester's Standards for Seed Use strictly controls the planting of non-indigenous (non-B.C. source) forest tree species (and populations) on Crown land. There are almost no plantations of exotic forest tree species on Crown land. On average, the area planted with exotic (non-indigenous, non-B.C. source; Figure 5-4) tree species amounts to less than 0.02% of the area of Crown land harvested annually.
- Certain well-tested provenances of noble fir, coastal Douglas-fir, Sitka spruce, and western white pine that originate from outside of British Columbia are permitted to be planted on Crown land. In addition, some exotic species, such as Siberian larch (*Larix sibirica*), are still being planted from seed registered prior to the Chief Forester's Standards for Seed Use coming into effect.

- Hybrid poplar is both grown from cuttings made in nurseries in B.C. and from cuttings brought in from other nurseries in Canada. The hybrid poplar trees are predominately planted in the Coast region, on both private and public land.

Information

- Although there are restrictions for Crown land, exotic forest tree species can be planted on private land.
- References: Chief Forester's Standards for Seed Use, RESULTS, SPAR

Related international and national indicators

- MP 2.c CCFM 1.2.4

Summary and Assessment

State

Of the different groups of invasive alien species (diseases, insects, and plants) discussed in this chapter, all contain examples of pests that are affecting and threatening forest and range environments, and the economy of British Columbia. Invasive alien species can become predators, competitors, parasites, hybridizers, and diseases of native and domesticated forest and range plants. The impact of invasive alien species on native ecosystems, habitats, and species can be severe and often irreversible.

Trend

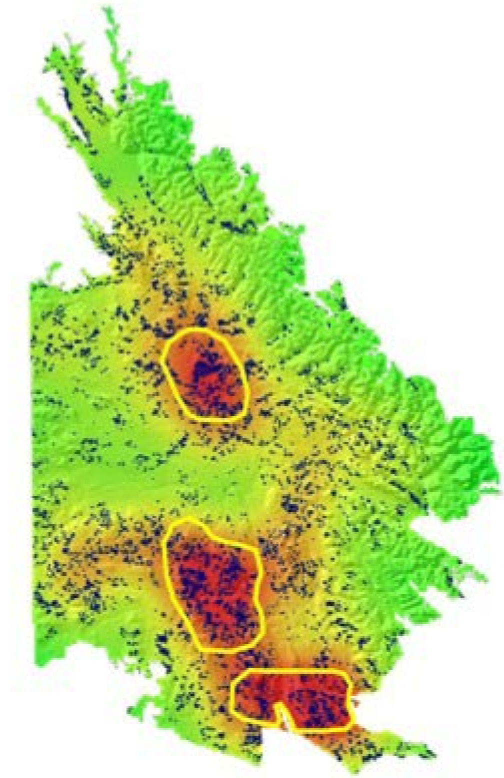
The introduction and spread of invasive alien species do pose a threat to British Columbia's environment and economy. International trade increases the probability of unintentional invasive alien species introductions. The trend in the number of alien species that are establishing in British Columbia is increasing; however, historical baseline information is extremely limited for invasive alien species.

Information

The lack of knowledge about invasive alien species often impedes or slows control measures.

6 Genetic Diversity

Genetic diversity is a fundamental element of biodiversity.



Seed deployment density mapping of silviculture openings by genetic source (red areas indicate orchard seed use) – Chen Ding

tions of lodgepole pine cones – Michael Carlson, MFR

Whitebark pine – Elizabeth Campbell, MFR

Why is this important?

Genetic diversity, a fundamental component of biological diversity, is required for adaptation and evolution.

Overview

- Genetic diversity is genetic variation within individual organisms, within populations, and among populations of a species.[1]
- Genetic diversity is a fundamental element of biodiversity. Genetic diversity plays an important role in the survival, adaptability, and productivity of species and populations.
- British Columbia's forests are genetically diverse, with over 49 native tree species that grow in a wide range of environmental conditions.
- Genetic resource management (GRM) of tree species in British Columbia is comprised of three components: conservation, resilience, and value.[2]
- Management of protected areas and sound reforestation practices support genetically adapted, healthy, and productive ecologically resilient forests.

- Among seedlings planted in harvested areas, the level of genetic diversity is high.
- Since the 1980s, the proportion of harvested area reforested by natural regeneration has declined, and the proportion regenerated by planting has increased. Increasingly since the 1990s, planted seedlings have been derived from seed produced in tree seed orchards where parent trees are bred to improve tree growth, quality, and health.

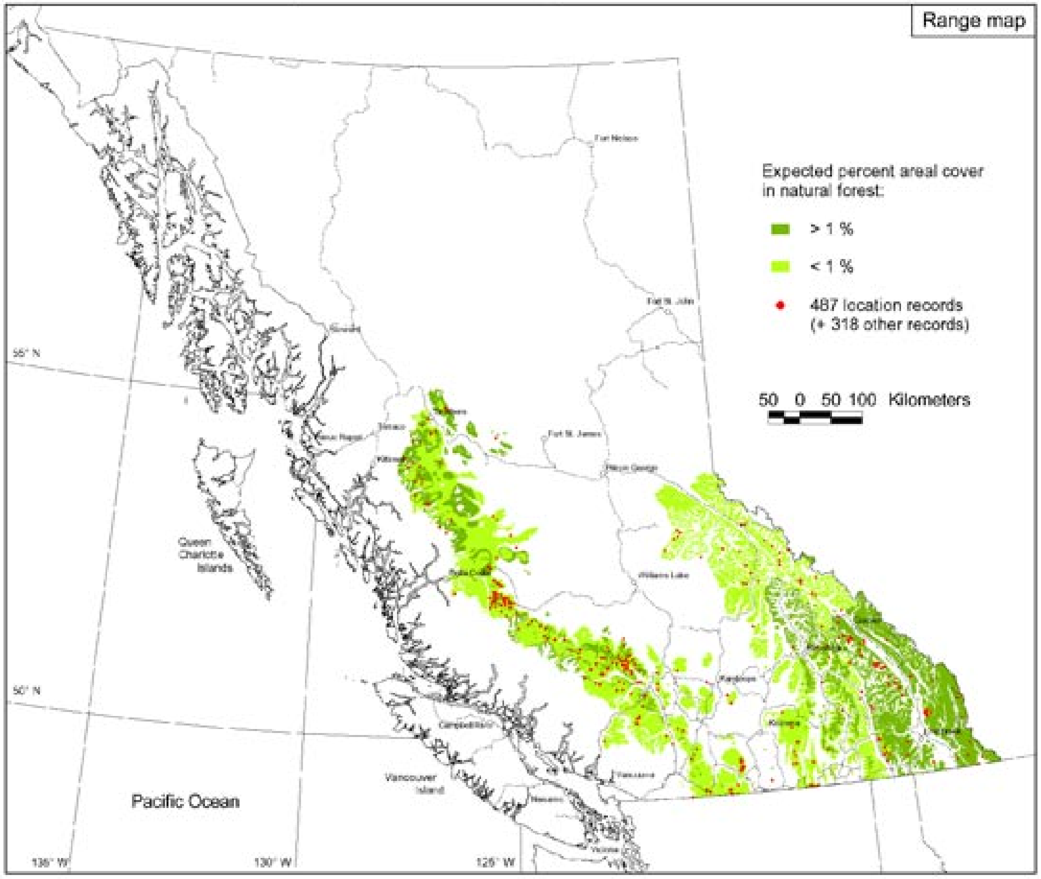
Questions about genetic diversity

6-1: How well conserved are the genetic resources of trees?
6-2: What level of genetic diversity exists in regenerated forests?
6-3: What is the proportion of forest regeneration by genetic source?
6-4: What is the extent and source of genetic variation in forest regeneration across the province?
► Summary and assessment

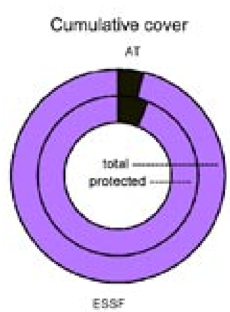
Related indicators

- Land use change, harvesting, natural disturbance, reforestation, and climate change may change the genetic diversity of tree species (see Ecosystem diversity, Timber harvest, Silviculture, Forest carbon and greenhouse gases).
- Seed use adaptation strategies may help mitigate the effects of climate change (see Forest carbon and greenhouse gases) and increase benefits from investments in tree improvement and reforestation (see Silviculture).
- Management responses include reserves (see Protected forests, Timber production forests), forest genetics research, tree breeding, seed use regulation, planting improved tree seedlings, and effectiveness evaluations (see Law).

6-1 How Well Conserved Are the Genetic Resources of Trees?



Conservation status



BEC Zone	Species range (ha)	Protected (%)	Number of reserves with cumulative cover > 2.5 ha	> 5 ha	> 10 ha	> 50 ha
AT	1,253,145	36.6	22	20	14	5
ESSF	6,596,628	23.7	72	61	51	33

Figure 6-1. *Example of genetic resource conservation information, whitebark pine.*

Why is this important?

Conservation of genetic resources maintains the capacity for local adaptation, and rare but potentially important genes for disease and pest resistance.

State and trend

- Protected areas provide *in situ* reserves that conserve locally adapted genetic resources. Most forest tree species in British Columbia are well represented in protected ecosystems. Representation in the number and size of protected areas varies by species, biogeoclimatic zone, and seed planning unit.
- Consider the example of whitebark pine (*Pinus albicaulis*; see Figure 6-1), a high-elevation species found in subalpine ecosystems throughout southern and central British Columbia. In 2001, whitebark pine was well protected throughout most of its range. In the AT (Alpine Tundra) zone 36.6%, and in the ESSF (Engelmann Spruce–Subalpine Fir) zone 23.7% of its range was protected. Protected areas containing adequate populations of whitebark pine were estimated at 14 in the AT and 51 in the ESSF. In both zones, whitebark pine exceeded the minimum threshold of three reserves with at least 10 hectares of cumulative cover.
- In 2008, whitebark pine was added as a provincial blue-listed species. It is considered at risk due to high mortality from blister rust, the mountain pine beetle, climatic warming, and successional replacement.
- Field verification of tree species and ecosystems found in protected areas is currently underway to support forest tree genetic catalogue updates.
- *Ex situ* genetic conservation consists of trees planted in installations for genetic research, tree breeding, and archiving outside the natural range of the species. British Columbia has genetic resource archives and hundreds of provenance and progeny test sites around the province providing *ex situ* conservation for all commercial and several non-commercial species.
- Seed collections for commercial use, genetic archives, and research exist for most species, with over 8,000 seedlots in long-term storage.

Information

- Maps and statistics of *in situ* reserves are published for 49 species.[3]
- Spatial data relevant to genetic conservation are available from the Land and Resource Data Warehouse (LRDW).
- The Centre for Forest Conservation Genetics (CFCG) is established in the Department of Forest Sciences at the University of British Columbia.
- Genetic Conservation is a subprogram of the Forest Genetics Council of British Columbia (FGC).
- References: LRDW; BC Parks; CFCG

Related international and national indicators

- MP 1.3.c CCFM 1.3.2

6-2 What Level of Genetic Diversity Exists in Regenerated Forests?

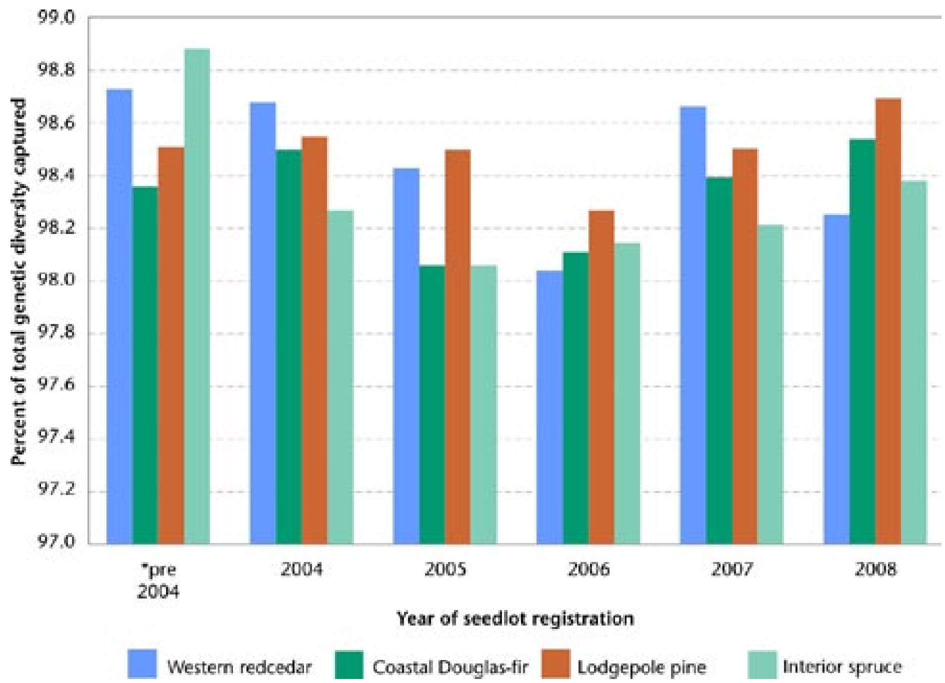


Figure 6-2. *Genetic diversity in orchard seedlots of four tree species over six time periods.*

Why is this important?

Maintenance of natural genetic diversity within ecosystems is important to survival and adaptation.

State and trend

- Genetic diversity is a key element of biodiversity. It is the foundation for the diversity found at the species and ecosystem levels. Genetic diversity is genetic variation within individual organisms, within populations, and among populations of a species.
- Naturally regenerated forests have similar genetic diversity as the original forest. Planted forests, where trees are grown from seed obtained from tree seed orchards, have similar or higher genetic diversity than naturally regenerated forests. This is due to the mating of genetically diverse parents and crop management practices to reduce inbreeding in the seed orchard.
- Genetic diversity can be measured using biochemical or molecular markers. There is a close relationship between genetic diversity of a seedlot and its effective population size.[4]
- In British Columbia, minimum genetic diversity standards must be met to register seed from natural and seed orchard sources for use in reforestation on public land.

- Between 2004 and 2008, the genetic diversity estimated in orchard seedlots, expressed as a percentage of the total genetic diversity found in natural stands, ranged from 98.26 to 98.68%.
- The genetic make-up and effective population size of natural stand and orchard seedlots fluctuates from year to year due to differences in the number of contributing parents and cone crop size. Cone crop abundance, periodicity, and seed set are important attributes for evaluating the genetic diversity of seedlots collected from natural stands and orchards.

Information

- Genetic diversity information (seed source, number of seed source trees, effective population size) is stored in the Seed Planning and Registry system (SPAR).
- Standards established to maintain the identity, adaptability, diversity, and productivity of the province's tree gene (genetic) resources are based on extensive research and testing. The standards are published in the Chief Forester's Standards for Seed Use.
- Tree Breeding and Seed Transfer are subprograms of the FGC.
- References: SPAR, RESULTS, Chief Forester's Standards for Seed Use

Related international and national indicators

- MP (none)   CCFM 1.3.1

6-3 What Is the Proportion of Forest Regeneration by Genetic Source?

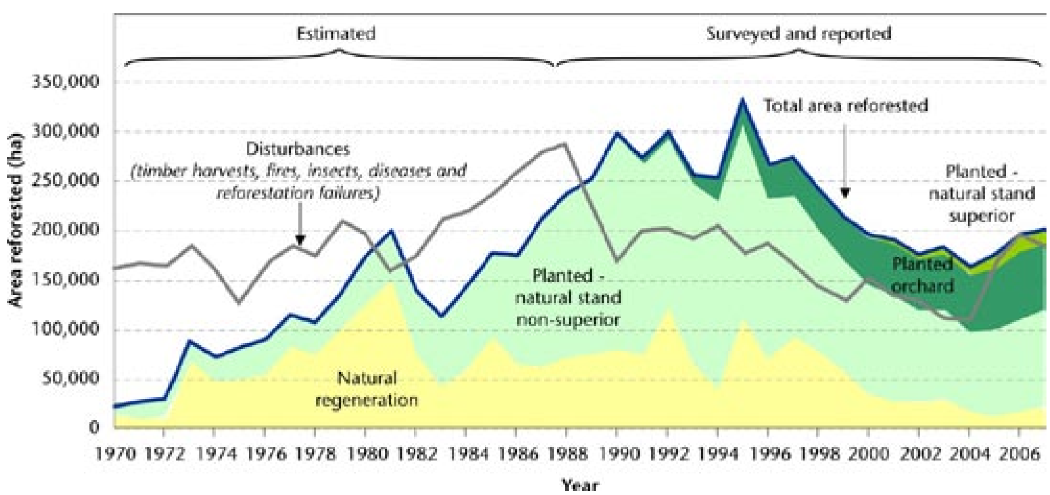


Figure 6-3. *Area disturbed, naturally regenerated, planted with natural stand non-superior seed, planted with natural stand superior seed, and planted with orchard seed, 1970–2007. Year refers to the year in which the area was reported as disturbed or reforested.*

Why is this important?

Reforestation using a range of genetically adapted seed sources is a forest management strategy to produce healthy, productive, diverse, and resilient forests.

State and trend

- After fire or harvest, reforestation occurs by natural regeneration (from roots or naturally available seed), or by planting. Seed used for planting may be from natural forests or tree seed orchards. Select seed, characterized as seed selected for specific traits (growth, pest resistance, and wood density), is increasingly used for reforestation. Select seed includes seed from orchards and natural stand superior provenances.
- The area reforested annually increased in the 1970s and 1980s, peaked in the 1990s, and has since declined. The peak is partly attributable to a large silviculture program from the mid-1980s to the mid-1990s in which reforestation by planting was increased to reduce accumulated not satisfactorily restocked areas.
- The area reforested by planting has increased over time. The cumulative area reforested by planting increased from an estimated 922,348 hectares between 1970 and 1987 to 3,583,691 hectares between 1988 and 2007. As planting increased, reliance on natural regeneration decreased, and an increasing proportion of regeneration was from planted stock. From 1970 to 1985, 44% of reforestation was accomplished by planting, and from 1988 to 2007, 75% was accomplished by planting.[5]
- Operational use of select seed, particularly orchard seed, began in the 1980s. Increased availability of orchard seed, and legislation requiring use of the best genetic material, increased the use of select seed from 12% (27,004 hectares) of the area reforested in 1995 to 46% (82,511 hectares) in 2007.
- The growth gain expected from select seed has increased over time. For select seed used in B.C., the predicted average growth gain increased from 3% in 1995 to 12% in 2007.
- In 2007, as a percent of the total area planted, the area planted with select seed having a genetic gain greater than or equal to 5% was 34%, 36%, and 30% in the Coast, Northern Interior, and Southern Interior, respectively.

Information

- Silviculture (area planted, species) and genetic source (seedlot) are available in the provincial Reporting Silviculture Updates and Land status Tracking System (RESULTS).
- Information about seedlot genetic source, genetic value (growth, pest and disease resistance, and wood density), and area of use (seed transfer) is stored in SPAR.
- Spatial seed use reports are available in MapView and SeedMap.
- References: MFR's annual reports, SPAR, RESULTS, SeedMap, MapView

Related international and national indicators

- MP 2.c CCFM 1.3.1

6-4 What Is the Extent and Source of Genetic Variation in Forest Regeneration across the Province?

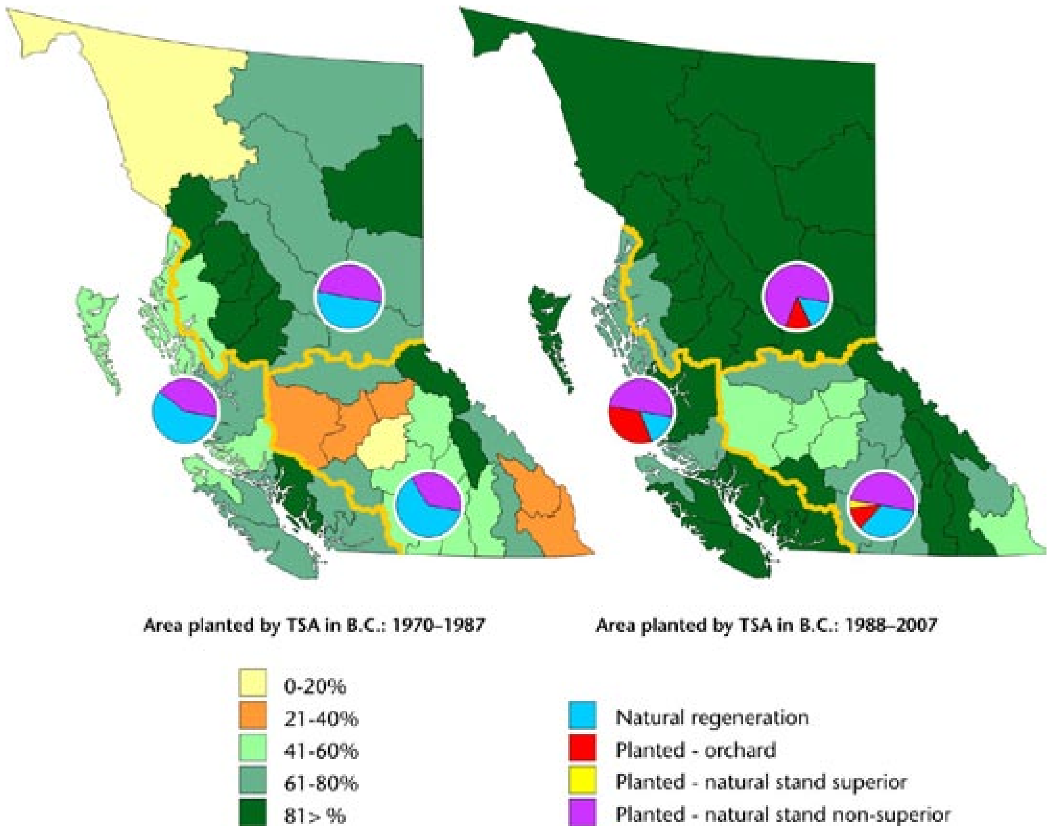


Figure 6-4. *By timber supply area, the percent of harvested area that was planted in 1970–1987 and 1988–2007. Pie charts depict the proportion of coast, south, and north area reforested by natural regeneration, planting with seed orchard seed, planting with superior natural stand seed, and planting with non-superior natural stand seed.*

Why is this important?

Genetic adaptation is increased through applying appropriate regeneration choices and seed transfer standards across the landscape. Tracking the extent and source of genetic variation in regenerated stands is important for understanding the adaptability, resilience, and productivity of forests in a changing world.

State and trend

- The extent, distribution, and genetic source of forest regeneration have shifted since the late 1980s as planting has become the dominant reforestation method. From 1970 to 1987, only 9 TSAs had over 81% of the area planted after harvest. From 1988 to 2007, 26 TSAs had over 81% of the area planted after harvest. Also, over time the proportion of planted trees originating from seed produced in tree seed orchards has increased.[6]

- Regional differences are evident in the number and proportion of genetic sources used for reforestation. This is in part due to the availability of seed from tree improvement programs (orchard and superior provenance).
- Rapid climate change may result in forests being maladapted. Local seed sources will not necessarily be the most resilient or productive.
- Genetic adaptation of planted stock is regulated and managed through seed registration and transfer standards that match the genetic suitability of seed sources to planting sites. Seedlots are assigned "areas of use" at the point of registration through the application of seed transfer limits.
- Recent changes in seed use policy were made in response to observed warming trends (over the past 100 years) and anticipated changes in climate using projections to 2030. Seedlot updates included expansion of upward elevation transfer for both natural stand and orchard tree species.[7]
- Climate change adaptation strategies, such as assisted migration (planting species and populations adapted to future climates), will require new and/or modified species selection and seed transfer systems that are based on climate.[8]
- In British Columbia, the Assisted Migration Adaptation Trial (AMAT) is underway to plant 16 tree species from a range of provenances (seed sources) across 48 sites representative of different climates in B.C. and parts of the United States (Washington, Oregon, and Idaho).[9]

Information

- Regeneration, including natural and artificial (planted), is tracked spatially at the forest (silviculture) opening level using RESULTS and VRI. GRM information such as seedlot area of use (seed transfer limits) can also be determined through linkages to SPAR.
- ClimateBC provides historical weather station data and global circulation model regional future predictions of climate change for British Columbia, the Yukon Territories, the Alaska panhandle, and part of Alberta and the United States (northwest).
- Genetic resource decision support is a subprogram of the FGC.
- References: MFR's annual reports, SPAR, RESULTS, VRI, SeedMap, MapView, Chief Forester's Standards for Seed Use, ClimateBC

Related international and national indicators

- MP 2.c CCFM 1.3.1

Summary and Assessment

State

Maintaining genetic diversity is critical to the health, productivity, and adaptation of forest tree populations and ecosystems. Forest tree genetic resources are currently well represented in British Columbia's protected areas network. Standards for seedlot genetic diversity and seed use support the use of adapted, productive, and resilient reforestation stock on public land. Forest genetics research and tree breeding are well established and supported by recent developments in climate modelling, genecology, and genetic conservation. Development of a climate-based seed transfer system is underway, including interim changes to seed transfer limits. A provincial strategy for management of the province's genetic resources is in place.

Trend

Although forest tree species are well represented in British Columbia's network of protected areas, there is increasing uncertainty due to climate change and associated ecosystem stress. The area reforested by planting, select seed use, and genetic gain has increased. Seedlots planted at the lower and higher margins of their transfer limits may be less or more vulnerable due to warming climates, respectively. Climate change genetic resource impact and vulnerability assessments have been initiated. Climate change adaptation strategies such as assisted migration, matching genotypes to sites and future climate, and increasing stand and landscape level genetic diversity are being developed. Tree breeding and seed orchard programs are factoring in an increased tolerance to climate change impacts, diseases, and pests.

Information

British Columbia's forest tree genetic resources have been catalogued by the Ministry of Forests and Range and the University of British Columbia's Centre for Forest Gene Conservation. Updates are planned based on field verification results and revised analyses. Linkages between SPAR (a provincial genetic resource registry, management, and reporting system) and SeedMap support verification of genetic source and seedlot registration. Seed Planning Units have been revised (expansion of upward elevation limits). Climate BC data are available for forest genetic research, climate modelling, and the climate-based seed transfer system. New indicators to support monitoring of climate change impacts on genetic resources are needed. GIS-based forest genetic analyses are being undertaken to support the development of policy, climate change adaptation strategies, and a climate-based GRM decision support framework. Stakeholder input for the provincial GRM program is supported by the Forest Genetics Council of British Columbia.

7 Soil

Soil conservation maintains water quality, aquatic and riparian habitats, ecosystem productivity, and future economic benefits.

Assessing soil – Mike Curran

Why is this important?

Soil is the foundation upon which forest and range ecosystems develop.

Overview

- Soil holds much of the nutrients and biological mass of forest and range lands. It consists of inorganic material, decaying organic matter, air, water, and many microbial and larger organisms.
- Soil provides a wide range of important functions including sustaining plant growth; absorbing, storing, filtering, and moving water; modifying the atmosphere; providing habitat for beneficial soil micro-organisms; and providing a medium upon which engineering structures (e.g., roads) can be constructed.
- Forest practices, range practices, and recreational activities (access road construction, timber harvesting, site preparation for planting trees, cattle grazing, and use of all-terrain vehicles) can have negative and, in some cases, positive impacts on soil's ecological functions.
- In the early 1970s, concern about the nature and extent of forest soil degradation prompted government to develop forest practices guidelines to limit negative impacts on soil. These guidelines have been updated over time based on scientific research into the long-term effects of forest and range practices on soil productivity.
- Soil conservation requires detailed consideration of site conditions, season, and equipment used in forest and range management.

- The percent of harvested area taken up by roads has declined since the 1990s and currently averages 3.5%.
- Since the mid-1990s, the number of soil disturbance enforcement actions taken each year has sharply declined.

Questions about soil

7-1: How much of the harvested area is occupied by permanent access structures?
7-2: How frequently are soil disturbance limits exceeded in harvested areas?
► Summary and assessment

Related indicators

- Environmental pressures such as wildfires (see Ecosystem dynamics) may affect soil productivity. Economic and social pressures may lead to soil degradation (see Timber harvest; Recreation, tourism, and visual quality) or soil conservation (see Law, Public involvement).
- Soil conservation measures help maintain water quality, aquatic and riparian habitats (see Water), ecosystem productivity, and future economic benefits (see Timber harvest, Jobs and communities).
- Management responses include developing and implementing better forest practices based on research (see Knowledge, Law, Silviculture).

7.1 How Much of the Harvested Area Is Occupied by Permanent Access Structures?

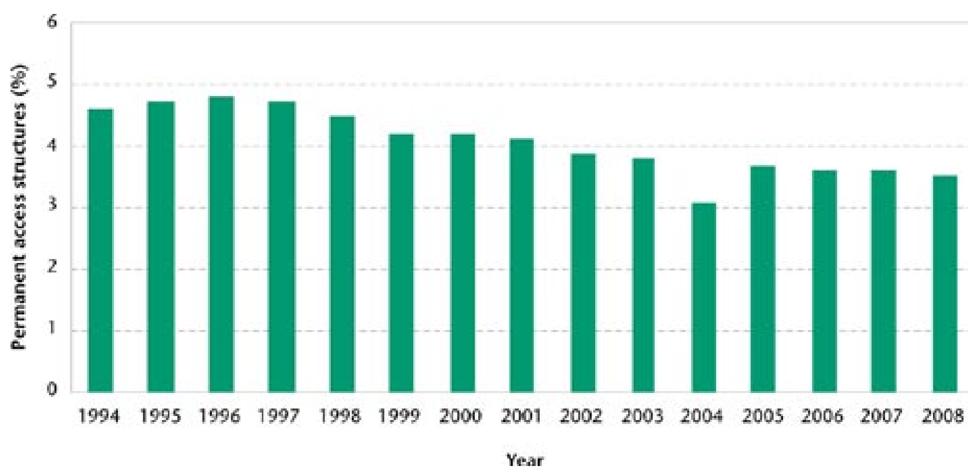


Figure 7-1. *Percent of cutblock occupied by permanent access structures, 1994–2008.*

Why is this important?

Permanent access structures create a fundamental change in the ground's surface, reducing the productive land base and affecting hydrologic function over large areas.

State and trend

- Permanent access structures within harvested areas include main roads, permanent spur roads, landings, and borrow pits.
- Of the area harvested in 2008, 3.5% was converted to permanent access structure in order to access the timber.
- The amount of permanent access structure required for harvesting has declined from roughly 4.6% in the mid-1990s.
- Currently, for most harvested areas, the legal maximum is 7%.
- Until 2003, permanent access structure was regulated under the *Forest Practices Code of British Columbia Act* (the Code). In 2004, the Code was replaced with the *Forest and Range Practices Act* (FRPA). In Figure 7-1, data until 2003 demonstrate performance under the Code. Data from 2004 to 2008 include permanent access structures authorized and constructed under a mix of these regulatory regimes (Code and FRPA).[1]
- Figure 7-1 reports the average for all area harvested on public forest land taken from the Ministry's RESULTS database. The reported values are consistent with data gathered from random sampling of the province's soil resource conducted since 2005 under the Forest and Range Evaluation Program (FREP).[2]

Information

- For each area harvested on public forest land, the percent permanent access structure is recorded in the Ministry's RESULTS database.
- Permanent access structure information gathered in the Ministry's random sampling-based resource stewardship monitoring program is recorded in the FREP Information Management System (IMS) database.
- RESULTS provides information over a 15-year period from 1994 to 2008 and FREP IMS covers the years 2005 to 2008.
- For additional information on roads, see Indicators 3-4, 8-3, and 16-1.

Related international and national indicators

- MP 4.2a, 4.2b CCFM 3.1

7.2 How Frequently Are Soil Disturbance Limits Exceeded in Harvested Areas?

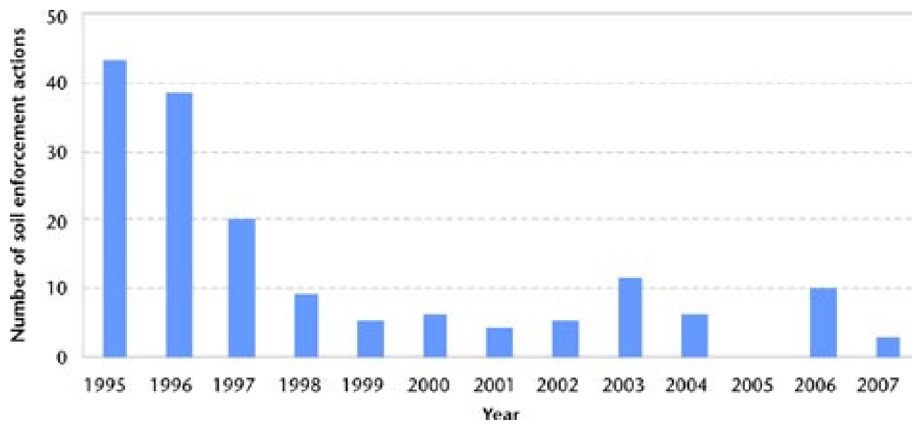


Figure 7-2. *Number of soil disturbance enforcement actions, 1995–2007.*

Why is this important?

Widespread compaction or soil displacement can negatively affect both soil productivity and hydrologic function (i.e., drainage)**.**

State and trend

- Soil disturbance is a disruption of the integrity of the soil on that portion of a harvested area that is expected to be reforested (i.e., the net area to be reforested).
- Soil disturbance can result from creating temporary access structures, gouges, ruts, scalps, and areas compacted by repeated machine travel.
- On every harvested area on public forest land, there is a legal requirement to keep below a specified limit the soil disturbance that results from forest operations.
- The Ministry inspects harvested areas, assesses the degree of soil disturbance, and takes enforcement action when appropriate.
- In 2007, roughly 5,300 areas were harvested and three soil disturbance enforcement actions were taken. The number of enforcement actions per year has declined since 1995 when 43 actions were taken.
- Soil disturbance monitoring under the Ministry's FREP suggests that the shift from processing trees at landings to processing them at roadside work areas may lead to increases in concentrated soil disturbance (e.g., compaction and water puddling within areas that are expected to be reforested).
- Figure 7-2 reports data from the Ministry's Compliance and Enforcement Program, which records soil disturbance actions that have been taken.

Information

- Detailed records of the number of soil disturbance enforcement actions taken by the Ministry's Compliance and Enforcement staff are recorded in the Ministry's Enforcement Action, Administrative Review and Appeal Tracking System (ERA).
- Soil disturbance information from the Ministry's random sampling-based resource stewardship monitoring program is recorded in the Forest and Range Evaluation Program (FREP) Information Management System (IMS) database.

Related international and national indicators

- MP 4.2.a, 4.2.b   CCFM 3.1, 3.2

Summary and Assessment

State

The available data suggest that forest operations in B.C. are conserving the soil resource. A relatively low proportion of the harvested area is converted to permanent access structures. Enforcement actions are rare although the Ministry maintains an active program inspecting harvested areas for compliance with soil disturbance limits. Soil conservation and management depends partly on government policies and funding. These policies are based on science and have evolved over time to meet changing environmental, economic, and social expectations. Continuing evolution is required to meet the challenges posed by climate change and the mountain pine beetle (MPB) epidemic.

Trend

The amount of harvested area occupied by permanent access structures has decreased over the past 15 years due (in part) to improvements in harvesting systems and their proper use. Over the same period, while the Ministry conducted an active Compliance and Enforcement Program, there has been a general decrease in the number of soil disturbance enforcement actions taken. Thus, the available data suggest an improving trend. However, emerging information suggests an increase in the use of temporary access roads within harvested areas and roadside work areas, which may have a negative impact on the soil resource.

Information

Complete and long-term data are available on permanent access structures. A rich dataset on soil resources is developing under FREP but is currently incomplete. Less information is available for private lands. Research in soil conservation and management is increasing. The impacts of climate change and the mountain pine beetle epidemic on the health of the soil are being investigated. Both the Ministry and the Province's Forest Practices Board are currently carrying out studies to determine the impact of harvesting on soil in MPB-affected areas.

8 Water

Freshwater resources sustain human, animal, and plant populations.

Vancouver Island watershed - Ian McDougall

Coastal BC - Candace Kenyon

City of Cranbrook community watershed study - MFR

Why is this important?

Water is essential for sustaining forest, stream, wetland, and lake ecosystems and a wide range of human activities. Forestry can affect water quantity, water quality, and the integrity and functions of terrestrial and aquatic environments.

Overview

- Freshwater resources sustain human, animal, and plant populations. They supply water for drinking and other domestic and industrial needs.
- British Columbia has abundant sources of fresh water, but supply in some areas is limited. In the future, competition for fresh water is expected to increase.
- Forest soil stores and filters fresh water. Forest vegetation plays a vital role in protecting the quantity, quality, and timing of water flows. Riparian forests provide structure and stream bank stability for many streams. They also provide shade, organic materials, nutrients, and food organisms for aquatic communities in streams, lakes, and wetlands.
- Both natural disturbances (e.g., wildfire and insect outbreaks) and management activities (e.g., road construction and maintenance, log hauling, use of herbicides, fertilizing, and cattle grazing) can affect water quality. Potential impacts include sedimentation, pollution, and modification of water levels, stream flows, and aquatic habitats.

- Through careful management and monitoring, adverse impacts of forest and range activities on water quality can be minimized.

Questions about water

8-1 What steps are taken to protect water quality during forest operations?
8-2 Are riparian forestry practices protecting streams, stream-riparian functions, and fish habitats?
8-3 Are forest resource road stream crossings maintaining fish passage?
► Summary and assessment

Related indicators

- Fires, insect infestations such as the current mountain pine beetle epidemic, and timber harvesting affect water quantity, water quality, and the physical and biological characteristics of aquatic habitats (see Ecosystem dynamics, Timber harvest).
- Water quantity and quality, and the timing of water flows can affect ecosystem functions (see Ecosystem diversity, Species diversity, Soil).
- To manage and conserve water resources, response options include research to better understand watershed function (see Knowledge), monitoring and evaluation (see Law), planning, forest practices, and restoration.

8.1 What Steps Are Taken to Protect Water Quality during Forest Operations?

Figure 8-1. *Riparian reserve in a harvested area. Courtesy: Peter Tschaplinski, MFR.*

Why is this important?

Due to the critical importance of water, steps must be taken to protect water resources during forest operations.

State and trend

- In British Columbia, forest and range activities are managed to protect water quality through legal requirements, forest planning, forest practices, monitoring, research, and training.
- Many statutes contain provisions aimed at protecting water quality including the provincial *Water Act* and *Drinking Water Protection Act* and the federal *Fisheries Act.* Under the *Forest and Range Practices Act* (FRPA), protection is provided for community watersheds and fisheries-sensitive watersheds, and government specifies objectives for water that apply to all forest and range operations. In addition, FRPA specifies legal requirements for riparian reserves, and stipulates various restrictions on road building, harvesting, and silviculture that protect water resources. Government inspections help ensure that the legal requirements are met (see Law). Additional audits of the forest planning and practices that affect water quality are undertaken by the Forest Practices Board.
- Most forestry activity in B.C. is undertaken by operators with a sustainable forest management certification (see Certification). The certification regimes contain provisions designed to ensure that water resources are conserved and protected during forest operations. Third-party audits help ensure that operations conform to the certification standards.
- Forest resource planning at both the strategic and operational levels helps protect water resources. Planning measures include delineation of community watersheds, fisheries-sensitive watersheds, and riparian areas in which forest operations are prohibited or significantly limited. As of January 2010, 467 areas in B.C. had been formally designated as community watersheds, with the associated suite of legal limitations on forest practices in these areas.
- Modern practices in road building, harvesting, and silviculture are followed to help protect water quality.
- Within B.C., research is conducted on questions related to protecting water quality and minimizing the impact of forest operations on water resources. Various training and extension programs ensure that the latest information is available to forest workers (see Knowledge).
- Water quality and riparian forestry practices are monitored under the Forest and Range Evaluation Program (see Indicators 8-2 and 21-4).
- Apart from forestry operations, water quality is affected by a variety of natural events and other uses. Livestock grazing in and around harvested areas, for example, can have a significant impact on water quality.[1]

Information

Information is readily available to the public on many of the steps taken to protect water resources, including the various legal requirements, planning activities, and monitoring results.

Related international and national indicators

- MP 4.3.a, 4.3.b CCFM 3.2

8.2 Are Riparian Forestry Practices Protecting Streams, Stream-riparian Functions, and Fish Habitats?

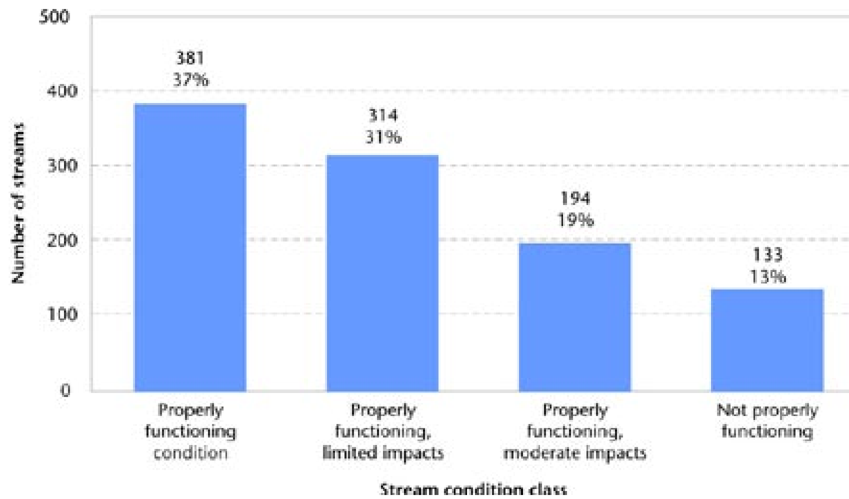


Figure 8-2. *Number of streams in four stream condition classes based on province-wide assessments of stream-riparian condition conducted between 2005 and 2007.*

Why is this important?

Improper or ineffective forest practices in riparian areas can damage streams, stream-riparian functions, and fish habitats.

State and trend

- In harvested areas, a total of 1,022 riparian site assessments were completed between 2005 and 2007.
- These assessments were made on streams and riparian areas managed since 1996 under the *Forest Practices Code of British Columbia Act* (the Code). Beginning in 2004, the Code was gradually replaced by the *Forest and Range Practices Act* (FRPA). Comparable results are not yet available for areas harvested under FRPA.
- In these 1,022 riparian assessments, key physical and biological attributes of streams and adjacent riparian areas were assessed after logging and compared to reference conditions found in mature, undisturbed forest stands. On this basis, sites were classified as follows: (1) properly functioning condition (PFC), (2) properly functioning condition with limited impacts (PFC-L), (3) properly functioning condition with moderate impacts (PFC-M), and (4) not properly functioning (NPF).

- Eighty-seven percent of all streams were in one of the three PFC categories and 13% were assessed as not properly functioning (NPF, "unhealthy").
- Of the 1,022 stream sites assessed, nearly 50% were class S6 non-fish-bearing headwater streams, and nearly 20% were the smallest fish-bearing stream class (S4).
- In addition to the riparian site assessment protocol, a water quality assessment protocol is being developed. In 2007 and 2008, 1,202 water quality assessments were completed at stream crossings on forest roads throughout B.C. Six percent of assessed sites were judged to have high potential (and 25% were judged to have moderate potential) to deliver fine sediment to streams.
- Studies of areas harvested in the late 1980s and early 1990s found much higher levels of stream disturbance than are found in areas harvested in recent years.[2]

Information

- Riparian, stream, and fish habitat assessments were performed by Ministry of Forests and Range district staff sometimes augmented by staff from the Ministry of Environment. These post-harvest assessments were performed on randomly selected streams within or adjacent to randomly selected cutblocks. Cutblocks were eligible for assessment if harvesting was two years old or older. The assessment protocol was developed for the Forest and Range Evaluation Program (FREP). All field data reside with the Forest Practices and Investment Branch in the FREP Information Management System database.[3]
- The water quality assessment procedure is also being developed for the FREP. The 2007 data were collected from 14 of 29 forest districts in B.C. The 2008 data were collected from 18 of 29 forest districts in B.C.[4]

Related international and national indicators

- MP 4.3.a, 4.3.b CCFM 3.2

8.3 Are Forest Resource Road Stream Crossings Maintaining Fish Passage?

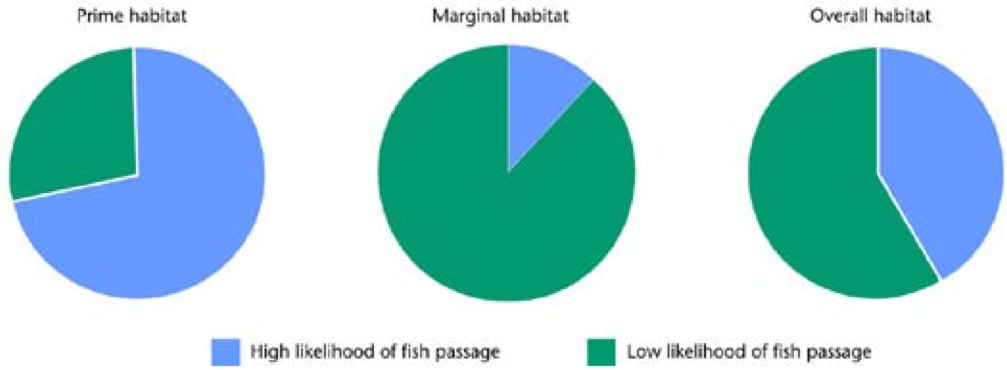


Figure 8-3. *In 19 watersheds, the proportion of stream crossings assessed as having high and low likelihood of allowing fish passage in prime habitat, marginal habitat, and overall. Results of a study by the Forest Practices Board of watersheds on Vancouver Island, the Central Interior, and the Northern Interior.*

Why is this important?

Fish populations can decline if road stream crossings block fish passage to upstream or downstream habitat.

State and trend

- The total length of roads in B.C. has increased from an estimated 387,000 kilometres in 1988 to 702,574 kilometres in 2005.[5] The total number of stream crossings (where a road crosses a stream) increased from 421,830 in 2000 to 488,674 in 2005.[6]
- In 2009, the Forest Practices Board released a report on the results of fish passage assessments in 19 watersheds in B.C. In total, 1,110 road crossings of fish-bearing streams were examined. The majority of these stream crossings were forestry-related, but some crossings were due to residential, agricultural, highways, and other developments. Crossings were of various ages. Some were built before the implementation of the 1995 *Forest Practices Code of British Columbia Act* (the Code). Some were built during the Code era and some were built after the Code was replaced by the *Forest and Range Practices Act* in 2004.
- Overall, 42% of road crossings in fish-bearing habitat had a high likelihood of passing fish, with individual watersheds ranging from 20 to 94%. The remainder had a moderate to high risk of limiting fish passage.
- In prime habitat (the classes “important” and “critical” in the Board’s report), 72% of the examined crossings had a high likelihood of passing fish.
- In areas with marginal habitat, 12% of crossings had a high likelihood of passing fish.

- Open bottom stream crossing structures accounted for most of the success in providing fish passage.
- Provincial and federal agencies and forest licensees have developed a strategic plan to address the fish passage concerns identified in the Board's report.

Information

- This study of fish passage was conducted by the Forest Practices Board, an independent forestry watchdog agency, and documented in a Special Investigation Report. Stream crossings were assessed in 19 watersheds in the Central and Northern Interior and on Vancouver Island.[7]

Related international and national indicators

- MP 4.3.a, 4.3.b CCFM 3.2

Summary and Assessment

State

British Columbia's approach to protecting water resources includes legal requirements, strategic and operational planning, careful forest operations, monitoring and evaluation, research, and worker training. Detailed evaluations of forest roads and harvested areas have concluded that most sampled locations have a low potential to deliver sediment to streams. Detailed evaluations of riparian areas within cutblocks have concluded that riparian areas at most sampled locations are healthy. Fish passage has been impeded by road crossings in some watersheds. Further assessment of the overall situation, and the remediation of priority stream crossings, is underway.

Trend

For many aspects of water and riparian condition, trend data are not yet available. However, pressures on water quality and fish passage, such as the amount of road and the number and density of stream crossings, are increasing over time. Studies of areas harvested in the late 1980s and early 1990s found much higher levels of riparian impact than are found in areas harvested in recent years. The management of riparian areas appears to be improving over time.

Information

Information is available for estimating the state and trend of road length and density and stream crossing number and density. In recent years, detailed and rigorous methods to assess water quality and riparian condition have been developed in the government's Forest and Range Evaluation Program (FREP). Over time, trend data will accumulate from these ongoing programs.

9 Air

Some forest practices and forest-related industrial activities can impact air quality

Wildfire smoke – MFR

Why is this important?

Forests and forest management can affect air quality, which in turn can affect both human and forest health.

Overview

- Air pollutants can contaminate soil and water and severely reduce tree growth and overall forest health.
- The common air contaminants of greatest concern to forest health are ground-level ozone and sulphur dioxide.
- Air quality is affected by forests and forest-based activities, both positively and negatively.
- Forests release volatile organic compounds such as terpenes, which can contribute to the formation of ground-level ozone and regional haze.
- Forest-related air pollution is caused by wildfires, prescribed fires, and wood milling activities. Along with ecological and economic benefits, these activities produce smoke and other contaminants that cause respiratory and cardiovascular problems and impair visibility.
- Fire suppression to protect timber, property, and lives reduces smoke emissions in the short term but causes fuel buildup that can eventually lead to catastrophic fires.
- Over the last 30 years in B.C., the number of wildfires averaged 2,300 per year and the area burned averaged 67,500 hectares per year.
- Open burning, forest products manufacturing, and residential wood combustion are the largest source of fine particulate (PM2.5) emissions in the province.

- Ozone pollution and acid deposition, serious problems in many forests worldwide, are not believed to be a problem in B.C. forests at this time.
- Legislation related to open burning is being revised to better protect air quality in smoke-sensitive areas (near major population centres), allow for greater flexibility in the working forest, and encourage alternatives to open burning for the disposal of woody debris.

Questions about air

9-1: What are the size and frequency of wildfires in B.C.?
9-2: What are the source and magnitude of fine particulate (PM2.5) emissions from the forest sector?
9-3: What area of forest is subject to ozone?
► Summary and assessment

Related indicators

- Some forest practices and forest-related industrial activities negatively affect air quality (see Silviculture, Forest products and the economy).
- Air quality directly affects soil productivity, water quality (see Soil, Water), and growth of trees, which may have implications for future timber supplies (see Timber harvest).
- Forestry activities and natural forest dynamics can add to or reduce atmospheric greenhouse gas concentrations (see Forest carbon and greenhouse gases).
- Climate change, through its impact on temperature and precipitation patterns, is expected to have an indirect impact on air quality by increasing the likelihood of forest fires and ozone formation.
- Management responses to forest-related air quality issues include adjustment of forest and fire management practices and regulation of industrial activities that pollute the air (see Law).

9-1 What Are the Size and Frequency of Wildfires in B.C.?

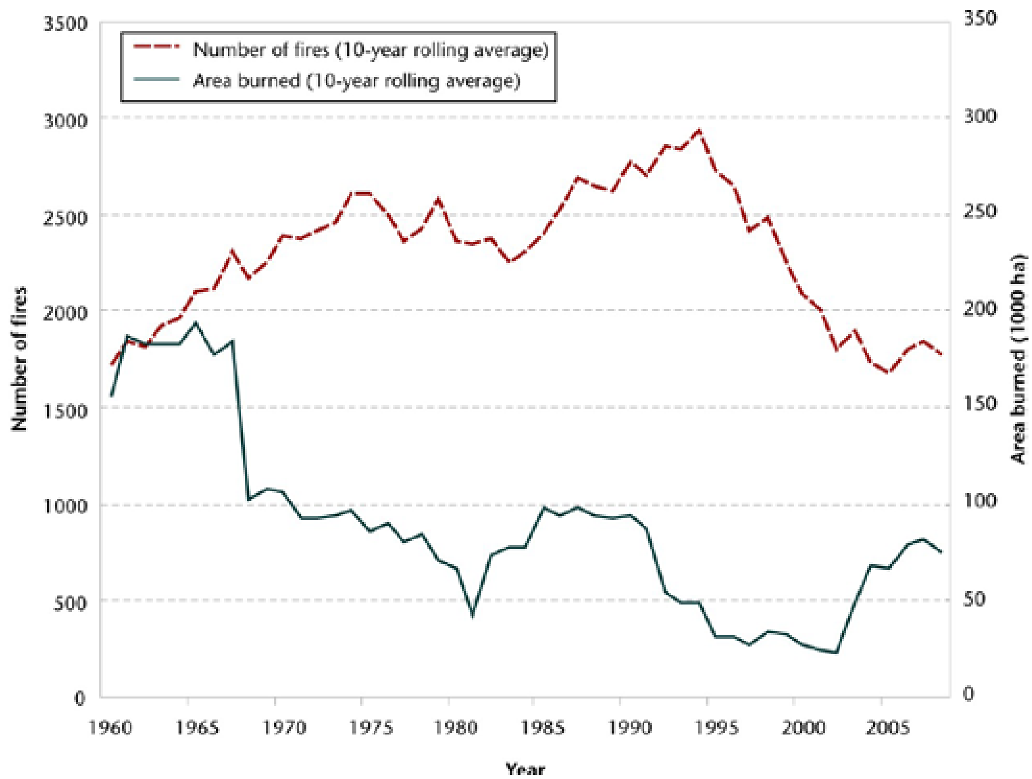


Figure 9-1. *Number of wildfires and area burned, 10-year rolling average, 1960–2008.*

Why is this important?

The smoke from forest fires can reduce air quality and pose a human health risk.

State and trend

- Forest fires are an important element of forest ecosystem renewal.
- This contrasts with the destructive nature of forest fires, including their impact on air quality and human health.
- The number and size of wildfires per year are a function of many factors, including weather, fuel loading, and fire suppression capability. Consequently, there is considerable year-to-year variation in both the number and size of forest fires.
- In 2008, almost 2,000 wildfires occurred in B.C., covering approximately 13,000 hectares.
- Over the last 30 years in B.C., the number of wildfires averaged 2,300 per year and the area burned averaged 67,500 hectares per year.
- The trend in the number of fires per year increased from 1960 to 1994 and then showed a general decline. In contrast, the area burned by wildfires per year decreased from 1960 to 2002, and has increased since then.

- In 2003, catastrophic wildfires occurred in the Southern Interior as a result of abnormally hot and dry weather conditions together with fuel buildup in the forests.
- During the wildfires of 2003, ambient levels of fine particulate matter (i.e., PM2.5) in Kelowna reached 186 $\mu g/m^3$ on a 24-hour basis. This compares with the interim provincial air quality objective of 25 $\mu g/m^3$.
- The province has placed a greater emphasis on fuel management treatments and increased use of both prescribed and natural fire to help mitigate major wildfire events in the future.

Information

- Reference: Ministry of Forests and Range wildfire database (to Oct. 7, 2008); BC Air Quality website[1]
- The annual area disturbed by wildfire is also discussed in Indicator 3-1.

Related international and national indicators

- MP 3.b CCFM 2.3

9-2 What Are the Source and Magnitude of Fine Particulate (PM2.5) Emissions from the Forest Sector?

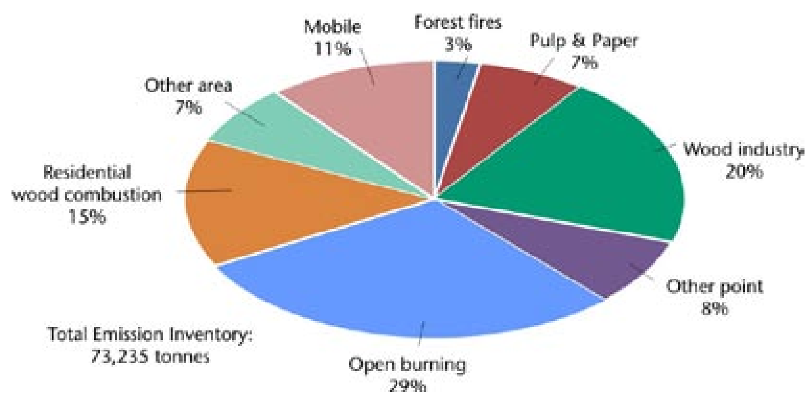


Figure 9-2. *Source and magnitude of fine particulate emissions in B.C., 2005.*

Why is this important?

Fine particulate matter is considered the most important outdoor air pollutant in B.C.

State and trend

- PM2.5 refers to fine particles that are 2.5 micrometres or smaller in diameter.
- PM2.5 is considered the most important outdoor air pollutant in B.C. from a human health perspective.

- Long-term exposure is associated with reduced lung function, development of chronic bronchitis, and premature death. Short-term exposure can aggravate lung disease, and may increase susceptibility to respiratory infections; for those with pre-existing heart conditions, it may contribute to heart attacks and arrhythmias.
- In 2005, forestry-related activities were the largest source of PM2.5 emissions in the province.
- The wood industry and pulp and paper mills contributed 27% of provincial emissions, while forest fires contributed an additional 3%. Open burning (much of which occurs on Crown forest and range lands) generated 29% of total provincial PM 2.5 emissions.

Information

- Emission inventory information is available from the Ministry of Environment.[2]
- A provincial emission inventory is developed every five years. At the time of analysis, 2005 was the most recent year for which a provincial inventory had been compiled.
- The National Pollutant Release Inventory provides an annually updated inventory of pollutants released, disposed of, and recycled by industrial, institutional, and commercial facilities in Canada.[3] However, this inventory does not include information on area sources, as the provincial inventory does.

Related international and national indicators

- MP (none) CCFM (none)

9-3 What Area of Forest Is Subject to Ozone?

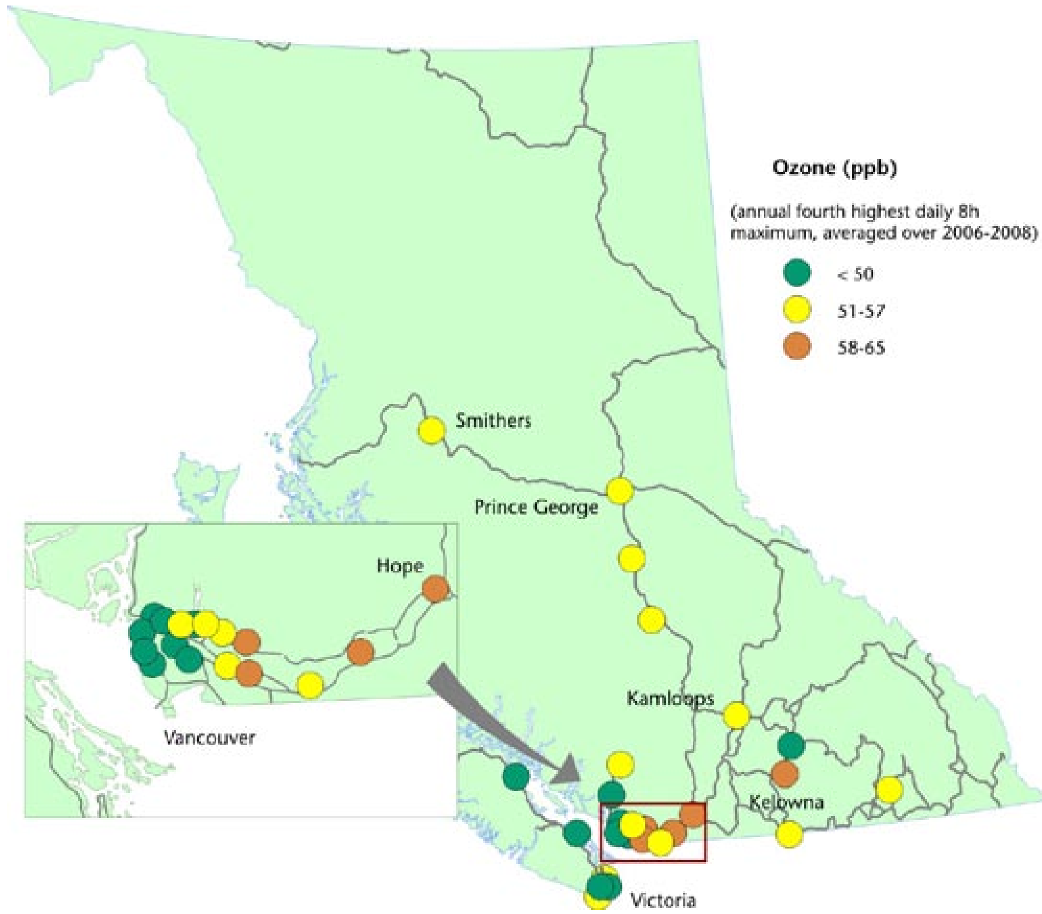


Figure 9-3. *Ozone concentrations at monitoring sites in B.C.*

Why is this important?

Ozone pollution is a common damage agent in forests around the world.

State and trend

- Ground-level ozone is a highly reactive gas that can negatively affect forest health and productivity.
- Ozone exposure is linked to reduced tree growth, changes in species composition, and greater susceptibility to insect and disease attack.
- Many factors influence the rate at which ozone uptake occurs, including soil pH, moisture, species, temperature, sunlight, and ozone concentration.
- Ground-level ozone is formed from reactions involving nitrogen oxides and volatile organic compounds (VOCs) in the presence of sunlight. Combustion is a major source of both pollutants. Some natural VOCs, such as isoprene emitted by deciduous trees and terpenes emitted by evergreen trees, also contribute to ozone formation.

- Most ozone monitoring sites in B.C. are situated near major population centres so may not accurately portray forest exposures.
- The Canada-wide Standard (CWS) for ozone is 65 parts per billion (ppb; based on the annual fourth-highest daily 8-hour maximum, averaged over three consecutive years).
- Although the CWS metric is not specific to forest ecosystems, levels above 65 ppb are considered potentially harmful to the health of sensitive tree species.
- Based on 2008 data, no monitoring sites in B.C. exceeded the CWS level, although the site in Hope reached a level of 64 ppb.

Information

- Resource: B.C. Ministry of Environment

Related international and national indicators

- MP 3.b CCFM 2.4

Summary and Assessment

State

Air pollution, and in particular PM2.5, is considered a serious health concern in B.C. Natural forest processes and forest sector activities are major sources of fine particulate (PM2.5) emissions in the province. Over the last 30 years in B.C., the number of wildfires averaged 2,300 per year and the area burned averaged 67,500 hectares per year. Recent wildfire events demonstrate that forest fires can have a large impact on ambient PM2.5 levels.

Air pollution can also pose a threat to the environment, including forest health. However, less is known about the exposure of forests in B.C. to air pollution. To date, acid deposition has not been identified as a major threat to forest health in B.C. as it has been in other parts of Canada. However, ongoing oil and gas development in the northeast sector may necessitate future tracking of this issue. Although ozone pollution damages many forests around the world, the vast majority of B.C.'s forests are thought to be unimpaired by ozone. However, based on existing monitoring data taken from populated areas, ozone concentrations in the eastern Lower Fraser Valley are at levels that are potentially harmful to sensitive tree species.

Trend

In response to the 2003 interface fires in the Interior of B.C., the Firestorm 2003 Provincial Review recommended a reduction in fuel buildup through such strategies as prescribed fire, thinning followed by prescribed fire, mulching and chipping, and fuel removal from the site.[4] The mountain pine beetle infestation further compounds these challenges. It is expected that efforts to reduce fuel buildup will lead to increased prescribed burning in the near term, with subsequent pressures on local air quality. The Open Burning Smoke Control

Regulation is currently being revised to be more protective of human health in community airsheds, to be more flexible in the working forests, and to encourage alternatives to open burning for the disposal of woody debris. Availability of beetle-kill wood further encourages residential wood combustion. A provincial woodstove exchange program, used to promote the shift to cleaner-burning technologies, should alleviate some of the air quality impacts resulting from increased woodstove use. The pulp and paper sector is currently taking substantial downtime at its mills as a result of economic factors, which has resulted in a decrease in sectoral air emissions. Within North America, including B.C., there is a general trend towards decreasing peak ozone concentrations but increasing background levels. Local and global factors, including increased production of precursor emissions globally, are believed to contribute to this finding. This will result in greater exposure of forests to ozone.

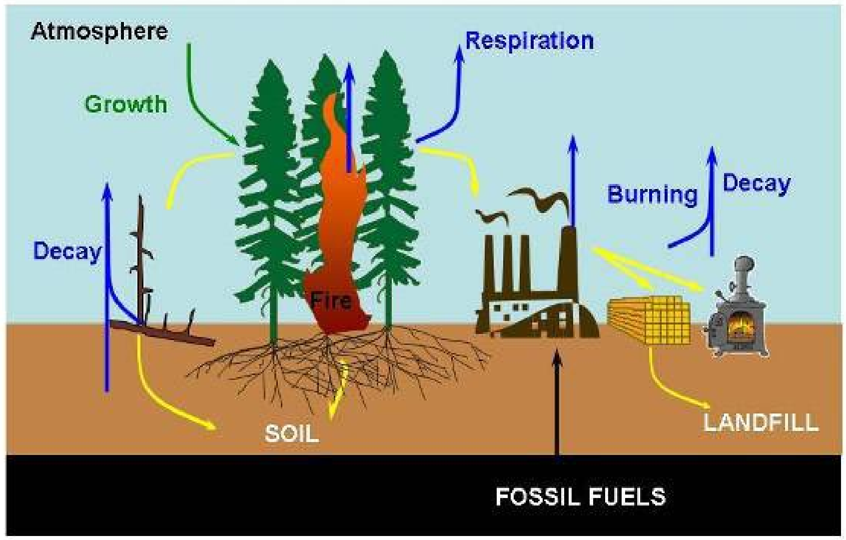
Information

Wildfire data are collected by the Ministry of Forests and Range. Air quality and emissions data are collected and archived by the B.C. Ministries of Environment and Healthy Living and Sport, respectively, in cooperation with Environment Canada and Metro Vancouver. In general, air quality is monitored near populated areas and may not be fully representative of forest exposures.

10 Forest Carbon and Greenhouse Gases

Greenhouse gas emissions can be reduced by using wood instead of fossil fuel-intensive products such as concrete and steel.

Forest Sector Carbon Flows



Why is this important?

British Columbia's forests, their management, and the products produced from them have a significant impact on greenhouse gas emissions and provide opportunities to mitigate climate change.

Overview

- British Columbia's forests play an important role in the global carbon cycle–taking up carbon dioxide through growth ("sink") or releasing it and other greenhouse gases when they burn or decompose ("source").
- B.C.'s forests were a carbon sink until 2003 when a combination of wildfires and the mountain pine beetle outbreak increased the release of carbon dioxide into the atmosphere.
- A wide variety of forest management activities can increase greenhouse gas uptake (or decrease emissions) relative to the levels that would occur with natural forest dynamics.
- Greenhouse gas emissions can be reduced by using wood instead of fossil fuel-intensive products such as concrete and steel.
- In addition, greenhouse gas emissions can be reduced by improving energy efficiency, increasing recycling, and reducing consumption.
- Concern about increases in atmospheric greenhouse gases as the main cause of climate change led to the *Greenhouse Gas Reductions Target Act*. The Act puts into law British Columbia's target of reducing greenhouse gas emissions.[1] As a result, the Ministry of Environment reports annually on all greenhouse gas emissions, including emissions from forests and the forest industry.

Questions about forest carbon and greenhouse gases

10-1: Are B.C.'s forest ecosystems a source or a sink for greenhouse gases?
10-2: How much of the carbon that leaves the ecosystem is turned into long-term forest products?
10-3: What is the magnitude of fossil fuel emissions from the forest sector?
10-4: How much forest area is being lost and gained through human activities?
► Summary and assessment

Related indicators

- Fire, insects, logging, and reforestation change the amount of carbon stored in forests from year to year (see Ecosystem dynamics, Timber harvest).
- Retaining older forests (e.g., age > 80 years) may help store carbon in the forest and provide habitat for species dependent on older forest conditions (see Species diversity).
- Management responses to address short-term mitigation targets include prompt reforestation, planting trees on previously non-forested land, controlling fire and pests, longer rotations (see Silviculture, Timber harvest), and reducing fossil fuel use.

10-1 Are B.C.'s Forest Ecosystems a Source or a Sink for Greenhouse Gases?

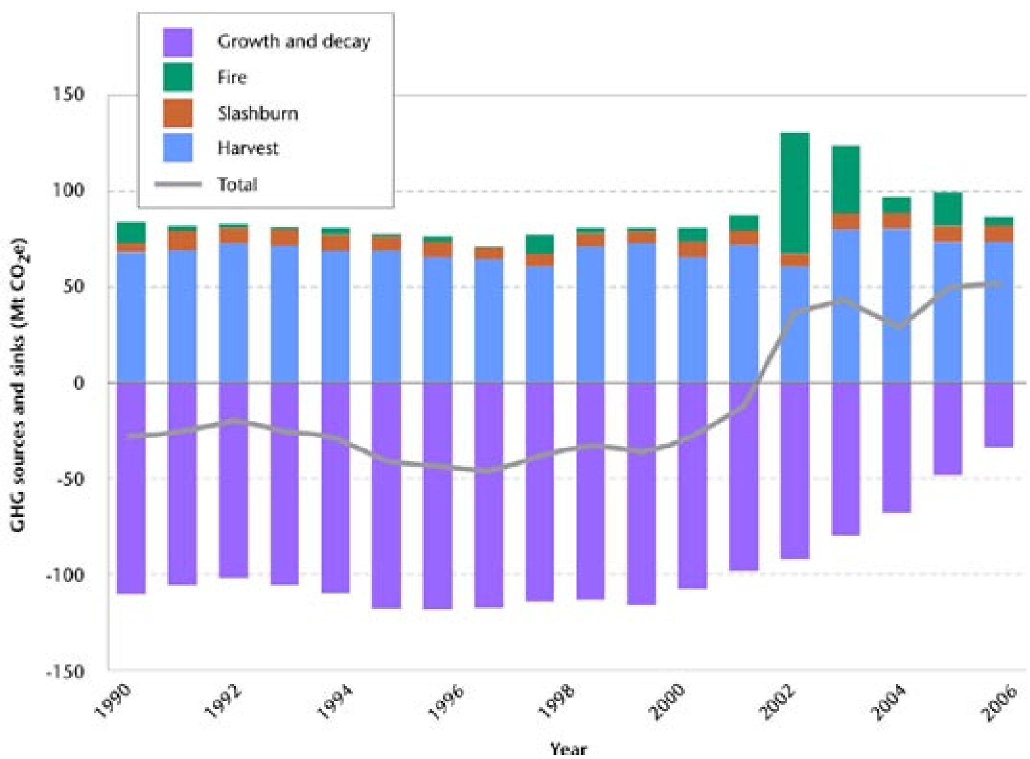


Figure 10-1. *Greenhouse gas sources and sinks in B.C.'s forests, 1990–2006.*

Why is this important?

B.C.'s vast forests can add or remove significant amounts of greenhouse gases from the atmosphere. The net balance changes over time in response to both natural events and forest management.

State and trend

- Figure 10-1 depicts net greenhouse gas emissions from B.C.'s forests (in megatonnes of carbon dioxide equivalent, CO_2e) along with the primary cause of various sources and sinks. The grey line shows the net greenhouse gas balance. Tree growth and decay were a net sink for CO_2, although recently this sink has decreased due to the mountain pine beetle killing trees. Harvesting, wildfires, and slashburning caused emissions.
- From 1990 to 2003, B.C.'s forests were a carbon sink, providing a net removal of carbon from the atmosphere.
- By 2003, the combination of wildfires, the mountain pine beetle outbreak, and salvage logging had increased the release of carbon dioxide into the atmosphere to the point that B.C.'s forests became a net source.
- In 2003 and 2004, large areas were burned by wildfire, resulting in large emissions.
- Since 2003, B.C.'s forests have remained a carbon source, providing a net addition of carbon to the atmosphere each year.
- In accordance with current international standards for carbon accounting, in Figure 10-1 the carbon in harvested timber is reported as immediately released to the atmosphere (see section 10-2 for more information). This assumption greatly overstates the emissions from B.C.'s forests.

Information

- The data in this summary were produced by Canada's National Forest Carbon Monitoring, Accounting, and Reporting System, a federal and provincial collaborative effort led by the Canadian Forest Service.
- Reference: British Columbia Greenhouse Gas Inventory Report 2007[2]

Related international and national indicators

- MP 5.a CCFM 4.1.1

10-2 How Much of the Carbon That Leaves the Ecosystem Is Turned into Long-term Forest Products?

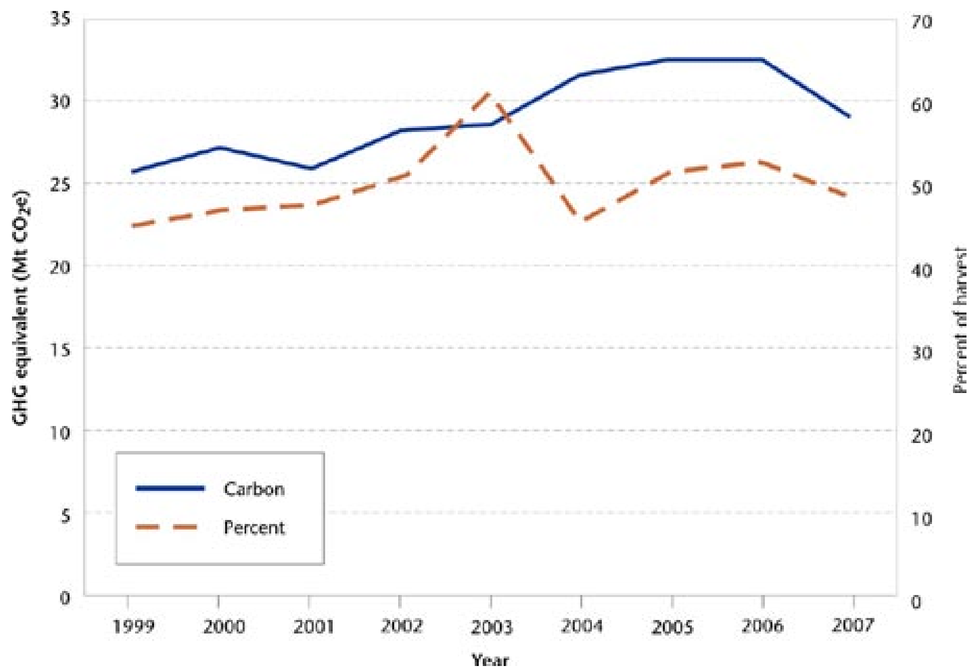


Figure 10-2. *Carbon in B.C.'s annual lumber and plywood production, and the percent of harvest volume in these products, 1999–2007.*

Why is this important?

Forests take up carbon from the atmosphere. When trees are harvested, some of this carbon is put into long-term storage in lumber and other long-lived forest products. Through this process, forest management helps mitigate climate change when these products are used in place of more fossil fuel-intensive alternatives such as concrete and steel.

State and trend

- Figure 10-2 shows the amount of sawn lumber and plywood produced annually in British Columbia expressed in units of megatonnes of carbon dioxide equivalents. On the right axis is the proportion of the scaled volume that ends up in these long-lived products.
- When trees are harvested and removed from the forest, roughly one-half of the carbon removed is turned into long-lived forest products like lumber and panels. In B.C., this translates to 25–30 million tonnes of carbon dioxide (CO_2e) moved into long-term storage each year.
- Current international carbon accounting rules do not recognize the long-term storage of carbon in durable forest products. Instead, all of the carbon in harvested trees is reported as immediately released to the atmosphere. This is an emission of 71 millions of tonnes CO_2e per year in B.C.'s case.

- A more realistic first approximation of greenhouse gas emissions from the burning or decay of historical and current forest products is about 45–65% of the emission currently being reported.
- Provincially, nationally, and internationally work is underway to improve the method for estimating and reporting greenhouse gas emissions from forest products.
- The emission of greenhouse gases from forest products can be reduced by reducing consumption, increasing recycling, and using longer-lived products.
- In B.C., several organizations promote the increased use of wood, including the provincial government through its Wood First initiative.

Information

- Data from B.C. forest sales volume and internal MFR modelling

Related international and national indicators

- MP 5.b CCFM 4.1.3

10-3 What Is the Magnitude of Fossil Fuel Emissions from the Forest Sector?

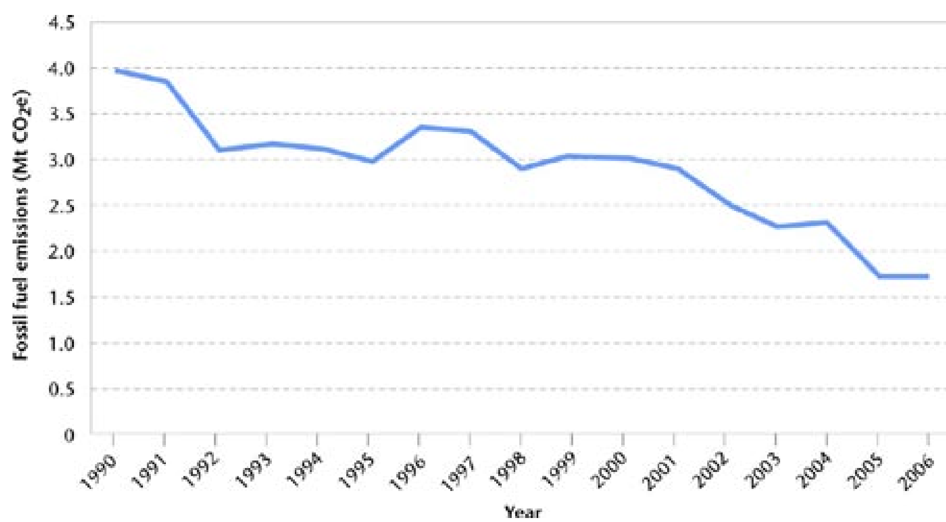


Figure 10-3. *Greenhouse gas emissions from fossil fuel use in the forest sector, 1990–2006.*

Why is this important?

Forest sector operations consume fossil fuels and emit greenhouse gases.

State and trend

- Forestry operations in B.C. consume fossil fuels in mills, processing, and manufacturing facilities and through transportation. There are only limited data available.
- In 2006, the greenhouse gas emissions from fossil fuel use in pulp and paper manufacturing and forestry were approximately 1.8 megatonnes CO_2e. These estimates exclude emissions associated with electricity use and CO_2 from bioenergy. Emissions have decreased since 1990 as facilities have become more efficient. More recently, mill closures and a reduction in industrial activity have contributed to the decrease in emissions. This downward trend is expected to continue at least until forest products markets improve. Operational efficiency and technological improvements are expected to affect the long-term trend in emissions.
- Since 1990, pulp and paper manufacturers have reduced their greenhouse gas emissions by roughly two-thirds, primarily by replacing the use of fossil fuels with the use of wood residues.

Information

- Data from Natural Resources Canada, Office of Energy Efficiency[3]

Related international and national indicators

- MP (none) CCFM 4.1.4

10-4 How Much Forest Area Is Being Lost and Gained through Human Activities?

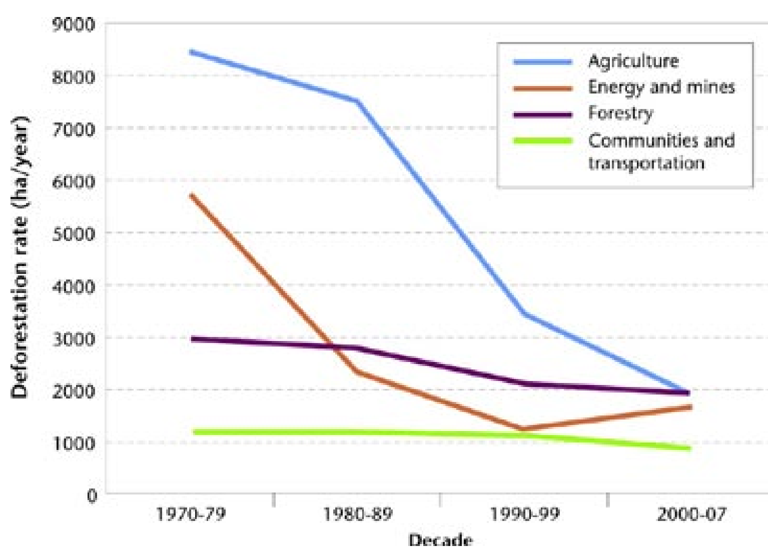


Figure 10-4. *Annual rate of conversion of forest lands to other uses by source, 1970–2007.*

Why is this important?

When the forest land is converted to another use, greenhouse gases are released and land's ability to sequester carbon is reduced.

State and trend

- From 1970 to 2007, British Columbia's forests decreased in total area by about 12,000 hectares per year due to deforestation (the conversion to other land use). The rate of deforestation has been declining since the 1970s when there was considerable hydroelectric and agricultural development. Since 2000, the annual rate has been approximately 6,200 hectares per year.
- Deforestation is defined as the conversion of forest to other land uses. Harvesting, when it is followed by regeneration, is not deforestation. Afforestation is defined as the planting of trees on land that has not been forested since 1989.
- The loss of forest area and conversion to other land uses accounts for 10 to 30% of greenhouse gas emissions globally, but only 4% of emissions in B.C.
- In B.C., the afforestation rate was approximately 1,000 to 2,000 hectares per year from 1990 to 2007, primarily due to planting trees on abandoned farmland. Uncertainty in this estimate is due to a current lack of information systems to estimate afforestation activities.
- Changes in land use through urban development (e.g., roads and settlements) impact not only biodiversity and water quality but also carbon storage. In B.C., communities are becoming increasingly aware of this impact and factoring it into their planning and decision-making. Government programs, such as the provincial government's Trees for Tomorrow program, have re-established or increased tree cover on public lands.

Information

- Deforestation data are from the Canadian Forest Service. Afforestation data are from a voluntary registry run by the Canadian Forest Service and from other voluntary submissions to MFR.
- Reference: British Columbia Provincial Greenhouse Gas Inventory Report 2007[4]

Related international and national indicators

- MP 5.a CCFM 4.1.1

Summary and Assessment

State

Driven by a massive outbreak of the mountain pine beetle, B.C.'s forests have become a net source of greenhouse gases to the atmosphere. By treating all timber harvest as an immediate release of carbon to the atmosphere, current reporting protocols tend to overstate the emissions from forests. Large amounts of carbon are stored in the long-lived wood products manufactured from B.C.'s forests. Greenhouse gas emissions resulting from fossil fuel use in the forest sector have decreased since 1990. Deforestation rates have decreased since the 1970s. In 2010, the Province introduced the *Zero Net Deforestation Act.*

Trend

Greenhouse gas emissions from B.C.'s forests are expected to remain high for the next few years. Over the next decades, these emissions are expected to decrease as the forest regrows following the mountain pine beetle epidemic. Emissions from fossil fuel use and land use change have decreased and are expected to continue to decrease in the future.

Information

In this topic area, the information base is very strong for some elements and weak for others. A federal-provincial collaborative program provides state-of-the-art modelling of forest carbon balance. However, information needs to be improved for some key aspects such as the emissions from forest product pools and substitution effects. Provincially, nationally, and internationally the rules around estimating and reporting GHG emissions from forest products are being revised to better represent what is received by the atmosphere. The data presented here should be considered a first approximation that will evolve in the future. The emissions from fossil fuels by forest operations in B.C. have not regularly been reported separately from other industrial and transportation activities. In B.C., afforestation reporting has been incomplete, but that may change with the growing interest in mitigating climate change.

11 Ownership and Timber Harvest Rights

Most of the province's land and forests are publicly owned.

Why is this important?

Benefits and obligations are tied to ownership and rights to harvest Crown timber. Public interests include access to resources, local employment opportunities, forest stewardship, and the maintenance of a viable forest sector.

Overview

- Ownership conveys both rights to benefits and responsibilities for resource stewardship.[1]
- Most (94%) of B.C.'s land and forests are owned by the Province of British Columbia.
- Rights to harvest Crown timber are granted to various parties through timber harvesting licences.
- Forest use and management are controlled primarily through provincial laws and policies, and to a lesser degree by international, national, and local laws and policies.
- Changes in ownership and the allocation of harvesting rights are driven by government priorities, which change in response to public opinion and change to address emerging issues, opportunities, and challenges.
- In 2009, roughly one-half of the timber harvesting rights were held in long-term licences, down from three-quarters in 1999.
- The share of harvesting rights held by the largest companies has remained relatively stable over the past 30 years.

Questions about ownership and timber harvest rights

11-1: Who owns B.C.'s land and forests?
11-2: What is the allocation of timber harvesting rights by type of licence?
11-3: What share of the right to harvest Crown timber is held by large forest companies?
► Summary and assessment

Related indicators

- Ownership and rights to harvest Crown timber are affected by resolution of Aboriginal rights and title issues and changing social values (see First Nations involvement, Public involvement).
- The security and stability of ownership and rights to harvest Crown timber affect economic activity and communities (see Forest products and the economy, Jobs and communities).
- Changes to ownership and rights issues require revision of laws and policies (see Law).
- Changes to ownership and rights impact who is responsible for management of the forest (see Management capacity).

11-1 Who Owns B.C.'s Land and Forests?

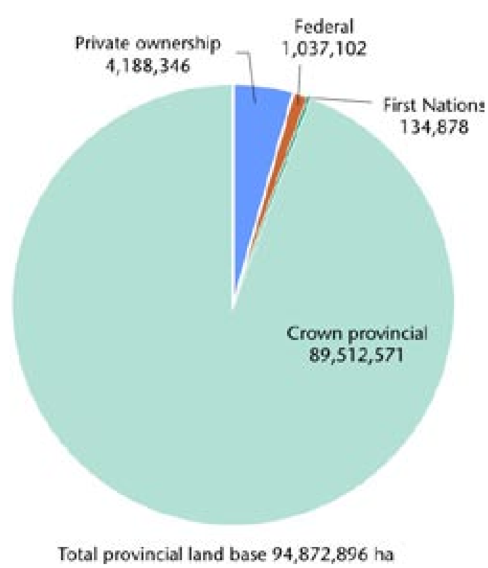


Figure 11-1. *Area of provincial lands in four ownership categories, 2009.*

Why is this important?

The right to make land use and forest management decisions depends primarily on ownership and rights to harvest timber.

State and trend

- Most of the province's land and forests are publicly owned. The province owns 94% and the federal government owns 1% of the area of B.C.
- Private owners hold 4% of the provincial land base. In 2000, 0.1% was granted to First Nations, mostly as Nisga'a treaty settlement lands.
- Over the past 25 years, 350,000 hectares within provincial forests changed ownership category. This amounts to less than 1% of the province's forests.
- Issues of Aboriginal rights, title, and interests affect land use and forest management decisions on public and private forest land.
- Extensive forest practices regulations apply to forest land owned by the Province. Private forest land use regulations apply to some private land designated as managed forest land.
- Private owners have the right to control public access to private land.

Information

- Private land forest cover inventories are not publicly available.
- In Figure 11-1, the area under First Nations ownership may be underestimated. Using more recent data, treaty settlement lands were estimated at 227,000 hectares by the Ministry of Agriculture and Lands.[2]
- References: 2008 Forest Ownership data, Forest Analysis and Inventory Branch

Related international and national indicators

- MP 7.1.a CCFM 6.1.2

11-2 What Is the Allocation of Timber Harvesting Rights by Type of Licence?

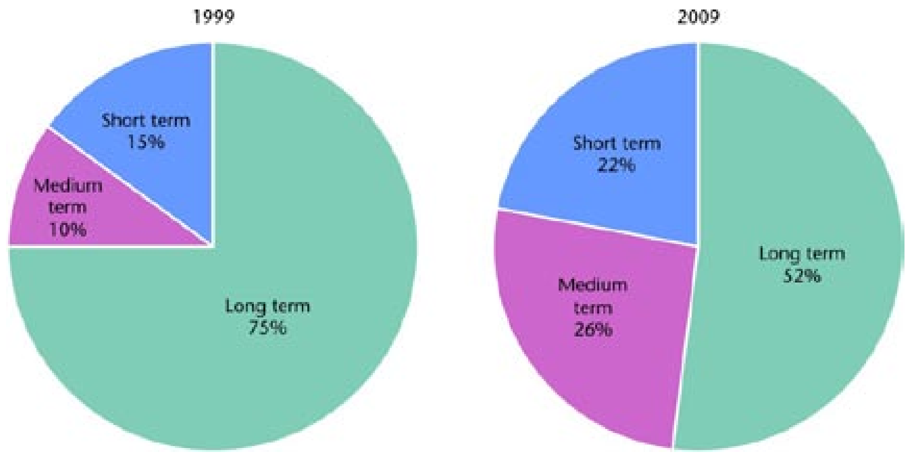


Figure 11-2. *Percent of timber volume under tenure in short-, medium-, and long-term licences in 1999 and 2009.*

Why is this important?

Different types of timber harvesting licences confer different rights and obligations.

State and trend

- Long-term licences include tree farm licences, replaceable forest licences, woodlot licences, and community forest agreements. These are "evergreen" licences where under most circumstances the rights to harvest timber and associated responsibilities continue indefinitely.
- Medium-term licences (non-replaceable forest licences) generally confer rights to harvest timber that last from 5 to 20 years.
- Short-term licences (timber sale licences, forestry licences to cut) generally have terms from one to four years.
- In 1999, 75% of the timber volume under tenure was administered under a long-term licence.
- In 2003, a significant portion of the timber harvesting rights under long-term licences was reallocated to BC Timber Sales, woodlot licences, community forest agreements, and First Nations tenures.
- By 2009, the percentage of timber harvesting rights under long-term licence had decreased to 52%.
- The percentage of timber harvesting rights under medium-term licences increased from 10% in 1999 to 26% in 2009.
- No new large, long-term licences have been awarded for 20 years.

Information

- Current allocations of timber tenures are publicly available. See the website of the Ministry of Forests, Mines and Lands, Forest Tenures Branch.[3]
- References: MFR Timber Tenures Apportionment System

Related international and national indicators

- MP 7.1.a CCFM 5.2.1

11-3 What Share of the Right to Harvest Crown Timber Is Held by Large Forest Companies?

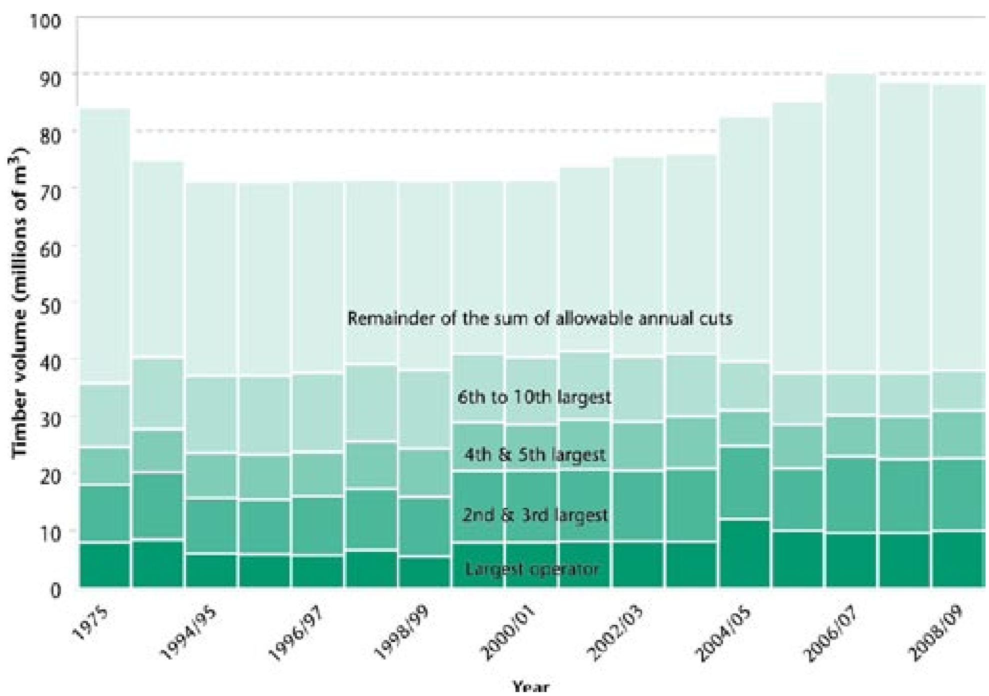


Figure 11-3a. *Timber harvesting rights held by large operators, 1975–2009.*

AAC rank	1999	2005	2009
1	Slocan Forest Products	Canadian Forest Products	Canadian Forest Products
2	MacMillan Bloedel	West Fraser Mills	Western Forest Products
3	Canadian Forest Products	Weyerhaeuser Company	West Fraser Mills
4	West Fraser Mills	Western Forest Products	Tolko Industries
5	Doman Industries	International Forest Products	International Forest Products
6	International Forest Products	Riverside Forest Products	Weyerhaeuser Company
7	Northwood Inc.	Tolko Industries	Tembec Industries
8	Riverside Forest Products	Tembec Industries	Ainsworth Lumber Co.
9	Skeena Cellulose	NWBC Timber & Pulp	Louisiana-Pacific Canada
10	Weldwood of Canada	Louisiana-Pacific Canada	RPP Holdings

Figure 11-3b. *The 10 companies with the largest share of the provincial AAC in 1999, 2005, and 2009.*

Why is this important?

Larger companies can be stronger competitors in global markets. However, concerns can arise over maintaining adequate market competition within B.C. if a large share of the timber harvest is controlled by a few companies.

State and trend

- Over the past 30 years, the largest amount of harvesting rights held by a single company has ranged from 8 to 12 million cubic metres per year. In 2008/09, this value was 10 million cubic metres per year, 11% of the provincial total.[4]
- The timber volume under licence to the top 10 companies has remained relatively constant over the past 30 years at roughly 40 million cubic metres per year.
- Recent increases in the allowable annual harvest have resulted in an increase in the timber volume licensed to smaller operators.
- Both federal and provincial laws exist to maintain market competition for logs, lumber, and chips.

- Ownership of companies and rights to harvest timber change over time.
- Only 3 of 10 companies that had the most timber rights in 1999 still existed in 2009.

Information

- Current ownership and allocation information is publicly available on the internet for timber supply areas and tree farm licences.
- References: MFR Timber Tenures Apportionment

Summary and Assessment

State

Public land and forests account for 95% of the provincial land base, with the Province owning 94%. Approximately 4% of the provincial land base is privately owned. Just over half of the rights to harvest Crown timber are held under long-term licences. Presently, the 10 companies with the largest shares of rights to harvest Crown timber hold 42% of government-set allowable annual cuts (AACs).

Trend

Forest ownership has been stable over the past 25 years, and less than 1% has changed from provincial to other ownerships. Since 1999, the volume allocated to longer-term replaceable licences has decreased, and correspondingly the volume allocated to small, shorter-term tenures has increased. The portion of government-set AACs held by the top 10 companies peaked at 57% in 1999/2000. Their combined AAC holdings have decreased both in terms of volume and percentage, despite ongoing consolidation of companies, due to the reallocation of AACs and short-term AAC increases. The number of licences and the associated timber volume dedicated to First Nations, small woodlots, and community forest agreements are increasing.

Information

Historical ownership data are not in a readily useable form. Current allocations of timber tenures are readily available on the internet. Some historical information on tenure allocations is available.

12 Timber Production Forests

The volume of timber in B.C.'s forests totals roughly 11 billion cubic metres.

Young forest on logged site – MFR

Mosaic of clearcuts and patch cuts – MFR

Why is this important?

The area available and suited to timber production provides the resource base for B.C.'s forest industry.

Overview

- Timber production forests—forests from which timber has been or is expected to be harvested—exclude protected forests, other reserves, and forests that are uneconomical for timber production.
- In B.C., the timber production forest area is approximated by the timber harvesting land base (THLB), which is derived as part of the process of setting allowable annual cuts (AACs).
- On B.C.'s public forest lands, the THLB totals roughly 22 million hectares. The size of the THLB has remained relatively stable over the last 10 years. On private forest lands, an additional 2 million hectares may be suitable for timber harvesting.
- The volume of timber in B.C.'s forests totals roughly 11 billion cubic metres, with lodgepole pine, spruce, and hemlock accounting for 60% of the growing stock. Douglas-fir, true fir, western redcedar, deciduous, and other conifers make up the remainder.
- Approximately one-half of B.C.'s timber volume is located on land suitable for harvesting (i.e., the THLB or the private land equivalent).
- The ongoing mountain pine beetle epidemic is decreasing the mature, live lodgepole pine growing stock in B.C.'s forests.
- The THLB has been derived and recorded for TSAs only since 1996. Some TFLs have recorded THLB dating back to 1950.

- The specific criteria used to derive the THLB vary by management unit. The THLB is re-evaluated approximately every five years before setting the AAC to reflect recent changes in forest management policies, local land use planning objectives, and improvements in data sources.

Questions about timber production forests

12-1: How much area is in timber production forests?
12-2: How much timber is in B.C.'s forests?
12-3: What is the extent of mountain pine beetle mortality in B.C.'s forests?
▶ Summary and assessment

Related indicators

- Timber production forests are subject to competing demands for land use and pressures from natural disturbances and climate change (see Protected forests; Recreation, tourism, and visual quality; Rangeland; Ecosystem dynamics; Forest carbon and greenhouse gases).
- The state of timber production forests may affect wildlife habitats, water quality (see Ecosystem diversity, Water), and economic outputs (see Timber harvest, Jobs and communities, Forest products and the economy).
- Management responses include land use planning and operational planning (see Public involvement, First Nations involvement, Law), prompt reforestation, controlling wildfires and pests, and regulating the rate of logging (see Silviculture, Ecosystem dynamics, Timber harvest).

12-1 How Much Area Is in Timber Production Forests?

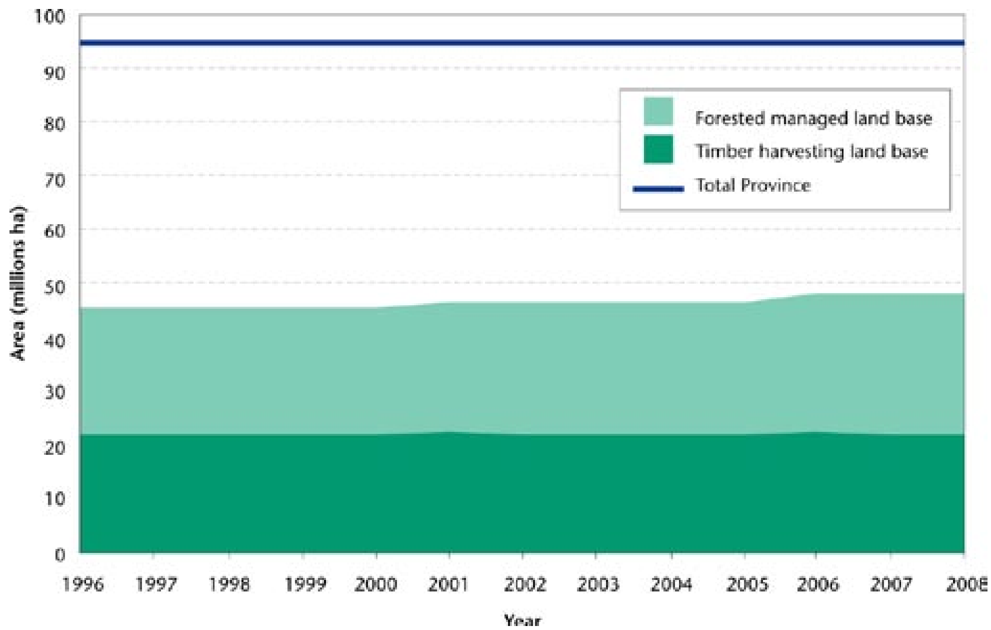


Figure 12-1. *Area of timber harvesting land base (THLB) and forest management land base (FMLB) in management units with government-set AACs, 1996–2008. For reference, the total provincial land base is shown.*

Why is this important?

The size of the forest sector that can be sustained in British Columbia depends in part on the amount of land in timber production forests.

State and trend

- The THLB is an approximation of the forest area where timber harvesting is considered both acceptable and economically feasible given objectives for all relevant forest values, existing timber quality, market values, and applicable technology.
- The size of the THLB is estimated when the provincial government's Chief Forester sets AACs for the 37 timber supply areas (TSAs) and 34 tree farm licences (TFLs). The government's senior decision-makers also consider the THLB when setting AACs for the more than 800 woodlot licences and community forests.
- There is no requirement to identify the THLB on lands with no government-regulated AACs, primarily private land.
- Forested land is termed the Forest Management Land Base (FMLB, see Indicator 1-2). The graph above shows the size of the FMLB in management units with government-set AACs. An additional 7 million hectares of FMLB exists on other land in B.C. The forest area outside of the THLB (i.e., the difference between the FMLB and THLB) contributes to meeting non-timber

management objectives such as wildlife habitat, cultural areas, old growth, and biodiversity.

- The graph above shows the total area of the province. The difference between the FMLB and the total area of the province is mostly non-forested area such as grassland, lakes, rock, or ice. However, in this case, since the THLB and FMLB are presented for areas with AACs, this difference also includes private land, urban areas, and some parks.
- In management units with government-set AACs, the FMLB has increased by approximately 3 million hectares over the last 10 years to 48 million hectares. This is mostly attributed to changes in the criteria used to identify the FMLB and improvements in data sources.
- In management units with government-set AACs, the THLB has remained stable at approximately 22 million hectares over the same time period. Changes in the THLB for individual management units have occurred over the last 10 years but they have averaged to yield a consistent provincial total. On private forest lands, an additional 2 million hectares may be suitable for harvest.
- Since 1996, the THLB has been estimated for all management units under government AAC regulation. The THLB is re-evaluated for each management unit approximately every five years before setting the AAC to reflect recent changes in forest management policies, local land use planning objectives, and improvements in data sources.

Information

- Analyses and rationales for government-set AACs describe the derivation of the THLB and FMLB.[1] Little information is available for forests without government-set AACs.
- References: Forest Analysis and Inventory Branch

Related international and national indicators

- MP 2.a CCFM 2.2

12-2 How Much Timber Is in B.C.'s Forests?

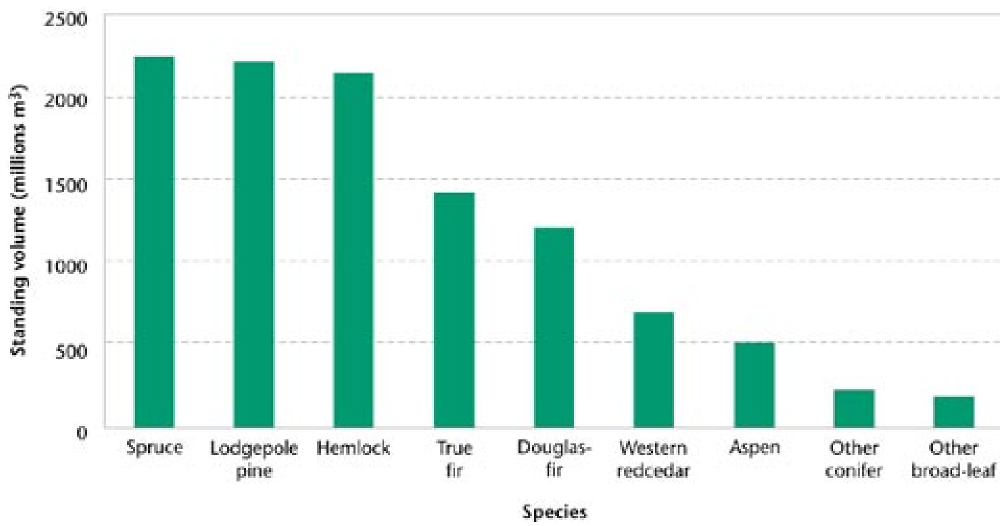


Figure 12-2. *Timber volume in B.C.'s forests by species, 2007.*

Why is this important?

The volume of timber is an important determinant of the level of forest sector economic activity that can be supported in British Columbia.

State and trend

- There is roughly 11 billion cubic metres of timber in B.C.'s forests. Of this, approximately one-half is located on land suitable for harvesting (i.e., the THLB or the private land equivalent of THLB).
- Spruce, lodgepole pine, and hemlock account for 61% of the growing stock.
- A massive outbreak of the mountain pine beetle has killed pine trees over much of the Interior of the province. These losses are not reflected in Figure 12-2. As a result, future estimates will show significant reductions in the volume of lodgepole pine.

Information

- Timber volume estimates are maintained and updated by the Forest Analysis and Inventory Branch.
- Data in Figure 12-2 is from the National Forest Inventory.[2]

Related international and national indicators

- MP 2.b CCFM 2.1

12-3 What Is the Extent of Mountain Pine Beetle Mortality in B.C.'s Forests?

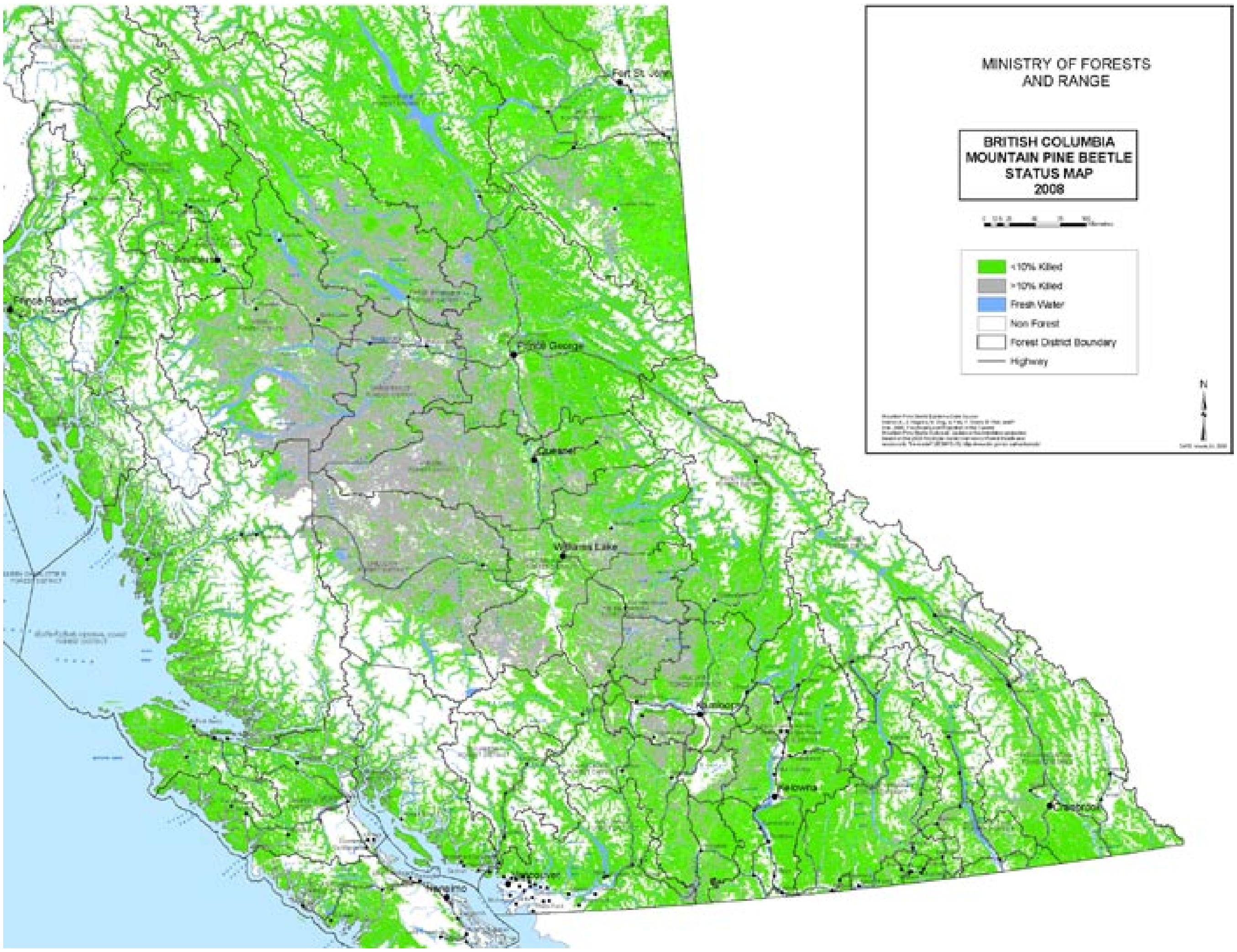


Figure 12-3. *Percent of timber killed by the mountain pine beetle, 2008.*

Why is this important?

A mountain pine beetle epidemic has killed a large proportion of the standing volume in B.C.'s interior forests.

State and trend

- The Ministry estimates that by 2008 the mountain pine beetle had killed a total of 620 million cubic metres of timber since the infestation began.
- The cumulative area of B.C. affected to some degree (red-attack and grey-attack in 2008) is estimated at 14.5 million hectares, more than four times the size of Vancouver Island.

- Newly attacked trees turn red about one year after infestation. Trees can stay in the red-attack stage for two to four years before turning grey as they lose their needles.
- On a provincial level, the infestation has peaked and is now slowing down.
- In 2008, 7.8 million hectares of red-attack was found. This is compared to 10.1 million hectares the year before. This is the first decrease in red-attack since the current infestation began.
- The amount of habitat available to the beetle has begun to diminish as the beetle has already attacked most of the mature lodgepole pine in the Central Plateau region.
- The rate of spread in other areas of the Interior has been slowed by more diverse terrain and forests with a greater diversity of timber species.
- The mountain pine beetle in B.C. is as far-ranging as Fort St. John to the north, the Alberta border to the east, Terrace to the west, and the United States border to the south.

Information

- Since 1999, the Ministry has surveyed the majority of the forested land in the province using the classic sketch mapping technique known as the over-view survey method. The purpose of the survey is to record and report the general trends in disturbance patterns across the provincial forested land base (including provincial parks, private land, and tree farm licences but not federal parks). This survey has been a key source of data documenting the development of the current mountain pine beetle outbreak in the Interior of B.C.
- Maps of the extent and severity of the mountain pine beetle outbreak are publicly available.[3]
- References: Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak[4]

Summary and Assessment

State

The resource base for B.C.'s forest industry is that portion of the forest that is suitable for timber production and harvesting. In B.C., the timber production forest area is referred to as the timber harvesting land base (THLB). The THLB is derived as part of the process of setting allowable annual cuts (AACs). On Crown forest land, the THLB totals roughly 22 million hectares, 46% of the forested area within management units. On private forest lands, an additional 2 million hectares may be suitable for harvest. The standing volume in B.C.'s forests totals about 11 billion cubic metres, with spruce, lodgepole pine, and hemlock accounting for 61% of the growing stock. Over the last several years, the mountain pine beetle has killed lodgepole pine trees over a vast portion of the Interior.

Trend

At the provincial level, the THLB has remained relatively stable over the last 10 years. The total forested area in management units with government-set AACs has increased slightly over the same time period. Since the THLB is an indicator of the current economics, relevant forest values, existing timber quality, market values, and applicable technology, it will continue to vary in the future as these values change. The current mountain pine beetle outbreak is continuing to kill vast areas of lodgepole pine. Therefore, the estimate of the mature, live volume of timber in B.C. is expected to decline in the near future.

Information

Substantial, detailed information showing how THLB is derived is documented in timber supply analyses and AAC determination rationales for management units with government-set AACs. Most of this information is publicly available. There is no requirement to approximate the THLB on lands with no government-set AACs, primarily private land and some public land. There is limited information about the timber production forests within these areas. For public lands, good estimates of the amount of timber are available.

13 Timber Harvest

Natural disturbances such as wildfires and pest infestations affect planned timber harvest levels.

Falling - MFR

Yarding – MFR

Loading – MFR

Why is this important?

Timber harvests have direct implications for environmental integrity and sustainable economic activity.

Overview

- Timber harvesting supported much of British Columbia's economic development, and it continues to be important to the province's economy (see Forest products and the economy, Jobs and communities).[1]
- Since the 1900s, the annual volume of timber harvested in the province has increased, reaching roughly 90 million cubic metres in 1987 and again in 2005. Between these peaks, the annual harvest fluctuated around an average of 77 million cubic metres, with 89% of the timber volume coming from public forest land.
- On all public and some private land, the Province specifies an allowable annual cut (AAC), the maximum permitted harvest. Over the last 10 years, to address the mountain pine beetle epidemic, AACs have been increased 18 million cubic metres to a current total of 88 million cubic metres per year. However, actual harvests over this period averaged 12% less than the totalled AACs.
- Throughout the Interior, the mountain pine beetle is killing most of the mature lodgepole pine. Once timber salvaging is no longer feasible, harvest levels are expected to decline to 50–60 million cubic metres per year for several decades. The long-term sustainable harvest level on AAC-regulated land is currently estimated at 70 million cubic metres per year.
- Trends in forecast timber supply vary across the province. Many of the areas with the largest projected reductions are in the Central Interior of B.C.

Questions about the timber harvest

13-1: How much timber is harvested annually?
13-2: How does the actual harvest compare with the allowable annual cut?
13-3: What is the provincial timber supply forecast?
► Summary and assessment

Related indicators

- Natural disturbances such as wildfires and pest infestations affect planned timber harvest levels (see Ecosystem dynamics).
- The level of timber harvest affects the economy (see Forest products and the economy, Jobs and communities), ecosystems (see Ecosystem diversity, Species diversity), and perhaps even the climate (see Forest carbon and greenhouse gases).
- Management responses include planning, appropriate forest practices (see Law), and reforestation (see Silviculture, Genetic diversity).

13-1 How Much Timber Is Harvested Annually?

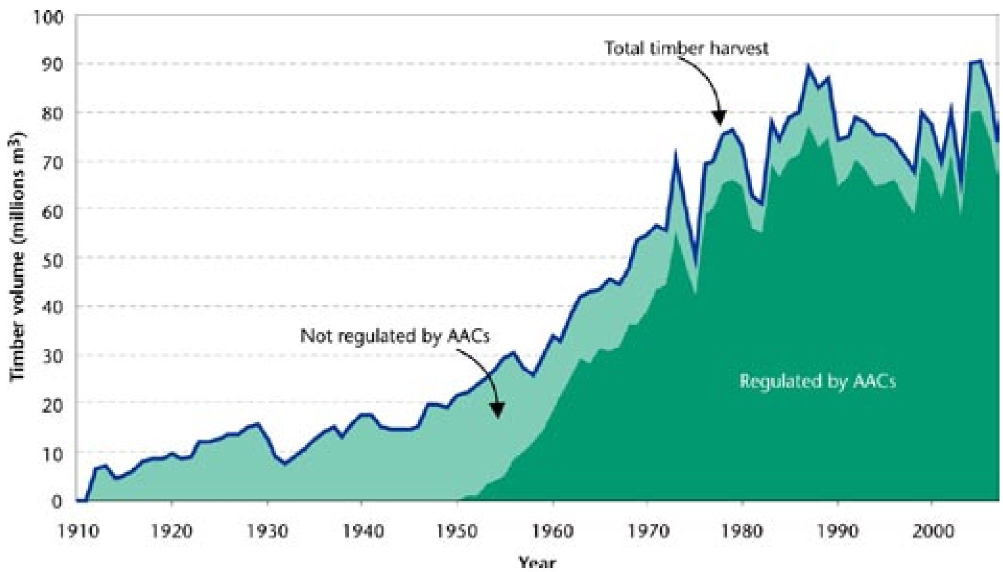


Figure 13-1. *Timber harvest from areas regulated and not-regulated by AACs, 1910–2008.*

Why is this important?

Timber harvesting contributed substantially to B.C.'s economic development and continues to provide the economic base for many rural communities.

State and trend

- The annual timber harvest from all public and private land increased 10-fold since the 1900s, and levelled off in the 1990s. Annual harvest reached 90 million cubic metres in 1987 and again in 2005.
- Concern about the rapid increase led to government regulation of harvest levels to ensure sustainable timber supplies and community stability. Beginning in 1949, government set allowable annual cuts (AACs) to regulate harvest levels on public land and some private land.

- Almost all of the harvest regulated by AACs is from timber supply areas (TSAs) and tree farm licences (TFLs) for which the provincial government's Chief Forester sets AACs. Senior government decision-makers also set AACs for more than 800 woodlot licences and community forests that sum to roughly 4% of the overall AAC.
- Over the last 10 years, the average total timber harvest was 78 million cubic metres per year, of which 69 million cubic metres per year (89%) was from forests where harvest levels are regulated by AACs. The remaining 9 million cubic metres of timber harvested per year (11% of the total harvest) was from lands with no government-set AACs, primarily private land and some public land.

Information

- Detailed data on timber harvest volumes and areas by land status and species exist for most of the past century, with only a few minor gaps.
- Data are publicly available in the Ministry's annual reports.
- References: MFR Resource Tenures and Engineering Branch; MFR annual reports[2]

Related international and national indicators

- MP 2.d CCFM 5.3.1

13-2 How Does the Actual Harvest Compare with the Allowable Annual Cut?

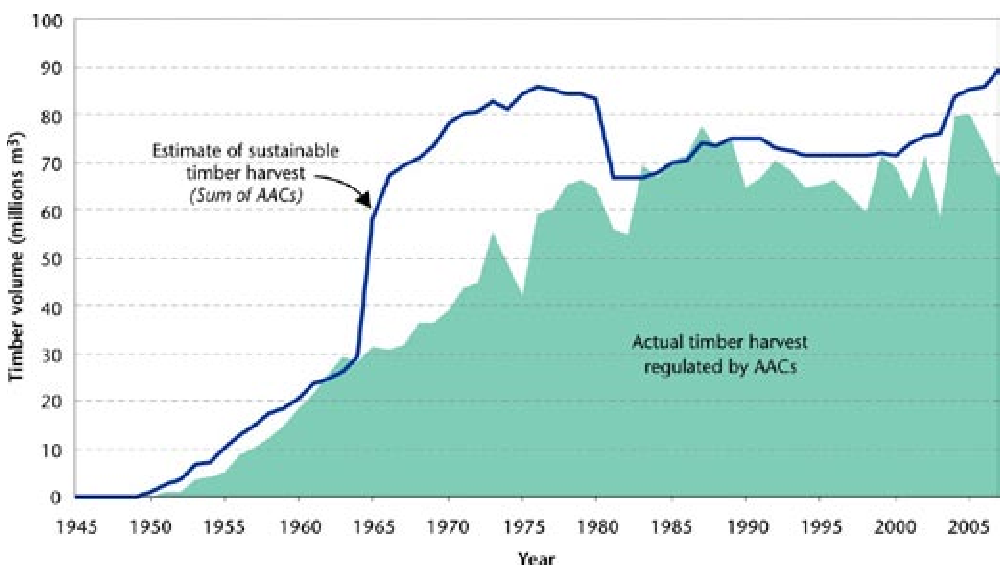


Figure 13-2. *Actual timber harvest and the maximum permissible harvest on areas regulated by AAC, 1945–2008.*

Why is this important?

Environmental integrity and sustainable economic activity depend on maintaining a long-term balance between forest growth and timber harvest.

State and trend

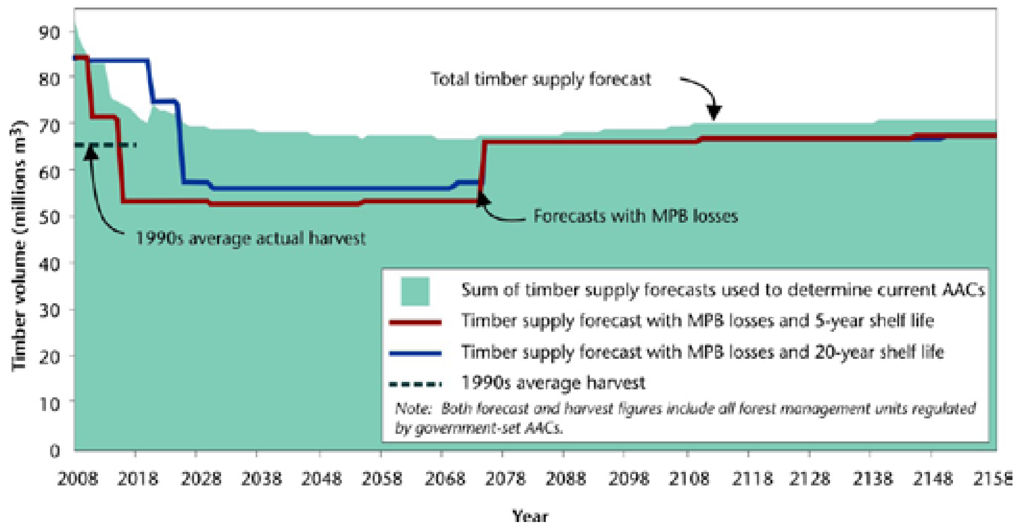
- Actual timber harvest can be compared to the allowable annual harvest for areas regulated by government-set AACs. In the last 10 years, these areas accounted for 89% of the total harvest.
- Each forest management unit's AAC represents a harvest level that balances environmental, economic, and social considerations.[3]
- On public land in B.C., the amount of timber harvested each year is consistently below the AAC. Over the last 10 years, on areas regulated by AACs, the average harvest was 69 million cubic metres per year and the average AAC was 78 million cubic metres per year. Among the causes for this difference are market fluctuations and delays in forest planning.
- In the last 10 years, AACs of some management units were increased to address the mountain pine beetle epidemic with pest control measures and salvage programs. From an average AAC in the 1990s of 72 million cubic metres per year, the provincial AAC in 2009 was 88 million cubic metres per year. However, beginning in 2006, a downturn in market conditions resulted in decreasing actual harvest despite the increases in AACs. In those management units with beetle-related AAC increases, large decreases in AAC are projected for the future.
- An AAC is the maximum average level of harvest permitted over a five-year period. Within this period, actual harvest may exceed the AAC in some years if offset by lower subsequent harvests.
- AACs have changed over time reflecting new harvesting and milling technologies (increases in the 1960s, 1970s, and 1980s), new legislation (the decrease around 1980), and the establishment of new parks and forest practices regulations (the decrease in the early 1990s).

Information

- Analyses and rationales for government-set AACs are publicly available. Little information is available for forests without government-set AACs.
- References: MFR Forest Analysis and Inventory Branch

Related international and national indicators

- MP 2.d CCFM 5.3.1



13-3 What Is the Provincial Timber Supply Forecast?

Figure 13-3. *Long-term timber supply forecast under three scenarios with 1990s average actual harvest level, 2008–2158.*

Why is this important?

Predictable timber supplies are important to the provincial economy and to customers who rely on B.C.'s forest products.

State and trend

- Timber supply forecasts change over time in response to changes in the forest and new information, forecasting methods, and assumptions.
- Until relatively recently, B.C. was forecast to have a stable mid- and long-term timber supply (Figure 13-3, sum of timber supply forecasts). However, a massive outbreak of the mountain pine beetle is killing mature lodgepole pine forests throughout the B.C. Interior. New forecasts that account for the impact of the beetle predict a large reduction in mid-term timber supply before supply recovers in the long term (Figure 13-3, timber supply forecast with MPB losses).
- To encourage harvesting for pest control and salvage programs in beetle-impacted management units, AACs have been increased. In 2009, the provincial total AAC was 88 million cubic metres (33% above the average actual harvest of 66 million cubic metres per year in the 1990s before the AAC increased).
- Recent analysis projects a decrease in timber supply to 50–60 million cubic metres per year by 2025, due to mortality caused by the mountain pine beetle epidemic. The forecast timber supply returns to approximately 65–70

million cubic metres per year by 2075.
- In the wake of the mountain pine beetle, the timber volume forecast to be available depends, in part, on the "shelf-life" of trees killed by the beetle. Shelf-life refers to the number of years after a tree is killed that it continues to provide useful timber products. Estimates of shelf-life typically vary between 5 and 20 years. Figure 13-3 illustrates the impact on timber supply of 5- and 20-year shelf-life for beetle-killed pine.
- For most management units in the B.C. Interior, large reductions in mid-term timber supply are predicted.[4] In contrast, timber supply is predicted to increase in the future in some coastal management units.
- Timber supply forecasts are influenced by many factors: past harvest levels, the mountain pine beetle epidemic, the shift to harvesting more second-growth forests, and estimates of future growth rates. Current harvests are based on accumulated volumes in older forests. Future harvests will rely on the faster growth of second-growth forests.

Information

- Detailed timber supply forecasts and their related assumptions are publicly available for timber supply areas and tree farm licences.[5]
- Uncertainties in timber supply forecasting include merchantability of species, operability, future management practices, the future timber production land base, wildfires, and insect epidemics. AACs are determined every five years using the latest information to reduce the risks related to uncertainty.
- References: MFR Forest Analysis and Inventory Branch; MFR Research Branch

Related international and national indicators

- MP 2.d CCFM 5.3.1

Summary and Assessment

State

British Columbia's early economic development was highly dependent on timber harvests that increased rapidly since the 1900s. Forest management units with government-regulated AACs provided 89% of the total harvest in the last 10 years, and harvests in these units averaged 12% below the permissible level represented by the provincial sum of AACs. The mountain pine beetle epidemic led to temporary increases in AAC of about 18 million cubic metres per year to enable the harvest of timber that would otherwise become commercially unusable. The provincial harvest in 2005/06 was a record 90 million cubic metres, well above the average of 78 million cubic metres over the last 10 years. Harvest levels have rapidly decreased since then and are now below the 10-year average due to poor market conditions.

Trend

Collectively, over the long term, forests with government-regulated AACs are forecast to have timber supplies that will provide a stable, long-term base for the provincial economy. Currently, however, some forest management units have had temporary AAC increases of over 70% to address the mountain pine beetle epidemic. Despite these AAC increases, actual harvest levels in recent years have decreased sharply due to poor market conditions. In the units with temporary AAC increases, large future decreases in AAC are forecast to compensate for the accelerated harvest and pine mortality. While reduced mid-term timber supply is predicted in the B.C. Interior, mid-term supply is predicted to rise in some coastal forests. The actual timber harvest is now at reduced levels not forecasted until 2020. This has caused economic consequences requiring transitions for workers and communities.

Information

Substantial, detailed information related to timber supply exists for forests with government-regulated AACs. Most of this information is publicly available. Recent analysis now forecasts that mid-term timber supplies will decrease to 50–60 million cubic metres per year due to mortality caused by the mountain pine beetle epidemic. Forests that do not have government-regulated harvest levels (mostly on private land) account for 11% of the provincial timber harvest. The government has little information about the sustainability of harvests from privately held forests.

14 Silviculture

On average, 180,000 hectares of Crown forest land are harvested each year.

Wildlife tree patch – MFR

Conifer seedlings – MFR

Mechanical brushing – MFR

Why is this important?

Silvicultural choices shape forests and their future contributions to the environment, economy, and communities.

Overview

- Silviculture is the art, science, and practice of growing and cultivating trees in forests to meet the objectives and values of the landowner.[1]
- With British Columbia's high level of public ownership, most silvicultural activities in B.C. have depended on government policies or funding.
- Changes in silvicultural practices over the past 30 years have increased reforestation and increased the volume and value of future timber supplies.
- Since 1970, the area of Crown forest land harvested each year has ranged from 120,000 hectares to 240,000 hectares. Over the last decade, average cutblock size has significantly decreased and the proportion of areas with live trees reserved at harvest has significantly increased.
- Large areas of NSR (not satisfactorily restocked) land accumulated in the 1970s and early 1980s. Beginning in the mid-1980s, most of these areas were reforested by a large government funded restoration program.

- Since 1987, holders of timber harvesting licences have been required to reforest the areas that they harvest. Of the areas harvested in the past two decades, virtually all have been successfully reforested.
- From 1976 to 2007, silvicultural treatments to improve the growth and quality of timber (e.g., fertilization, pruning, spacing, and the use of select seed) were applied to 1.6 million hectares of Crown forest.
- In recent years, wildfires and the mountain pine beetle have created new areas of NSR land that the Province is reforesting through the Forests for Tomorrow reforestation program.

Questions about silviculture

14-1: What silvicultural systems are used?
14-2: How much is reforested after disturbances?
14-2: What other silvicultural treatments have been done?
14-4: What gains do silvicultural investments yield?
▶ Summary and assessment

Related indicators

- Silvicultural choices are often influenced by natural disturbances, public expectations, and market demands (see Ecosystem dynamics, Public involvement, Certification).
- Silvicultural practices affect many aspects of forest ecology (see Ecosystem diversity, Species diversity, Genetic diversity) and can create short-term and long-term economic opportunities for rural communities (see Jobs and communities).
- Management responses to improve silvicultural practices include new government policies (see Law), non-governmental codes of practice (see Certification), and research (see Knowledge).

14-1 What Silvicultural Systems Are Used?

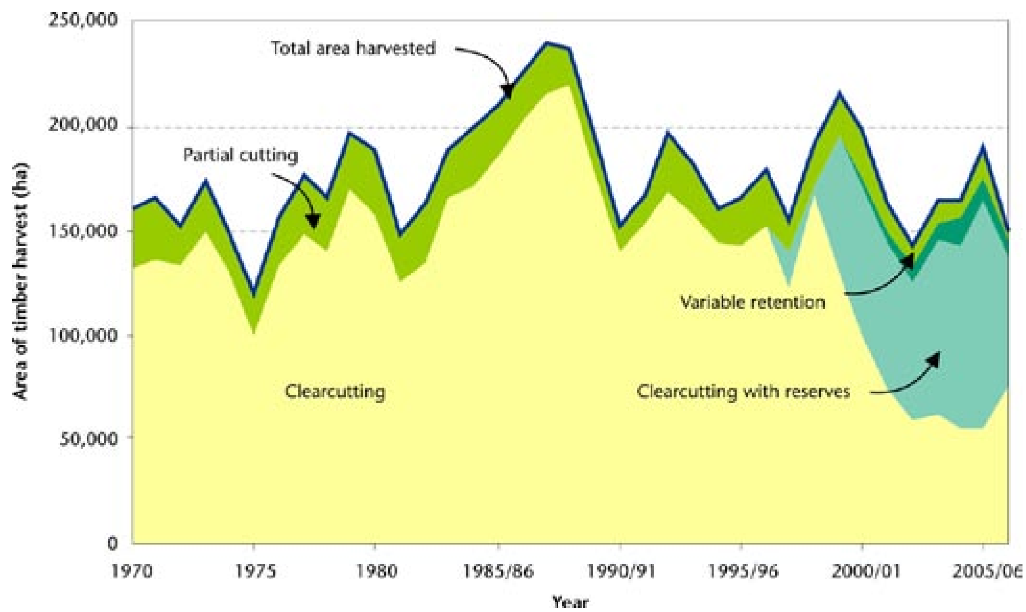


Figure 14-1. *Area harvested under various silvicultural systems, public land, 1970–2007.*

Why is this important?

Silvicultural systems are chosen to achieve specific environmental, economic, and social objectives over the life of a stand.

State and trend

- A siviculture system is a planned program of activities that encompasses how trees are harvested, regenerated, and managed over time. Selection of a silvicultural system depends on the ecological traits of the tree species, and on balancing the objectives of the landowner.
- From 1970 to 1998, clearcutting systems were applied on 87% of the area harvested on public land, and various partial cutting systems on 13%. Clearcutting systems were chosen for their low logging costs, worker safety near large trees, and efficient reforestation. Partial cutting was chosen to complement the ecological characteristics of drier forests in the B.C. Interior.
- Advances in knowledge and a shift in the balance of objectives towards conservation of biological diversity led to the use of clearcutting with reserves and variable retention systems. Since 1999 on public land, 44% of the area has been harvested by clearcutting, with the remaining 56% harvested under clearcutting with reserves, variable retention, and other partial cutting systems. Where appropriate and well implemented, these systems can provide greater stand structure and diversity that better emulates natural disturbances, conserves wildlife trees, and increases stand-level biodiversity while enabling acceptable volume growth of new trees.

- Social concerns about large cutblocks led to a decrease in average size of cutblocks on public land from 45 hectares in 1989 to 30 hectares in 2006.[2]
- Since 1970, the area of Crown forest harvested annually has ranged from 120,000 hectares to 240,000 hectares, with an average of roughly 180,000 hectares each year. From 1983 to 2007, harvesting on private land averaged roughly 20,000 hectares per year.

Information

- Detailed silvicultural records are stored in the Reporting Silviculture Updates and Land status Tracking System (RESULTS).
- For private land, data on area harvested are not available before 1983.
- References: MFR annual reports, RESULTS[3]

Related international and national indicators

- MP (none) CCFM 2.3

14-2 How Much Is Reforested after Disturbances?

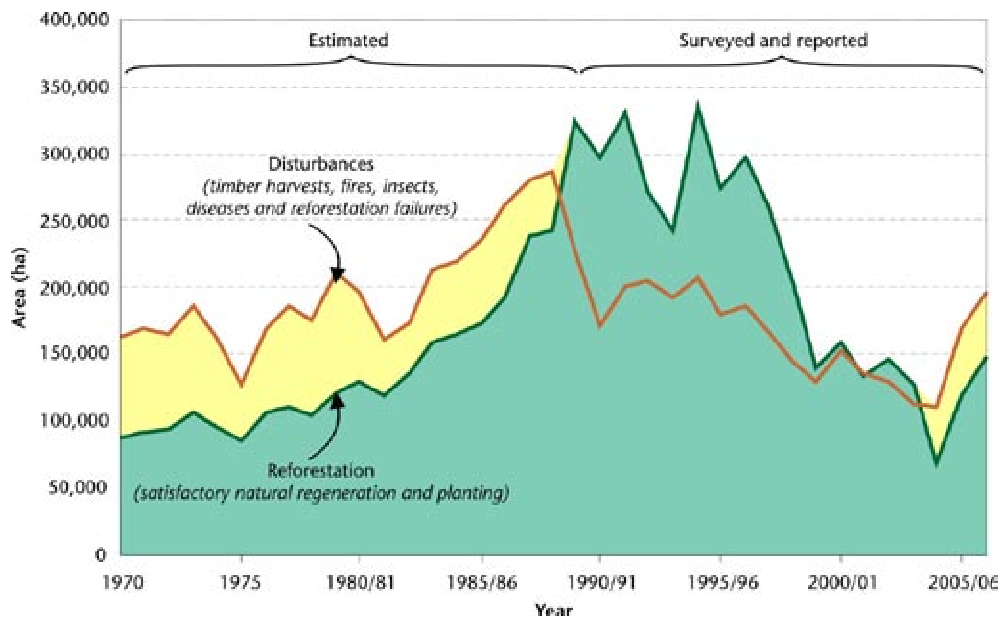


Figure 14-2. *Area disturbed and reforested on public land, 1970–2007.*

Why is this important?

Prompt reforestation increases future timber supplies and can help prevent soil erosion and restore wildlife habitats.

State and trend

- Forests disturbed by timber harvests and other causes reforest naturally over time. Silvicultural investments can accelerate reforestation and thereby increase timber supplies and restore ecological services sooner.
- In the 1970s and 1980s on Crown forest land, the area disturbed exceeded the area reforested. As a result, the area deemed not satisfactorily restocked (NSR) after timber harvesting and other disturbances increased over several decades.
- This gap was closed during the 1980s with increasing investments in site preparation, planting, backlog planting, brushing, and research to ensure prompt restocking and the growth of desired trees.
- In 1987, explicit reforestation obligations on public land were introduced. Since 1987, holders of harvesting rights are required to reforest the areas they harvest. This led to planting of a greater proportion of current harvest areas.
- By 2002/03, the backlog of economically treatable NSR area was reduced to 0.07 million hectares.[4]
- Catastrophic wildfires in 2003 and 2004, and the mountain pine beetle epidemic, may add large new NSR areas over the next several years.
- On areas harvested in the past 20 years, reforestation has been extremely successful.[5]

Information

- Reported disturbances and reforestation on public land are published annually (since 1989/90).
- Owners of private land outside tree farm licences are not required to report NSR data. For private land, reporting of silviculture information is voluntary and incomplete.
- References: MFR annual reports, RESULTS

Related international and national indicators

- MP (none) CCFM 2.3, 2.5

14-3 What Other Silvicultural Treatments Have Been Done?

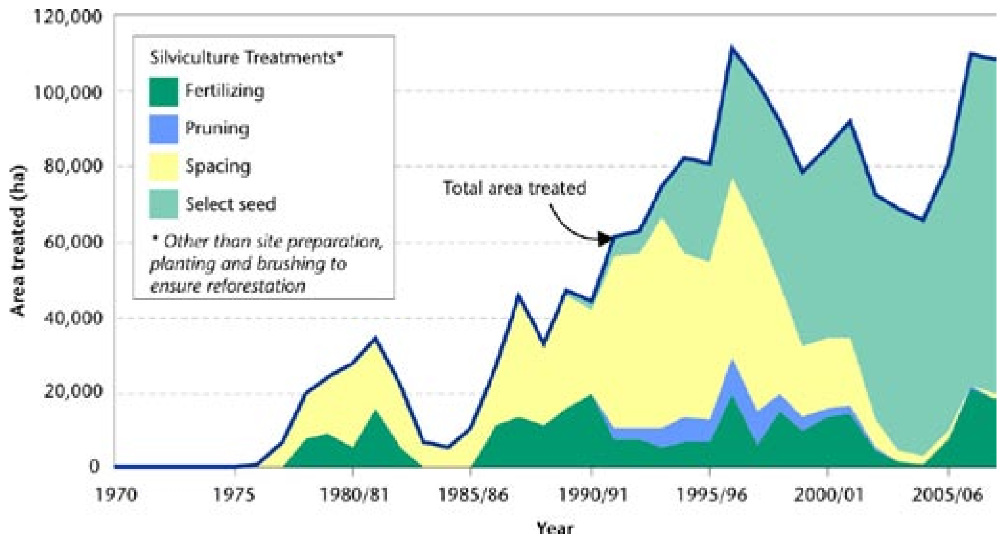


Figure 14-3. *Area of various silvicultural treatments on public land, 1970–2008.*

Why is this important?

Silvicultural treatments are investments in future timber production and environmental benefits from forests.

State and trend

- Beyond reforestation activities, additional silvicultural treatments can increase timber quantity and quality, manage forest health and fire risks, and improve specific habitats, water management, and visual landscapes. Silvicultural treatments also create employment opportunities for forest workers.
- Between 1976 and 2006/07, investments to improve the growth and quality of future crop trees included fertilizing (260,000 hectares), pruning (55,000 hectares), spacing (667,000 hectares), and use of select seed for planting (605,000 hectares). Over this period, these treatments totalled 1.6 million hectares (an individual site may be treated more than once).
- Since the 1970s, as the amount of treated area has increased, there have been significant shifts in the types of treatments undertaken.
- Spacing was most common in the 1990s. From a high point in the mid-1990s of almost 50,000 hectares per year, the annual area spaced decreased to less than 1,000 hectares in 2006/07.
- The area pruned follows a trend similar to the area spaced. Almost 9,000 hectares were pruned in 1996/97, and this declined to 210 hectares pruned in 2006/07.
- In contrast to spacing and pruning, the annual area planted with select seed has greatly increased since the mid-1990s.

- The annual area fertilized fluctuates over time, typically around 9,100 hectares per year. In 2006/07, over 21,000 hectares were fertilized—a 10-year high.

Information

- Treatments are tracked in RESULTS and in MFR annual reports. Recent data for fertilizing may be incomplete.
- Private landowners are not required to report treatments.
- References: MFR annual reports, RESULTS

Related international and national indicators

- MP (none) CCFM (none)

14-4 What Gains Do Silvicultural Investments Yield?

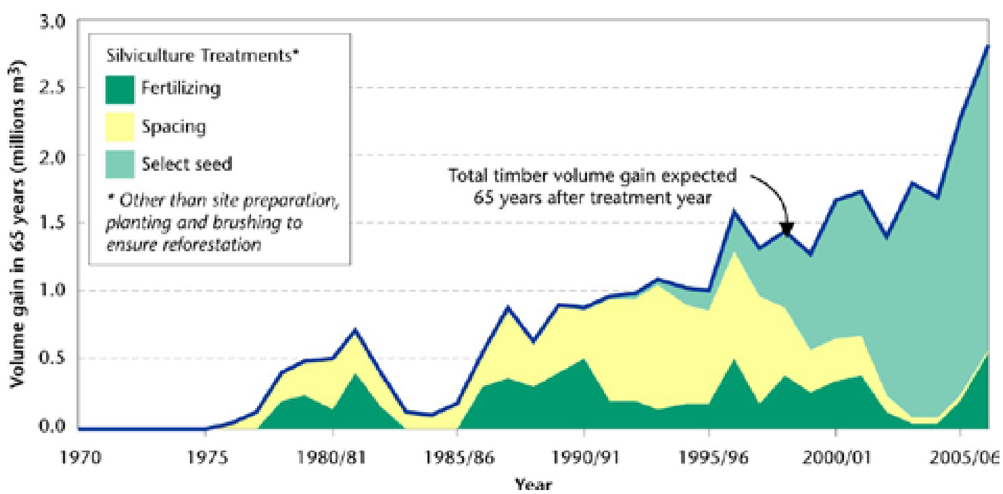


Figure 14-4. *Volume gain expected in 65 years from selected silvicultural treatments completed in B.C., public land, 1970–2007.*

Why is this important?

Investments in silviculture depend on clear objectives and adequate expected returns.

State and trend

- Gains in timber volume, quality, and timing of harvests are often the primary objectives of silvicultural treatments. Short- and long-term employment opportunities and various conservation values are at times the main objectives. Economic returns on investment are usually considered and often disputed.

- Compared with natural regeneration, planting increases harvestable volume by about 15%, and about 25% with the use of select seed.
- Recent levels of planting in B.C. are expected to increase future harvests by at least 6 million cubic metres per year, and the use of select seed adds about 2 million cubic metres per year.[6] The annual gain of 8 million cubic metres per year amounts to 12% of the average annual harvest of 66 million cubic metres on public land during the 1990s.
- Cumulative volume gains 65 years after investments in reforestation and other treatments since 1970 are estimated at 273 million cubic metres based on planting (99 million m^3), backlog planting (143 million m^3), fertilizing (7 million m^3), spacing (11 million m^3), and select seed (13 million m^3).[7]
- Other gains from silvicultural treatments include increased short- and mid-term timber supply, accelerated development of mature or old-growth forest characteristics where needed for wildlife or biodiversity, higher wood quality (e.g., by pruning), and more pleasing visual landscapes. These are measured in different ways that cannot be readily summed.

Information

- Volume gains were estimated with the Performance Measures Calculator used for results published in Forest Renewal B.C.'s annual reports.
- Genetic gain data are in the Seed Planning and Registry system (SPAR).
- References: MFR annual reports, RESULTS, SPAR

Related international and national indicator

- MP (none) CCFM (none)

Summary and Assessment

State

Silvicultural systems and treatments depend on government policies and funding in most of British Columbia. Policies have evolved to reflect changing public priorities and new scientific information. The dominant silvicultural system is now clearcutting with reserves for maintaining stand-level biodiversity. Past shortfalls in reforestation after logging have been corrected with policy changes and large investments in planting during the 1980s and 1990s. Currently, virtually all logged areas are reforested within allowable time frames. Reforestation and other silvicultural investments in 1970–2006/07 increased future timber volumes by an estimated 273 million cubic metres (equivalent to four years of the provincial harvest from public land), and improved other timber and non-timber values.

Trend

The use of clearcutting with reserves and variable retention has increased since the late 1990s, and the average size of clearcuts decreased, improving the balance of environmental and economic objectives. Improved practices increased the success rates for natural regeneration and planting, and reduced failures by 90% since 1989. The quantity and quality of select seed used are increasing over time. Silvicultural investments increased in the 1980s; however, public funding for several treatments has been significantly reduced since 2001 because of the reduction in the backlog NSR. The mountain pine beetle epidemic is creating substantial reforestation challenges, the loss of past silvicultural investments, and areas that are inadequately stocked. The provincial government created the Forests for Tomorrow program in 2005 to reforest and restore areas damaged by the mountain pine beetle or wildfire that would otherwise remain unharvested.

Information

Research has greatly improved the effectiveness of silvicultural activities. Large amounts of operational data are collected in the RESULTS database to track silvicultural activities on public land. Data on seed selection, planned use, and seedlot genetic quality are tracked in the SPAR database. Information from RESULTS and SPAR is used for policy development, strategic planning, silvicultural investment decisions, prediction of timber supplies, support of AAC decisions, habitat modelling, and effectiveness monitoring at the management unit level.

15 Rangeland

Rangeland grazing is central to the success of ranchers and guide-outfitters.

B.C.'s Rangelands are comprised of grasslands, forests (logged and unlogged), wetlands, alpine and subalpine, parkland and shrubland.
Rangelands are not intensely cultivated lands.

Why is this important?

Rangelands provide wildlife habitat and support the livestock and guide-outfitter industries. The Ministry of Natural Resource Operations administers rangeland tenures, which cover one-third of B.C.'s land base.[1]

Overview

- More than 34 million hectares, approximately one-third of B.C.'s land base, are managed by B.C.'s Ministry of Natural Resource Operations for rangeland ecosystem health and forage production.
- B.C. is unique among jurisdictions managing rangelands because the majority of B.C.'s rangelands are in forests and not open grasslands. Approximately 82% of B.C.'s Crown rangelands are forested.[2]
- Rangelands provide food, water, shelter, medicine, and spiritual values for First Nations.[3]
- B.C.'s beef cattle and guide-outfitter industries form a significant part of B.C.'s heritage, with both industries becoming established as businesses in the 1800s.[4] These industries depend on Crown rangeland and make a significant contribution to local communities and the provincial economy.
- Providing forage while maintaining health of the rangelands has been a long-standing goal in B.C. Prescribed rangeland management dates back to the *Grazing Act*, 1919.[5]

- Invasive plant species degrade rangeland quality and they are present across the province. In the Bunchgrass (BG), Ponderosa Pine (PP), and Interior Douglas-fir (IDF) zones, for example, invasive plant species occupy over 100,000 hectares and threaten an additional 2.9 million hectares.
- In dry forest ecosystems, rangeland has been lost as decades of fire suppression has allowed tree density to increase in areas that were formerly open forests. To restore healthy ecosystem condition, 7,300 hectares have been treated with a regime that involves harvesting, spacing, and prescribed burning.
- The health of rangeland ecosystems is monitored. Recent evaluations classified two-thirds of the 865 sites examined as in moderate or better condition.

Questions about rangeland management

15-1: How varied and extensive are B.C.'s rangelands?
15-2: How is rangeland grazing affecting B.C.'s ecosystems?
15-3: How are invasive plants impacting the range resource?
15-4: What is the status of tree ingrowth and encroachment in open forest and open range ecosystems?
15-5: What is the value of Crown range to B.C.'s beef cattle and guide-outfitting industries?
▶ Summary and assessment

Related indicators

- Competing land uses impact rangeland management (see Ecosystem diversity; Ownership and timber harvest rights; Recreation, tourism, and visual quality; Timber production forests; Timber harvest; Silviculture; Forest carbon and greenhouse gases).
- Timber harvesting and silvicultural practices, invasive plants (see Exotic species), and natural disturbances (see Ecosystem dynamics) affect forage productivity.
- Inclusive planning processes and enforcement of forest and range regulations may mitigate resource use conflicts and related impacts (see Public involvement, Law).
- Rangeland grazing is central to the success of the ranching and guide-outfitter industries (see Jobs and communities).
- Livestock grazing can create positive or negative impacts on wildlife habitat availability and quality (see Species diversity).

15-1 How Varied and Extensive Are B.C.'s Rangelands?

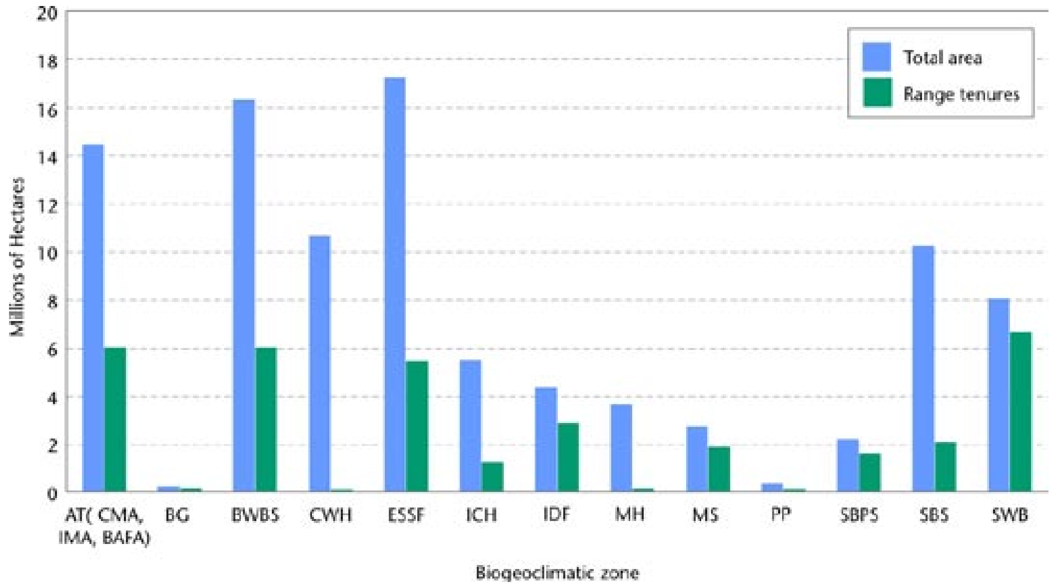


Figure 15-1a. *Area under Crown range tenure and total area by biogeoclimatic zone.*

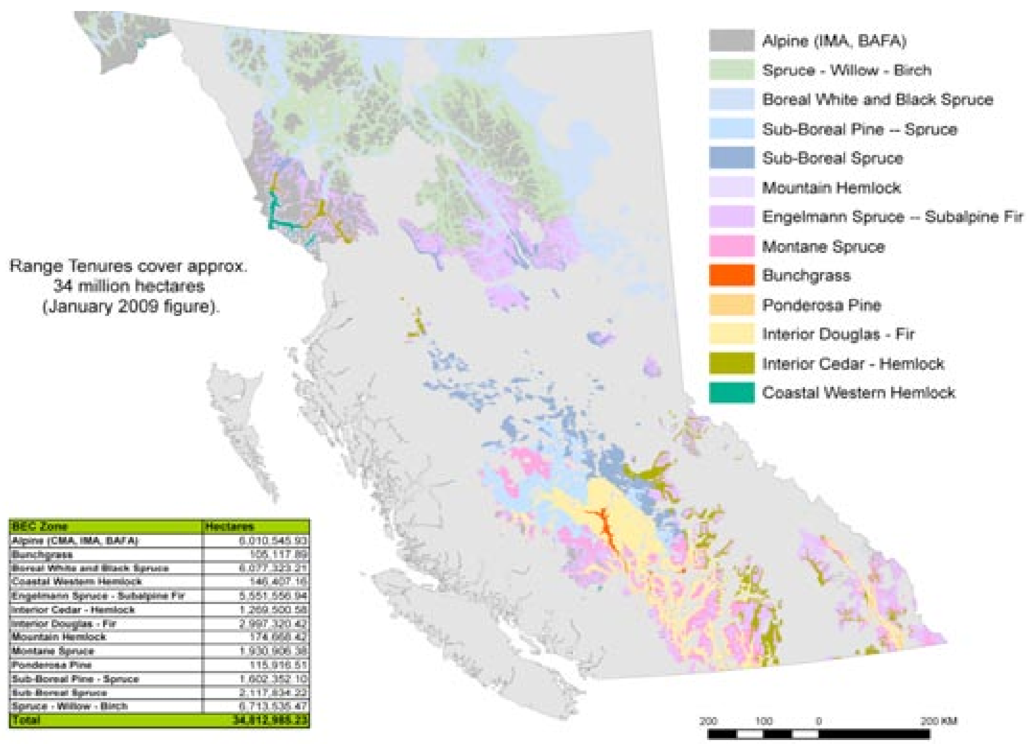


Figure 15-1b. *Range tenure area by biogeoclimatic zone.*

Why is this important?

B.C. rangelands comprise dense coniferous forests, open coniferous forests maintained by fires, dry valley bottoms with bunchgrasses, moist/wet meadows, hardwood forests, mixed prairie, and alpine environments. These rangeland types provide varying forage opportunities and present unique management challenges.

State and trend

- B.C.'s rangelands comprise grasslands, forests (logged and unlogged), wetlands, alpine and subalpine, parkland, and shrubland. Rangeland occurs in 15 of 16 biogeoclimatic zones (Figure 15-1a,b).[6]
- "All areas of the world that are not barren deserts, farmed, or covered by bare soil, rock, ice, or concrete can be classified as rangelands" (Holecheck et al. 1995:1).[7] In B.C., broad variations in climate, soils, elevation, latitude, and topography combine to produce a diversity of plant communities for grazing and browsing.
- Rangelands produce forage (grass, sedges, and forbs for cattle, horses, elk, bighorn and thinhorn sheep, and caribou), woody browse (trees and shrubs for deer, moose, and goats), water, botanical forest products, and wood fibre.[8]
- Ranchers and guide-outfitters are allocated use through tenures to graze cattle, horses, sheep, and goats. Range tenures cover more than 34 million hectares (roughly one-third of B.C.'s land base).
- Crown rangeland provides 60% of the total provincial annual livestock forage requirement. The remaining 40% is produced on private rangeland and pasture. In B.C., 70% of all grassland range is private.[9]

Information

- Figures 15-1a and 15-1b show range tenure areas and locations by biogeoclimatic (BEC) zone. Over time, the geographic extent of tenures varies resulting in minor fluctuations in the area totals.
- References: B.C. Rangelands: Diverse Landscapes, Diverse Values; MFR BEC; MFR Grazing Tenures and Leases; Sustainable Rangelands Roundtable (SRR) Criteria & Indicators

Related international and national indicators

- MP 1.1 a, 2.e   CCFM 1.1.1, 6.5.1   SRR 12, 49

15-2 How Is Rangeland Grazing Affecting B.C.'s Ecosystems?

Range Health Status				
Rangeland ecosystem	**Proper functioning condition**	**Moderately at risk**	**Highly at risk**	**Total**
Stream reaches	156 (56%)	39 (14%)	82 (30%)	277
Wetlands	83 (59%)	11 (8%)	46 (33%)	140
Uplands	237 (53%)	72 (16%)	139 (31%)	448

Figure 15-2. *Health status of 865 rangeland sites assessed from 2001 to 2008. Range health classes are as follows. The proper functioning condition (PFC) class includes areas assessed as PFC and areas assessed as slightly at risk. The highly at risk class includes areas assessed as highly at risk and areas assessed as non-functional.*

Why is this important?

B.C.'s rangelands provide diverse products and services, including water, recreation, timber, and non-timber forest products. Healthy rangelands sequester carbon and contribute to mitigating the impacts of increased levels of greenhouse gases. Balanced use of rangelands by livestock and wildlife ensures sustainable use.

State and trend

- Rangeland health[10] is the degree to which the soils and ecological processes[11] of rangeland systems are sustained.
- Rangeland health evaluations follow a standard procedure.[12] Using this procedure, the health status of 865 sites was assessed from 2001 to 2008 (Figure 15-2):
  - 55% were assessed as healthy and exhibiting proper functioning condition;
  - 14% were rated as moderately at risk; and
  - 31% were rated as highly at risk.
- Some rangelands[13] show the effects of over 150 years of grazing and other impacts. Timber harvesting, high wildlife numbers, unregulated feral horse populations, and invasive plant species can contribute to poor rangeland health.[14]
- By monitoring the health of rangeland ecosystems, the impacts of grazing and browsing on B.C.'s rangelands can be assessed.[15]
- The impacts of grazing on rangeland ecosystems are monitored through range health assessments[16] and sampling at Range Reference Areas.[17]
- A score of "at risk" may trigger some follow-up action (e.g., more detailed monitoring or a change in management) or, if an improving trend emerges, may verify that the management prescription is working. Generally, where

upland or riparian conditions are highly at risk to non-functional, remediation is required.[18]

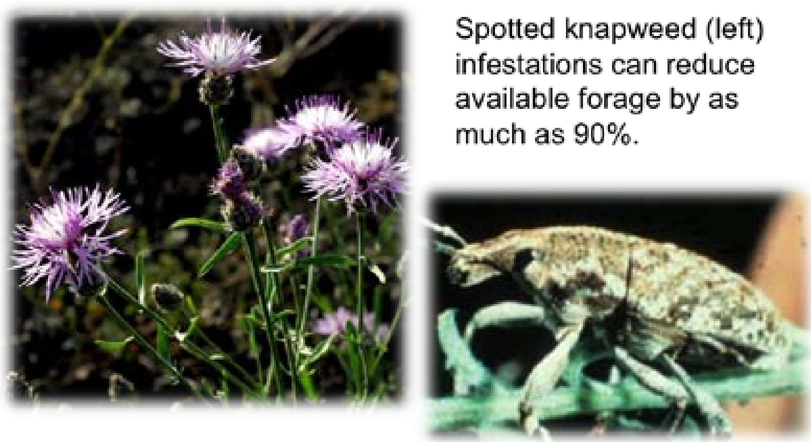
Information

- Rangeland health information is collected and analyzed by the Ministry of Natural Resource Operations using hand-held computers, standardized forms, GPS, and ArcPad.[19]
- References: MFR Range Program Health Brochures; Sustainable Rangelands Roundtable (SRR) Criteria & Indicators

Related international and national indicators

- MP 4.1, 4.2, 4.3, 5.a, 5.b
- CCFM 3.1, 3.2, 4.1.1-4, 5.3.2, 5.3.5
- SRR 1, 4, 5, 6, 7, 12, 17, 20, 21

15-3 How Are Invasive Plants Impacting the Range Resource?



Spotted knapweed (left) infestations can reduce available forage by as much as 90%.

The knapweed root-attacking weevil *Cyphocleonus achates* (above right) is a biocontrol agent reducing knapweed density on sites in the southern interior.

Figure 15-3. *Spotted knapweed impacts the range resource.*

Why is this important?

Many invasive plant species are well adapted to rangeland ecosystems and will displace preferred plant species, disrupt rangeland ecosystem function, and reduce foraging opportunities for livestock and wildlife. Containing the spread of established invasive plants through treatment programs and preventing the establishment of new species is critical to reduce ecological, economic, and social impacts.

State and trend

- Invasive plants reduce the quantity and quality of forage that is available for use by livestock and wildlife, and create negative impacts for B.C.'s ranching and guide-outfitter industries. Estimated economic impacts of invasive plants include forage losses of $9.36 per hectare (diffuse knapweed) and $10.00 per hectare (purple loosestrife). Overall estimated economic impacts range between $20 and $110 per hectare.[20]
- Containment activity on a limited number of priority invasive plants is slowing their spread; however, the majority of invasive plant species are continuing to expand.
- Some areas have more complete inventories, providing greater certainty to estimates. For example, invasive plant species currently occupy over 100,000 hectares in the BG, PP, and IDF biogeoclimatic zones, and threaten an additional 2.9 million hectares in these areas.[21]
- Many invasive alien plant species[22] are well adapted[23] to grasslands and open forests (BG, PP, and IDF biogeoclimatic zones) and associated riparian habitats,[24] and once established can out-compete native plants, including "at risk" species and those important for forage and cultural uses.[25, 26]
- The successful implementation of biological control programs on some invasive plant species, including diffuse knapweed (*Centaurea diffusa*), Dalmatian toadflax (*Linaria genistifolia* ssp. *dalmatica*), and hound's-tongue (*Cynoglossum officinale*), has reduced ecological and economic impacts associated with these species.
- In the grassland and open forest types, some improvements are evident. For those invasive plant species that respond well to biological control agents, plant density has been reduced. Also, the beneficial effects of improved range management practices are evident.[27]

Information

- Analysis of the current distribution of selected invasive plant species and the total area of suitable rangeland habitat is used to evaluate the invasive plant threat to forest and range values.
- The Range Program is building a comprehensive inventory of invasive plants through the Invasive Alien Plant Program (IAPP) application. IAPP displays locations of invasive plants surveyed, detected, and reported outside established containment lines. Data are not yet complete for all legislated[28] invasive plants.
- The Inter-Ministry Invasive Plant Working Group and the Invasive Plant Council of BC are developing standards for establishing containment lines for all invasive plant species in the province.
- References: MFR BEC; MFR Invasive Alien Plant Program (IAPP) application; B.C. Conservation Data Centre; Invasive Plant Regulations, *Forest and Range Practices Act*; Weed Control Regulations, *Weed Control Act*; Sustainable Rangelands Roundtable (SRR) Criteria & Indicators

Related international and national indicators

- MP 3.a, 3.b
- CCFM 1.2.4, 2.1, 2.3
- SRR 12, 18, 20, 21, 27, 32

15-4 What Is the Status of Tree Ingrowth and Encroachment in Open Forest and Open Range Ecosystems?

Ingrowth - MFR

Encroachment - MFR

Restored dry forest ecosystem - MFR

Figure 15-4. *Tree ingrowth, encroachment, and ecosystem restoration.*

Why is this important?

Forest and grassland ecosystems restored to an ecologically appropriate condition create a resilient landscape that supports the economic, social, and cultural interests of British Columbians.

State and trend

- Decades of fire suppression, and an absence of prescribed fire or application of surrogate disturbance have contributed to tree ingrowth in previously open forests and tree encroachment onto historic grasslands.
- Tree ingrowth and encroachment threaten the ecological integrity of grasslands and open forest types while reducing their resiliency in the face of climate change. Additionally, it has led to an increased risk of catastrophic wildfire and damage by insects and diseases. Ingrowth and encroachment

can have an adverse impact on First Nations traditional plants, timber quality, critical wildlife habitats, recreational and aesthetic opportunities, and forage quantity and quality.

- Mapping and estimating the area lost to ingrowth and encroachment are underway but are not yet complete.
- Ad hoc efforts to address ingrowth and encroachment and restore ecosystem condition have occurred in the past, but until recently there has been no effective coordinated approach.
- A multi-sectoral provincial Ecosystem Restoration[30] (ER) initiative, led by the MFR's Range Program, commenced in 2006. In the dry forests, ER employs harvesting, spacing, and prescribed burning in a variable retention silvicultural system. This regime provides stand structure, emulates natural disturbances, conserves wildlife trees, and increases stand-level biodiversity while enabling acceptable volume growth of new trees.
- Under the ER program, since 2006:
  - strategic planning and ER treatments have occurred in 8 of the 12 Southern Interior forest districts;
  - 7,331 hectares have been restored to a maintenance condition; and
  - another 5,342 hectares are currently under prescription.
- Beyond the dry forests, other key sites and ecosystems across B.C. are being identified and considered for ecosystem restoration.

Information

- ER accomplishments taken from summary data presented to the Forest Investment Account
- References: MFR BEC; Sustainable Rangelands Roundtable (SRR) Criteria & Indicators

Related international and national indicators

- MP 3.a, 3.b, 6.5 a
- CCFM 1.1-3, 2.1-3, 2.5, 4.1.1-4, 5.1.4, 6.1.1, 6.2.1
- SRR 12, 14, 18, 20, 27, 32

15-5 What Is the Value of Crown Range to B.C.'s Beef Cattle and Guide-outfitting Industries?

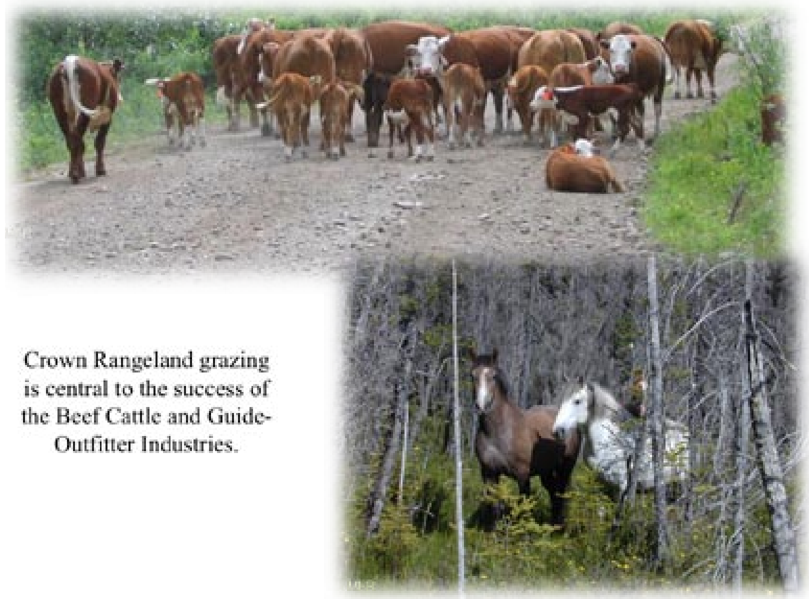


Figure 15-5. *The beef cattle and guide-outfitting industries depend on Crown range-lands.*

Why is this important?

B.C.'s rangelands provide high quality, reliable forage for the beef cattle and guide-outfitting industries.

State and trend

- The value of Crown land grazing is estimated at \$17 to \$30 million per year.[31]
- Range tenures are allocated for grazing by beef cattle, horses, sheep, and goats.
- Many of the beneficiaries of economic activity are in rural and remote areas of the province.
- Crown land grazing is the foundation of B.C.'s beef cattle industry because most of the herd spends five months of the year on Crown range.
- Crown land grazing sustains the guide-outfitting industry by providing forage to saddle horses and packstock in backcountry B.C.
- The B.C. beef cattle industry contributed \$252 million to the B.C. economy from the sale of cattle and calves in 2007.[32] Access to land and water under Crown tenures is crucial to the industry's success.[33]
- The economic spinoffs (e.g., seed, veterinary services, fencing suppliers, equipment dealers, trucking) from B.C.'s beef cattle industry support other agribusinesses.[34]

- Direct revenue to the guide-outfitting industry is approximately $50 million per year.[35] Economic spinoffs are estimated to be $116 million in total economic activity, including employment of approximately 2,000 people.[36] Clients of guide-outfitters come primarily from outside Canada (84% American; 13% outside North America).[37]

Information

- Information on the economic value of Crown rangeland is available from various sources. See endnotes.
- References: B.C. Cattlemen's Association; Guide Outfitters Association of B.C.; Sustainable Rangelands Roundtable (SRR) Criteria & Indicators

Related international and national indicators

- MP 2.e, 6.1 b, 6.1 e, 6.2 a, 6.3 e, 6.4 a, 6.5 b
- CCFM 5.1.4, 5.1.5, 5.3.2, 5.3.3, 5.3.5, 5.3.6, 6.3.1
- SRR 27, 32, 43, 44, 47

Summary and Assessment

State

B.C.'s rangelands provide First Nations traditional plant values, critical wildlife habitats, recreational and aesthetic opportunities, and forage for the livestock and guide-outfitter industries. Approximately one-third of the province's land base is tenured as Crown range and administered under the Range Program. Most of B.C.'s beef cattle herd spends five months on Crown rangeland. Rangeland monitoring tracks ecosystem impacts and trends. Where appropriate, mitigation or remediation measures are taken. Invasive plants and forest ingrowth and encroachment threaten B.C.'s rangelands.

Trend

Availability of forage for grazing remains essential to B.C.'s livestock and guide-outfitter industries. Rangeland health is variable depending on history of land use. Threats to rangelands persist. Containment activity on a limited number of priority invasive plants is slowing their spread; however, the majority of invasive plant species are continuing to expand. Centralized inventory methods assist in quantifying the threat as well as identifying areas for priority treatment. Decades of fire suppression and an absence of prescribed fire or application of surrogate disturbance has contributed to tree ingrowth in previously open forests and encroachment onto historic grasslands. This trend threatens the ecological integrity of grasslands and open forest types while reducing their resiliency in the face of climate change. Additionally, it has led to an increased risk of catastrophic wildfire and damage by forest insects and diseases.

Information

Managing B.C.'s rangelands requires a diverse knowledge base. Existing spatial inventories (vegetation inventories) address primarily timber, not rangeland, values. By monitoring the health of rangeland ecosystems, the impacts of grazing and browsing on B.C.'s rangelands can be recorded and assessed. Range Reference Areas provide samples of grazing impacts, with records for some sites extending back several decades. The Invasive Alien Plant Program collects records of invasive plant occurrences as data are entered by government and community partners. Estimates of forest ingrowth and encroachment are completed as resources permit. The valuation of Crown land grazing is based on calculations of the cost of alternative feed and does not reflect externalities, such as the heritage value associated with grazing on Crown land.

16 Recreation, Tourism, and Visual Quality

Each year, millions of residents and visitors enjoy B.C.'s wilderness for nature-based recreation.

Horseback riders in a woodlot – Candace Kenyon

Canoe on a lake – MFR

Why is this important?

British Columbia's forest recreation and tourism opportunities are highly valued by both British Columbians and visitors from around the world. Recreation and tourism generate substantial socio-economic values to users, communities, and the province. Scenic viewing is one activity that is highly valued by tourists and residents alike.

Overview

- British Columbia's Crown lands (including parks) offer diverse roaded and roadless opportunities for a wide variety of forest recreation activities such as scenic viewing, camping, hiking, biking, boating, fishing, hunting, snowmobiling, and quad riding.
- Public forest recreation facilities (such as campgrounds and trails) and commercial facilities (such as lodges and cabins) accessed by a substantial resource road network help support both guided and non-guided activities.
- Each year, parks and forests in B.C. support nature-based recreation and tourism enjoyed by millions of residents and visitors.
- Substantial benefits are derived from forest recreation, including health and fitness, environmental appreciation, community and social awareness, economic benefits due to expenditures, and cultural heritage understanding and respect.
- Trip expenditures by residents and visitors contribute substantially to the health and diversity of B.C.'s economy and the economies of smaller communities that provide gateways to park and forest recreation and tourism.
- Scenic landscapes provide an important backdrop for the recreation and tourism industries. Visually sensitive areas in B.C. have been mapped. Objectives for visual quality have been legally established for 10 million

hectares in B.C. Studies confirm that the public prefers landscapes with lower levels of disturbance by harvesting. Evaluations of the impact of timber harvesting on visual quality are being undertaken. Evaluation results will support the continuous improvement of forest policies and practices.

Questions about recreation, tourism, and visual quality

16-1: What types of recreation opportunities are supported by B.C.'s forests?
16-2: What types of facilities exist to support forest recreation opportunities in B.C.?
16-3: What are the levels of use and satisfaction among recreation users?
16-4: What are the socio-economic values supported by recreation activities in B.C.?
16-5: How much of B.C. is considered visually sensitive?
16-6: What is the location and extent of areas managed for visual quality?
16-7: How are public preferences affected by the degree of landscape modification?
▶ Summary and assessment

Related indicators

- Forest ownership and timber harvesting affect the access to and nature of recreation opportunities (see Ownership and timber harvest rights, Timber production forests, Management capacity).
- Nature-based tourism and recreation, including activities in parks, make significant contributions to the economy (see Protected forests, Forest products and the economy, Jobs and communities).
- Some recreation uses, if inappropriately located or undertaken, can impact native species (see Species diversity) and other users, leading to recreation use conflict.
- First Nations and public engagement help determine where recreational opportunities, including facilities, should be provided and how to best manage them (see First Nations involvement, Public involvement).

16-1 What Types of Recreation Opportunities Are Supported by B.C.'s Forests?

Figure 16-1. *Location of roaded and roadless recreation opportunities in B.C.*

Why is this important?

Provision of secure and diverse opportunities supports a wide array of recreation activities for B.C. residents and non-residents.

State and trend

- B.C.'s land base is 95% publicly owned and generally available for recreation.
- About 15% of B.C.'s land base is in protected areas, including national and provincial parks. The total protected area has more than doubled since 1991. Most protected areas provide diverse opportunities for non-motorized recreation, although specified motorized use opportunities occur in some protected areas.

- About 80% of B.C. consists of provincially owned Crown lands outside of protected areas where diverse opportunities for both motorized and non-motorized recreation and adventure tourism exist.
- Private lands occupy 4% of B.C. where owners may allow recreation to occur.
- Recreation opportunities in areas of the province that are road accessible differ from the opportunities for backcountry experiences that are provided in roadless settings.
- Roadless areas can be defined as areas larger than 2,000 hectares that are more than five kilometres from a road (or other linear access feature such as railway or seismic line). The remaining areas can be defined as roaded.
- The proportion of British Columbia classified as roaded is increasing over time. About 69% of B.C. was roaded in 2005. In 1994, roaded areas represented about 44% of B.C.
- As roaded areas are increasing, roadless areas are decreasing. In 2005, 31% of B.C. provided roadless area recreation opportunities. In 1994, about 56% of B.C. was classified as a roadless area.
- Of the 31% of B.C. that was roadless in 2005, 8% was found in protected areas and 23% was found on other Crown lands.
- Over a 10-year span there has been a significant increase in road-accessible opportunities with a corresponding decrease in roadless backcountry recreation settings.

Information

- Provincial level data regarding land ownership are reasonably accurate.
- Data regarding roaded/roadless areas was compiled from a 2005 inventory of roads throughout the province.[1] For related analyses and statistics, see Indicators 3-4 and 8-3.
- Although roaded/roadless area definitions differ slightly, comparisons with a 1994 assessment appear reasonable.
- More detailed Recreation Opportunity Spectrum (ROS) inventories have not been updated for most of the province since the early 1990s.
- References: 2007 Environmental Trends in BC; 1994 Forest, Range and Recreation Resource Analysis

Related international and national indicators

- MP 6.4a CCFM (none)

16-2 What Types of Facilities Exist to Support Forest Recreation Opportunities in B.C.?

Figure 16-2. *Facilities that support forest recreation in B.C. Number of campsites (left) and kilometres of trails (right) by managing agency. MTCA is the B.C. Ministry of Tourism, Culture and Arts.*

Why is this important?

Many forest recreation activities are dependent on the provision of facilities such as campgrounds and trails.

State and trend

- About 1,650 campgrounds are provided on public land in B.C. with 25% located in parks and 75% on other Crown lands. In addition, there are 863 private and municipal campgrounds.
- The campgrounds support nearly 23,000 campsites with over 50% located in parks (where campgrounds are normally larger) and nearly 50% in generally smaller rustic locations on other Crown lands. Private and municipal campgrounds provide an additional 40,000 campsites.
- The number of campgrounds on Crown land outside parks has not substantially changed in the last 20 years. Although the condition at some sites is poor, most sites in general meet the objectives of being safe, sanitary, and environmentally sound.
- About 2,500 trails, representing nearly 20,000 kilometres of trail, are provided on public land in B.C. with about 50% located in parks and 50% managed or authorized on other Crown lands. Municipalities provide nearly 4,000 trails and 10,000 kilometres of additional opportunities in urban and rural settings.
- Between 2008 and 2010, under the Job Opportunities Program that provides short-term employment for unemployed forest workers, the federal and provincial governments will spend $25 million upgrading recreation sites and trails throughout B.C.

- The tenured nature-based tourism industry offers additional facilities on public land such as lodges, cabins, and trails.

Information

- Information on campgrounds and trails is considered relatively accurate.
- Campground conditions on Crown lands outside parks were sampled in 2004.
- References: Parks Canada, BC Parks, and Ministry of Tourism, Culture and the Arts websites; Forest Range and Evaluation Program; 1994 Forest, Range and Recreation Resource Analysis

Related international and national indicators

- MP: 6.2a, 6.4a CCFM (none)

16-3 What Are the Levels of Use and Satisfaction among Recreation Users?

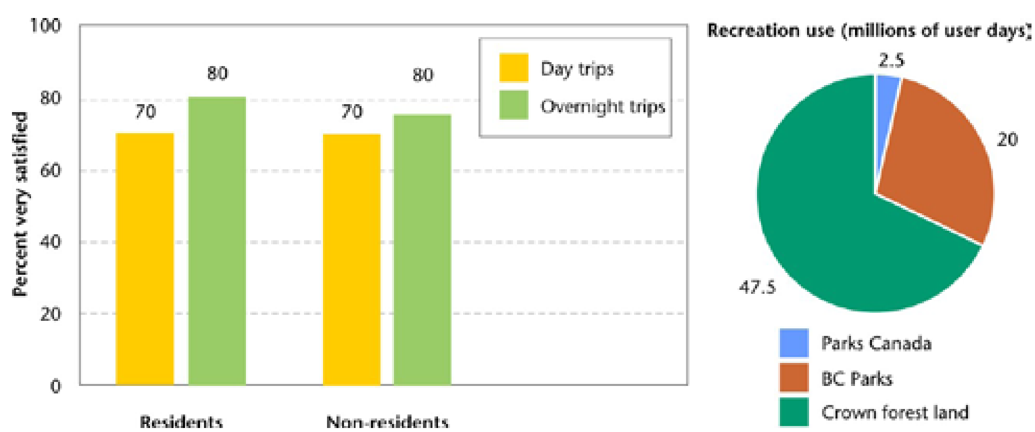


Figure 16-3. *User satisfaction with outdoor activities (left) and forest recreation user-days in parks and other Crown land (right) in B.C.*

Why is this important?

Recreation use and satisfaction enable a number of social and economic benefits to be derived by individuals participating in recreation, local communities, and the province at large.

State and trends

- Between 310 and 360 million user-days of outdoor recreation are estimated to occur by B.C. residents aged 19 years and older. This includes recreation on private land, in urban and rural areas, and on water ways.
- About 70 million user-days of forest recreation (approximately 20% of all recreation) is estimated to occur on public lands with about 33% of forest recreation use in parks and 67% on other Crown lands.

- Trends in forest recreation on Crown lands outside parks have not been estimated due to inadequate information.
- About 72% of recreation trips by residents are for day use whereas 28% are for overnight use.
- About 52% of overnight tourism use in B.C. (recreation and non-recreation) is from B.C. residents whereas 48% is from non-residents.
- For 20% of both resident and non-resident overnight tourism users, the primary trip purpose was outdoor/wilderness activities. Most users, regardless of trip purpose, were involved in some outdoor recreation while in B.C.
- About 1 million residents and non-residents participate in commercial nature-based tourism activities in B.C. per year.
- About 80% and 75% of B.C. residents and non-residents, respectively, were very satisfied with their outdoor activities while on their overnight trip in B.C. Compared to other rated aspects of their trip, outdoor activities received the highest level of satisfaction rating.
- About 70% of residents and non-residents were very satisfied with outdoor activities associated with their day trip in B.C. This too was higher than other rated aspects of their trip.
- More than 80% of BC Parks users reported excellent and above average satisfaction with park services each year from 2001 to 2007.

Information

- Several good studies focus on various aspects of outdoor recreation and tourism by residents and non-residents, but no comprehensive survey has been undertaken.
- The studies that have been completed are difficult to compare due to various methods used, questions asked, and the year the survey was undertaken.
- It is difficult to estimate trends in forest recreation use since user surveys are infrequent and sometimes not comparable.
- References: Various outdoor recreation and tourism studies were used (see technical support document).[2]

Related international and national indicators

- MP 6.4b CCFM (none)

16-4 What Are the Socio-economic Values Supported by Recreation Activities in B.C.?

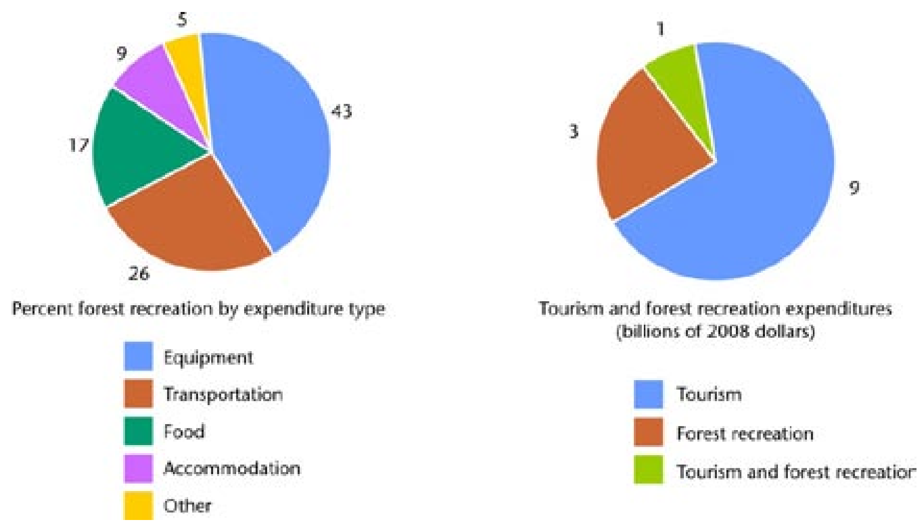


Figure 16-4. *Tourism and forest recreation expenditures.*

Why is this important?

Expenditures associated with recreation and tourism in B.C. contribute substantially to the local economy of many communities as well as to the overall provincial economy. Recreation use also supports many social values such as improved health and fitness, and environmental and cultural heritage appreciation.

State and trends

- Total expenditures by tourism and forest recreation users are estimated to be $13 billion per year with about $4 billion from forest recreation in parks and other Crown land.
- About $3.6 billion in forest recreation expenditures are from B.C. residents and $0.4 billion are from non-residents.
- About 66% of B.C. resident forest recreation expenditures (outside parks) is from trip expenses (e.g., accommodation, transportation, food), whereas 34% is from the purchase of equipment used primarily for recreation activities (e.g., camping gear, guns, boots, canoes, and binoculars).
- The estimate above regarding equipment expenditures does not include major items such as all-terrain vehicles (ATVs), boats, snowmobiles, or motorhomes. About 25% of total expenditures by recreational ATV users in Canada is spent on the purchase of new ATVs, with an additional 11% spent on ATV insurance.
- The economic impact of total expenditures (excluding major items and insurance) by tourism and forest recreation includes about a $7 billion contribution to B.C.'s gross domestic product (GDP), employment income that

supports nearly 150,000 direct jobs, and about $1.4 billion in provincial tax revenue per year.

- Forest recreation expenditures contribute about 30% to the total economic impact of tourism and forest recreation: $2.2 billion GDP, about 45,000 direct jobs, and more than $0.4 billion in provincial tax revenue yearly.
- B.C. residents derive consumer surplus values from their recreation use in that they are willing to increase their expenditures before deciding to forego these activities.
- B.C. residents also hold non-use values in that they are willing to pay to preserve opportunities so that they or others can enjoy recreation activities in the future.
- To users and society, the additional benefits associated with recreation are substantial and varied; they include improved health and fitness, environmental appreciation, community and social awareness, and cultural heritage understanding and respect.

Information

- Several good studies exist that focus on various economic benefits derived from outdoor recreation and tourism by residents and non-residents, but no comprehensive survey has been undertaken.
- The studies that have been completed are difficult to compare due to various methods used, data collected, and the year the survey was undertaken.
- It is difficult to estimate trends in the economic value of forest recreation in B.C. since user surveys are infrequent and sometimes not comparable.
- References: Various outdoor recreation and tourism studies were used (see technical support document).[3]

Related international and national indicators

- MP 6.1.c, 6.3.a, 6.3.e CCFM (none)

16-5 How Much of B.C. Is Considered Visually Sensitive?

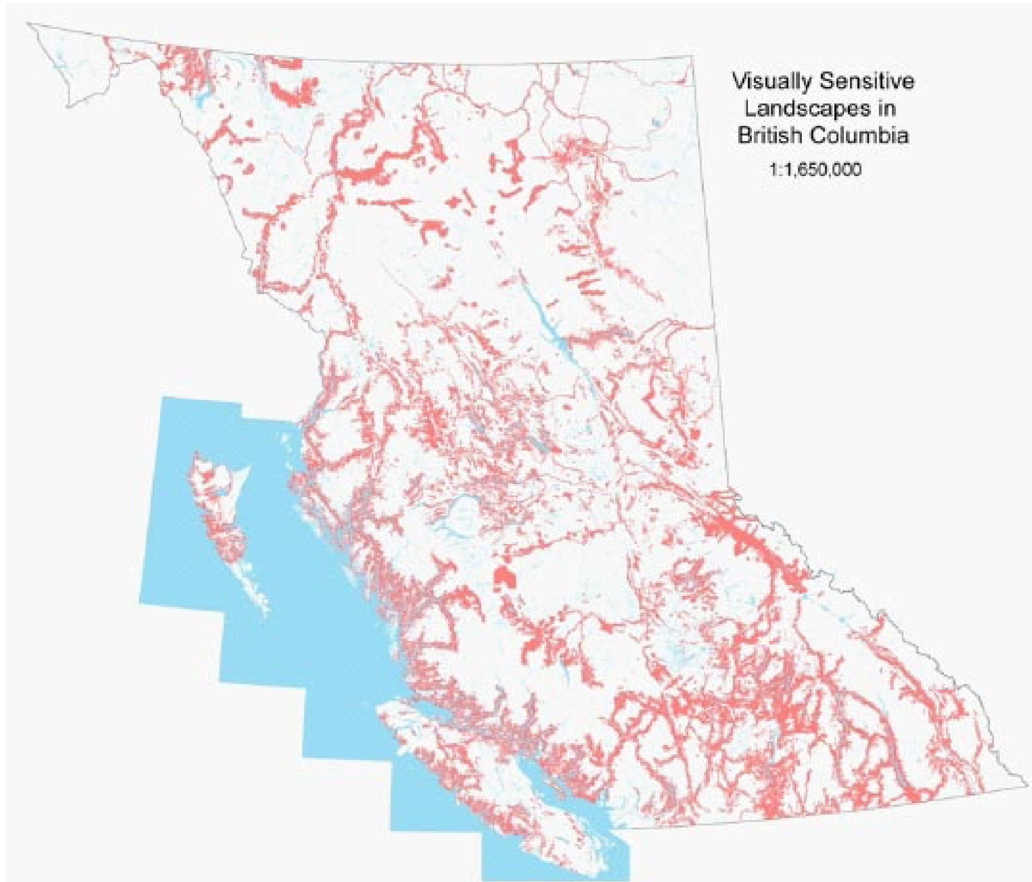


Figure 16-5. *Visually sensitive areas in B.C.*

Why is this important?

Knowing what is visually sensitive is the first step in managing the landscape for visual quality.

State and trend

- Visually sensitive landscapes are those landscapes that (1) are visible from communities, public use areas, or travel corridors, (2) possess inherent scenic value, and (3) are important to the viewing public and visitors.
- On Crown forest land, the Ministry's Visual Landscape Inventory is the means by which visually sensitive landscapes are identified.
- In 2004, 15,082,762 hectares of Crown forest land was identified as visually sensitive. This area is roughly 15% of the gross provincial land base.
- In 2009, 14,587,068 hectares were identified as visually sensitive.
- The change from 2004 to 2009 represents a 3.3% drop in visually sensitive area. The amount of visually sensitive area changed due to the establishment of new parks, the removal of private land from some TFLs, and more refined mapping that excluded water bodies greater than 25 hectares.

Information

- Visually sensitive areas are mapped by the MFR.
- The information is publicly available.

Related international and national indicators

- MP 6.4.a, 6.6 CCFM (none)

16-6 What Is the Location and Extent of Areas Managed for Visual Quality?

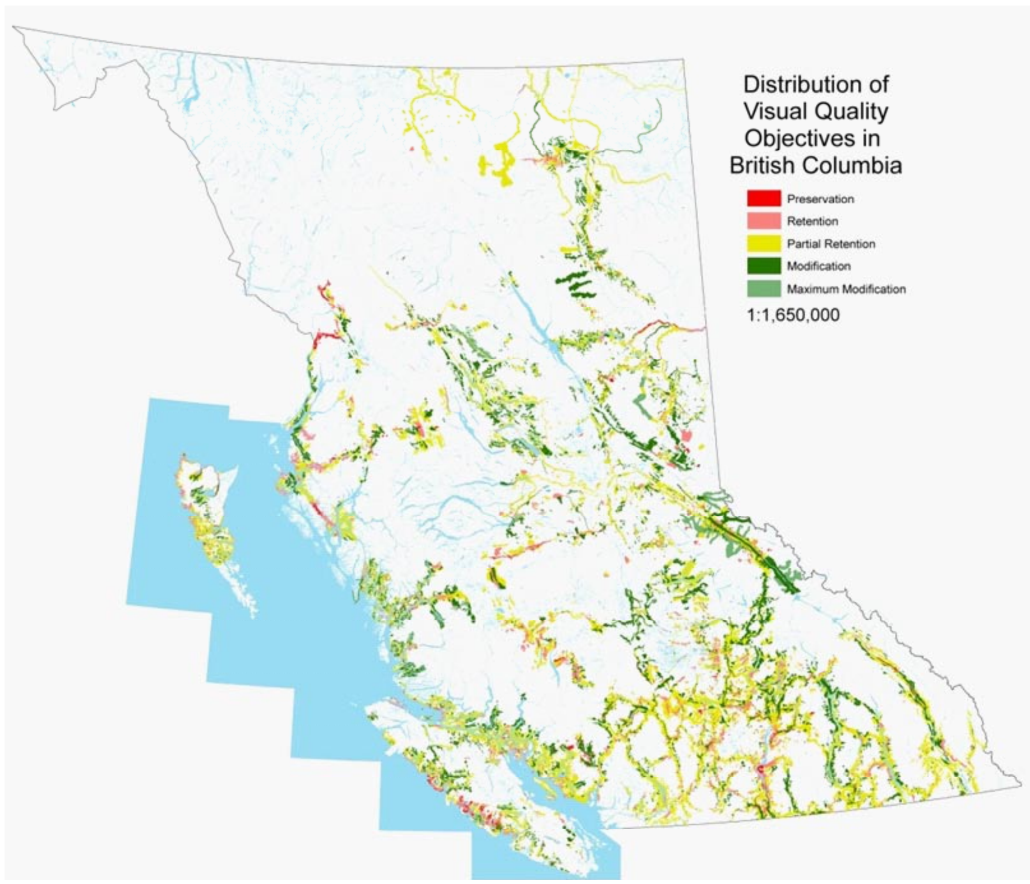


Figure 16-6. *Visual quality objectives established in B.C.*

Why is this important?

Visual quality objectives define the levels of alteration allowed on B.C.'s scenic landscapes and indicate that there is a legal requirement in place to manage visual resources.

State and trend

- Objectives for visual quality are specified in five classes: preservation, retention, partial retention, modification, and maximum modification. Across the classes, progressing from preservation to maximum modification, the alteration of the forest landscape is larger and easier to see.
- Visual quality objectives (VQOs) are specified for 10,470,859 hectares of gross provincial land base.
- The Preservation VQO applies to 109,746 hectares (1% of the area under a VQO).
- The Retention VQO applies to 1,326,945 hectares (13% of the area under a VQO).
- The Partial Retention VQO applies to 5,395,445 hectares (52% of the area under a VQO).
- The Modification VQO applies to 3,177,422 hectares (30% of the area under a VQO).
- The Maximum Modification VQO applies to 461,301 hectares (4% of the area under a VQO).
- VQO information is used in timber supply analysis and strategic planning. VQOs provide guidance to Forest Stewardship Plans. VQOs specify the objectives against which results can be monitored and legal requirements can be enforced.

Information

- VQO data may be viewed by the public, industry, and government using the Internet Mapping Framework viewers like Mapview and IMap BC.

16-7 How Are Public Preferences Affected by the Degree of Landscape Modification?

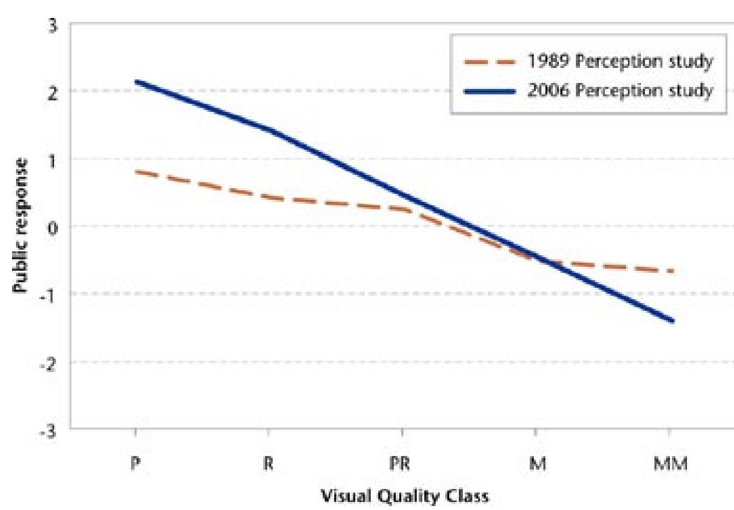


Figure 16-7. *The public response to harvest practices in British Columbia at the landscape and stand level, 2006. Source: Logging in the Kootenay Landscapes, 1989; Public Response to Forest Practices, 2006.*

Why is this important?

Understanding the public's response to forestry activities is key to determining what management practices are acceptable on B.C.'s scenic landscapes.

State and trend

- Surveys of the public indicate that natural or untouched landscapes are preferred over landscapes with higher levels of logging disturbance.
- The trends in public preferences have not changed significantly since the first forestry public perception study was undertaken in B.C. in 1989.
- In perception studies, survey respondents indicate their level of preference for landscapes with various levels of disturbance. In Figure 16-7, preference is expressed on a numeric scale with positive values indicating "like" and negative values indicating "dislike." Mean values are shown in the following visual quality classes: P (preservation), R (retention), PR (partial retention), M (modification), and MM (maximum modification).
- The threshold between like and dislike occurs between the Partial Retention and Modification visual quality classes. Under the *Forest and Range Practices Act*, Partial Retention is defined as an alteration that is easy to see, small to medium in scale, and natural not rectilinear or geometric in shape.
- Scenic quality is consistently rated among the top three forest management priorities by the public.

Information

- The Logging in Kootenay Landscapes study used a five-point Likert scale. The more recent studies use a seven-point Likert scale. To facilitate comparison with recent studies, the 1989 data were adjusted to fit the seven-point scale.
- References: MFR public perception studies; Logging in Kootenay Landscapes, 1989; The Public Response to Harvest Practices in British Columbia at the Landscape and Stand Level, 2006[4]

Related international and national indicators

- MP: (none) CCFM (none)

Summary and Assessment

State

Recreation and tourism associated with B.C.'s forest and range lands, and the scenic beauty of those landscapes, provide many benefits to British Columbians. Outdoor recreation makes a significant contribution to local economies and the overall provincial economy. When on an overnight trip, residents and non-residents consistently report a high level of satisfaction with their outdoor activities in B.C. Seventy million user-days of forest recreation are estimated to occur each year. B.C. provides both roaded and roadless recreation opportunities. Roughly 23,000 campsites and 20,000 kilometres of trail are developed on public land in B.C. Across B.C., visually sensitive areas are mapped and objectives for visual quality are legally established. The public expresses a preference for landscapes with a low level of logging disturbance.

Trend

The area providing roaded recreation opportunities is increasing while the area providing roadless opportunities is decreasing. Many trends in recreation and tourism use and socio-economic impact have not been estimated. Public preference for low levels of landscape modification is unchanged over the last 15 years. Evaluations are being undertaken of the impact of timber harvesting on visual quality. As results become available, they should support the continuous improvement of forest policies and practices.

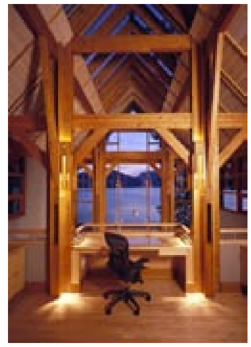
Information

Several good studies exist that focus on various economic benefits derived from outdoor recreation and tourism by residents and non-residents, but no comprehensive survey has been undertaken. Visual quality information is comprehensive and publicly available. Visual quality evaluations are being undertaken but are not yet published.

17 Forest Products and the Economy

Timber harvested in B.C. is used to make lumber, pulp and paper, panel boards, and a multitude of value-added wood products.

Lumber – www.naturallywood.com



Architect – Brian Hemingway photo by Peter Powles

Staircase handrails – www.naturallywood.com

Why is this important?

Forestry is one of the most important natural resource industries in B.C., contributing billions of dollars annually to the economy.

Overview

- British Columbia's forests and rangelands provide a wide variety of forest products and services, and generate substantial public and private revenues.[1]
- The timber harvested in B.C. is used to make lumber, pulp and paper, panel boards, and a multitude of value-added wood products. Non-timber forest products include forage for livestock, mushrooms, and medicinal products.
- In 2009, B.C. forest products accounted for 30% of B.C.'s total exports, and B.C. forest industry shipments accounted for 26% of B.C. total manufacturing shipments. The B.C. forest sector accounted for 4.1% of provincial economic activity. On average, each cubic meter harvested contributes $126 (constant 2002 dollars) to the provincial economy.
- With its reliance on export markets, B.C. forest sector is susceptible to changes in international competition, trade restrictions and currency exchange rates. The B.C. forest sector has experienced one of the worst cyclical downturns in history—affected by the slumping U.S. housing market, historically low lumber prices and the high Canadian dollar.
- B.C. forest products exports to China have increased dramatically over the past decade, partially offsetting declines in exports to the U.S. and Japan. China is now the second largest export market for B.C. forest products with a share of 17% in 2009, after the U.S. (53%) and ahead of Japan (12%).
- B.C. forest industries along with the provincial and federal governments have made various investments and funded programs and initiatives to expand markets in China and elsewhere, making the B.C. forest sector less dependent on U.S. and Japan markets.

- The use of wood biomass to produce electricity, heat and bio-products represents a significant opportunity in B.C. B.C. has an abundance of underutilized wood in the form of sawmill residues, logging debris, and timber killed by the mountain pine beetle.

Questions about forest products and the economy

17-1: What is the current economic situation faced by B.C.'s forest sector?
17-2: How much does timber harvesting contribute to provincial GDP?
17-3: What is the value of forest product exports from the province?
▶ Summary and assessment

Related indicators

- Access to forest resources and regulatory requirements affect the economic viability of forest-based industries (see Ownership and timber harvest rights, Timber production forests, Timber harvest, Law, Certification).
- Forest-based industries help support many of B.C.'s communities (see Jobs and communities, First Nations involvement). They also affect the province's environmental integrity (see Species diversity).
- The beef cattle, tourism and recreation sectors rely on forests and are major contributors to the B.C. economy (see Rangeland; Recreation, tourism, and visual quality).
- Trade policy and other regulations consider industry viability (see Law).

17-1 What is the Current Economic Situation Faced by B.C.'s Forest Sector?

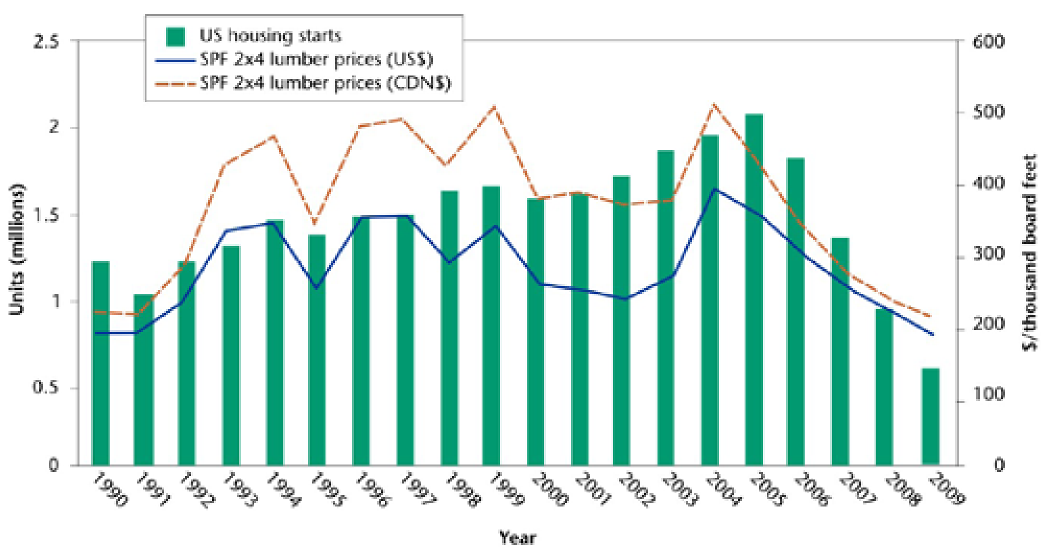


Figure 17-1. *U.S. housing starts and SPF 2x4 lumber prices, 1990-2009.*

Why is this important?

The economic benefits generated by the forest sector are determined by the economic conditions faced by the sector.

State and trend

- In 2008 and 2009, the B.C. forest sector experienced one of the worst cyclical downturns in history—affected by the slumping U.S. housing market, historically low lumber prices and the high Canadian dollar.
- U.S. housing starts are at the lowest levels in 40 years. U.S. housing starts totalled 558,000 in 2009, down 73% from the 2005 peak of over 2 million, and 38% below the 2008 level of 903,000. Consequently, U.S. lumber consumption fell to 31.9 billion board feet in 2009, down 51% from the 2005 peak of 64.5 billion board feet, and down 22% from 2008.
- As a result of the weak lumber market, harvest volume in B.C. totalled 48 million cubic metres in 2009, down 22% from 2008. B.C.'s lumber production was 9.7 billion board feet, down 19% from 2008. B.C.'s lumber exports to the U.S. totalled 5 billion board feet in 2009, down 25% from 2008.
- The SPF 2x4 price averaged U.S. $181 per thousand board feet in 2009. This was a 40-year low in nominal terms and a 25-year low in real terms.
- Rising mortgage foreclosures, dropping home sales and historically high unemployment rates are expected to slow the pace of the recovery of U.S. economy. The outlook is for U.S. housing starts to remain weak for the next couple of years. As a result, the demand for B.C. lumber from the U.S. market will stay weak, and major North American lumber prices will remain low in 2010 and 2011.
- Canadian lumber producers who sell most of their products in the U.S. and are paid in U.S. dollars are significantly affected by the U.S.-Canada exchange rate. The chart (Figure 17-1) shows that B.C. producers have seen a bigger drop in Canadian dollar prices since 2004 because of changes in the value of the dollar. The Canadian dollar is forecast to close to parity in 2010 and 2011.
- Pulp and paper manufacturing accounted for 20% of B.C. forestry GDP, and accounted for 46% of B.C. total forest products export value in 2009. The biggest product is market pulp with a share of 27% of B.C. total forest products export value. China is B.C.'s largest export market for pulp.
- Changes in commodity prices, exchange rates and economic conditions in export markets have contributed to a decline in the value of B.C. forest products exports to $7.6 billion in 2009 from $16.6 billion in 2000 (Figure 17-3a). The primary market for B.C. forest products exports is the U.S. with a share of 53% in 2009, a drop from 57% in 2000 (Figure 17-3b). The second largest market is China (including Hong Kong) with a share of 17% in 2009, a dramatic increase from the share of 3% in 2000. Japan, formerly B.C.'s second largest market with a share of 18% in 2000, is now the third largest export market with a share of 12% in 2009.
- China's demand for forest products is expected to continue to expand over the next few years. With the various private sector investments and government funded initiatives promoting sales of B.C.'s forest products in China,

the continuing increase of China's share of B.C. forest products exports market is foreseeable in the near term.

- B.C. has set a goal of meeting 50% or more of the province's renewable fuel requirements by 2020 with biofuels produced in B.C. The use of wood biomass to produce electricity, heat and bio-products represents a significant opportunity in British Columbia.
- B.C. has an abundance of underutilized wood in the form of sawmill residues, logging debris, and timber killed by the mountain pine beetle. The B.C. government is putting policies in place to encourage the utilization of wood-fibre bioenergy (creating new uses for waste wood and beetle-killed forests) and stimulate new investment and economic diversification.
- The Clean Energy Act (2010) supports new jobs and private sector investment in wood pellet plants and cellulosic ethanol production as well as biomass technologies. B.C.'s 11 wood pellet plants, located in B.C.'s interior region, produce nearly 1.2 million tonnes of products. In 2009 about 98% of B.C.'s wood pellet production was exported to Europe, the U.S. and Asia.

Information

- Housing starts are from U.S. Census Bureau.[2]
- Lumber price data is from *Madison's Lumber Reporter.*

Related international and national indicators

- MP 6.1 CCFM 5.1

17-2 How Much Does Timber Harvesting Contribute to Provincial GDP?

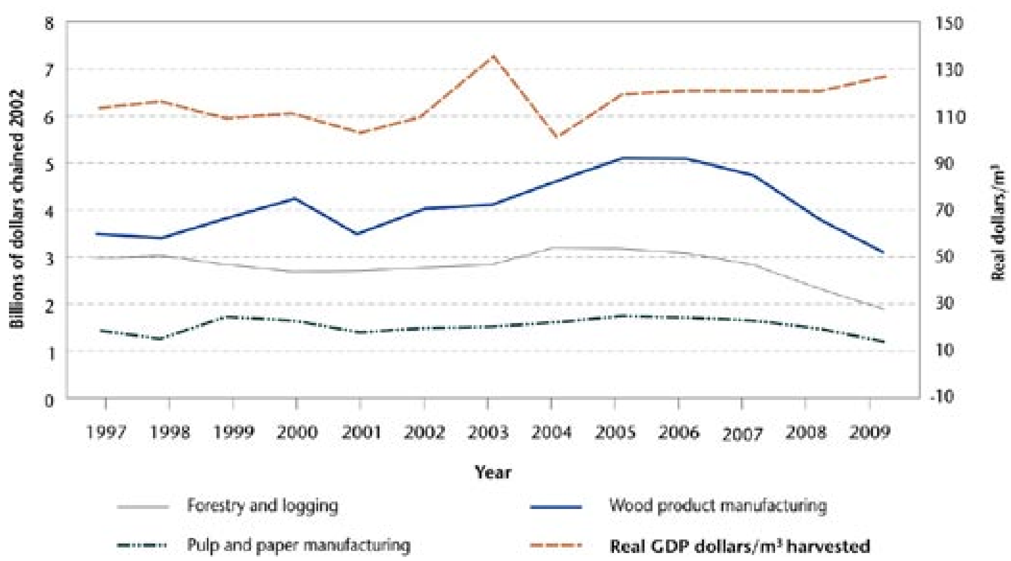


Figure 17-2. *Contribution to provincial GDP per cubic metre harvested by sector, 1997–2009.*

Why is this important?

A significant portion of economic activity in the province derives from the forest sector.

State and trend

- Direct 2009 forest industry economic activity, as measured by gross domestic product (GDP) expressed in constant 2002 dollars, totalled $6.1 billion, representing 18.7% of goods-producing industry GDP and 4.1% of total provincial GDP.
- Within the forest sector, wood products manufacturing accounted for 50% of total forest GDP in 2009 while pulp and paper manufacturing and forestry and logging contributed 20% and 30%, respectively.
- GDP per cubic metre harvested is an indicator that highlights the direct contribution of the timber harvest to the provincial economy. In 2009, a cubic metre of harvested timber contributed $126 (constant 2002 dollars) to the provincial economy, up 5% from 2008 level due to bigger drop in harvesting volume (22%) than the drop in GDP (18%).
- In the 2003 to 2005 period, as the harvest was increased to salvage the mountain pine beetle-killed wood, GDP in the wood products sector increased substantially. In 2008 and 2009, forestry and logging and wood products manufacturing suffered the most due to the weak lumber market and slow-down in harvesting activities.
- Total harvest volume in B.C. peaked at 92.3 million cubic metres in 2004 and declined 48% to 48 million cubic metres in 2009 due to the weak lumber market.
- Softwood lumber is the dominant wood product produced in B.C. with U.S. the largest export market (see 17-3).
- Pulp and paper manufacturing accounted for 20% of B.C. forestry GDP in 2009 and includes manufacturers of market pulp, newsprint, lightweight coated paper, corrugated paper, and other paper products. Pulp is our major product in the pulp and paper sector with China as the largest export market (see 17-3).

Information

- GDP data is from BC Stats.[3]
- Harvest data is from Pricing Branch of B.C. Ministry of Forests and Range.

Related international and national indicators

- MP 6.1 CCFM 5.1.1

17-3 What Is the Value of Forest Product Exports from the Province?

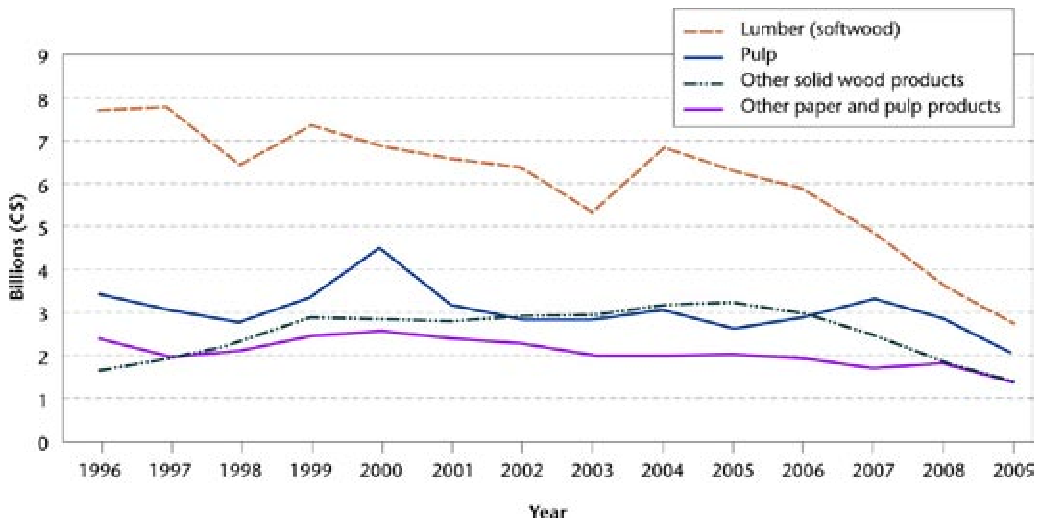


Figure 17-3a. *Value of forest product exports (C$) from B.C. by product group, 1996-2009.*

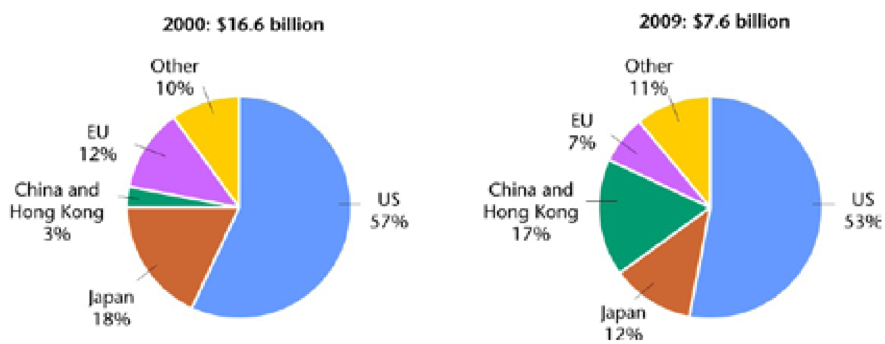


Figure 17-3b. *B.C. forest product exports by market, 2000 and 2009.*

Why is this important?

Given the small size of domestic markets, B.C. must export forest products to sustain a high level of economic activity in the forest sector.

State and trend

- Forest products are the province's most important export commodity accounting for 30% of the total value of B.C. goods exports in 2009. However, because of the weak lumber market, historically low lumber prices and the increased exports of other commodities, B.C. forest products' total share of exports has declined over the past several years.

- The B.C. forest industry is highly export oriented, with most exports sold in U.S. dollars. The total exports value is significantly affected by U.S.-Canada exchange rates.
- The total value of B.C. exports of forest products has declined, after averaging $14.7 billion per year between 1996 and 2004. In 2009, exports fell to a 15-year low of $7.6 billion, down 50% from 2004 and down 25% from 2008.
- Most of the decline since 2004 was driven by reduced lumber exports due to the collapse of the U.S. housing market. B.C. softwood lumber exports decreased to $2.75 billion in 2009, down 34% from 2008 and down 60% from its peak year in 2004.
- In 2009, softwood lumber exports accounted for 36% of B.C. total forest products exports value, other wood products accounted for 18%, pulp for 27% and other pulp and paper products for 19%.
- The U.S. has remained B.C.'s largest export market for softwood lumber with a share of 56% of softwood lumber exports value in 2009.
- Exports of other wood products including value added products, other panel products, logs, cedar shingles and shakes, veneer and plywood, doubled to $3.2 billion between 1996 and 2005. The value added component increased from $0.6 billion to $1 billion during the same period. Because of the weakness in U.S. housing, the value of exports of other wood products fell 57 % between 2005 and 2009.
- Pulp accounted for 27% of B.C. total forest products exports value in 2009. China has remained the largest export market for B.C. pulp (in both value and volume) since 2007, followed by U.S., Japan and Italy.
- B.C. forest product exports to China have increased dramatically over the last decade (Figure 17-3b). In 2009, exports to China totalled $1.25 billion, up 5% from 2008 and triple the level of 1995.
- China's demand for forest products is expected to continue to expand over the next few years. China's share of B.C. forest products exports are expected to increase, due to various private sector investments and government funded initiatives that are promoting sales of B.C.'s forest products in China.

Information

- Data is from Statistics Canada.

Related international and national indicators

- MP 6.1.a, 6.1.f. CCFM 5.1.3

Summary and Assessment

State

Forestry is one of the most important natural resource industries in B.C. Forest products are the province's most important goods exports. In 2009, B.C. forest products accounted for 30% of B.C.'s total exports, and B.C. forest industry shipments accounted for 26% of B.C. total manufacturing shipments. The forest sector accounted for 4.1% of provincial economic activity (direct GDP). On average, each cubic metre harvested contributes $126 (constant 2002 dollars) to the provincial economy. B.C.'s forest sector is currently experiencing one of the worst cyclical downturns in its history. Prices for most forest products are depressed and demand is weak due to poor economic conditions in B.C.'s largest export market--the U.S. However, B.C.'s forest products exports to China have increased dramatically and there is potential for increased market share with expected robust economic growth in China.

Trend

The production and export of forest products, and the contribution of the forest sector to the provincial economy, have declined since 2005 to 2007 due to a sharp reduction in commodity demand and prices. As the global economy slowly recovers from the current economic crisis, the demand for B.C. forest products is anticipated to increase starting in 2011.

Information

Complete and up-to-date information is readily available on many aspects of forest products production, export, and its associated economic impact. Information about emerging industries including bioenergy is not as readily available as for the established solid wood and pulp and paper industries.

18 Jobs and Communities

Average income in forest-based industries was $41,000, 12% higher than for all industries.

Forest workers – BC Forest Safety Council

Community timber processing facility – MFR

Why is this important?

Forests provide a major source of employment and income for many of B.C.'s communities.

Overview

- Forest-based jobs support individual workers, their families, and the economic and social fabric of their communities. Worker safety is a vital aspect of maintaining this support.[1]
- Many of British Columbia's rural and First Nations communities are dependent on forest-based employment.
- Since 1970, annual forest-based employment has ranged from 105,000 to 142,000 jobs. Since 2007, a sharp decline in demand and prices in forest products markets has reduced forest sector employment and negatively impacted communities.
- In 2008, direct and indirect forest-based jobs provided 7% of the employment in B.C.
- Forest-based jobs tend to pay well. The average income in forest-based industries was 12% higher than in all industries in the latest study. In 2005, direct and indirect forest-based labour income was $6.75 billion, or 8.2% of the provincial labour income from all industries.
- As the province's economy has grown and diversified, provincial dependence on the forest sector has decreased, but many areas are still highly dependent. Many communities throughout B.C. obtain a high proportion of their basic income from the forest sector.
- Compared with most other industries, work in timber-based industries can be dangerous. However, over the past three decades, the annual number of injuries and fatalities in the forest sector has declined.

Questions about jobs and communities

18-1: How many jobs rely on B.C.'s forests?
18-2: How much income is based on B.C.'s forests?
18-3: How dependent on forests are B.C.'s communities?
18-4: How many injuries and fatalities occur in the forest sector?
▶ Summary and assessment

Related indicators

- Changes in technology and market demands affect employment in the forests and related manufacturing (see Timber harvest, Forest products and the economy).
- Employment and community stability affects government revenues and expenses.
- Management responses include policy changes (see Law).

18.1 How Many Jobs Rely on B.C.'s Forests?

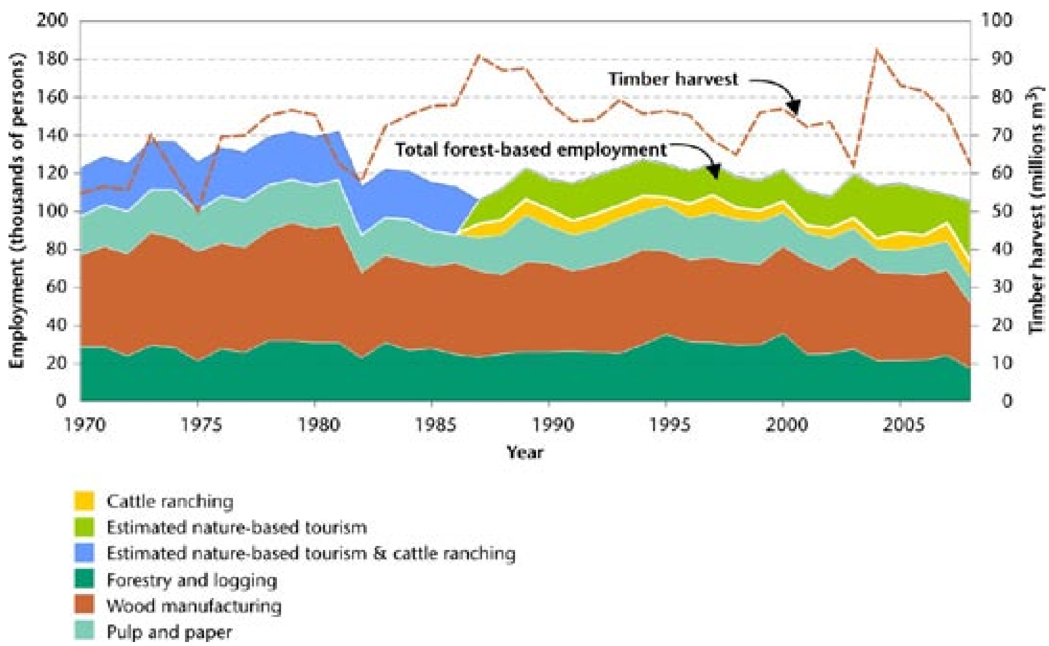


Figure 18-1. *Forest-based employment by sector and annual timber harvest, 1970–2008.*

Why is this important?

A large number of jobs in the province depend on B.C.'s forests.

State and trend

- Forest-based industries include harvesting and processing of timber, cattle ranching, nature-based tourism, and non-timber forest products.
- Over the past 29 years, direct employment in these industries ranged from 105,000 to 142,000 positions, fluctuating with changing product demand, increasing productivity, a changing mix of products and services, and contracting.
- Indirect employment in sectors that support forest-based industries was estimated at 52,000 additional jobs in 2008.
- Direct forest-based employment accounted for 4.6% of total employment in B.C. in 2008. Direct and indirect employment accounted for 6.8%.
- From 1987 onward, timber-based industries provided, on average, about 90,000 jobs or 77% of forest-based jobs. Mechanization in sawmills in the early 1980s and pulp and paper mill closures and modernization in the late 1990s reduced employment while the timber harvest increased. Mill closures and curtailments have intensified since late 2007 due to the U.S. housing and lumber market downturn. Timber-based employment dropped dramatically to 64,800 in 2008, (down 23% from 2007) and 52,000 in 2009.
- From 1987 to 2007, direct employment in the cattle ranching industry averaged about 7,000 jobs or 6% of forest-based jobs, but increased to 8,700 jobs in 2008.
- Direct employment in nature-based commercial tourism that relies on forests (e.g., hunting, fishing, wildlife viewing, and backcountry hiking) averaged an estimated 19,400 jobs from 1987 onward, and trend varied by activity.
- Forest-based employment accounted for 11.6% of B.C. goods-producing sector employment and 2.3% of B.C. all industries employment in 2009, down from 12.9% and 2.8% respectively in 2008.

Information

- Employment data are from Statistics Canada's Labour Force Survey, with adjustments by BC Stats. Tourism data are estimated.
- Non-timber forest products (NTFPs) industries are estimated to provide the main employment for less than 1,500 people.
- References: 2006 Census, Statistics Canada; BC Stats; BC Wilderness Tourism; Tourism BC; FPB Integrating NTFPs[2]

Related international and national indicators

- MP 6.3.a CCFM 5.3.5

18.2 How Much Income Is Based on B.C.'s Forests?

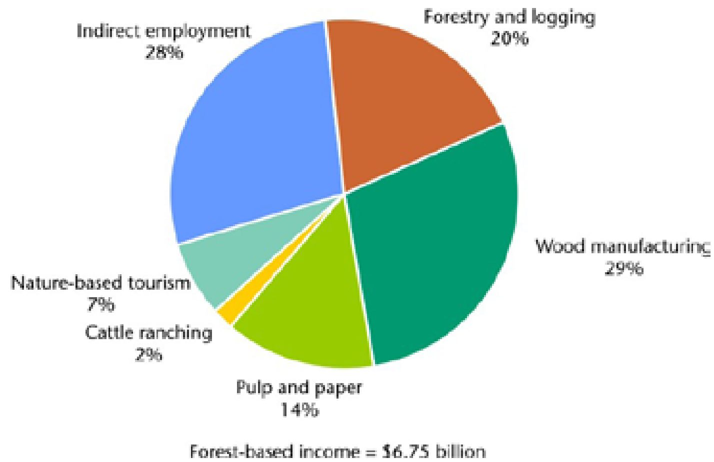


Figure 18-2. *Total labour income from forest-based industries by sector, 2005.*

Why is this important?

Income based on forests supports many of B.C.'s workers, their families, and communities.

State and trend

- Forest-based labour income is earned through direct employment in forest-based industries and indirect employment in service industries that support the forest-based industries.
- In 2005, direct and indirect forest-based labour income was $6.75 billion or about 8.2% of the provincial labour income from all industries.
- Timber industries (forestry, logging, lumber, panels, pulp and paper) accounted for $4.20 billion (87% of direct forest-based income).
- Non-timber industries (cattle ranching and nature-based tourism) accounted for $0.65 billion (13% of direct forest-based income).
- Average income in forest-based industries was $41,000, 12% higher than the $36,600 in all industries. It was highest in pulp and paper ($65,800), followed by wood manufacturing ($48,000), logging ($46,000), nature-based tourism ($18,600), and cattle ranching ($18,400).
- Between 1991 and 2008, average weekly earnings adjusted for inflation increased about 10% in forestry and wood manufacturing, 4% in pulp and paper, and 8% in nature-based tourism.

Information

- Labour income statistics for 2005 are from the 2006 census.
- Reliable data are not available for labour income from harvesting NTFPs. The work is generally seasonal and few people identify this as their primary employment. Earnings vary greatly, as do skills and experience.
- References: 2006 Census; Survey of Labour and Income Dynamics[3]

Related international and national indicators

- MP 6.3.b CCFM 5.3.6

18.3 How Dependent on Forests Are B.C.'s Communities?

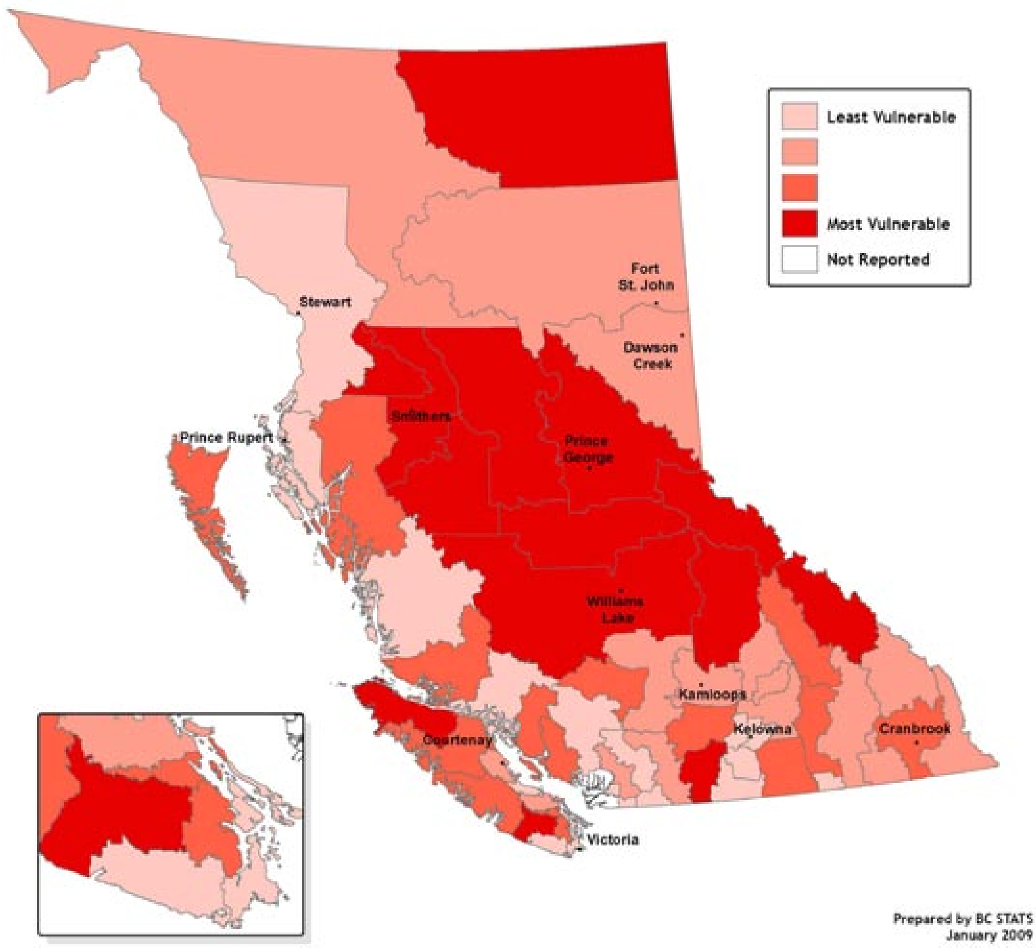


Figure 18-3. *Regional sensitivity to forest sector economic downturn. Vulnerability is high where a large share of local income derives from the forest sector and the local economy is not highly diversified.*

Why is this important?

Many B.C. communities depend on a strong local forest industry for their economic and social well-being.

State and trend

- Community sustainability depends on many factors such as income, diversity of income source, potential for and proximity to alternative employment, amenity values, and leadership in addressing change.
- The sale of forest-based goods and services provides basic income that flows into a community, pays resident employees, and creates other local jobs as the money circulates within the community.
- Many B.C. communities obtain a high proportion of their basic income from timber-based industries. In 2006, 25 of 63 local areas (excluding Greater Vancouver) obtained 20 to 48% of their basic income from the timber and tourism industries. These areas include 47 communities with a total population of 303,000, not including surrounding rural areas.
- The map of forest sector vulnerability (Figure 18-3) shows relative sensitivities of the 63 local area economies to downturns in timber-based industries.
- Many of the most vulnerable communities are in areas where future timber supplies are at risk due to the mountain pine beetle epidemic (see Indicators 12-3 and 13-4).

Information

- The vulnerability index is based on the percentage of income from timber-based industries and on the diversity of basic income sources.[4]
- References: BC Stats, 2006 Census

Related international and national indicators

- MP 6.3.c CCFM 6.3.1 to 6.3.4

18.4 How Many Injuries and Fatalities Occur in the Forest Sector?

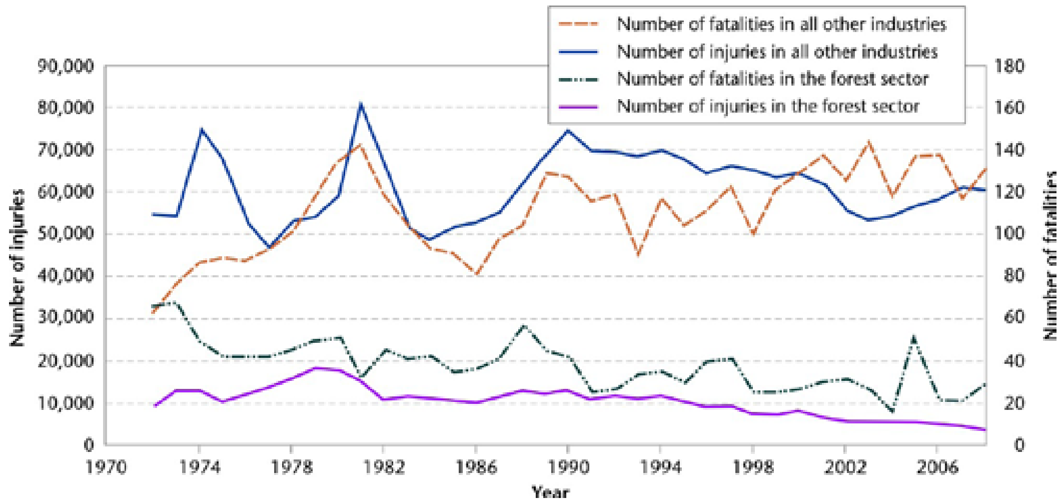


Figure 18-4. *Injuries and fatalities in the forest sector and all other industries, 1970–2008.*

Why is this important?

Injuries and fatalities disrupt workers' lives, families, and communities, and reduce the forest sector's productivity and ability to attract skilled workers.

State and trend

- Injuries and fatalities result from dangerous situations, equipment failure, cultural attitudes, market and workplace pressures, human error, and other factors (fatigue, dehydration, inadequate conditioning, stress, drugs, and alcohol).
- The forest sector's number of fatalities has generally decreased over the past 38 years, but its number of fatalities is still the second highest of all sectors (the transportation sector is highest). The number of fatalities for other industries has increased over the past 23 years.
- The number of injuries reported in the forest sector has decreased since the 1970s. No clear trend is apparent for the sum of all other sectors.
- Annual, inflation-adjusted benefits paid out for disability and fatalities from 1991 to 2008, inclusive, averaged $130 million (in 2008 dollars) for the forest industry and $545 million for all other industries. Benefits paid per worker in the forest industry were almost four times those paid in all other industries ($1,187 and $346 per person-year, respectively) from 1991 to 2007.

Information

- Serious injury and fatality data are updated monthly and published annually.
- References: WorkSafeBC; BC Forest Safety Council[5]

Related international and national indicators

- MP 6.3.b CCFM (none)

Summary and Assessment

State

Direct forest-based employment accounted for about 5% of total employment and 6% of labour income in British Columbia in 2005. Timber-based industries accounted for most of this employment and provided substantially higher average incomes than nature-based tourism and cattle ranching. In more than one-third of B.C.'s 63 local economies, over 20% of labour income was forest-based in 2006. Many communities and surrounding rural areas are vulnerable to downturns in timber product markets and the impacts of the current mountain pine beetle epidemic. Compared with most other industries, work in timber-based industries can be dangerous. Average benefits paid for forest worker injuries and fatalities are almost four times the average for other industries.

Trend

Forest-based employment continues to play an important role in B.C.'s economy and communities. However, market downturns and trade disputes have reduced employment in the timber-based industries in recent years. As companies continue to reduce their non-skilled labour force to stay viable and competitive, communities can no longer rely on timber-based industries to provide employment to large numbers of mill workers and will need to continue looking for employment growth in other sectors. Forest worker injuries and fatalities have generally decreased since the 1970s. However, incident increases do occur in some years (e.g., 2005 and 2008). When this happens, the organizations concerned with forest worker safety strive to understand the anomalies and continue to improve worker safety.

Information

Extensive employment and labour income statistics are publicly available. However, census information is only updated every five years. Statistics for nature-based tourism are not tracked separately and can only be estimated. Changes in the classifications of sub-sectors of timber-based industries may cause minor unreliability of trend analyses by sub-sector. Sophisticated modelling of community dependence on the forest sector and other sectors has been reported periodically. Some injury and fatality data are published annually.

19 First Nations Involvement

Since 2002, the Province has entered into interim measures agreements with 158 First Nations to provide access to 39 million cubic metres of timber and over $230 million in forest revenues

Why is this important?

Forests have been economically, culturally, and spiritually significant to First Nations people for thousands of years.

Overview

- Many First Nations in B.C. have unresolved Aboriginal rights and title issues that are being addressed by the Province through treaty, incremental treaty agreements and interim measures, and broad-based discussions with the B.C. government.[1]
- The Province is committed to a relationship with First Nations based on reconciliation and respect.
- In 2005, the Government of British Columbia entered into a New Relationship with B.C.'s First Nations to build stronger and healthier relationships between government and Aboriginal people. The new relationship commits to establishing processes and institutions for shared decision-making, sharing revenue and benefits, and supporting economic self-sufficiency for First Nations.
- In November 2005, the Transformative Change Accord was signed by B.C. First Nations and the Governments of British Columbia and Canada. The goal of the accord is to close the socio-economic gap between First Nation citizens and other British Columbians.
- The *New Relationship Trust Act* establishes a not-for-profit corporation and a seven-member board of directors to manage a $100-million fund to support First Nations capacity-building.
- First Nations involvement in forest management activities includes consultation in decision-making processes and access to forests for traditional and cultural purposes.
- First Nations people (not including Métis) make up about 8% of British Columbia's rural population who live near the provincial forest land base.
- The Province shares forest revenue with First Nations and provides economic opportunities by way of forest tenures and silviculture contracts.

- The Province's goal is to support increased First Nations participation in the forest sector.
- Involvement by First Nations in the forest sector's economic opportunities has increased over the past 25 years.
- Since 2002, the Province has entered into interim measures agreements with 158 First Nations to provide access to 39 million cubic metres of timber and over $230 million in forest revenues.
- The First Nations Forestry Council was established in 2006 to assist British Columbia's First Nations with forestry-related matters. Under the First Nations Mountain Pine Beetle Initiative, $8.9 million has been transferred to the First Nations Forestry Council.
- In December 2007, the Supreme Court of Canada released two decisions: R. v. Sappier and R. v. Gray. These decisions address a First Nation's ability to access timber for domestic purposes as an Aboriginal right.

Questions about First Nations involvement

19-1: In what ways do First Nations participate in the forest sector?
19-2: What timber harvesting opportunities do First Nations have?
19-3: How are First Nations interests considered in forest management?
19-4: Are unresolved Aboriginal rights and title issues being addressed?
▶ Summary and assessment

Related indicators

- Timber harvesting may impact First Nations traditional and cultural uses of the forests, including hunting of wildlife (see Species diversity).
- High rates of unemployment in many First Nations communities create difficult social pressures (see Jobs and communities).
- Management responses include consultation, revenue sharing, changes in policy, law, allocation of forest resources (see Law, Ownership and timber harvest rights), and resolution of Aboriginal rights and title issues.

19-1 In What Ways Do First Nations Participate in the Forest Sector?

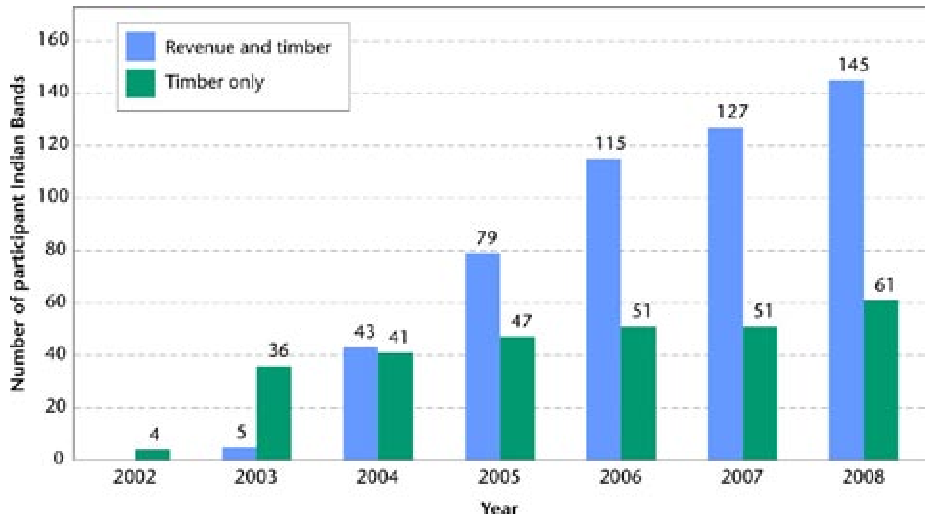


Figure 19-1a. *Number of First Nation forestry agreements, 2002–2008.*

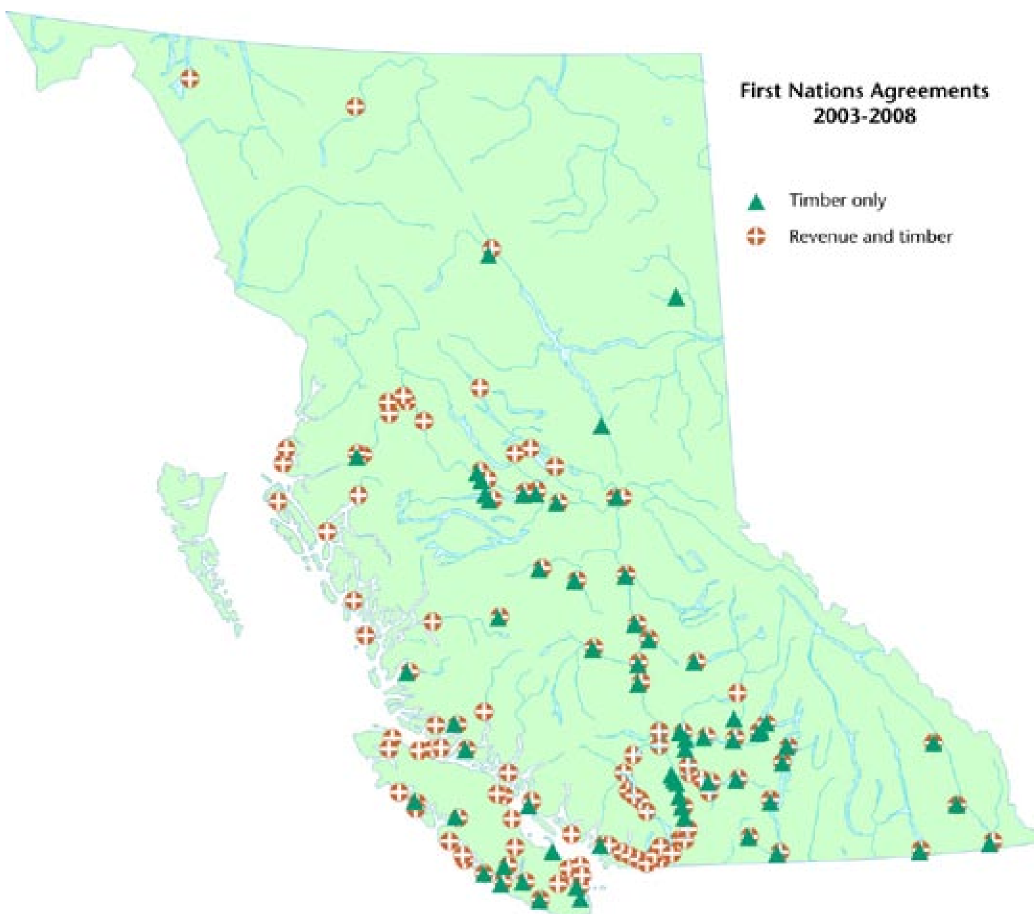


Figure 19-1b. *Location of First Nation forestry agreements, 2003–2008.*

Why is this important?

Participation in the forest sector provides First Nations opportunities for economic benefits, including capacity development and employment, and opportunities to influence forest management.

State and trend

- The New Relationship commits the provincial government to involve First Nations leaders in public policy work that affects the lives of Aboriginal people.
- Under the Transformative Change Accord, the Province and the First Nations Leadership Council committed to develop policies and programs to close the social and economic gap that exists between Aboriginal people and other British Columbians.
- The Aboriginal Forest Industries Council and the First Nations Forestry Council (established in 2006) assist and support B.C. First Nations with respect to forestry-related matters and work with the Ministry of Forests and Range on policy matters.
- Agreements such as Forest and Range Agreements, Interim Agreement on Forest and Range Opportunities, Direct Awards, and Treaty Related Interim Measures have provided revenue-sharing and access to timber volume for First Nations.
- The Province has supported First Nations involvement in mountain pine beetle spread control, fire suppression and fuel management, and silviculture (such as the Forests for Tomorrow program).
- First Nations hold timber tenures, work in the forest sector (e.g., forest management, logging, milling, fire fighting, and tree planting), pursue training in forestry, and consult on forest management decisions. Employment provides direct economic benefits to individuals and communities.
- With increasing education and training in forestry, First Nations individuals are filling more technical and professional positions.
- The Province has provided funding support to the University of British Columbia Forestry Faculty's First Nations Strategy, and the Forest Technician Training Program at the Nicola Valley Institute of Technology.
- The provincial government consults with First Nations before making administrative or operational decisions. First Nations participation in the consultation process ensures that their Aboriginal interests are properly considered and, where appropriate, accommodated before a decision is made.
- Harvesting of fish, wildlife, and other non-timber forest products continues to play an important role in First Nations livelihoods and culture.

Information

- Detailed information about agreements is publicly available.
- References: MFR Aboriginal Affairs Branch website[2]

Related international and national indicators

- MP 6.3.e, 7.1, 7.2 CCFM 6.1

19-2 What Timber Harvesting Opportunities Do First Nations Have?

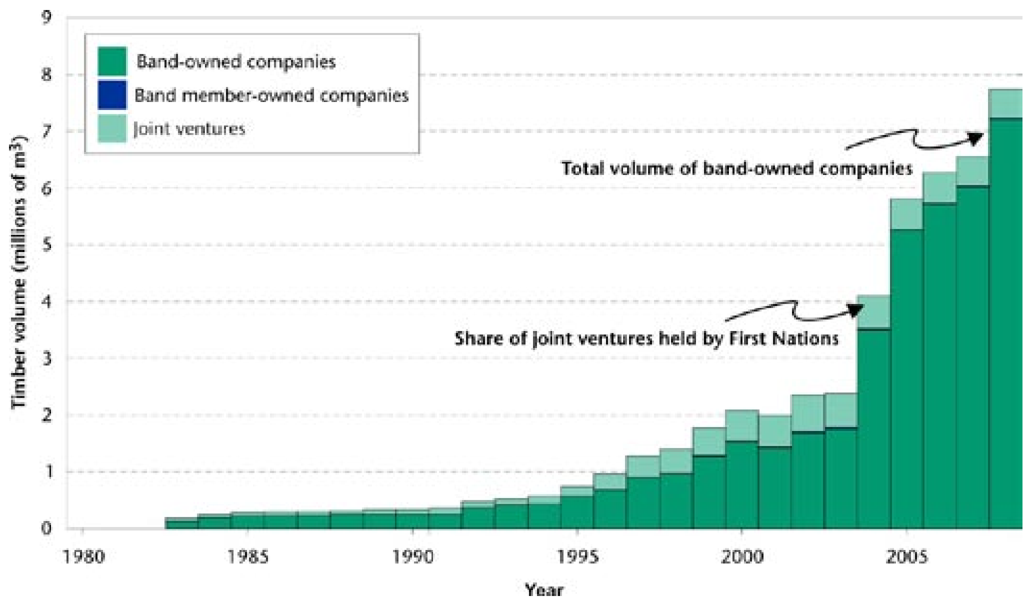


Figure 19-2. *Timber volume licensed to First Nations, 1980–2008.*

Why is this important?

Timber harvesting and milling provide an important source of economic opportunity for First Nations.

State and trend

- Agreements such as Forest and Range Agreements, Interim Agreements on Forest and Range Opportunities, Direct Awards, and Treaty Related Interim Measures have provided revenue sharing and access to timber volume to First Nations.
- The timber harvest volume under tenures held by First Nations, through both competitive and direct awards processes, has increased to 10.5% of the provincial allowable annual cut (AAC) over the past two decades.
- Rates of involvement vary around the province depending on First Nations interest, capacity, and the availability of unallocated timber.
- The Province is supporting the emergence of the First Nations value-added wood products sector.
- First Nations have raised concerns about the viability of the forest tenures offered to them under interim agreements. This viability issue is compounded by the current poor lumber and log markets, the mountain pine beetle

epidemic, high administrative and overhead costs, and a lack of access to markets. Both First Nations and the Province are looking at options to address this situation.
- About 20 First Nations have or are pursuing a Community Forest Agreement, providing new economic opportunities on a defined land base and an opportunity to manage the recreation, wildlife, watershed, and cultural heritage resources.

Information

- Records of First Nations timber tenures are reliable for recent years. Some minor gaps are known to exist in the data before 1995.
- The volumes presented in Figure 19-2 represent rights to harvest, not actual volumes harvested.
- References: MFR Aboriginal Affairs Branch website[3]

Related international and national indicators

- MP 6.3.e, 7.1, 7.2 CCFM 5.2.1, 6.1

19-3 How Are First Nations Interests Considered in Forest Management?

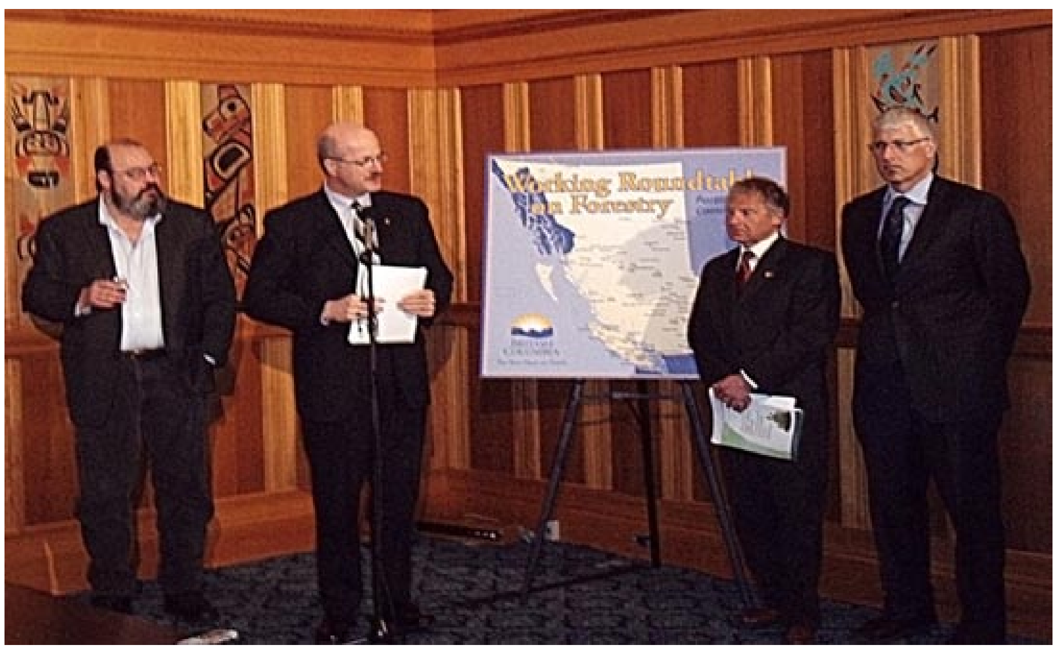


Figure 19-3. *The Forestry Roundtable was established to identify key issues and opportunities facing the forest sector in British Columbia.* [4]

Why is this important?

Forest management directly affects the economic, social, and legal interests of First Nations.

State and trend

- The government and the forest industry consider information on Aboriginal interests in relation to proposed activities such as land use planning and forest management decision-making.
- Through the First Nation consultation process undertaken by government agencies, including information sharing that may be required by the forest industry, the government is in a position, where appropriate, to address Aboriginal interests that are impacted by a proposed decision. The government also supports many projects that assist in collecting information on Aboriginal interests.
- British Columbia is moving towards a coordinated First Nations consultation and engagement framework. This coordinated approach is intended to be more efficient, reducing the referral workload on First Nations and government, and to be more effective by coordinating information and resources.
- The Province is continually seeking to improve the consultation process. Two examples of this are a First Nations Information Sharing Bulletin related to Forest Stewardship Plans under the *Forest and Range Practices Act,* and the development of a consultation matrix to help the Province engage First Nations in discussion with respect to their consultation interests.
- The Forest and Range Evaluation Program (FREP) was put in place as a multi-agency program to evaluate practices under the *Forest and Range Practices Act* in relation to the government's intent for the sustainable use of resources, including cultural heritage resources. Cultural heritage resources may include specific traditional use areas, sites, or features on the landscape. There are also many natural resources (e.g., plants, animals, habitat types) to which cultural values may be attached.

Information

- An overview of how First Nations interests are considered is provided on the MFR Aboriginal Affairs Branch website.
- References: MFR Aboriginal Affairs Branch website[5]

Related international and national indicators

- MP 7.1, 7.2 CCFM 6.1.1

19-4 Are Unresolved Aboriginal Rights and Title Issues Being Addressed?

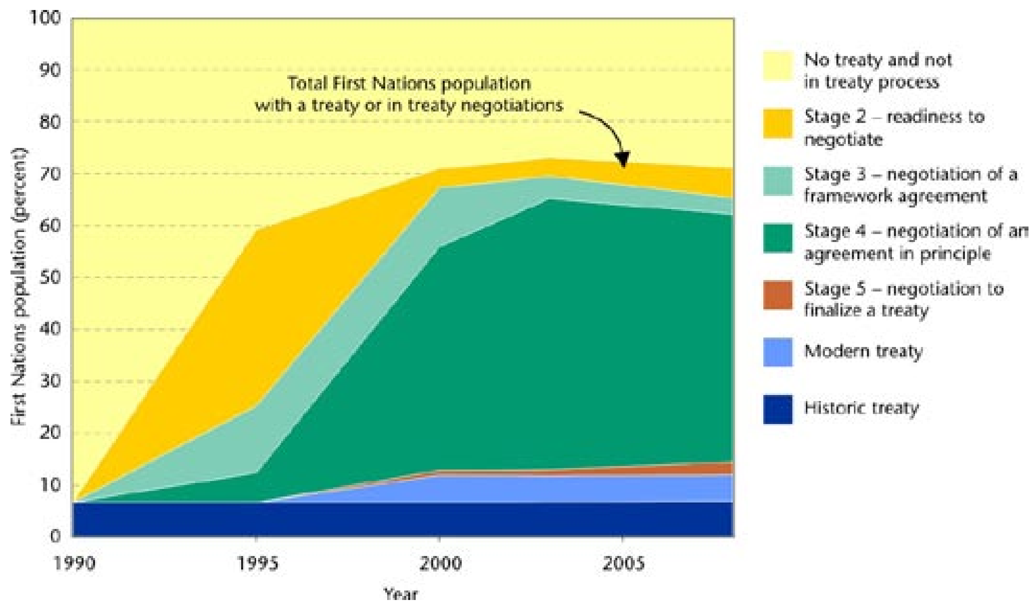


Figure 19-4. *First Nations population by treaty stage, 1990–2008.*

Why is this important?

Resolution of Aboriginal rights and title issues will contribute to an environment of respect and recognition while it increases certainty for land and resource development in B.C. Treaty negotiations address these matters in the long term.

State and trend

- Historical treaties signed in the 1800s covered 7% of the First Nations population in 1999.
- In 2000, the Nisga'a Treaty and an adhesion to Treaty 8 increased that coverage to 12% of the First Nations population.
- The B.C. treaty process is open to all First Nations in the province. First Nations decide how they will organize themselves for the purposes of treaty negotiations. At some tables, there is a single First Nation represented, while at others there may be two or more. Currently, there are 42 negotiating tables in the BC Treaty Commission process.
- These negotiations are overseen and facilitated by the BC Treaty Commission (BCTC), an independent body established in 1992 by Canada, British Columbia, and the First Nations Summit.
- A Final Agreement is the stage at which the three parties (First Nations, Province, and Canada) work out the technical and legal issues to produce a Final Agreement or treaty. First Nations with ratified Final Agreements are

Tsawwassen First Nation and Maa-nulth First Nations. First Nations currently negotiating Final Agreements are Sliammon First Nation, Yale First Nation, Yekooche First Nation, and In-SHUCK-ch Nation.[6]

- Incremental Treaty Agreements are a new approach that does not follow the framework of the BCTC. This approach allows First Nations and the Province to enjoy shared benefits in advance of a Final Agreement. The Incremental Treaty Agreement between Tla-o-qui-aht First Nations and B.C. was the first signed between the Province and a First Nation.
- Interim measures agreements, such as those mentioned previously, are used to consider Aboriginal rights and title issues while treaty negotiations are under way. They provide interim solutions, economic accommodation, and opportunities such as forest tenures and revenue sharing.

Information

- Treaty process information is well documented and readily available.
- References: BC Treaty Commission, Ministry of Aboriginal Relations and Reconciliation, Indian and Northern Affairs Canada[7]

Related international and national indicators

- MP 7.1 CCFM 6.1

Summary and Assessment

State

Forests are economically, culturally, and spiritually significant to B.C.'s First Nations, who have depended on them for thousands of years. The timber harvest volume held by First Nations has increased to 10.5% of the provincial allowable annual cut (AAC). The number of First Nations people employed in the forest sector has increased. First Nations interests are considered in forest management decisions, and the Province is moving towards a coordinated consultation and engagement framework. The Province has committed to a New Relationship with First Nations and a Transformative Change Accord. Treaty negotiations currently involve more than 42 negotiating tables, and incremental treaty agreements allow First Nations to enjoy shared benefits in advance of a Final Agreement.

The economic situation of many First Nations is not satisfactory. It is expected to improve with treaty settlements and other economic initiatives. First Nations have expressed concerns about the viability of the tenure offered to them under interim agreements. This issue is compounded by the current economic climate in the forest sector.

Trend

Over the past two decades, First Nations access to economic opportunities based on timber has increased substantially. First Nations involvement and employment in the forest sector has increased. Consultation on forest management decisions continues to improve. First Nations continue to negotiate modern treaties, and many are well into the process. Further work is required to resolve many Aboriginal rights and title issues. In the long term, these changes are expected to provide greater certainty around forest management and help close the socio-economic gap between First Nations and other British Columbians as identified in the Transformative Change Accord.

Information

Large amounts of information continue to be collected and documented to inform forest management decisions and track progress of interim measures agreements and treaty negotiations.

20 Public Involvement

Public involvement in land planning exercises in B.C. remains high.

Workshop and field tour – Pat Teti

Why is this important?

Public involvement can improve decision-making and reduce conflicts.

Overview

- The provincial government owns approximately 94% of the province's land on behalf of the public, and is accountable to manage it in the public interest.
- In the late 1970s, in response to land and resource use conflicts, public involvement was initiated at strategic and operational planning levels.
- By the 1990s, the public was involved in many planning processes, including the Old Growth Strategy, Parks and Wilderness for the 90s, the Commis-

sion on Resources and the Environment (CORE), land and resource management plans (LRMPs), and the *Forest Practices Code of British Columbia Act*.
- Public involvement was an important component of the processes for developing strategic land and resource plans that covered 86% of B.C. in 2008. All parts of the province with forestry-dependent populations and local forestry infrastructure have undergone some level of planning requiring a public process.
- Public involvement is an important element of recreation management on public forest lands in B.C.
- Today, public involvement continues to be intensive in strategic-level processes such as SLRPs (Strategic Land and Resource Plans) and operational plans under the *Forest and Range Practices Act*.
- Sustainable forest management (SFM) certification schemes require the forest industry to commit to principles of public consultation. They are audited for compliance with these principles. In 2008, roughly two-thirds of the harvest in B.C. was from SFM-certified areas.
- New approaches and methods for enabling public involvement continue to be developed. Examples include model forests and forest visualization technologies.
- A recent public opinion poll about the level of satisfaction with forest management in B.C. found that 37% were satisfied, 51% were dissatisfied, and 12% did not know.

Questions about public involvement:

20-1: How much of the province is subject to consensus-based strategic land and resource plans?
20-2: How satisfied are British Columbians with management of the public forests?
20-3: How aware are British Columbians of the opportunities and tools available for public involvement in decisions concerning the management of public forests?
▶ Summary and assessment

Related indicators

- B.C.'s growing population and increasing demand for goods and services from forests (see Protected forests; Timber harvest; Recreation, tourism and visual quality) raise the need for public involvement to help resolve potential conflicts.
- Involvement in land use planning and forest management planning can place considerable demands on the participating public. Government also has a legal commitment to provide meaningful engagement with First Nations (see First Nations involvement).
- Management responses include providing opportunities for public involvement (see Law, Certification) and access to information (see Knowledge).

20-1 How Much of the Province Is Subject to Consensus-based Strategic Land and Resource Plans?

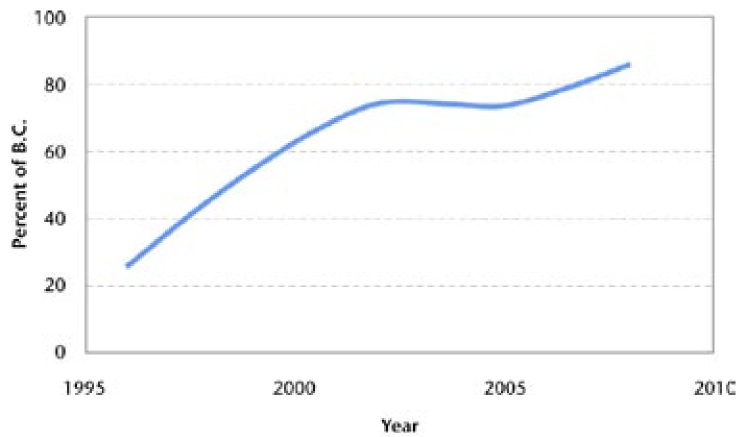


Figure 20-1. *Percent of B.C. covered by a land use plan, 1996–2008.*

Why is this important?

Consensus-based land use planning requires intensive public involvement in both the planning process and approving the plan. The amount of such planning in B.C. is an excellent indicator that the public is involved.

State and trend

- By 2008, 86% of the provincial land base had been covered by a consensus-based LRMP or RLUP (regional land use plan), involving thousands of public participants.
- The percent of B.C. with a land use plan in place has increased steadily since 1993.
- Plans include forest management, mining, recreation, biodiversity, and many other land and resource use provisions.
- All parts of the province with forestry-dependent populations and local forestry infrastructure have undergone some level of planning requiring a public process.
- In addition to land use planning, there are public involvement processes in other elements of forest management, including developing operational plans and maintaining forest certification.

Information

- The provincial government maintains records on the area under various plan types.
- Reference: BC Ministry of Agriculture and Lands; Integrated Land Management Bureau[1]

Related international and national indicators

- MP 7.1, 7.2 CCFM (none)

20-2 How Satisfied Are British Columbians with Management of the Public Forests?

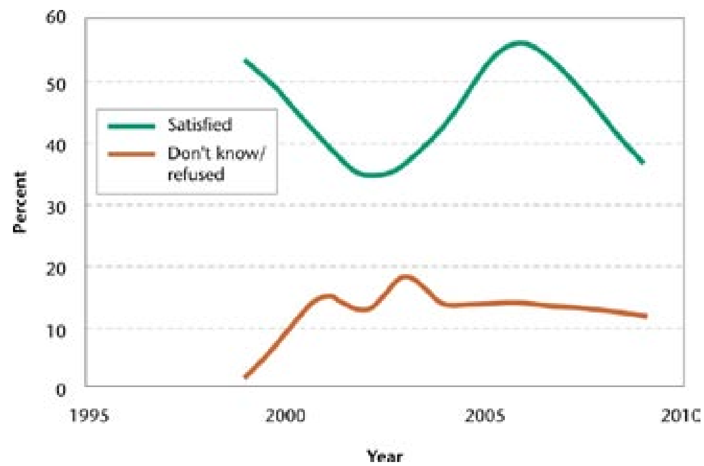


Figure 20-2. *Public satisfaction with the quality of forest resource management in B.C., 1999–2009. Results of public opinion polls commissioned by the ABCFP.*

Why is this important?

Public satisfaction with the management of British Columbia's forests is a key indicator for measuring how well government and forest companies are doing.

State and trend

- Periodically, the Association of BC Forest Professionals (ABCFP) polls British Columbians on their views on various forestry matters.
- Eight times from 1999 to 2009 a large, random sample of the public was asked to describe its level of satisfaction with the quality of forest resources management in B.C.
- In Figure 20-2, the responses "very satisfied" and "somewhat satisfied" are combined.
- From 1999 to 2009, satisfaction levels have varied, with 35% to 56% of the public satisfied with the quality of forest management in B.C.
- In 2009, 37% reported being satisfied, 51% dissatisfied, and 12% did not know or were unresponsive.
- In 2006, satisfaction was highest in the Greater Vancouver Regional District, northern B.C., and central B.C. In 2006, satisfaction was lowest in the Fraser Valley and on Vancouver Island.

Information

- Data are courtesy of ABCFP. In the 2009 survey, 572 people throughout the province were polled. Results have expected accuracy of ± 4.1%, 95 times out of 100.
- Reference: ABCFP 2009 Public Opinion Poll Results[2]

Related international and national indicators

- MP (none) CCFM 6.4.1

20-3 How Aware Are British Columbians of the Opportunities and Tools Available for Public Involvement in Decisions Concerning the Management of Public Forests?

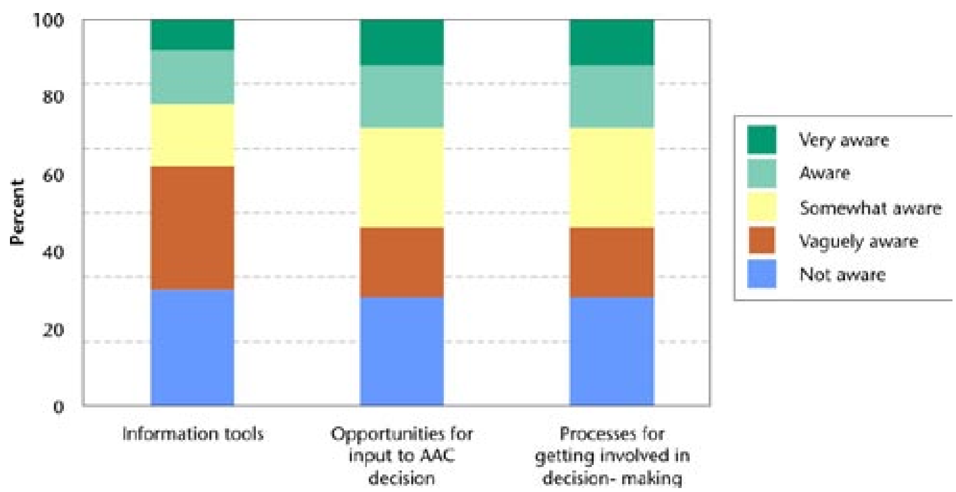


Figure 20-3. *Survey respondent awareness of three opportunities and tools for public involvement in decisions concerning the management of public forests.*

Why is this important?

To foster public engagement, knowledge of the opportunities and tools is necessary.

State and trend

- In a preliminary, non-statistical survey of individuals with a known interest in forest issues, respondents described their level of awareness of the opportunities (and tools) available for public involvement in decisions concerning the management of public forests.
- Approximately 38% of respondents described themselves as very aware, aware, or somewhat aware of the information sources and tools available to find out more about the management of the public forest.

- Approximately 54% were very aware, aware, or somewhat aware of opportunities to have input to allowable annual cut decisions. Roughly 2% had participated in the decision-making process.
- Approximately 54% described themselves as very aware, aware, or somewhat aware of the various processes that are available for getting involved in decision-making on the management of public forests.
- Since this is the first time these finding have been reported, no trend can be determined.

Information

- Using an email contact list supplied by the Forest Practices Board, individuals with an existing interest in forest issues were surveyed. Fifty responses were obtained, approximately 10% of total potential respondents. As this was not a large, statistically controlled polling, the results should be read as indicative only.
- The poll questions assessed: (1) How aware is the public of available information tools relevant to the management of public forests, such as the BC Gazette or iMapBC? (2) The provincial allowable annual cut (AAC) is often cited as the most important forest allocation decision in B.C. How aware is the public of opportunities for public input into the AAC decision? (3) How much awareness is there of the various processes for getting involved as a member of the public in decision-making over the management of public forests in B.C.?

Related international and national indicators

- MP 7.1 CCFM (none)

Summary and Assessment

State

British Columbians have invested heavily in the development of land and resource management plans. By 2008, 86% of the province was under a consensus-based, strategic land use plan. Public involvement in land planning exercises in B.C. remains high. Over the last decade, the percent of British Columbians that are satisfied with the quality of forest management in the province has ranged from 35 to 56%. In 2009, 37% of British Columbians described themselves as satisfied with the quality of forest management in the province. In addition to land use planning, many other opportunities and tools are available for the public to get involved in forest management decision-making. However, preliminary and partial information suggests that public awareness and use of these tools and opportunities are relatively low. In major forest policy initiatives, public comment is solicited and representatives of various public groups get involved. Recent examples include the Forestry Roundtable in 2008 and 2009 and the Silviculture Discussion Paper in 2009.

Trend

Public involvement has exhibited an improving trend over the last 15 years. The percent of the provincial land base with a consensus-based land use plan increased from 25% in 1993 to 86% in 2008. All parts of the province with forestry-dependent populations and local forestry infrastructure have undergone some level of planning requiring a public process. When surveyed in 2009, public satisfaction with forest resource management had declined from over the preceding five years.

Information

The coverage and currency of the information required to assess public involvement is mixed. Information is very good on the area under land use plans. The public polling conducted by the ABCFP is very useful. On certain issues, such as use of the full suite of public information tools and involvement opportunities, information is incomplete.

21 Law

British Columbia has a comprehensive framework of forest law

British Columbia Legislature, Victoria – MFR

Forest practices audit – Forest Practices Board

Why is this important?

A comprehensive framework of forest law enables and supports sustainable forest management.

Overview

- All forest activities from timber harvesting to recreation are governed in varying degrees by law, exercised on the basis of tradition, contractual requirements, administrative policies, and legislation.[1]
- British Columbia has a comprehensive framework of forest law.
- B.C.'s forest law enables and supports sustainable forest management.
- Through site inspections and patrols, the provincial compliance and enforcement officers assess compliance with forest law. Currently, between 15,000 to 16,000 inspections are conducted per year, down from 33,000 per year in the late 1990s.
- Over the past five years, the number of compliance actions and enforcement actions averaged 14% and 2.7%, respectively, of the number of inspections.
- As the Compliance and Enforcement Program has evolved and more effectively targeted high-risk sites, the number of inspections has declined while the rate of compliance and enforcement actions has increased.

- B.C.'s legal and institutional framework includes an independent agency, the Forest Practices Board, that is a watchdog for sound forest practices. Since 1995, the Board has audited thousands of cutblocks, roads, and bridges and found that compliance rates are generally high.
- B.C. is developing and implementing a Forest and Range Evaluation Program (FREP) focussed on key forest resources. FREP undertakes detailed field assessments of resource condition and identifies opportunities to improve policy and practices.

Questions about law

21-1: How are the elements of sustainable forest management governed?
21-2: Is government assessing compliance with the law?
21-3: What corrective measures are taken?
21-4: Is the law effective in achieving sustainable forest management?
▶ Summary and assessment

Related indicators

- Stakeholder interests in forests are formalized as specific rights and obligations in law (see Ownership and timber harvest rights, Timber harvest, First Nations involvement, Public involvement).
- Excessive complexity of laws governing sustainable forest management can lead to high costs for government, the forest industry, and other stakeholders (see Jobs and communities).
- The province can reduce costs of governance by delegating some management obligations to tenure holders (see Ownership and timber harvest rights, Management capacity).
- Historical perceptions of inadequacies in the law of various states led to the emergence of non-state governance (see Certification).

21-1 How Are the Elements of Sustainable Forest Management Governed?

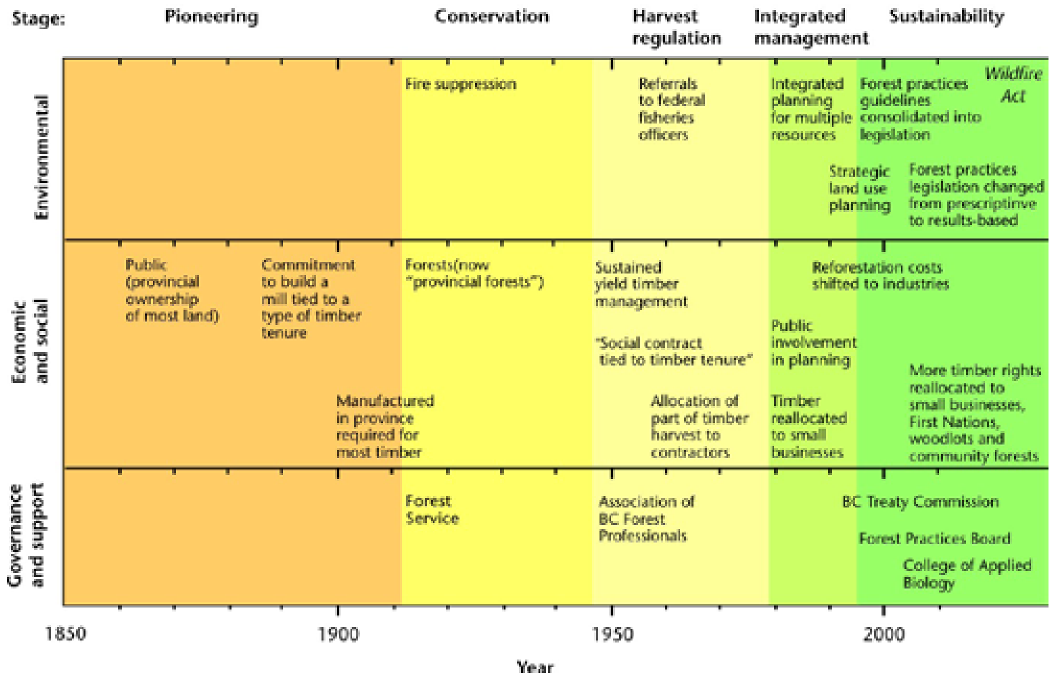


Figure 21-1. *Some milestones in the development of the legal framework that supports sustainable forest management in B.C.*

Why is it important?

Forest law continues to evolve and develop different approaches to protect and balance changing environmental, economic, and social values.

State and trend

- B.C.'s forest law establishes organizations and professions to support forestry, and functions to allocate economic opportunities, conserve forests, and set requirements for forest planning and forest practices.
- These laws serve to authorize or constrain activities to reduce harm and the risk of harm.
- Laws that focus on administration of timber extraction have been enhanced over time with increasingly comprehensive requirements to ensure sustainable forest and range resources. Early lack of consideration for non-timber values has been replaced by legal requirements for planning, First Nations consultation, public involvement, and explicit objectives to conserve environmental, economic, social, and cultural values.

- Initial reliance on contract law and administrative policy was replaced over time by prescriptive regulatory requirements and, in recent years, by regulatory requirements that enable innovation with a focus on achieving defined results and strategies to meet the objectives of sustainable forest management. More serious offences continue to be enforced through criminal and quasi-criminal law.
- The legal recognition of the profession of forestry and the roles within it has evolved, reflecting the increasing breadth and complexity of forestry.

Information

- Various inquiries document the reasons for major changes in the law.[2]
- References: MFR Forest legislation; ABCFP Forest Legislation and Policy Reference Guide[3]

Related international and national indicators

- MP 7.1, 7.2, 7.3 CCFM 6.5.4

21-2 Is Government Assessing Compliance with the Law?

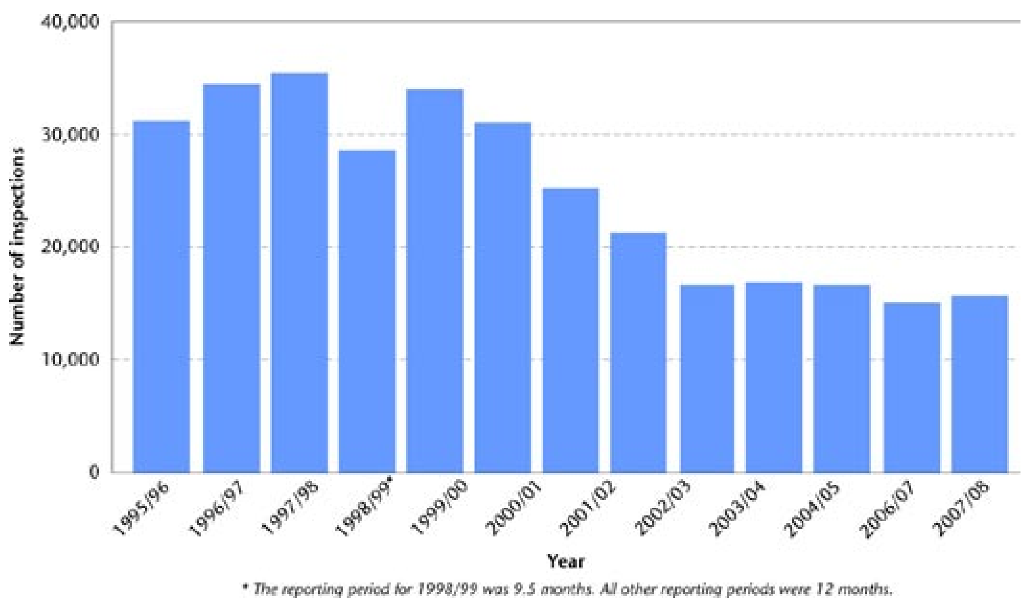


Figure 21-2. *Number of compliance inspections by the Ministry of Forests and Range, 1995–2008.*

Why is this important?

Assessing compliance with the law is required to ensure that forest practices are being conducted in a manner that supports sustainability.

State and trend

- Before 1979, government's compliance inspections focussed on timber harvesting contracts and unauthorized timber harvesting (illegal logging).
- Inspection of forest practices and non-timber values was added in 1979, but inspections were not systematic. Compliance inspections became more systematic to enforce the *Forest Practices Code of British Columbia Act* of 1995, and their rigour was improved in 2001 with the development of a more independent Compliance and Enforcement arm of the MFR and the introduction of a dedicated electronic reporting system. The *Forest and Range Practices Act*, introduced in 2004, has resulted in further enhancement of compliance inspections. The addition of the *Wildfire Act* in 2004, and its enactment through associated regulations in 2005, broadened the scope of compliance and enforcement activities to include activities related to fire management.
- After 2001, inspections were focussed on areas at greatest risk for non-compliance regarding environmental, social, and revenue obligations. In the future, forest certification may be considered when assessing risks and setting priority for inspections.
- The independent Forest Practices Board, set up in 1995, audits forest practices and the appropriateness of government enforcement. It also investigates complaints and participates in administrative appeals. Since 1995, the Board has published reports on the results of 129 compliance audits and 12 enforcement audits. The Board has audited 8,029 cutblocks, 4,060 kilometres of road construction, 43,657 kilometres of road maintenance, 2,256 kilometres of road deactivation, and 3,309 bridges. The Board has found that compliance rates are generally high.[4]
- The provincial government works with federal Fisheries and Oceans Canada (DFO) to protect fish and fish habitat.
- Since 2007, with the implementation of the Resource Management Coordination Program, there has been an increased focus on interagency coordination of compliance and enforcement among provincial natural resource agencies.

Information

- The MFR Compliance and Enforcement Program and the Forest Practices Board publish annual reports that provide comprehensive statistics and information on their activities.
- References: MFR Compliance and Enforcement Program; Forest Practices Board[5]

Related international and national indicators

- MP 7.1, 7.2.e CCFM 3.1, 3.2, 6.4.2

21-3 What Corrective Measures Are Taken?

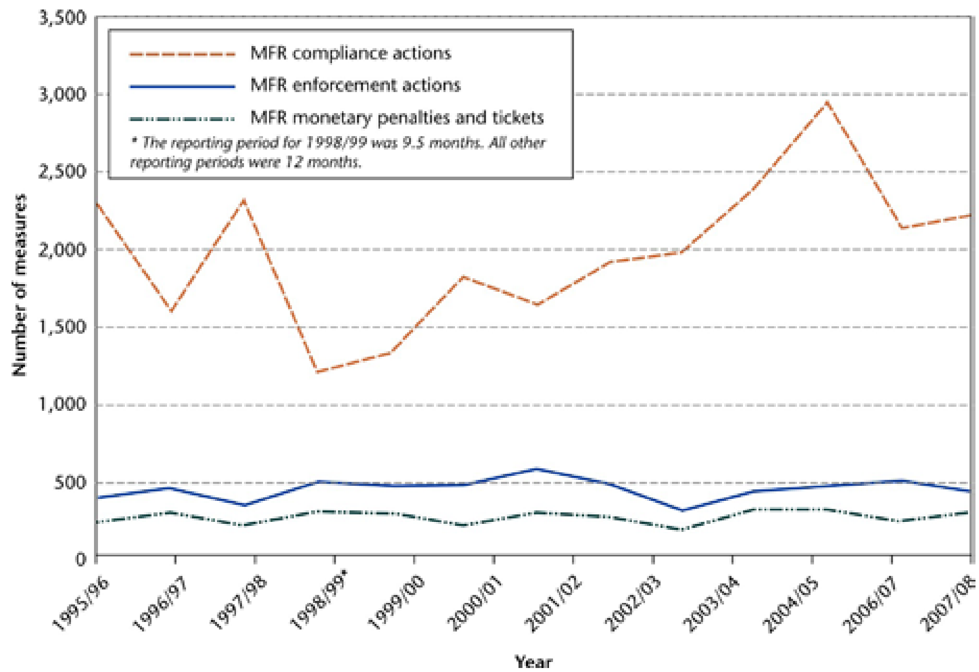


Figure 21-3a. *Number of compliance actions, enforcement actions, and monetary penalties and tickets by Ministry of Forests and Range, 1995–2008.*

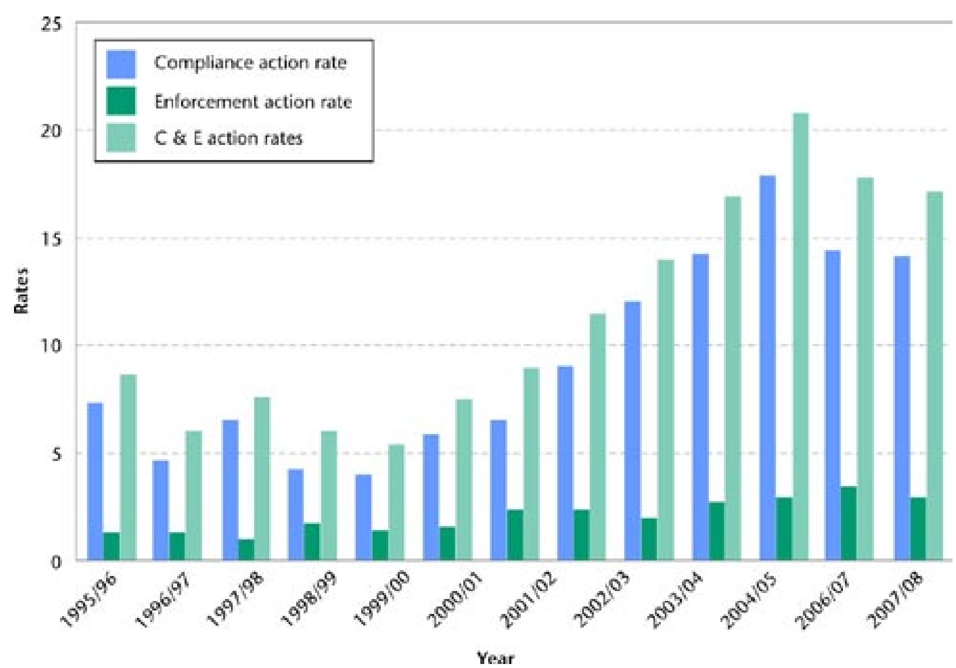


Figure 21-3b. *Compliance action rate, enforcement action rate, and combined compliance and enforcement action rate, 1995–2008. Rate specified in terms of percent of inspections undertaken. Ministry of Forests and Range actions only.*

Why is this important?

Corrective measures detect non-compliance, promote compliance with the law, and prevent non-compliance.

State and trend

- Compliance actions by the Ministry of Forests and Range, averaging 1,994 per year, mitigate minor problems and avoid major problems by identifying these problems to tenure holders for correction.
- Enforcement actions, averaging 461 per year, result in formal sanctions. They include monetary penalties, violation tickets, and court-enforced measures such as fines and jail sentences. Their purposes are to remedy harm, compensate for loss, prevent profit from a contravention, and deter careless or intentional misconduct.
- The rate of compliance and enforcement actions taken on inspections has increased in the last five years due to the inspections being concentrated on higher priority (higher risk) activities and sites. Compliance action rates (number of compliance actions as a percent of the number of inspections) averaged 14.2% and enforcement action rates averaged 2.7% during the last five years.
- Monetary penalties and violation tickets averaged 275 per year with an average total value of $0.5 million annually. Most are for relatively minor infractions, and over 80% of the monetary penalties are therefore for amounts of $5,000 or less. The largest penalty, for unauthorized timber harvesting, was $235,000 in 1999/00. It included the value of the timber. The introduction of Section 103.1 of the *Forest Act* in 2003 removed stumpage compensation from the penalty amounts and resulted in lower overall penalty amounts in future years.
- There has been an increase in the rate of compliance and enforcement actions since 2002. This can be attributed to the implementation of a risk-based inspection approach supported by a dedicated electronic system for planning and recording inspections. More high-risk inspections were conducted as part of the overall inspections performed. Focussing on high risks provides a high level of deterrence on those activities needing the most effective oversight. After accounting for the emphasis on high-risk inspections, the overall level of compliance was estimated at 94% for the year ending March 31, 2008.[6]
- Courts have ordered about two jail sentences per year.
- Enforcement actions by the Ministry of Environment averaged 25 fines per year for pollution from mills, especially pulp mills. These have decreased in number. The largest single fine was $250,000 in 1990.
- Administrative appeals under forestry-related legislation are available through the Forest Appeals Commission.[7]
- B.C. is a low-risk jurisdiction with respect to illegal logging due to its strong legal framework, inspections, enforcement, and demonstrated high level of compliance with forest law.

Information

- The MFR Compliance and Enforcement Program annual report provides comprehensive statistics and information on their activities.
- Reference: MFR Compliance and Enforcement Branch[8]

Related international and national indicators

- MP 7.1, 7.2.e CCFM 3.1, 3.2, 6.4.2

21-4 Is the Law Effective in Achieving Sustainable Forest Management?

Forest value	Status of FREP monitoring and evaluation
Biodiversity	Stand-level biodiversity evaluation protocol developed. 1,500 cutblocks sampled. Six reports produced. Landscape-level protocol under development.
Cultural heritage resources	Pilot project in progress. Evaluation protocol developed. One report produced. Additional protocol under development.
Fish/riparian	Two evaluation protocols developed (routine and intensive). 1,322 streams sampled. One report in final peer review.
Range, forage, and associated plant communities	Evaluation protocol developed. 865 range sites sampled. 16 reports produced.
Recreation resources	Evaluation protocol developed. 120 recreation sites sampled. One report produced.
Resource features	Karst: Evaluation protocol developed.
Soils	Cutblock-level soil evaluation protocol developed. 115 cut-blocks sampled. One report produced.
Timber	Species and genetic diversity – two special studies completed. Partial cutting – evaluation protocol developed. One report produced. Free growing – evaluation protocol developed. 310 cutblocks sampled. 1 report produced. Safety – special study completed.
Visual quality	Evaluation protocol developed. 260 samples taken.
Water	Evaluation protocol developed. 1,202 sites sampled.
Wildlife	In development.

Figure 21-4a. *Status of FREP monitoring and evaluation of forest resource values, 2009.*

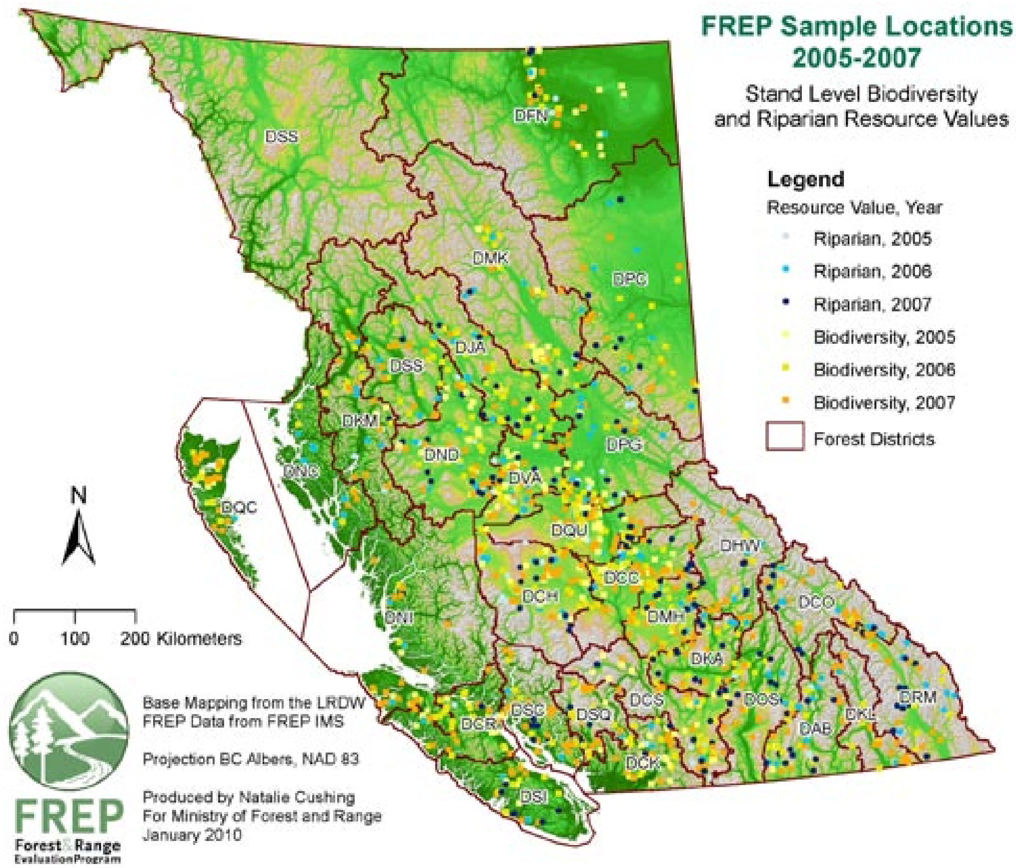


Figure 21-4b. *Location of FREP biodiversity and riparian assessment samples.*

Why is this important?

Ensuring that the law is effective requires systematic monitoring, evaluation, and continual improvement.

State and trend

- The Forest and Range Evaluation Program (FREP) conducts monitoring and effectiveness evaluations for the 11 key resource values identified under the *Forest and Range Practices Act*.
- FREP evaluations measure the current status of these resource values and they assess whether the legislation achieves sustainable management of B.C.'s forest and range resources. FREP evaluations are not compliance inspections.
- As summarized in Figure 21-4a, for each resource value, FREP monitoring and evaluation is at a differing stage of development and implementation.
- FREP monitoring indicators and protocols are rigorously peer-reviewed and field-tested to ensure scientific validity and managerial relevance.
- Resource stewardship monitoring (RSM) by district staff identifies resource value status, trends, and implementation issues that can be used to help improve local practices and planning or identify issues that require more intensive evaluations by regional and headquarters staff.

- Both RSM and intensive evaluations can lead to recommendations to improve forest and range practices, policies, and legislation.
- Many reports have been published under FREP and results are being shared with government and licensee field staff.[9] As FREP reports are produced, the results are incorporated into *The State of B.C.'s Forests*. Other reviews by government also evaluate policies and law.
- The Forest Practices Board cooperated with the Ministry of Forests and Range and the Ministry of Environment in developing and testing evaluation indicators, and used them to assess effectiveness of forest practices and comment on relevant legislation.
- Royal commissions and other inquiries periodically assess the law's effectiveness in protecting and balancing economic and social values.[10]

Information

- FREP monitoring protocols and results
- References: MFR FREP; Forest Practices Board

Related international and national indicators

- MP 7.1.b, 7.1.d, 7.4 CCFM 6.5.4

Summary and Assessment

State

British Columbia's legal framework encourages economic development while maintaining high environmental standards through forest practices regulations that are among the most stringent in the world and by facilitating public involvement to ensure consideration of social values.

The government systematically checks compliance and enforces the law. Practices in the forest, and the compliance and enforcement system itself, are also independently audited. The rate of compliance is high, so the number of corrective measures required and the total amount collected in monetary penalties and fines are relatively low.

Trend

During the 1990s, the increasing complexity of forest law resulted in high costs of operation and administration for both the forest industry and government. Recent adjustments to the legal framework have aimed to reduce these costs, increase the potential for innovation in forest and range practices, and redirect efforts from a focus on compliance with prescriptive regulations to a focus on achievement of desired objectives.

Over the past 10 years, the minor nature of most contraventions and the increasing number of decisions by government to take no further enforcement action reflect an increasing understanding of, and compliance with, the law.

Historically, natural resource agencies have acted relatively independently of each other in compliance and enforcement matters. During the past two years there has been an increasing focus on cross-government compliance and enforcement by natural resource agencies. There will be increasing collaboration and increasing focus on the higher government risks across all agencies. Agencies will work toward enforcing all laws regulating the environment—not just those traditionally within their purview.

Information

The development of forest law in B.C. is well documented. Data on Ministry of Forests and Range compliance assessments and corrective measures are publicly available, as are the well-documented, independent audits of the Forest Practices Board.

New processes are rigorously assessing the ultimate effectiveness of the law in achieving specific objectives of sustainable forest management but have not yet provided conclusive evaluations and recommendations for changes.

22 Management Capacity

B.C. is internationally recognized as a leader in wildfire management and is known for its focus on personnel training, safety, and technology.

Why is this important?

Management capacity is society's collective ability to effectively administer the forest resource to achieve a sustainable flow of benefits. Without adequate management capacity, sustainable forest management is not achievable.

Overview

- Managing British Columbia's forests requires substantial capacity in the form of personnel, financial resources, physical and planning infrastructure, and the ability to adapt current practices to meet changing conditions and future demands.
- B.C.'s government has a long history of leveraging its management capacity by sharing management responsibility with the forest industry and, more recently, local communities and First Nations.
- Management plans help ensure the protection and productivity of forests, identification and integration of land uses, orderly resource development, and consideration of different rights and perspectives.
- A wide range of personnel are involved, from tree planters to forest-level planners to wildlife biologists, who have specialized skills and knowledge that must be continually updated.
- The size of B.C.'s forest land base requires the development and maintenance of an extensive network of roads, air transport, and communications systems. These systems are developed and maintained by both government and private forest companies.
- B.C. is internationally recognized as a leader in wildfire management and is known for its focus on personnel training, safety, and technology expertise. The Wildfire Management Branch manages an average of 2,300 wildfires annually on both Crown and private lands with priority on interface areas (the zone where wildland and urban development meet).

- B.C.'s forest management capacity depends highly on forest industry profitability and sufficient financial returns to government. Even under strong business conditions, management capacity takes a long time to develop and requires ongoing effort to maintain.

Questions about management capacity

22-1: Who manages B.C.'s land base?
22-2: What financial resources are available for forest management activities?
22-3: What disciplines are involved in managing B.C.'s forest and range lands?
22-4: Does B.C. have the capacity to track a core set of indicators of sustainable forest management?
▶ Summary and assessment

Related indicators

- Changes in the economic climate can impact the management efforts of both government and industry (see Timber harvest, Silviculture, Forest products and the economy). Differing stakeholder perspectives can create significant challenges for management (see First Nations involvement, Public involvement, Ownership and timber harvest rights).
- The level of management capacity affects outcomes for all environmental, economic, social, and governance aspects of forest management (see all other report sections).
- Management responses include new roles and responsibilities (see Law), long-term development of human resources, improved planning methods, and research (see Knowledge).

22-1 Who Manages B.C.'s Land Base?

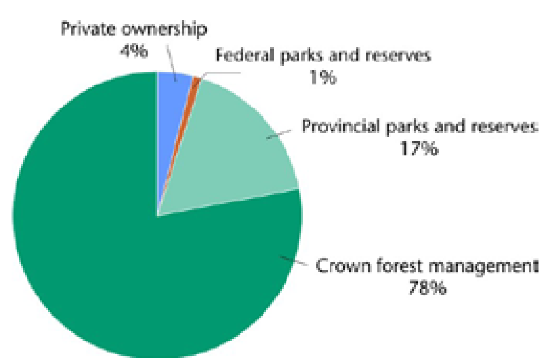


Figure 22-1. *Percent of B.C. in various ownership and management classes. A wide variety of reserves are included in the category "Provincial parks and reserves".*

Why is this important?

Sustainable forest management is directly related to the capacity of those responsible for managing the land (e.g., government, licensees, First Nations, private landowners). Additionally, forest management results depend on the rights and objectives of the manager. Therefore, understanding the division of management responsibility for B.C.'s forest lands is important context for interpreting the indicators of management capacity.

State and trend

- B.C.'s land base is predominantly publicly owned and managed in an integrated manner for a variety of uses. The expectations for forest management of Crown land are embodied in legislation and carried out through contracts (tenure) and government programs.
- The provincial government administers many activities on the forest land base through programs such as fire management, inventory, forest practices and research, compliance and enforcement, and through the administration of forest revenue systems and Crown tenures that authorize the commercial use of public timber.
- Various forms of Crown timber tenure exist that range in term (from single-use to replaceable 25-year terms), exclusivity of rights (volume- vs. area-based), and management obligations conveyed such as planning, reforestation, and road building. Crown tenure holders range from community forest licensees to First Nations to major international forest companies.
- Provincial parks and a wide variety of reserves are managed directly by the B.C. government for conservation, recreation, wildlife, and other non-timber values. Fire management activities are conducted in both provincial and federal parks to help maintain these values.
- First Nations are increasingly engaged as forest land managers. Agreements (including treaties) with First Nations often involve parcels of Crown forest land, and many First Nation bands and enterprises hold forest tenure (see First Nations involvement).
- The capacity of all parties involved in managing B.C. forest lands is subject to many influences. The B.C. government, First Nations, and forest sector partners are currently grappling with numerous challenges including the effects of market and economic shifts, preliminary impacts of climate change, adapting to second-growth harvesting and utilization, increasingly costly harvesting access, and a demanding regulatory framework.

Information

- Land ownership data are tracked by the B.C. government and are available.
- Reference: Timber Tenures in British Columbia: Managing Public Forests in the Public Interest[1]

Related international and national indicators

- MP 1.1.a, 1.1.b, 6.4.a, 7.1 CCFM 5.2.1

22-2 What Financial Resources Are Available for Forest Management Activities?

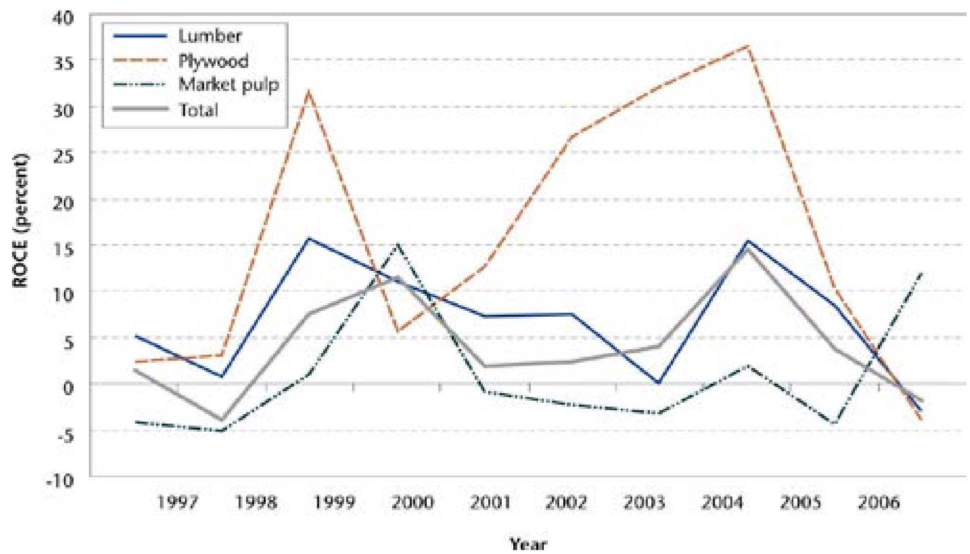


Figure 22-2. *Return on capital employed (ROCE) by sector in the forest industry, 1997–2006. The 2006 data are for the B.C. Interior only.*

Why is this important?

Return on capital employed (ROCE) is a commonly used indicator of profitability in the B.C. forest industry. Positive ROCE values indicate a capacity to reinvest and sustain business practices and services.

State and trend

- In B.C., many forest management activities—planning, development, and stand re-establishment—are carried out by forest companies rather than the government. ROCE measures the efficiency of revenue generation in the forest industry and provides an indicator of the availability of funds for all purposes, including sustaining management capacity and conducting forest management activities.
- B.C. forest companies supply dimensional lumber, pulp and paper, and value-added products in international markets. As such, B.C. industry returns are strongly tied to fluctuations in these markets. Low prices in pulp and paper markets from 2001 to 2003 led to depressed ROCE values in B.C. for those years. Conversely, strong lumber market performance in 2004 bolstered forest sector ROCE in that year.

- Since 2004, the B.C. forest industry has seen a steady decline in ROCE to 4.1% in 2005 and -1.8% in 2006 (for B.C.'s Interior industry) due to historically low lumber and oriented strand board prices (mainly as a result of the collapsing U.S. housing market) and a high Canadian dollar. Low returns continued in 2007 and 2008. The 11 largest Canadian forest, paper, and packaging companies posted an average ROCE of 0% in 2007 and -5% in 2008.[2]
- Since many B.C. forest companies hold timber harvesting rights to supply their processing facilities, low returns to these companies place significant pressure on them to reduce the costs and extent of forest management activities, both on Crown land and privately held forest land.
- Capital investment in processing facilities has declined. Investment has been impeded by a number of factors such as rising energy costs, reduced fibre supply, and an inefficient cost structure. Without capital investment, financial returns may remain low.
- Over the last decade, ROCE in B.C.'s forest sector has ranged widely. In recent years, returns in B.C. have been well below those in many other regions around the world.

Information

- ROCE is collected by PricewaterhouseCoopers on behalf of forest industry associations and can be tracked province-wide or by industry sections (e.g., B.C. Coast or B.C. Interior). When data are available, this information is often shared with the Ministry of Forests, Mines and Lands.
- References: Ministry of Forests and Range Economics and Trade Branch; Council of Forest Industries; PricewaterhouseCoopers[3]

Related international and national indicators

- MP 6.1.a, 6.2.a, 7.2.d CCFM 5.3.3

22-3 What Disciplines Are Involved in Managing B.C.'s Forest and Range Lands?

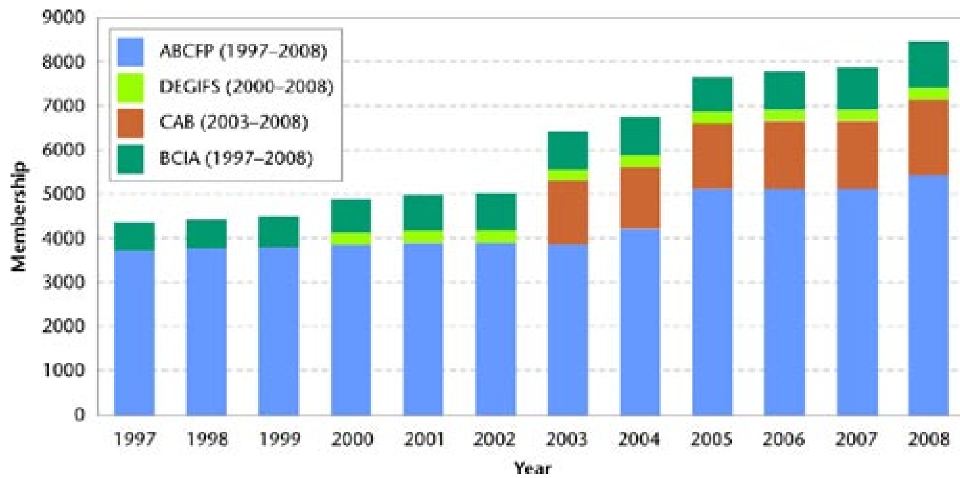


Figure 22-3. *Registered members in four associations that are involved in forestry, 1997–2008. The associations are ABCFP (Association of BC Forest Professionals), DEGIFS (Division of Engineers and Geoscientists in the Forest Sector, Association of Professional Engineers and Geoscientists of BC), CAB (College of Applied Biology), and BCIA (BC Institute of Agrologists).*

Why is this important?

In B.C., resource professionals carry the mandate to practice good stewardship of the land base. The number of practicing professionals provides an indication of the recruitment and attrition rates, level of training, and specialized knowledge available to pursue sustainable forest and range management.

State and trend

- Each resource profession in B.C. is established under an Act of the legislature that sets out the right to practice and the duty to uphold the public interest.
- To obtain registration and the right to practice, candidates must attain a level of education and practical experience prescribed by their professional association. Members are obligated to ensure their continuing competency by engaging in training, skills practice, and continually updating their knowledge.
- Each professional organization has several active membership classes that entitle the holder to practice in their profession. In recent years, many new membership classes have been added to B.C.'s resource professions to reflect the diversity of skills required to manage forest resources.
- In B.C., the majority of practicing resource professionals engaged in forest management are registered with the Association of BC Forest Professionals (ABCFP). These include professional foresters, forest technologists (a mem-

bership class added in 2003 leading to the spike in membership for 2004), and a new category available in spring 2009 of timber cruisers and timber evaluators. Professional biologists, engineers, geologists, and agrologists are also commonly involved in forest management activities.
- The Division of Engineers and Geoscientists in the Forest Sector (DEGIFS), a subset of The Association of Professional Engineers and Geoscientists of BC (APEGBC) formed in 1995, works explicitly in land-based forest management.
- The College of Applied Biology (CAB) was created in 2003 to register and regulate the practice of professional biology in B.C. It was created under the broader Association of Professional Biologists of BC, who existed previously but did not carry regulatory authority governing the profession of biology. The CAB began registering technologists in 2009, which can be expected to result in a membership spike for several years following as technologists obtain registration.
- The BC Institute of Agrologists (BCIA) regulates the profession of agrology. Although the BCIA does not explicitly track members working in the field of forestry, professional agrologists have a wide scope of practice that allows them versatility to work across a diversity of speciality areas, including many aspects of forest resource management.
- Notwithstanding the addition of new membership categories, B.C.'s professional associations have maintained relatively constant levels of registration. The enrolment/graduation from prerequisite post-secondary institutions for registration was significantly depressed during the past decade in B.C. The effects of this period of low enrolment upon registration in professional organizations and B.C.'s management capacity in general may not yet be fully felt.
- B.C.'s professional associations have developed various Memorandums of Understanding to help clarify under what circumstances a given professional must be involved (e.g., engineers are required to oversee construction of specific classifications of bridges).
- The management of B.C.'s forests requires contributions far beyond those made by registered resource professionals. A wide range of specialists from numerous organizations, backgrounds, educations, and experiences are involved, such as experts, technicians, program managers, and administrators, to name a few. Strong leadership and support is also needed in areas such as corporate services, human resources, and marketing for forest management activities to be successful.

Information

- Annual membership statistics for each professional association are available through annual reports online or by contacting the respective office of the registrar.[4]
- Membership data are also available by membership class, but the APEGBC is the only professional association (other than the ABCFP) that tracks members who work directly in forestry.

Related international and national indicators

- MP 7.2.c CCFM (none)

22-4 Does B.C. Have the Capacity to Track a Core Set of Indicators of Sustainable Forest Management?

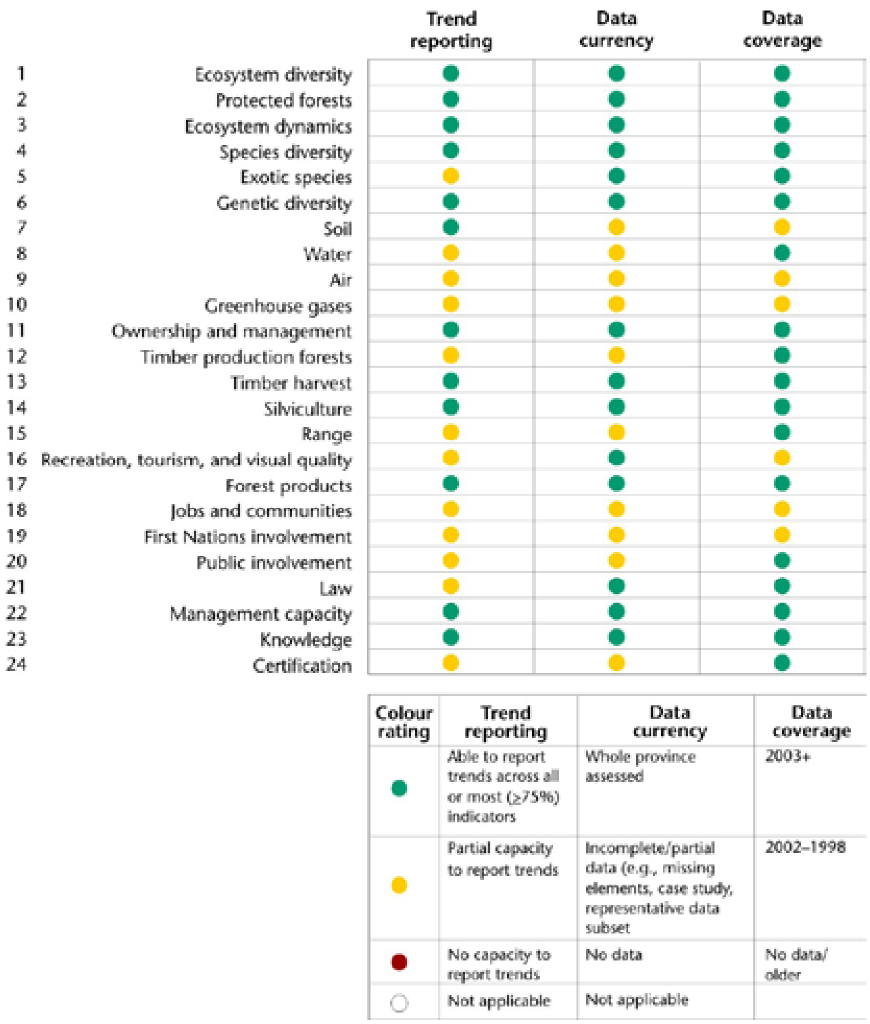


Figure 22-4. *Adequacy of information in 24 topic areas as rated by authors of The State of British Columbia's Forests, Third Edition.*

Why is this important?

To align management decisions with the principles of sustainable forest management (SFM) a jurisdiction must have the capacity to track a core set of SFM indicators.

State and trend

- Overall, B.C.'s forest management framework is supported by current data that are relatively complete with the ability to report trends in some key areas. However, there are specific elements of SFM for which the supporting data are weaker (in terms of data currency, coverage, and ability to report trends). The information base behind each SFM element has, at minimum, partial utility to managers.
- Currently, the ability to report trends is generally greater for the traditional, timber-oriented datasets and related ecosystem knowledge. In contrast, areas of new and emerging demand for data (e.g., forest carbon and greenhouse gases) indicate lesser capacity to report trends. This is expected to change as new data relevant to emerging issues are collected and reported over time.
- The codes of ethics of resource management professions in B.C. require forest land managers to remain apprised of, and incorporate, the most current and rigorous information available into their management decisions.
- As this is a new indicator, it is not possible to report a trend in provincial-level capacity to track a core set of SFM indicators. However, the availability of more data and new kinds of data to forest managers in B.C. is a positive step toward ensuring an adaptive management framework, assuming that current levels of data integrity can be maintained as new datasets are developed.

Information

- Data for this indicator were collected from the individuals who led the development of each section of this report.[5] These specialists were asked to rank their indicator data according to the criteria shown in Figure 22-4.

Related international and national indicators

- MP 7.4 CCFM 6.5.1

Summary and Assessment

State

B.C.'s management capacity is under pressure due to many factors including market downturns and the mountain pine beetle epidemic. B.C. has a long history of forest management and has accumulated a significant amount of management capacity in quality data, skilled personnel, and infrastructure. However, B.C. is currently experiencing an industry downturn compounded by other factors including a forest health epidemic, significant international market competition, and dramatically reduced forest products demand from the United States. The current economic environment strains the financial resources of all groups engaged in forest management and makes the investment necessary to sustain B.C.'s management capacity less certain. The industry will need to innovate to remain competitive in international markets.

Trend

The profile of who manages B.C.'s forests is changing—First Nations are becoming engaged at many levels, large companies continue to merge and consolidate milling capacity, and new forms of tenure in both forestry and other resource sectors support new players on the land. The capacity of these groups to manage B.C.'s forest resources is influenced by many factors such as market economics, access to financial resources, skill and knowledge available, and the obligations inherited through tenure. In some forest-related professional organizations, membership is generally constant. In others, membership is increasing in the short term as existing skilled personnel become registered under new membership categories. These new members will become professionally accountable for their practice, skill, and level of knowledge. However, the overall number of practicing professionals will likely decline over the coming decade, primarily from retirements. Whether quality data are available to support resource management personnel depends on how organizations involved in forest management adapt their spending and investment priorities to the challenges they face.

Information

The management capacity chapter is new, and for some indicators more time is required to establish a continuous dataset and trend reporting. The data compiled for this chapter are readily available and easily reproduced. Management capacity should also be interpreted by reviewing the complete set of indicators in this report, which help illustrate B.C.'s capacity to manage specific areas in greater detail.

23 Knowledge

Increasing use of new technologies, such as satellite imagery and the digital capture of field data, is enhancing accuracy and productivity.

Weighing a bear cub – Bruce McLellan

Forest inventory field crew measures a tree.

Why is this important?

The quality of resource management decisions depends on the ability to generate, store, access, and apply knowledge.

Overview

- B.C. maintains a multitude of forest and range resource maps and inventories, including ecosystems, recreation, terrain, traditional Aboriginal territories, transportation, visual quality, and watersheds. A spatial forest cover inventory database covers 90% of B.C.
- A diverse research community and ongoing research investments provide new knowledge to help address existing and emerging challenges in sustainable forest management (SFM).
- Investments in forest products and forest management research are estimated to range from $100 to $140 million per year, with roughly 60% focussed on forest management research.
- Knowledge access is facilitated by a number of collaborative processes, including a provincially-funded Provincial Forest Extension Program.

Questions about knowledge

23-1: How current and complete are B.C.'s inventories?
23-2: What is the level of investment in forest research?
23-3: Is the knowledge accessible?
▶ Summary and assessment

Related indicators

- Knowledge generation and dissemination are sensitive to budget pressures (see Management capacity).
- The state of knowledge about British Columbia's forest resources affects decision-making at all levels and the quality of information used for the indicators in this report.
- Management responses include new tools and partnerships to address complexity, accelerate learning, and extend knowledge.

23-1 How Current and Complete Are B.C.'s Inventories?

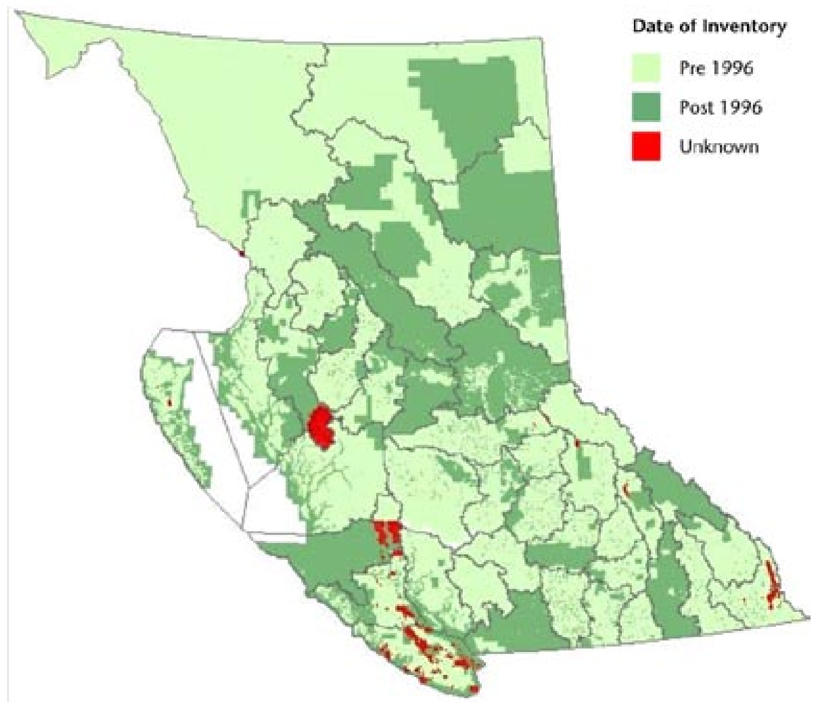


Figure 23-1. *Forest inventory coverage by date of inventory.*[1]

Why is this important?

Complete and up-to-date forest inventories support informed forest management decisions. The adage "You can't manage what you don't measure" applies to the practice of sustainable forest management.

State and trend

- Like other Canadian jurisdictions, B.C. relies primarily on map-based forest cover inventories derived from photo-interpretation and inventory field plots.

- The government's forest inventory database covers 90% of B.C. The remaining 10% (red areas on the map in Figure 23-1) includes some parks, private land, and tree farm licence areas. Many of these areas have some form of inventory but the data are not currently included in the government's forest inventory database.
- The majority of the forest cover inventory is based on photo-interpretation dating from 1953 to 1995. Since 1996, 26% of B.C. has been re-inventoried to the current Vegetation Resources Inventory (VRI) standard.
- Forest inventory maps and databases are updated every few years to reflect predicted timber growth, human-made disturbances (e.g., harvesting), and natural disturbances (e.g., fire, insects, and disease).
- In 2006, B.C. completed installing its portion of the National Forest Inventory (NFI), a nation-wide plot-based inventory.[2] The NFI complements B.C.'s existing map-based inventories. Over time, NFI re-measurements will strengthen the statistical foundation for SFM reporting.
- B.C. also maintains a multitude of other forest and range resource maps and inventories, including ecosystems, recreation, terrain, traditional Aboriginal territories, transportation, visual quality, and watersheds. In some cases, this information is less current than the forest cover inventory.

Information

- The status of B.C.'s forest inventories is well documented and used to support ongoing strategic planning of inventory investments.
- Increasing use of new technologies, such as satellite imagery and the digital capture of field data, is enhancing accuracy and productivity.
- References: MFR Forest Analysis and Inventory Branch; B.C. government GeoBC; CCFM National Forest Inventory[3]

Related international and national indicators

- MP 7.4 CCFM 6.5.1, 6.5.2

23-2 What Is the Level of Investment in Forest Research?

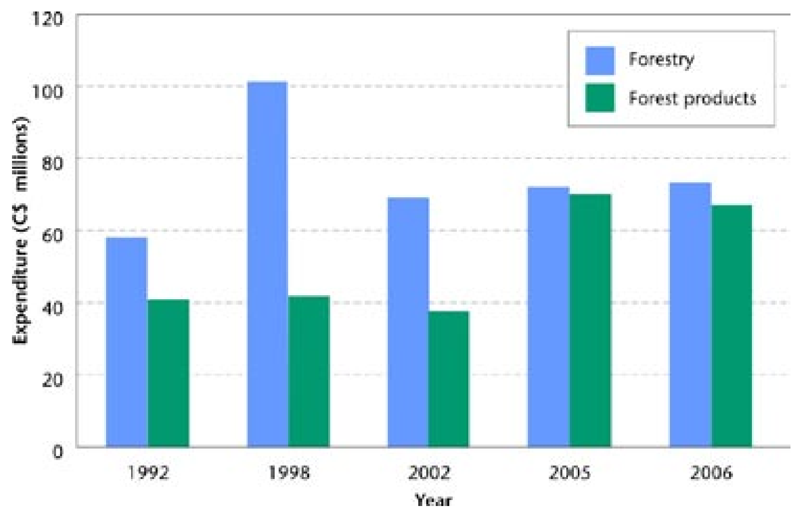


Figure 23-2. *Investment in forest research in British Columbia, 1992–2006.*[3]

Why is this important?

Ongoing research provides new knowledge to help B.C.'s forest managers address existing and emerging SFM challenges.

State and trend

- B.C. benefits from a diverse forestry research community involving many research institutions.[4]
- Since 1992, the total investment in forest management and forest products research has ranged from \$100 to \$140 million per year (C\$, 2005), with forest management research accounting for roughly 60%.
- Research investments historically fluctuate with provincial and federal budgets.
- Although continuing to invest in research, B.C.'s forest companies have followed North American trends and virtually eliminated in-house research capacity.
- Strategic planning processes involving researchers and natural resource practitioners help ensure research investments target priority issues.
- Initial indications are that the level of forest management research investment in 2008/09 will be less than 2005/06 levels.

Information

- To support strategic planning, data on research investments are compiled periodically. The number and diversity of funding sources, research organizations involved, and types of expenditures complicates this task. Consequently, the resulting estimates may not capture all investments, but the trends are still considered informative.
- References: Statistics Canada; B.C. Forest Investment Account, Forest Science Program (FIA-FSP)[5]

Related international and national indicators

- MP 6.2.b, 7.5 CCFM 6.5.3

23-3 Is the Knowledge Accessible?

Figure 23-3. *Workshops and websites are among the many methods that are employed to make knowledge accessible.*

Why is this important?

To effectively inform SFM decisions, best available knowledge must be readily accessible to forest practitioners, policy makers, land and resource planners, and the public.

State and trend

- Emphasis and investments in knowledge access have increased among provincial research organizations and funding programs.
- The process of making knowledge accessible is referred to as extension, technology transfer, or continuing education. Common methods include publications in scientific and popular press, newsletters, websites, social networks, communities of practice, conferences, workshops, and field tours.

- For 10 years, the provincial government has provided major funding support for an innovative Provincial Forest Extension Program. Additional efforts by individual organizations, such as the Ministry of Forests and Range library and web services, help to enhance access.[6]
- In 1998, sector-wide support for a collaborative extension partnership led to formation of a non-profit society, FORREX, which delivers the Provincial Forest Extension Program as well as other extension programs in B.C.[7]
- Surveys indicate that resource professionals and others feel information access has improved over the last several years.[8]
- The use of, and preference for, electronic media have also increased. Over the last 10 years, the internet has transformed knowledge access. Some peer-reviewed journals, such as the BC Journal of Ecosystems and Management, are freely available to the public through the internet.[9]

Information

- Data on knowledge access are compiled periodically to support strategic planning (e.g., user surveys).
- Knowledge access involves many individuals, organizations, and processes, making it difficult to assess objectively and exhaustively.
- References: MFR Library; FORREX Forum for Research and Extension in Natural Resources; B.C. Forest Investment Account, Forest Science Program (FIA-FSP)

Related international and national indicators

- MP 6.2.b, 7.2.a CCFM 6.5.3

Summary and Assessment

State

The quality of resource management decisions depends, in part, on the ability to generate, store, distribute, and apply knowledge. This knowledge exists in many forms, including inventories, scientific research, operational experience, and traditional knowledge. Forest cover maps and associated inventory data are available for 90% of B.C. Maps and inventories are also available for many other forest and range resources. However, currency and coverage are highly variable among these other inventories. Research and extension investments support a diverse and active research and extension community within the province. These investments in forest products and forest management research, ranging from $100 to $140 million per year, continue to fluctuate with federal and provincial budgets.

Trend

Older forest cover inventories are gradually being replaced: 26% of B.C. is now inventoried to modern VRI standards. The newly established NFI will further strengthen the statistical foundation for SFM reporting. Over the last 10 years, B.C. has also benefited from the development of a competitive funding program for forest research (FIA-FSP) and an innovative cross-sector forest extension partnership (FORREX). Recent indications are that the level of investment in forest management research is declining relative to investment levels a few years ago.

Information

Extensive status information is maintained and available to assist in the ongoing strategic planning and assessment of inventory, research, and knowledge access investments.

24 Certification

Certification rates are highest among BCTS and tree farm licences, lowest among woodlots and community forests, and intermediate among replaceable and non-replaceable forest licences.

Lumber bound for international customers – MFR

Why is this important?

Certification requires operators to adopt practices that support sustainable forest management.

Overview

- Certification is a voluntary process undertaken by organizations with forestry operations that gives buyers of forest products assurance that the products come from well-managed forests.[1]
- Certifying organizations develop standards. Forest certification standards address the environmental, economic, and social aspects of sustainable forest management. Organizations with forest operations commit to these standards. Third-party auditors examine forest operations to verify that the standards are being met.
- British Columbia is a world leader in forest certification as more than two-thirds of B.C.'s forest operations are certified. In mid-2010, forest operations on 54 million hectares in B.C. were sustainable forest management certified. More volume and area are certified to the CSA (Canadian Standards Association) standard than to the SFI (Sustainable Forestry Initiative) standard. Very few operations are FSC (Forest Stewardship Council) certified. Rates of certification are highest in tenure types held by large operators.

Questions about certification

24-1: What is the area of B.C.'s certified forest operations?
24-2: How much area is certified under each standard?
24-3: How much of the timber harvest is certified under each standard?
24-4: Does the rate of certification vary among tenure types?
▶ Summary and assessment

Related indicators

- Some major customers of the B.C. forest industry (see Forest products and the economy) have purchasing policies that favour certified products. This puts pressure on industry to become certified to maintain market access.
- Certification may require changes in forest practices (see Silviculture) and stakeholder involvement (see Public involvement).
- Government and industry may respond to the overlap between legal requirements and certification requirements for forest management and auditing by streamlining procedures and sharing costs (see Law).

24-1 What Is the Area of B.C.'s Certified Forest Operations?

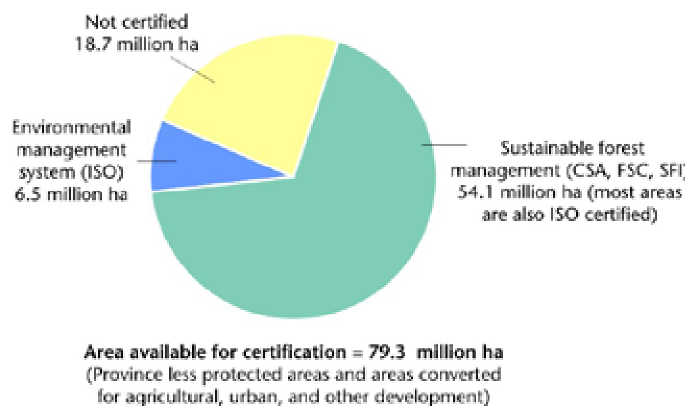


Figure 24-1. *Area by certification status, 2010.*

Why is this important?

Certified forest operations have made a substantive commitment to sustainable forest management.

State and trend

- Three sustainable forest management (SFM) certification standards are used in B.C. These standards were developed by Canadian Standards Association (CSA), Forest Stewardship Council (FSC), and Sustainable Forestry Initiative (SFI).[2] They are applied on both public and private lands, area- and volume-based tenures, and large and small forest areas in B.C.
- The SFM standards used in B.C. have been internationally recognized and endorsed. FSC International has accredited the FSC-BC standard, and the Programme for the Endorsement of Forest Certification (PEFC) has endorsed both CSA and SFI.[3]
- By mid-2010, an estimated 54 million hectares in B.C. were certified under an SFM standard. This area equals 68% of the province, excluding protected areas and areas converted to agricultural, urban, or other uses.
- ISO 14001 is the International Organization for Standardization standard for certification of environmental management systems.[4] It is a "systems only" standard that provides a framework for better forest management and is often the first step toward SFM certification. Including areas with only ISO 14001 certification, the total area certified increased to 60.6 million hectares in mid-2010 (76% of the applicable area of the province available for certification).
- Roughly 10% of the world's forests are SFM-certified. In 2008, 52% of the world's SFM-certified area was in Canada and 37% of Canada's SFM-certified area was in B.C.[5]

Information

- Certified areas generally include lakes, alpine areas, and other non-forest land within certified forest management units.
- Data on areas certified are publicly available, but there may be inconsistencies in reporting due to changes in tenure allocations.
- References: Metafore Forest Certification Resource Centre and Certification Canada; Forest Products Association of Canada; BC Timber Sales Certification Update.[6]

Related international and national indicators

- MP 7.1, 7.2 CCFM 6.5.4

24-2 How Much Area Is Certified under Each Standard?

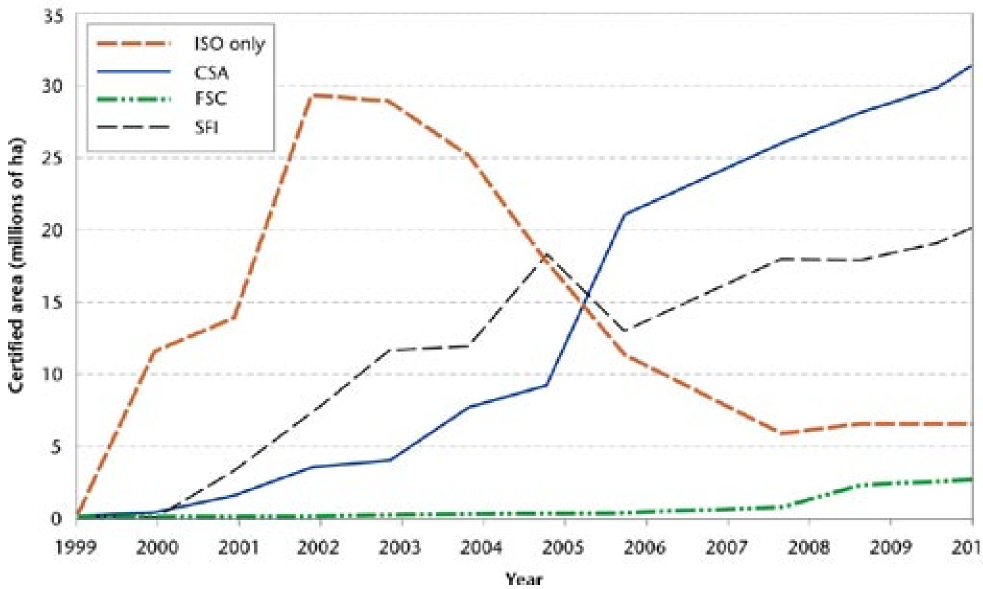


Figure 24-2. *Area by certification standard, 1999–2010. Area that is ISO certified with no additional SFM certification is shown.*

Why is this important?

The area certified shows the extent of each standard's influence on forest management in B.C.

State and trend

- In mid-2010, approximately 31.4 million hectares were CSA certified. The CSA standard is based on Canada-wide elements that guide the development of locally supported indicators. A set of core indicators is part of the recently released Z809_2008 CSA standard.[7]
- SFI is based on nine principles of sustainable forestry and has auditable performance measures and indicators that are consistent across Canada and the United States.[8] About 20.1 million hectares in B.C. were SFI certified by mid-2010.
- FSC has developed Canadian regional standards under principles and criteria for responsible forest management. The FSC's B.C. standard and the national boreal standard are both applicable in B.C.[9] By mid-2010, about 2.6 million hectares were FSC certified.
- In December 2009, several major operators were awarded FSC certification for 0.8 million hectares on B.C.'s mid-coast, an area also known as the Great Bear Rainforest.
- The ISO 14001 standard certifies that operators meet or exceed requirements of law and requires a process of continuous improvement. By mid-2010, approximately 6.5 million hectares were ISO-only certified (i.e., ISO certified

with no additional SFM certification). Many operators maintain both ISO certification and SFM certification. The area with both ISO and SFM certification is not reported in Figure 24-2.
- Since 1999, the area certified has increased enormously. Since 2006, the area certified under SFM standards has increased while the total area certified has only slightly increased as companies are shifting from systems-only (EMS) certification toward full SFM certification.

Information

- Certified areas generally include lakes, alpine areas, and other non-forest land within certified forest management units.
- Data on areas certified are publicly available, but there may be inconsistencies in reporting due to changes in tenure allocations.[10]
- In previous editions of The State of British Columbia's Forests, the area with ISO certification was reported as the area with ISO, with or without additional SFM certification.
- References: Metafore Forest Certification Resource Centre and Certification Canada; Forest Products Association of Canada; BC Timber Sales Certification Update.[11]

Related international and national indicators

- MP 7.1, 7.2 CCFM 6.5.4

24-3 How Much of the Timber Harvest is Certified under Each Standard?

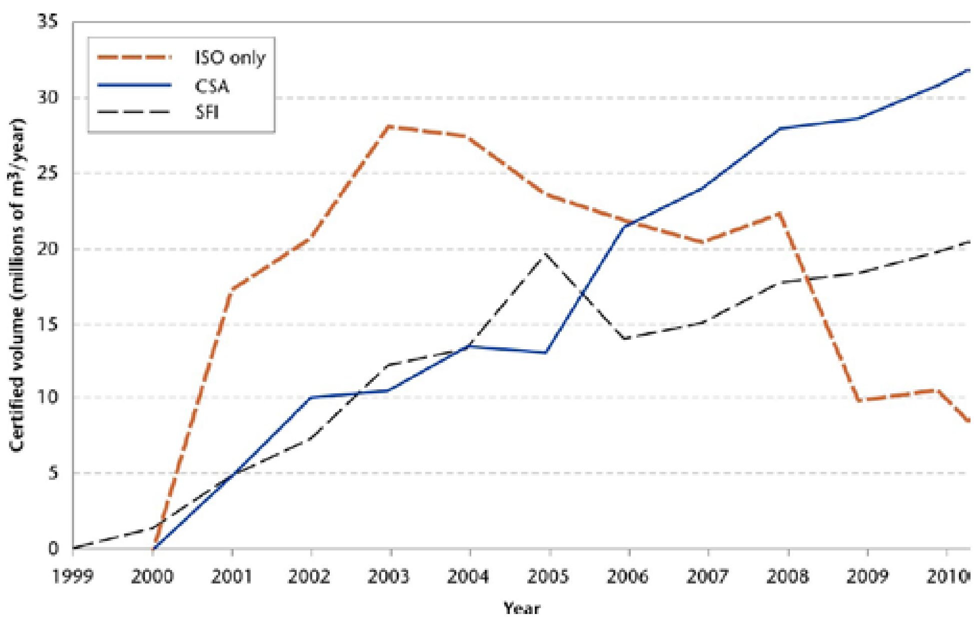


Figure 24-3. *Tenure volume by certification standard, 1999–2010. Volume that is ISO certified with no additional SFM certification is shown.*

Why is this important?

Each standard's acceptance by the forest industry and its customers is most clearly shown by the tenured volume certified.

State and trend

- By mid-2010, operators with CSA and SFI sustainable forest management certification were licensed to harvest 52 million cubic metres per year on public lands, which is 58% of the government-set allowable annual cut (AAC). In addition, SFM-certified operations harvested additional timber from private land. An accurate estimate of the volume licensed to FSC-certified operators was not available at publication.
- The CSA certified volume was 31.9 million cubic metres per year by mid-2010. The SFI certified volume was 20.4 million cubic metres per year.[12]
- Including volume under the ISO 14001 standard only (8.5 million cubic metres per year), the total volume certified by CSA, SFI,and/or ISO was 60.1 million cubic metres per year, or 67% of the sum of AACs and private land harvests. As described in Section 24-2, the ISO 14001 data are the volume that is ISO certified with no additional SFM certification.
- Since 2006, the volume certified under SFM standards has increased significantly while the total volume certified has roughly remained the same due to updated AAC information from the Ministry of Forests and Range and BC Timber Sales, and as companies have advanced from ISO-only to full SFM certification.

Information

- Volumes are based on government-set AACs of forest management units or portions of them, and on certified harvests from private land. On public land, the actual harvest is typically less than the maximum permissible harvest (see Indicator 13-2).
- Where gaps or inconsistencies with public data occurred, the Ministry of Forests and Range apportionment data were used.
- References: Metafore Forest Certification Resource Centre and Certification Canada; BC Timber Sales Certification Update; and Ministry of Forests and Range apportionment system, April 2009[13]

Related international and national indicators

- MP 7.1, 7.2 CCFM 6.5.4

24-4 Does the Rate of Certification Vary among Tenure Types?

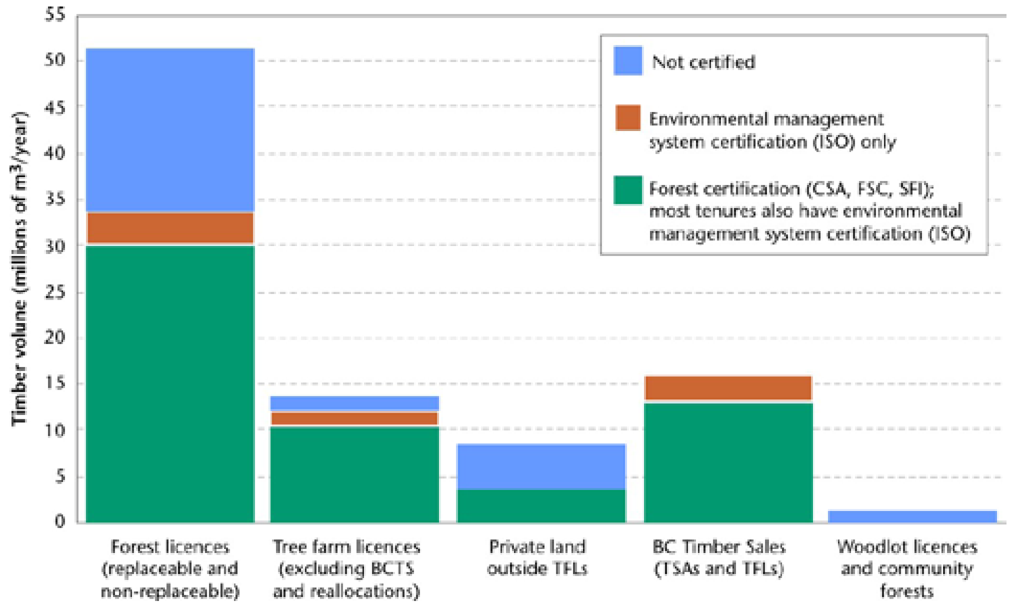


Figure 24-4. *Tenure volume by certification status and tenure type, 2009.*

Why is this important?

The various tenure types are subject to different market incentives and costs of certification.

State and trend

- Certification rates are highest among BCTS and tree farm licences, lowest among woodlots and community forests, and intermediate among replaceable and non-replaceable forest licences.
- BC Timber Sales (BCTS), a division of MFR formed in 2003, sells primarily timber sale licences. By early 2009, 80% of the BCTS volume was SFM certified, up from 41% in 2006.
- Long-term area-based tree farm licences (TFLs) have the second highest rates of SFM certification, increasing from 64% in 2006 to 76% in early 2009.
- Volume-based forest licences include both large long-term licenses and small non-replaceable forest licenses (NRFLs). Roughly 60% of the volume held under volume-based forest licences is SFM certified, essentially unchanged from 2006.
- By early 2009, 41% of private land harvest outside TFLs was SFM certified, up from 38% in 2006.
- In 2009, the rate of SFM forest certification for woodlots and community forests was 2.4%, similar to the level in 2006.
- Large long-term tenures account for most of the provincial harvest and tend to be held by large operators. Many large operators are members of the Forest Products Association of Canada, which required SFM certification of member operations by the end of 2008.

- Including the ISO 14001 standard, the 2009 rate of certification for each tenure type was 65% for forest licences, 88% for TFLs, 41% for private land outside TFLs, 100% for BCTS, and 5.7% for woodlots and community forests.

Information

- Where gaps or inconsistencies with public data occurred, the Ministry of Forests and Range apportionment data were used.
- References: Ministry of Forests and Range apportionment system, April 2009; BCTS Certification Update[14]

Related international and national indicators

- MP 7.1, 7.2 CCFM 6.5.4

Summary and Assessment

State

Forest certification is a voluntary, market-based instrument that provides buyers with assurance that a forest is well managed and meets the requirements of a certification standard. Some markets now favour forest products from certified forest operations.

Sustainable forest management certification under the CSA, FSC, and SFI standards is evidence of rigorous, systematic efforts to manage forests well, and is intended to be a guarantee of sustainable forest management. All three standards have common elements such as conserving biodiversity and ensuring harvest levels are sustainable.

In terms of area certified, B.C. is a world leader in SFM certification. The province of B.C. has more SFM-certified area than any nation in the world, except Canada as a whole. About 68% of the relevant public and private land base is certified under a sustainable forest management standard. Including the ISO standard for environmental management systems, 76% of the relevant land base and 67% of the harvest is certified.

Trend

Both domestically and internationally the number of buyers demonstrating a preference for certified forest products continues to grow. Increasingly, governments are adopting procurement policies that require forest products to be obtained from legal and sustainable sources. The growing popularity of green building standards reinforces preferences for certified forest products.

The area and volume that are SFM-certified in B.C. continues to increase. In 2009, about two-thirds of the province's relevant public and private land base and timber harvest was certified under the CSA and SFI forest certification standards. Only relatively small areas and volumes have been certified under the FSC standard, with the exception of one major tenure holder and a new group certification on the Mid Coast. BC Timber Sales has substantially increased CSA or SFI certification to 80% of its volume. Including the ISO 14001 certification, three quarters of the land base and timber harvest have been certified under one or more systems since 1999.

Information

The Metafore Forest Certification Resource Centre and Certification Canada monitors sustainable forest management certified areas and volumes for all of Canada and publishes its data, but the data are not always complete and occasionally the data, including the historical time series, are revised. The Ministry of Forests, Mines and Lands also monitors certified areas and volumes. Certified areas and volumes by tenure types are not tracked explicitly but can be derived from publicly available data.

Appendix 1 List of Contributors

Topic (Chapter) Leaders

The following individuals led the development of the main chapters of this report.

Kevin Bertram
William Bi
Sandy Currie
Deborough Dowsling
Caren Dymond
Elizabeth Easton
Nancy Elliot
Ed Fong
Brad Harris
Kathy Hopkins
Harry Kope
Leslie McAuley
Dave Maloney
Todd Manning
Jacques Marc
Bill Marshall
Tom Niemann
Gordon Nienaber
Kelly Osbourne
John Parminter
Rob Rawluk
Tim Salkeld
Brad Smith
Steve Stearns-Smith
Michael Stoehr
Natalie Suzuki
Terje Vold
Norah White
Brian Wilkes
Ralph Winter

Advisors and Contributors

In developing the report chapters, the chapter leaders solicited input and contributions from many individuals. These contributions took many forms, including:

1. providing review comments on the chapter work plans and drafts;
2. gathering, compiling, and analyzing data; and
3. providing maps, images, or text.

The following individuals provided advice and contributed to this report.

Ralph Adams
Sally Aitken
Denise Allen
Greg Anderson
Ken Baker
Al Balogh
Dan Barron
Shannon Berch
Marion Bernard
Megan Beveridge
Laura Blonski
Barry Boettger
Heath Bolster
Lynne Bonner
David Borth
Peter Bradford
Matthew Braun
Lynn Bremner
Reg Brick
Amanda Brittain
Guy Brownlee
Jennifer Burleigh
Brenda Callan
Michelle Carr
Linda Castagna
Bill Chapman
Lee Charleson
Pat Charpentier
Steve Chatwin
Trudy Chatwin
Doug Cunningham
Mike Curran
Patrick Daigle
Laura Darling
Rachel Dierolf
Stephane Dube
Tim Ebata
Scott Ellis
Kelly Finck
Jim Forbes
Bob France
David Fraser
Doug Fraser
Gerry Fraser
Rob Gibson
Diane Goode
Peter Graff
Dan Graham
Nathan Hagan-Braun
Dawna Harden
John Harkema
Howard Harshaw
Winn Hays-Byl
Jared Hobbs
Chris Hollstedt
Miles Homer
Graeme Hope
Russ Horton
Jeff Hoyt
Li Huang
Lee Humble
John Innes
Richard Kabzems
Rein Kahlke
Jodie Kekula
Paul Kerr
Bud Koch
Jodie Krakowski
Laura Kristiansen
Jim Langridge
Laura Lapp
Peter LaRose
Bruce Larson
Nathalie Lavoie
Greg Lawrance
Kevin Lee
Matt LeRoy
Tavis Macdonald
Caroline MacLeod
Conrad Malilay
Jeremy McCall
Warren McCormick
Colleen McKendry
Lois McNabb
Linda Michaluk
Val Miller
Rebecca Misener
Suzanne Moreau
Rhonda Morris
Chris Mosher
Allen Neal
Harry Nelson
Francis Njenga
Paul Nystedt
Darlene Oman
Sean Owens
Kathy Paige
Mike Pankhurst
Andrew Pantel
Dennis Paradine
John Parminter
John Pennington
Gillian Pichler
Allan Powelson
Atmo Prasad
Barbara Puchala
Rowena Rae
Lori Roter
Don Rugg
Tim Salkeld
Pat Salm
Jim Sayle
Dale Seip
Shane Sela
Jie Shu
Dave Spittlehouse
Corinne Stavness
Doug Steventon
Gerry Still
Linda Stordeur
Wei-Ting Sun
Kathie Swift
Mark Tassell
Steve Taylor
Sinclair Tedder
Peter Tschaplinski
Mei-Ching Tsoi
Roxanne Vingarzan
Jon Vivian
Vera Vukelich
John Wakelin
Adrian Walton
James Wang
Martin Watts
Andrew Wheatley
Pam Wilkins
Jack Woods
Alvin Yanchuck
Denise Young
Xiaoping Yuan

Project Management

The project to produce this report and associated products was managed by:

Lorne Bedford	Melanie Boyce
Patrick Martin	Diane Medves

Affiliations

ABCFP	Association of BC Forest Professionals
APEGBC	Association of Professional Engineers and Geoscientists of British Columbia
BCCA	BC Cattlemen's Association
BCIA	BC Institute of Agrologists
CAB	College of Applied Biology
CFIA	Canadian Food Inspection Agency
CFS	Canadian Forest Service
COTA	Council of Tourism Associations
EC	Environment Canada
FII	Forest Innovation Investment
FGC	Forest Genetics Council
FORREX	Forum for Research and Extension in Natural Resources
FPB	Forest Practices Board
GOABC	Guide Outfitters Association of BC
ILMB	Integrated Land Management Bureau
MAL	Ministry of Agriculture and Lands
MFR	Ministry of Forests and Range
MHLS	Ministry of Healthy Living and Sport
MOE	Ministry of Environment
MOH	Ministry of Health
MTCA	Ministry of Tourism, Culture and the Arts
ORC	Outdoor Recreation Council
PwC	PricewaterhouseCoopers
SFI	Sustainable Forestry Initiative
UBC	University of British Columbia

Appendix 2 The Montréal Process Criteria and Indicators (2007)[1]

Criterion 1: Conservation of biological diversity

1.1 Ecosystem diversity

1.1.a Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure

1.1.b Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage

1.1.c Fragmentation of forests

1.2 Species diversity

1.2.a Number of native forest associated species

1.2.b Number and status of native forest associated species at risk, as determined by legislation or scientific assessment

1.2.c Status of on site and off site efforts focussed on conservation of species diversity

1.3 Genetic diversity

1.3.a Number and geographic distribution of forest associated species at risk of losing genetic variation and locally adapted genotypes

1.3.b Population levels of selected representative forest associated species to describe genetic diversity

1.3.c Status of on site and off site efforts focussed on conservation of genetic diversity

Criterion 2: Maintenance of productive capacity of forest ecosystems

2.a Area and percent of forest land and net area of forest land available for wood production

2.b Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production

2.c Area, percent, and growing stock of plantations of native and exotic species

2.d Annual harvest of wood products by volume and as a percentage of net growth or sustained yield

2.e Annual harvest of non-wood forest products

Criterion 3: Maintenance of forest ecosystem health and vitality

3.a Area and percent of forest affected by biotic processes and agents (e.g., disease, insects, invasive species) beyond reference conditions

3.b Area and percent of forest affected by abiotic agents (e.g., fire, storm, land clearance) beyond reference conditions

Criterion 4: Conservation and maintenance of soil and water resources

4.1 Protective function

4.1.a Area and percent of forest whose designation or land management focus is the protection of soil or water resources

4.2 Soil

- 4.2.a Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources
- 4.2.b Area and percent of forest land with significant soil degradation

4.3 Water

- 4.3.a Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources.
- 4.3.b Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions

Criterion 5: Maintenance of forest contribution to global carbon cycles

- 5.a Total forest ecosystem carbon pools and fluxes
- 5.b Total forest product carbon pools and fluxes
- 5.c Avoided fossil fuel carbon emissions by using forest biomass for energy

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

6.1 Production and consumption

- 6.1.a Value and volume of wood and wood products production, including primary and secondary processing
- 6.1.b Value of non-wood forest products produced or collected
- 6.1.c Revenue from forest based environmental services
- 6.1.d Total and per capita consumption of wood and wood products in round wood equivalents
- 6.1.e Total and per capita consumption of non-wood products
- 6.1.f Value and volume in round wood equivalents of exports and imports of wood products
- 6.1.g Value of exports and imports of non-wood products
- 6.1.h Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption
- 6.1.i Recovery or recycling of forest products as a percent of total forest products consumption

6.2 Investment in the forest sector

- 6.2.a Value of capital investment and annual expenditure in forest management, wood and non-wood product industries, forest-based environmental services, recreation and tourism
- 6.2.b Annual investment and expenditure in forest-related research, extension and development, and education

6.3 Employment and community needs

- 6.3.a Employment in the forest sector
- 6.3.b Average wage rates, annual average income and annual injury rates in major forest employment categories
- 6.3.c Resilience of forest-dependent communities
- 6.3.d Area and percent of forests used for subsistence purposes
- 6.3.e Distribution of revenues derived from forest management

6.4 Recreation and tourism

6.4.a Area and percent of forests available and/or managed for public recreation and tourism

6.4.b Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available

6.5 Cultural, social and spiritual needs and values

6.5.a Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values

6.5.b The importance of forests to people

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

7.1 Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it:

7.1.a Clarifies property rights, provides for appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides means of resolving property disputes by due process

7.1.b Provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors

7.1.c Provides opportunities for public participation in public policy and decision-making related to forests and public access to information

7.1.d Encourages best practice codes for forest management

7.1.e Provides for the management of forests to conserve special environmental, cultural, social and/or scientific values

7.2 Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to:

7.2.a Provide for public involvement activities and public education, awareness and extension programs, and make available forest-related information

7.2.b Undertake and implement periodic forest-related planning, assessment, and policy review including cross-sectional planning and coordination

7.2.c Develop and maintain human resource skills across relevant disciplines.

7.2.d Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management

7.2.e Enforce laws, regulations and guidelines

7.3 Extent to which the economic framework (economic policies and measures) supports the conservation and sustainable management of forests through:

- 7.3.a Investment and taxation policies and a regulatory environment which recognize the long-term nature of investments and permit the flow of capital in and out of the forest sector in response to market signals, non-market economic valuations, and public policy decisions in order to meet long-term demands for forest products and services
- 7.3.b Non-discriminatory trade policies for forest products

7.4 Capacity to measure and monitor changes in the conservation and sustainable management of forests, including:

- 7.4.a Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with criteria 1-7
- 7.4.b Scope, frequency and statistical reliability of forest inventories, assessments, monitoring and other relevant information
- 7.4.c Compatibility with other countries in measuring, monitoring and reporting on indicators.

7.5 Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services, including:

- 7.5.a Development of scientific understanding of forest ecosystem characteristics and functions
- 7.5.b Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems
- 7.5.c New technologies and the capacity to assess the socio-economic consequences associated with the introduction of new technologies
- 7.5.d Enhancement of ability to predict impacts of human intervention on forests
- 7.5.e Ability to predict impacts on forests of possible climate change

Appendix 3 The Canadian Council of Forest Ministers (CCFM) Criteria and Indicators (2003)[1]

Criterion 1: Biological diversity

1.1 Ecosystem diversity

- 1.1.1 Area of forest, by type and age class, and wetlands in each ecozone.
- 1.1.2 Area of forest, by type and age class, wetlands, soil types and geomorphological feature types in protected areas in each ecozone.

1.2 Species diversity

- 1.2.1 The status of forest-associated species at risk.
- 1.2.2 Population levels of selected forest-associated species.
- 1.2.3 Distribution of selected forest-associated species.
- 1.2.4 Number of invasive, exotic forest-associated species.

1.3 Genetic diversity

- 1.3.1 Genetic diversity of reforestation seed-lots. (Core Indicator)
- 1.3.2 Status of in situ and ex situ conservation efforts for native tree species within each ecozone.

Criterion 2: Ecosystem condition and productivity

- 2.1 Total growing stock of both merchantable and non-merchantable tree species on forest land
- 2.2 Additions and deletions of forest area, by cause.
- 2.3 Area of forest disturbed by fire, insects, disease and timber harvest.
- 2.4 Area of forest with impaired function due to ozone and acid rain.
- 2.5 Proportion of timber harvest area successfully regenerated.

Criterion 3: Soil and water

- 3.1 Rate of compliance with locally applicable soil disturbance standards.
- 3.2 Rate of compliance with locally applicable road construction, stream crossing and riparian zone management standards.
- 3.3 Proportion of watersheds with substantial stand-replacing disturbance in the last 20 years.

Criterion 4: Role in global ecological cycles

4.1 Carbon cycle

- 4.1.1 Net change in forest ecosystem carbon.
- 4.1.2 Forest ecosystem carbon storage by forest type and age class.
- 4.1.3 Net change in forest products carbon.
- 4.1.4 Forest sector carbon emissions.

Criterion 5: Economic and social benefits

5.1 Economic benefits

- 5.1.1 Contribution of timber products to the gross domestic product.

- 5.1.2 Value of secondary manufacturing of timber products per volume harvested.
- 5.1.3 Production, consumption, imports and exports of timber products.
- 5.1.4 Contribution of non-timber forest products and forest-based services to the gross domestic product.
- 5.1.5 Value of unmarketed non-timber forest products and forest-based services.

5.2 Distribution of benefits

- 5.2.1 Forest area by timber tenure.
- 5.2.2 Distribution of financial benefits from the timber products industry.

5.3 Sustainability of benefits

- 5.3.1 Annual harvest of timber relative to the level of harvest deemed to be sustainable.
- 5.3.2 Annual harvest of non-timber forest products relative to the levels of harvest deemed to be sustainable.
- 5.3.3 Return on capital employed.
- 5.3.4 Productivity index.
- 5.3.5 Direct, indirect and induced employment.
- 5.3.6 Average income in major employment categories.

Criterion 6: Society's responsibility

6.1 Aboriginal and treaty rights

- 6.1.1 Extent of consultation with Aboriginals in forest management planning and in the development of policies and legislation related to forest management.
- 6.1.2 Area of forest land owned by Aboriginal peoples.

6.2 Aboriginal traditional land use and forest-based ecological knowledge

- 6.2.1 Area of forested Crown land with traditional land use studies.

6.3 Forest community well-being and resilience

- 6.3.1 Economic diversity index of forest-based communities.
- 6.3.2 Education attainment levels in forest-based communities.
- 6.3.3 Employment rate in forest-based communities.
- 6.3.4 Incidence of low income in forest-based communities.

6.4 Fair and effective decision-making

- 6.4.1 Proportion of participants who are satisfied with public involvement processes in forest management in Canada.
- 6.4.2 Rate of compliance with sustainable forest management laws and regulations.

6.5 Informed decision-making

- 6.5.1 Coverage, attributes, frequency and statistical reliability of forest inventories.
- 6.5.2 Availability of forest inventory information to the public.
- 6.5.3 Investment in forest research, timber products industry research and development, and education.
- 6.5.4 Status of new or updated forest management guidelines and standards related to ecological issues.

Appendix 4 Endnotes

Summary

1. The Canadian Council of Forest Ministers defines sustainable forest management as "management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social, and cultural opportunities for present and future generations." For example, see Canadian Council of Forest Ministers. 2008. A vision for Canada's forests. National Resources Canada, Ottawa, Ont. www.ccfm.org/english/coreproducts-nextnscf.asp
2. See the SFM criteria and indicator frameworks in Appendices 2 and 3.
3. Most jurisdictions with significant forest resources produce a State of the Forest report that conforms to one of the major SFM criteria and indicator frameworks. Examples include:
   a. Ontario's report (www.mnr.gov.on.ca/en/Business/Forests/Publication/196959.html)
   b. Europe's report (www.mcpfe.org/eng/What_we_work_for/Sustainable_Forest_Management)
   c. the Australian's state of Victoria's report (www.dse.vic.gov.au/DSE/nrenfor.nsf/LinkView/52BF92D03256680ACA25761F00224320A044DADB305A7076CA25748A001709F9)
   d. the United States report (www.fs.fed.us/research/sustain/2010SustainabilityReport)

About this report

1. See the non-legally binding instrument on all types of forests adopted by the United Nations General Assembly (Resolution 62/98) on December 17, 2007. http://documents.un.org

British Columbia's forests and society: An overview

1. Different sources provide slightly differing estimates of the number of species in B.C. These estimates are taken from page 287 of B.C. Ministry of Environment. 2007. Environmental trends in British Columbia. Victoria, B.C. www.env.gov.bc.ca/soe
2. For source, see the section Data Sources and Notes in B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof

Climate change

1. Spittlehouse, D.L. 2008. Climate change, impacts, and adaptation scenarios: climate change and forest and range management in British Columbia. Ministry of Forests and Range, Victoria, B.C. www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr045.htm
2. www.chicagoclimatex.com
3. www.ecx.eu

4. www.pacificcarbontrust.ca
5. www.for.gov.bc.ca/hts/Future_Forests
6. www.for.gov.bc.ca/hcp/ffs
7. carbon.cfs.nrcan.gc.ca/CBM-CFS3_e.html
8. www.env.gov.bc.ca/conservationframework/whatis.html
9. www.bcforestinformation.com/building-green/life-cycle-assessment
10. www.corrim.org
11. www.for.gov.bc.ca/hfp/mountain_pine_beetle/Ensuring_Sustainability_for_Communities.htm
12. www.fnforestrycouncil.ca
13. www.for.gov.bc.ca/mof/forestry_roundtable
14. www.env.gov.bc.ca/epd/codes/ggrta/offsets_reg.htm
15. www.leg.bc.ca/38th3rd/1st_read/gov44-1.htm
16. www.westernclimateinitiative.org

About sustainable forest management

1. The Sustainable Rangelands Roundtable has developed a set of core indicators for rangeland assessment. See sustainable.rangelands.org/

Ecosystem diversity

1. Extensive supplementary information on this topic is included in the sections Endnotes and Data Sources and Notes, B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. B.C.'s biogeoclimatic zones are BAFA (Boreal Altai Fescue Alpine), BG (Bunchgrass), BWBS (Boreal White and Black Spruce), CDF (Coastal Douglas-fir), CMA (Coastal Mountain-heather Alpine), CWH (Coastal Western Hemlock), ESSF (Engelmann Spruce–Subalpine Fir), ICH (Interior Cedar–Hemlock), IDF (Interior Douglas-fir), IMA (Interior Mountain-heather Alpine), MH (Mountain Hemlock), MS (Montane Spruce), PP (Ponderosa Pine), SBS (Sub-Boreal Spruce), SBPS (Sub-Boreal Pine–Spruce), and SWB (Spruce–Willow–Birch). Recent revisions to the classification system increased the number of zones from 14 to 16. The former AT zone was replaced by the CMA, IMA, and BAFA zones. For more information on B.C.'s biogeoclimatic ecosystem classification system, see the Ministry of Forests and Range website: www.for.gov.bc.ca/HRE/becweb
3. The area of converted land is estimated at between 1.9 and 2.2 million hectares, derived from the 2002 BTM (Base Thematic Mapping) dataset. The imagery used for BTM was taken between 1991 and 2001. This information has not been updated, and as a result, a more current estimate is not available for this edition of The State of British Columbia's Forests. Conversion estimates are supported by the recently published Taking Nature's Pulse, which estimates 2% of the area of B.C. has been converted to human use, with the following breakdown: CDF 49%, BG 21%, PP 18%, and all other zones 0–5%. See Austin, M.A., Buffett, D.A., Nicolson, D.J., Scudder, G.G.E., and Stevens, V. (editors). 2008. Taking nature's pulse: the status of biodiversity in British Columbia. Biodiversity BC, Victoria, B.C. www.biodiversitybc.org

4. When the rules used to classify "forest" change, the estimate of forested area changes. For forest area estimates based on alternative definitions of forest, see the following:
   (i) B.C. Ministry of Forests and Range. 2008. Reporting British Columbia forest resource and its changes from the national forest inventory photo-plot database. Forest Analysis and Inventory Branch, Victoria, B.C. www.for.gov.bc.ca/hts/nfi/reports.html
   (ii) B.C. Ministry of Environment. 2007. Environmental trends in British Columbia. Victoria, B.C. www.env.gov.bc.ca/soe/et07
5. These species composition values are validated by independent estimates from the National Forest Inventory. For reference, see endnote #4, above.
6. These area by age values are validated by independent estimates from (i) the National Forest Inventory (see endnote #4, above), and (ii) Environmental trends in British Columbia (see endnote #4, above).
7. For the geographic distribution of areas harvested since 1970, see page 197 of Taking nature's pulse: the status of biodiversity in British Columbia. For reference, see endnote #3, above.
8. See endnote #6, above.
9. See Taking nature's pulse: the status of biodiversity in British Columbia, referenced in endnote #3, above.

Protected forests

1. Extensive supplementary information on this topic is included the sections Endnotes and Data Sources and Notes in B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. The recently published Biodiversity Atlas estimates that all protected areas (forest plus non-forest, including regional parks and other conservation lands) total 14.1 million hectares. See Austin, M.A. and Eriksson, A. 2009. The biodiversity atlas of British Columbia. Biodiversity BC, Victoria, B.C. www.biodiversitybc.org
3. For long-term trends in the amount of protected area in B.C., see B.C. Ministry of Environment. 2007. Environmental trends in British Columbia. Victoria, B.C. www.env.gov.bc.ca/soe/et07
4. See pages 244–259 in Environmental trends in British Columbia, referenced in endnote #3, above.

Ecosystem dynamics

1. Extensive supplementary information on this topic is included the sections Endnotes and Data Sources and Notes in B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. The mountain pine beetle epidemic is attributed to the combined effect of fire suppression, which increased the beetle's food supply (mature lodgepole pine), and warm winters, which increased survival of beetles to the next year. The warmer winters are part of ongoing climate change in B.C.

3. For more information on the dynamics of the mountain pine beetle epidemic, see Walton, A. 2009. Provincial-level projection of the current mountain pine beetle outbreak. B.C. Ministry of Forests and Range, Research Branch, Victoria, B.C. www.for.gov.bc.ca/hre/bcmpb/BCMPB.v6.BeetleProjection.Update.pdf
4. For a comprehensive review of forest health conditions, see Westfall, J. and Ebata, T. 2008. Summary of forest health conditions in British Columbia. B.C. Ministry of Forests and Range, Forest Practices Branch, Victoria, B.C.
5. Woods, A., Coates, D., and Hamann, A. 2005. Is an unprecedented Dothistroma needle blight epidemic related to climate change? BioScience 55(9):761–769.
6. For a review of road density by ecoprovince, see pages 266–270 in B.C. Ministry of Environment. 2007. Environmental trends in British Columbia. Victoria, B.C. www.env.gov.bc.ca/soe/et07
7. See pages 199–202 in Austin, M.A., Buffett, D.A., Nicolson, D.J., Scudder, G.G.E., and Stevens, V. (editors). 2008. Taking nature's pulse: the status of biodiversity in British Columbia. Biodiversity BC, Victoria, B.C. www.biodiversitybc.org
8. For more information on the National Forest Inventory photo plots, see www.for.gov.bc.ca/hts/nfi/photo.html, https://nfi.nfis.org/home.php?lang=en, and Gillis, M.D., Omule, A.Y., and Brierley, T. 2005. Monitoring Canada's forests: the national forest inventory. Forestry Chronicle 81(2):214–221.

Species diversity

1. Extensive supplementary information on this topic is included the sections Endnotes and Data Sources and Notes in B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests, 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. For additional information, see Austin, M.A., Buffett, D.A., Nicolson, D.J., Scudder, G.G.E., and Stevens, V. (editors). 2008. Taking nature's pulse: the status of biodiversity in British Columbia. Biodiversity BC, Victoria, B.C. www.biodiversitybc.org
3. For more information on UWR and WHA designations in B.C., see www.env.gov.bc.ca/wld/frpa
4. For a recent study assessing this, see Forest Practices Board. 2006. Species composition and regeneration in cutblocks in mountain pine beetle areas. Forest Practices Board, Victoria, B.C. FPB/SIR/15. www.fpb.gov.bc.ca/publications.aspx?id=2688
5. Includes recovery strategies for forest- or range-associated vertebrates (including freshwater fish) and vascular plants which have been completed and/or posted on the Ministry of Environment website or federal SARA public registry as of March 2009.

Exotic species

1. For sources, references, and additional information, see the following:
   - B.C. Conservation Data Centre: www.env.gov.bc.ca/cdc/
   - Canadian Food Inspection Agency: www.inspection.gc.ca/english/plaveg/invenv/invenve.shtml
   - Chief Forester's Standards for Seed Use: www.for.gov.bc.ca/code/cfstandards/CFstds20Nov2008.pdf
   - E-Flora BC: www.eflora.bc.ca/
   - Flora ID Northwest: http://xidservices.com
   - Flora of North America: http://hua.huh.harvard.edu/FNA
   - *Forest and Range Practices Act:* www.for.gov.bc.ca/code
   - Forest Invasive Alien Species database and document library, Canadian Forest Service: http://exoticpests.gc.ca/db_list_eng.asp
   - Forest Invasive Alien Species of Canada: http://ravageursexotiques.gc.ca/default_eng.asp
   - Government of Canada's Alien Species Strategy for Canada: www.ec.gc.ca/eee-ias/default.asp?lang=En&n=98DB3ACF-1
   - Invasive Alien Plant Program: www.for.gov.bc.ca/hra/Plants
   - Invasive Alien Plant Program application: www.for.gov.bc.ca/hra/Plants/application.htm
   - Invasive Plant Council of BC: www.invasiveplantcouncilbc.ca
   - *Weed Control Act:* www.bclaws.ca/Recon/document/freeside/--%20W%20--/Weed%20Control%20Act%20%20RSBC%201996%20%20c.%20487/05_Regulations/10_66_85.xml

Genetic diversity

1. For sources, references, and additional information, see the following:
   - University of British Columbia Centre for Forest Gene Conservation. 2005. Range maps and conservation status of B.C. tree species. www.genetics.forestry.ubc.ca/cfcg
   - Hamann, A., S.N. Aitken, and A.D. Yanchuk. 2004. Cataloguing in situ protection of genetic resources for major commercial forest trees in British Columbia. Forest Ecology and Management 197(1-3):295–305. www.genetics.forestry.ubc.ca/cfcg
   - Hamann, A., P. Smets, S.N. Aitken, and A.D. Yanchuk. 2005. An ecogeographic framework for in situ conservation of forest trees in British Columbia. Canadian Journal of Forest Research 35:2553–2561. (Indicator 6-1)
   - Stoehr, M.U. and El-Kassaby, Y.A. 1997. Levels of genetic diversity at different stages of the domestication cycle of interior spruce in British Columbia. Theoretical and Applied Genetics 94:83–90. (Indicator 6-2)
   - Canadian Council of Forest Ministers. 2006. Criteria and indicators of sustainable forest management in Canada. ISBN 0-662-42817-X. Cat. no. Fo4-8/2005E.
   - B.C. Ministry of Forests and Range. Annual reports. www.for.gov.bc.ca/mof/annualreports.htm (Indicator 6-3)

- B.C. Ministry of Forests and Range. Reporting Silviculture Updates and Land status Tracking System (RESULTS) database. (Indicators 6-3, 6-4)
- B.C. Ministry of Forests and Range. Seed Planning and Registry (SPAR) database. (Indicators 6-3, 6-4)
- B.C. Ministry of Forests and Range. Whitebark pine – conserving a species at risk. Whitebark Pine Bulletin. July 2008, Issue 01. (Indicator 6-1)
- Endangered species and ecosystems. Ministry of Environment. www.env.gov.bc.ca/atrisk/red-blue.htm (Indicator 6-1)
- UBC Centre for Forest Conservation Genetics. In-situ conservation catalogue. www.genetics.forestry.ubc.ca/cfcg (Indicator 6-1)
- Tree Species Compendium. www.for.gov.bc.ca/hfp/silviculture/Compendium/WhitebarkPine.htm (Indicator 6-1)
- Whitebark Pine Ecosystem Foundation. www.whitebarkfound.org (Indicator 6-1)
- Timberline Natural Resource Group. 2009. Genetic resource management state of forest (2010) reporting in British Columbia: 1970–2007: Data and methods, June 2009. Prepared for B.C. Ministry of Forests and Range, Tree Improvement Branch, Victoria, B.C.

2. Forest genetic resource conservation and management (GRM) in British Columbia is a shared responsibility between the government of the province of B.C., private forest companies operating on Crown land, academia, and the federal government. The Forest Genetics Council of British Columbia (FGC) consists of representatives from the B.C. Ministry of Forests and Range, forest industry, universities, and the Canadian Forest Service. The FGC advises the provincial Chief Forester on policy, priorities, and business planning for publically funded GRM investments, and coordinates GRM-related activities among stakeholders. A revised FGC strategic plan for 2009–2015 is planned for publication in 2009. The revised strategic plan is informed by an extensive dialogue undertaken with members of the GRM community of practice, stakeholders, and the public between 2006 and 2008. See www.for.gov.bc.ca/hti/grm/grm_dialogue.htm
3. Supplementary information relevant to Indicator 6-1:
   - Species ranges (distribution and frequency) were modelled by combining data from 34,000 ecological sample plots established throughout the province with the biogeoclimatic ecosystem classification (BEC) of the land base into 14 zones, 97 subzones, and 152 variants (BEC version 4). The results presented here were subsequently confirmed by a similar, unpublished analysis of the seamless forest cover inventory that was developed for several indicators in The State of British Columbia's Forests – first and second editions. See Indicator 1-2 for details about the inventory.
   - The protected areas used in this analysis are as of 2001. The proposed protection areas identified in the preliminary land use plan for the Central Coast were not included. Levels of conservation of genetic resources were deemed adequate for the coastal areas, without including the proposed protection areas. Final land-use decisions with some adjustments were made in early 2006, further increasing the level of genetic resource conservation.

- Species range maps for 49 tree species found in B.C. are available at www.genetics.forestry.ubc.ca/cfcg
- Whitebark pine was uplisted to the Blue List in 2008 due to a severe negative long-term trend expected from mountain pine beetle infestations, white pine blister rust infections, climatic warming trends, and successional replacement.
- Blue-listed species at risk include any ecological community and indigenous species and subspecies considered to be of special concern (formerly vulnerable) in British Columbia. Elements are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed elements are at risk but are not Extirpated, Endangered, or Threatened. The rankings highlight species and ecological communities that have particular threats, declining population trends, or restricted distributions that indicate that they require special attention. These lists serve as a practical method to assist in making conservation and land-use decisions and to prioritize research, inventory, management, and protection activities.
- The support and maintenance of the GC catalogue is currently being moved over to the Ministry of Forests and Range; updates to the protected areas and BEC are planned.

4. Supplementary information relevant to Indicator 6-2:
    - The level of genetic diversity (GD) is not easily determined without molecular or biochemical markers. However, there is a close relationship between GD and effective population size (Ne). Based on population and quantitative genetics theory, the expected levels of genetic diversity can be calculated if the Ne of a seedlot is known. In B.C., each orchard seedlot, as a requirement for seedlot registration, must have the estimate of Ne included as part of this registration. For details on Ne calculations, see the Chief Forester's Standards for Seed Use. GD is proportional to Ne (GD = 1-1/2Ne). For example, a seedlot with Ne = 10 captures 95% of the genetic diversity of the population from which the orchard parents were selected. A seedlot with Ne = 20 captures 97.5% of the existing genetic diversity for that seed production unit.
    - In seed orchard seed, Ne is an expression of the parental proportion of seed and pollen produced by individual orchard trees. Information on cone and pollen production in orchards is based on crop surveys. For orchard seedlots, an estimate of Ne is required for registration (for details on Ne calculations see Chief Forester's Standards for Seed Use, Appendix 7).
    - In wild stand, wind-pollinated seedlots, Ne can only be approximated as the pollen parents are unknown. When cones are collected from squirrel caches, for example, Ne cannot be determined. On average, each seed tree adds a unit of 4 to the Ne estimate. Therefore, if cones are collected from 10 trees that are well spaced apart, the Ne would be around 40. For natural stand seedlots, the "number of trees from which cones are collected from" must be reported as part of seedlot registration.

5. Supplementary information relevant to Indicator 6-3:
   - The area successfully reforested (natural regeneration and planted) was extracted from RESULTS for 1970 to 2007. Data for subsequent years were incomplete at the time of analysis. The annual area reforested by natural regeneration and planting is also shown as "Reforestation" in Indicator 14-2.
   - Area disturbed on public (Crown) land is provided for comparison. Disturbances or "Additions to NSR" are areas that become not satisfactorily restocked (NSR) with crop trees due to harvesting, fire, insects, diseases, and other causes.
   - Data (aspatial data extracts) for both naturally regenerated and planted areas were prepared from RESULTS. These data were compiled and analyzed for each land base opening in British Columbia between 1970 and 2007. Natural regeneration extracts were based on the Ministry's Annual Service Plan (changes to the "not satisfactorily restocked" Crown land) to provide consistency with the annual report and to provide the most accurate estimate of naturally regenerated areas. The planted stands analysis is a summary of the areas and densities from planting records in the RESULTS activity report.
   - Area planted on public (Crown) land is provided for comparison. Area planted includes those areas where "PL" is recorded as the silviculture base code . To avoid the potential for double counting (multiple records of area treated on the same piece of ground), the analysis did not include a further query based on the silviculture technique code (i.e., areas recorded as "FP" for Fill Planting" are not included).
   - Genetic source of tree seed was determined as follows: Successful reforestation by natural regeneration necessarily uses wild seed (no selection for desired genetic traits). Successful reforestation by planting uses both wild seed (seed collected from natural stands) and select (seed from natural stand superior provenances and orchards) seed. The genetic source (Genetic Class and Seedlot) was extracted from SPAR for 1988 to 2006/07. Data for subsequent years were incomplete at the time of analysis.
   - The average growth gain expected from select seed is calculated as the weighted average genetic worth for growth, over all species, expressed as the timber volume gain expected at rotation age.
6. Supplementary information relevant to Indicator 6-4:
   - The extent and distribution of area regenerated (natural and planted) was based on changes in land status reported by management unit (timber supply area) and silviculture openings extracted from RESULTS for 1970 to 2007.
   - The genetic source is measured across spatio-temporal scales as determined by seedlot, recorded at the silviculture opening level, and genetic class (natural stand non superior provenance, natural stand superior provenance, and orchard seed).
   - The amount of area planted within an opening may change over time since a plantation treatment can occur over multiple years and/or over part of an opening. These multiple treatments are identified by the activity treatment unit. Consequently, the total area planted in an opening is the sum total of all planted area across all activity treatment units within

an opening. To report total area treated to the seedlot level, it is necessary to area-weight the total area treated within an opening by the total number of stems planted for each unique occurrence of opening, activity treatment unit, and seedlot.

- Information on ClimateBC can be found at: www.genetics.forestry.ubc.ca/cfcg/climate-models.html

7. Planting seedlings adapted to future climates (assisted migration) is recognized as a key strategy to address climate change, because it will help maintain healthy, productive forests, and ensure the capture of gains obtained from British Columbia's tree improvement program. In 2008, the feasibility of increasing the upper elevational transfer limits of orchard and natural stand seed sources was assessed to examine opportunities to incorporate assisted migration into British Columbia's seed transfer system. Elevational transfer increases of 100 and 200 m were evaluated based on the development of a scientifically based rationale for quantifying an appropriate climatic distance and range to migrate seed. The seed transfer standards were subsequently amended in the Chief Forester's Standards for Seed Use in April 2009. The purpose of these amendments is to address potential forest health and productivity impacts associated with climate change and to guide the appropriate selection and deployment of tree seed. More comprehensive recommendations regarding assisted migration will be developed along with a new climate-based seed transfer system. The recommended changes are based upon a report by O'Neill, G.A., et al. 2008. Assisted migration to address climate change in British Columbia: Recommendations for interim seed transfer standards. B.C. Ministry of Forests and Range, Victoria, B.C. Technical Report 48. See www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr048.htm
8. The Ministry of Forests and Range and University of British Columbia researchers are currently developing a new system of seed transfer based on climate, commonly referred to as the Climate Based Seed Transfer System (CBST). The CBST will incorporate climate change adaptation strategies, such as assisted migration, while considering technological advances (GIS, ClimateBC, and genecology models) to effectively guide seed transfer for the purposes of planting genetically adapted reforestation stock and maintaining genetic diversity; expanding seed deployment options, and increasing ecosystem resilience.
9. The Assisted Migration Adaptation Trial (AMAT), established in 2009, is a long-term Ministry of Forests and Range Research Branch field trial that will examine the climatic tolerance of 40 of British Columbia's most important tree populations (seedlots) from 16 species. It also includes 9 U.S. seedlots that may become important tree species for consideration in southern British Columbia in the future. The trial, the first of its kind, will test these seedlots across B.C. and the northwest United States using the information to develop guidelines on the use and migration of tree species and populations. For further information on this long-term project, see www.for.gov.bc.ca/hre/forgen/interior/AMAT.htm

Soil

1. While the Code was replaced by FRPA at the beginning of 2004, the data for 2004 to 2008 are not related exclusively to permanent access structures that were authorized under FRPA. Owing to the timing of construction, those structures could have been originally authorized and constructed under the Code, originally authorized under the Code and constructed under FRPA, or been both authorized and constructed under FRPA. Regulation under the Code is typically considered more "prescriptive," while regulation under FRPA is typically considered less prescriptive and more "results-based."
2. For more information on the FREP soil evaluations, see Bulmer, C., Berch, S.M., Curran, M., Chapman, B., Kranabetter, M., Dubé, S., Hope, G., Courtin, P., and Kabzems, R. 2008. Monitoring the effects of forest practices on soil productivity and hydrologic function. BC Journal of Ecosystems and Management 9(2):48–59. www.forrex.org/publications/jem/ISS48/vol9_no2_art6.pdf

Water

1. For example, see Fraser, D.A. 2009. Water quality and livestock grazing on Crown rangeland in British Columbia. B.C. Ministry of Forests and Range, Range Branch, Kamloops, B.C. Rangeland Health Brochure #12. www.llbc.leg.bc.ca/public/PubDocs/bcdocs/456002/Bro87.pdf
2. For further discussion, see Forest Practices Board. 1998. Forest planning and practices in coastal areas with streams. Victoria, B.C. Tech. Report. www.fpb.gov.bc.ca
3. For more information on FREP riparian evaluation, see www.for.gov.bc.ca/hfp/frep/values/fish.htm
4. For more information on FREP water quality evaluation, see www.for.gov.bc.ca/hfp/frep/values/water.htm
5. Total road length and density are well documented in B.C.
    - Data on the amount of road in B.C. is taken from page 267 of B.C. Ministry of Environment. 2007. Environmental trends in British Columbia. Victoria, B.C. www.env.gov.bc.ca/soe/et07
    - Road density by BEC zone is provided on page 201 of Austin, M.A., Buffett, D.A., Nicolson, D.J., Scudder, G.G.E., and Stevens, V. (editors). 2008. Taking nature's pulse: The status of biodiversity in British Columbia. Biodiversity BC, Victoria, B.C. www.biodiversitybc.org
    - Indicator 3-4 in this edition of The State of British Columbia's Forests depicts road density, and Indicator 16-1 shows roaded and roadless areas in B.C.
6. For stream crossing data, see page 239 in Environmental trends in British Columbia. For a map of the density of road stream crossings, see page 109 of Austin, M.A. and Eriksson, A. 2009. The biodiversity atlas of British Columbia. Biodiversity BC, Victoria, B.C. www.biodiversitybc.org
7. See Forest Practices Board. 2009. Fish passage at stream crossings. Victoria, B.C. FPB/SIR/25. www.fpb.gov.bc.ca

Air

1. For the BC Air Quality website, see www.bcairquality.ca
2. For emissions inventory information, see www.bcairquality.ca
3. For the National Pollutant Release Inventory, see www.ec.gc.ca/inrp-npri
4. For more information, see Filmon, G. 2004. Firestorm 2003 provincial review. www.2003firestorm.gov.bc.ca/firestormreport

Forest carbon and greenhouse gases

1. For more information on the *Greenhouse Gas Reduction Targets Act*, see www.env.gov.bc.ca/epd/codes/ggrta
2. For more information, see B.C. Ministry of Environment. 2009. British Columbia greenhouse gas inventory report, 2007. Victoria, B.C. www.env.gov.bc.ca/epd/climate/ghg-inventory
3. For more information, see oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_agg_bct.cfm
4. See endnote #2, above.

Ownership and timber harvest rights

1. Extensive supplementary information on this topic is included in the sections Endnotes and Data Sources and Notes B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. Jim Johnston, Ministry of Agriculture and Lands, pers. comm., October 19, 2009.
3. For apportionments, see the Ministry of Forests and Range, Resource Tenures and Engineering Branch website at www.for.gov.bc.ca/hth/apportionment/apportionment.htm
4. These AAC figures may differ slightly from AAC figures presented elsewhere in this report due to factors such as the date of data compilation.

Timber production forests

1. For more information on the THLB and FMLB in TSAs and TFLs in the province, see the Ministry of Forests and Range, Forest Analysis and Inventory Branch website at www.for.gov.bc.ca/hts/tsr.htm
2. For more detail, see B.C. Ministry of Forests and Range. 2008. Reporting British Columbia forest resource and its changes from the national forest inventory photo-plot database. Forest Analysis and Inventory Branch, Victoria, B.C. www.for.gov.bc.ca/hts/nfi/reports.html
3. For more information on the mountain pine beetle, see www.for.gov.bc.ca/hfp/mountain_pine_beetle. Maps of the extent and severity of the mountain pine beetle outbreak are available at www.for.gov.bc.ca/hfp/mountain_pine_beetle/maps.htm
4. Walton, A. 2009. Provincial-level projection of the current mountain pine beetle outbreak. Ministry of Forests and Range, Research Branch, Victoria, B.C. www.for.gov.bc.ca/hre/bcmpb/BCMPB.v6.BeetleProjection.Update.pdf

Timber harvest

1. Extensive supplementary information on this topic is included in the sections Endnotes and Data Sources and Notes B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests, 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. For Ministry of Forests annual reports, see www.for.gov.bc.ca/mof/annualreports.htm
3. For more information on AACs, see www.for.gov.bc.ca/hts/aac.htm
4. For detailed analysis of the impact of the mountain pine beetle on timber supply in the B.C. Interior, see B.C. Ministry of Forests and Range. 2007. Timber supply and the mountain pine beetle infestation in British Columbia. Forest Analysis and Inventory Branch, Victoria, B.C. www.for.gov.bc.ca/hts/pubs.htm
5. For more information on AACs, see www.for.gov.bc.ca/hts/aac.htm

Silviculture

1. In the sections Endnotes and Data Sources and Notes, extensive supplementary information on this topic is included in B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. For one study of cutblock size in B.C., see B.C. Ministry of Forests. 2005. Evaluation of cutblock sizes harvested under the Forest Practices Code, 1996–2002. Forest Practices Branch, Victoria, B.C. FREP Ser. 003. www.for.gov.bc.ca/hfp/frep/6_evaluation_reports.html
3. For past Ministry of Forests annual reports, see www.for.gov.bc.ca/mof/annualreports.htm. For current silviculture statistics, see www.for.gov.bc.ca/hfp/silviculture/statistics/statistics.htm
4. The 1979 Forest and Range Resource Analysis reported 1.1 million hectares of NSR. The 1984 Forest and Range Resource Analysis reported 1.6 million hectares of backlog (pre-1982) NSR on Crown land, of which 738,000 hectares were on good and medium sites, and considered economically treatable. The largest area of NSR reported was 2.1 million hectares in 1990, in Table 6 of the Ministry of Forests annual report for 1990/91 (www.for.gov.bc.ca/hfd/pubs/docs/mr/annual/ar_1981-93/annual_1991.pdf). In 1987, the government created legal obligations to reforest areas denuded by harvesting, fire, insects, and diseases, with the forest industry explicitly responsible for reforesting the areas it harvests. In 1995, the *Forest Practices Code of British Columbia Act* re-defined a backlog area as "an area from which the timber was harvested, damaged or destroyed before October 1, 1987; and, which in the district manager's opinion, is insufficiently stocked with healthy, well-spaced trees of a commercially acceptable species." This led to reporting of both pre-1982 and 1982–87 backlog NSR statistics for Crown land, with government responsible for funding reforestation of both. By 2002, extensive planting programs succeeded in reducing these backlog areas to 36,927 hectares of treatable pre-1982 backlog NSR on good and medium sites, and 33,585 hectares of treatable 1982–87 backlog NSR on good, medium, and poor sites (Ministry of Forests. 2002. Summary of backlog NSR, impeded,

and free growing forest land – 2002. www.for.gov.bc.ca/hfp/publications/00066/2002BacklogNSR.pdf). By 2002, the total NSR area had been reduced to 0.6 million hectares, approximately equal to three years of timber harvesting. Most of this NSR was "current"—the time since it was created by recent logging or other disturbances had not exceeded the legal time limits for reforestation. The 1.5 million hectare reduction from 2.1 million hectares in 1990 to 0.6 million hectares in 2002 was achieved through a combination of planting and natural regeneration. It also included about 0.4 million hectares that were reclassified from NSR forest to non-productive lands because their initial classification as NSR was inappropriate.

5. For independent reviews of reforestation performance in B.C., see B.C. Forest Practices Board. 2003. Reforesting B.C.'s public land–-an evaluation of free-growing success. Victoria, B.C. FPB/SR/16. www.fpb.gov.bc.ca
   B.C. Forest Practices Board. 2006. Achievement of free-growing forests - 2004 provincial update. Victoria, B.C. FPB/SR/25. www.fpb.gov.bc.ca
6. The 6 million cubic metres gain from planting is based on about 150,000 hectares planted annually and a gain of 40 cubic metres per hectare at the time of harvest, relative to the alternative of natural regeneration of satisfactorily restocked forests. This modest gain applies in the context of legislation that requires successful reforestation by one or another means. In the absence of such legislation, the benefit from planting would likely be 300 cubic metres per hectare or more for forests on the more productive, moist areas that tend to become covered by competing vegetation if not planted and brushed.
7. Cumulative volume gains were estimated for 65 years of growth using the following average annual rates per hectare:
   - 0.50 cubic metres per year with planting one to three years after logging (relative to satisfactory natural regeneration);
   - 2.93 cubic metres per year with backlog planting (relative to an NSR site, overgrown by competing vegetation);
   - 0.40 cubic metres per year with fertilizing;
   - 0.25 cubic metres per year with spacing (see below);
   - 0.41 cubic metres per year from select seed use (average gain in 2004/05, adjusted for lower and higher genetic quality in earlier and later years, respectively).

Site preparation before planting can improve planting success. No gain was calculated for site preparation before planting, because it is included in the gain from planting. Gains from site preparation to improve natural regeneration success were not estimated.

Similarly, brushing may be necessary on some sites to ensure successful reforestation. No gain was calculated for brushing after planting, because it is included in the gain from planting. Gains from brushing to maintain acceptable tree growth after natural regeneration were not estimated.

Spacing reduces competition among trees by reducing the number of trees per unit area and thereby provides more growing space, nutrients, water, and light to the trees that are kept for future harvest. These crop trees often respond with increased diameter and merchantable volume growth. However, spacing directly reduces the standing total volume and total photosynthetic capacity (volume productivity) at the time of treatment, and research has shown that total (gross) volume per unit area at the time of harvest typically does not exceed that of an untreated area. On the other hand, spacing can cause crop trees to reach harvestable size (diameter) sooner, and permit greater merchantable volumes to be harvested by a given date than would be commercially feasible without spacing. The combined effects at the forest level, involving many areas treated and harvestable at different times, are complex and can vary from one forest to another depending on age-class distribution and other factors.

Rangeland

1. Introductory comments on this chapter by are by David Borth, P.Ag., Director Range Branch, Ministry of Forests and Range:
    - Grazing on Crown range has a long history in British Columbia and is integral to the success of B.C.'s livestock and guide-outfitter industries, both of which date back into the 1800s. The administration of grazing on Crown range has been part of the Forest Service since its beginning in 1912, and grazing is the province's largest recognized non-timber forest value.
    - Roughly 34 million hectares of Crown land (~one-third of the land) are managed under tenure for rangeland health and forage production. B.C.'s rangelands are comprised of grasslands, forests (logged and unlogged), wetlands, alpine and subalpine, parkland, and shrubland. Rangelands are not intensely cultivated lands. Approximately 80% of grazing occurs under forest canopy.
    - The Range program's responsibilities include establishing sustainable levels of forage consumption, monitoring rangeland health, invasive plant detection and control, developing and delivering extension programs, and restoring forest and grassland ecosystems to ecologically appropriate conditions. Collectively, the program's responsibilities share characteristics with the ecological, social, and economic dimensions of sustainable forest management and therefore embody the goal of sustainable rangeland management.
    - The sustainable forest movement has been widely examined for its relevance to other natural resource sectors, and the Sustainable Range Roundtable (SRR), with its 27 core indicators of sustainable rangeland management, has emerged from this process. The parallel sustainable management strategies may function to bridge gaps among related resource users through greater integration and involvement. The U.S. State of Forests Report 2010, for example, identifies an approach to strengthen sustainable forestry by engaging non-wood-based forest sectors in existing dialogues. Their recognition of sustainable rangeland management as central to the development of a sustainable environmental landscape acknowledges the importance of cooperation.
    - We have identified five central indicators to measure our efforts towards achieving sustainable rangeland management. In future editions of this report, we intend to expand our criteria and indicators to capture the

ecological, economic, and social responsibilities of the Range program. Any feedback on this current effort is welcome.

2. Gross estimate calculated using percent of Crown rangeland in each biogeoclimatic zone. The Alpine zones and the Bunchgrass zone were considered to be "non-forested", while all other zones were categorized as "forested."
3. B.C. Ministry of Forests. 1996. The rangelands of British Columbia. Research Branch, Victoria, B.C.
4. See the following: (i) Bawtree, A.H. 2005. A history of range use in British Columbia. Rangelands 27(6):36–39. (ii) B.C. Ministry of Forests. 1996. The rangelands of British Columbia. (iii) Rutledge, L. 1987. The growth of guiding. In Our wildlife heritage: 100 years of wildlife management. Murray, A. (editor). Morriss Printing Company Ltd., Victoria, B.C. (iv) Steves, J. and McLean, A. 1989. History of the cattle industry in B.C. Rangelands 11(2): 62–64.
5. Steves, J., and McLean, A. 1989. History of the cattle industry in B.C. Rangelands 11(2): 62–64.
6. B.C. Ministry of Forests. 1996. The rangelands of British Columbia. For biogeoclimatic zone codes, see endnote #2 for the chapter Ecosystem Diversity.
7. Holechek, J.L., Pieper, R.D., and Herbel, C.H. 1995. Range management practices and principles. 2nd ed. Prentice Hall, N.J.
8. See endnotes #7.
9. See endnote #8.
10. Busbee, F.E. 1994. Rangeland health: new methods to classify, inventory and monitor rangelands. National Academy Press, Washington, D.C.
11. A U.S. National Research Council report advocates evaluating and monitoring the water cycle, the mineral cycle, plant and animal succession, and energy flow as the best approach to ensure rangeland health through proper ecosystem management.

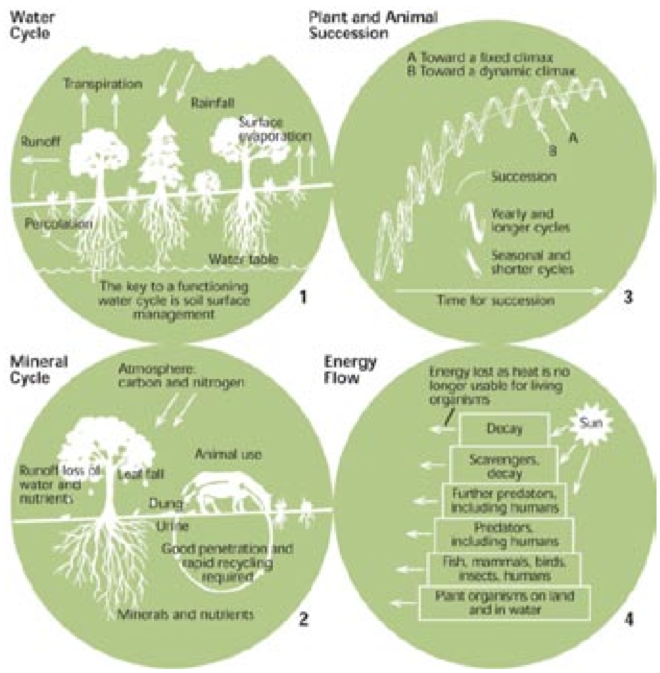


Figure A4-1: *The ecosystem processes functioning in rangelands. (Source: B.C. Ministry of Forests. 2002. Understanding ecosystem processes. Forest Practices Branch, Victoria, B.C. Rangeland Health Brochure 3).*

12. Fraser, D.A. 2006. Range resources assessment procedures. B.C. Ministry of Forests and Range, Range Branch, Kamloops, B.C. Rangeland Health Brochure 9.
13. Due to their soil, topographic, and climatic limitation, B.C. rangelands are uncultivated and predominantly provide habitat, forage, and browse for wildlife and livestock.
14. Rangeland Health Issues

Issues vary from region to region:

- In the Southern Interior region, some areas show the effects of more than 150 years of grazing and other impacts.
- Low water levels in wetlands because of reduced snowpacks.
- Timber harvesting, including mountain pine beetle salvage, that removes trees and barriers along small streams leads to unrestricted access by domestic livestock and subsequent trampling impacts.
- Many of the streams evaluated were highly embedded as a result of roads, culverts, and logging activities.
- In the East Kootenay region, high, unregulated wildlife numbers combined with domestic livestock use contribute to poor upland and streamside riparian health.
- Unregulated feral horse populations in the Chilcotin contribute to poor rangeland health of uplands and wetlands.
- Forest ingrowth and encroachment effectively reduce the available forage for grazing and browsing animals.
- Invasive plants reduce the amount of available forage.

Solutions

- Planned grazing systems that employ periodic planned rest during the growing season
- Adjusting stocking rates and allowable levels of use
- Control of invasive plants
- Ecosystem restoration that reduces fuel loading and opens the forest canopy has a positive effect on the forest understorey in terms of both species composition and forage production

15. Other tools used to ensure balanced use of rangelands are:
    - range use regulations and policies that deliver expected results; and
    - audits to ensure tenure holders follow acceptable practices.
16. Rangeland health information is presented in the series of Rangeland Health Brochures, available at: www.for.gov.bc.ca/hra/Practices.
17. Plant community and species composition, productivity, and soils data collected from a provincial network of Range Reference Areas provide benchmarks for interpreting and discussing the results of rangeland health assessment. Additional information on Range Reference Areas is available at: www.for.gov.bc.ca/hra/Ecology

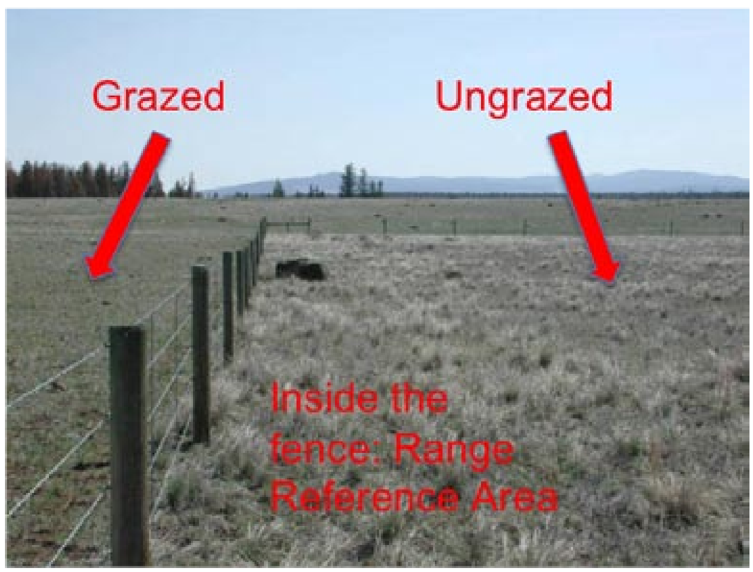


Figure A4-2. *Range Reference Areas are small areas considered typical of the different range ecosystems. These are monitored to help develop the range ecosystem classification and to provide a baseline for evaluating operational and proposed range management practices.*

18. In cases where remediation is required to improve a site's functionality, the Range Branch uses a Remedial Measures Model that provides a systematic decision-making process to guides managers in selecting appropriate remediation action that will aid restoration (B.C. Ministry of Forests. 2002. Arriving at remedial measures. Forest Practices Branch, Victoria, B.C. Rangeland Health Brochure 2).

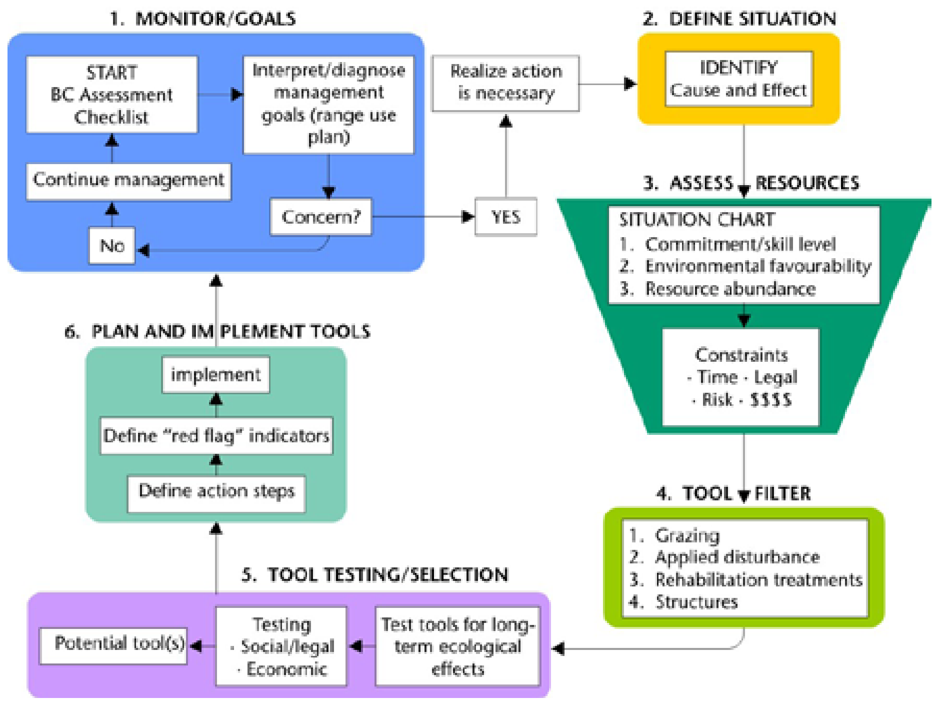


Figure A4-3. *Remedial Measures Model. Modified from: B.C. Ministry of Forests. 2002. Arriving at remedial measures. Forest Practices Branch, Victoria, B.C. Rangeland Health Brochure 2.*

19. Collecting rangeland health information with hand-held computers.

Figure A4-4. *Ministry of Forests and Range Agrologist Rob Dinwoodie completes a rangeland health inspection form using mobile GIS and a hand-held computer in the middle of a sedge meadow in B.C.'s Okanagan.*

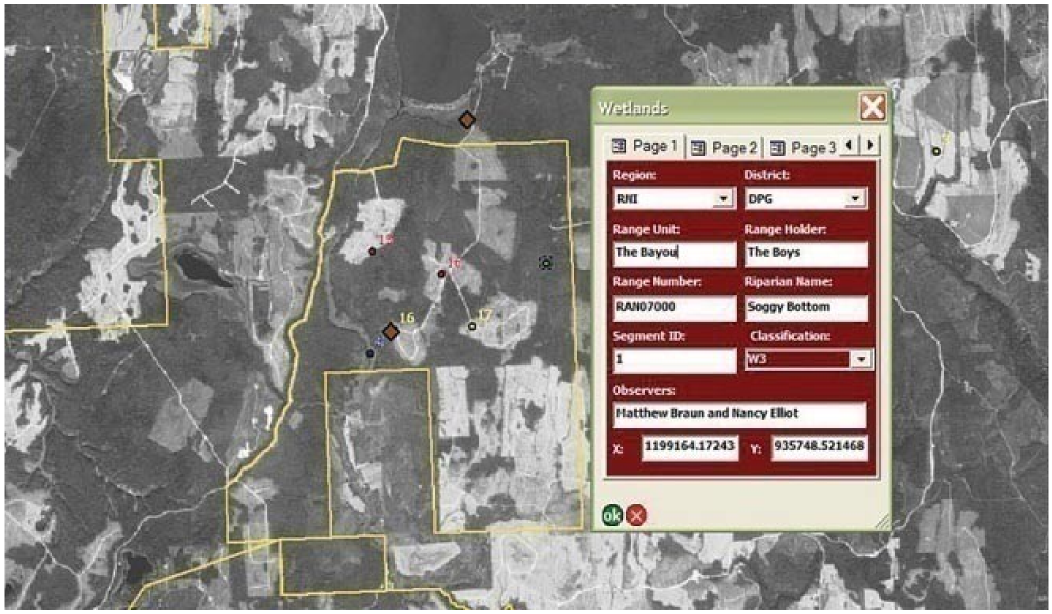


Figure A4-5. *Range health information is collected using ArcPad and digital forms. The data assist resource managers in ensuring that Crown lands provide palatable forage.*

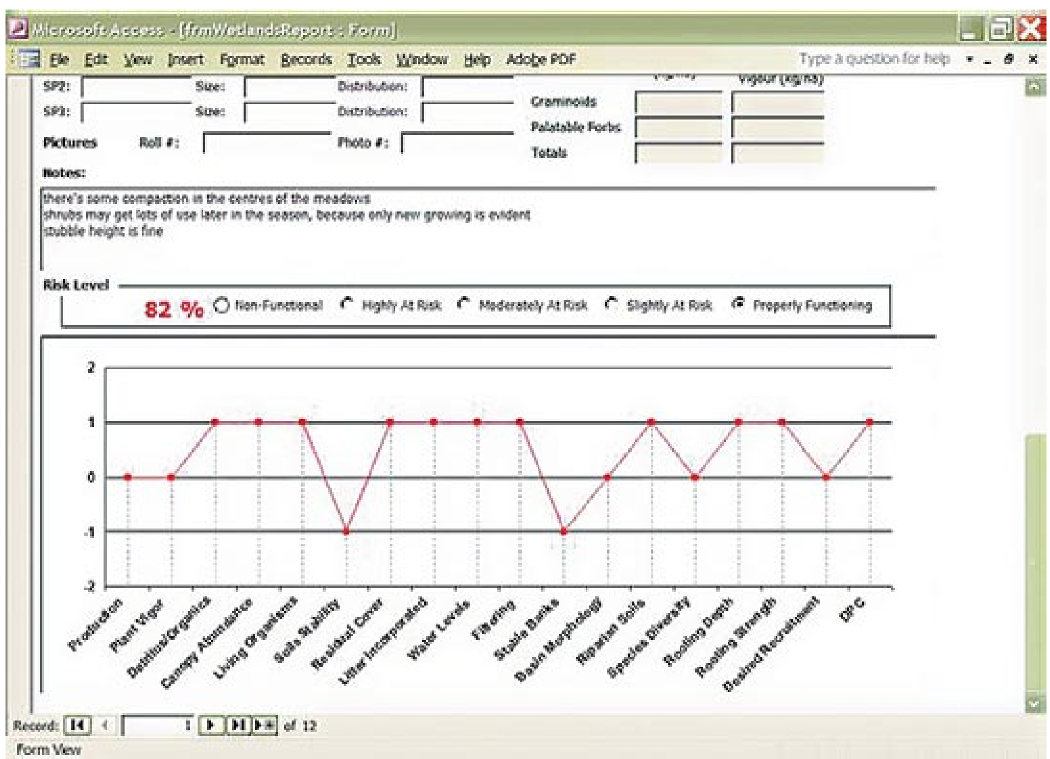


Figure A4-6. *Summary analysis from field data indicates the degree of risk to range health.*

20. Frid, L.D., Knowler, C.M., Myers, J., and Scott, L. 2009. Economic impacts of invasive plants in B.C. Prepared for the Invasive Plant Council of B.C. by Essa Technologies Ltd., Vancouver, B.C.
21. Val Miller, Invasive Plant Officer, Range Branch, Ministry of Forests and Range, pers. comm., March 5, 2009.
22. Invasive plants are "any invasive alien plant species that has the potential to pose undesirable or detrimental impacts on humans, animals or ecosystems" (Invasive Plant Council of British Columbia 2004). Invasive plants disrupt rangeland ecosystem function, altering soil chemistry, hydrology, nutrient cycling, and natural fire regimes. Forest and range practices that create disturbance and alter or stress native plant communities can lead to invasive plants successfully establishing and expanding their range, ultimately impacting many resource values.
23. Invasive plants generally reproduce rapidly and disperse through a variety of mechanisms including wind, water, vehicles, livestock, wildlife, and humans. Numerous invasive plant species require disturbance for their seeds or plant propagules to germinate and grow, and most take advantage and rapidly spread in native plant communities that are under stress from drought, over-use, trampling, compaction, harvesting, or other factors.
24. Riparian habitats are at risk from expanding purple loosestrife (*Lythrum salicaria*) and yellow flag iris (*Iris pseudacorus*) populations.
25. B.C.'s dry forest ecosystems provide suitable habitats for many plant and animal species. See Austin, M.A., Buffett, D.A., Nicolson, D.J., Scudder, G.G.E., and Stevens, V. (editors). 2008. Taking nature's pulse: The status of biodiversity in British Columbia. Biodiversity BC, Victoria, B.C. www.biodiversitybc.org
26. For example, forage yields can be reduced from 50 to 90% on areas heavily infested with knapweed (*Centaurea* spp.) (Wikeem, B.M., Mclean, A., Bawtree, A., and Quinton, D. 1993. An overview of the forage resource and beef production on Crown land in British Columbia. Canadian Journal of Animal Science 73:779–794).
27. Improved range management practice is helping to slow the establishment and spread of invasive alien plants.
28. See: Invasive Plant Regulations, *Forest and Range Practices Act;* Weed Control Regulations, *Weed Control Act*.
29. See Austin, M.A., Buffett, D.A., Nicolson, D.J., Scudder, G.G.E., and Stevens, V. (editors). 2008. Taking nature's pulse: the status of biodiversity in British Columbia. Biodiversity BC, Victoria, B.C. www.biodiversitybc.org
30. Ecosystem Restoration (ER) is the process of assisting with the recovery of an ecosystem that has been degraded, damaged, or destroyed by re-establishing its structural characteristics, species composition, and ecological processes (Society for Ecological Restoration (SER) International Science & Policy Working Group. 2004. The SER International Primer on Ecological Restoration. Tucson: Society for Ecological Restoration International. 2004).

31. Estimates calculated in the following manner (methods provided by Bob France, B.C. Cattlemen. Results discussed and accepted by Bob France, General Manager, B.C. Cattlemen's Association, March 12, 2009).

    Method A
    Authorized animal unit months (AUMs) multiplied by cost per AUM on private pasture:
    2008 = MFR authorized 882,448 AUMs on Crown range
    2007 estimates of cost of AUM on private pasture range from $10 to $30 per AUM
    882,448 AUMs x $20/AUM = $17,648,960

    Method B
    Calculate the amount of feed authorized AUMs would require:
    2008 = MFR authorized 882,448 AUMs on Crown range
    1 cow/calf pair requires 450 kilogram per month; a horse is calculated at 1.25 AUM
    Hay costs $50 to $ 100/2,200 lb. bale, approximately $75 per tonne or $0.075/kg
    882,448 AUMs x 450 kg/AUM x $0.075/kg = $29,782,620

32. Bob France, General Manager, B.C. Cattlemen's Association, pers. comm., December 12, 2008.
33. B.C. Cattlemen's Association. Questions for provincial party leaders in the May 12, 2009 provincial election, January 26, 2009.
34. B.C. Cattlemen's Association. Questions for provincial party leaders in the May 12, 2009 provincial election, January 26, 2009.
35. Economic information on guide outfitting was obtained from the website of the Guide Outfitters Association of British Columbia (www.goabc.org) and from an economic study. Dollar values from 2001 were scaled to 2008 using the GDP deflator. Original figures from: GS Gislason & Associates Ltd. 2002. The guide outfitting industry in British Columbia – an economic profile. Prepared for Economic Development Branch, B.C. Ministry of Sustainable Resource Management.
36. Source: Economic Contribution, Guide-Outfitters Industry of British Columbia.
37. GS Gislason & Associates Ltd. 2002. The guide outfitting industry in British Columbia – an economic profile. Prepared for Economic Development Branch, B.C. Ministry of Sustainable Resource Management.

Recreation, tourism, and visual quality

1. For this analysis of roaded and roadless area, see pages 260–270 in B.C. Ministry of Environment. 2007. Environmental trends in British Columbia. Victoria, B.C. www.env.gov.bc.ca/soe/et07
2. B.C. Ministry of Tourism, Culture and the Arts. 2009. Technical support document for recreation and tourism components of the State of B.C.'s Forests. 3rd ed. Recreation Sites and Trails Branch, Victoria, B.C.
3. See endnote #2.

4. B.C. Ministry of Forests and Range. 2006. The public response to harvest practices in British Columbia at the landscape and stand level. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/HFD/Pubs/Docs/Mr/Rec038.htm

Forest products and the economy

1. Extensive supplementary information on this topic is included in the sections Endnotes and Data Sources and Notes B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. See www.census.gov
3. BC Stats provides some data online. See www.bcstats.gov.bc.ca

Jobs and communities

1. Extensive supplementary information on this topic is included in the sections Endnotes and Data Sources and Notes B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. For more information, see Statistics Canada (www.statcan.gc.ca), BC Stats (www.bcstats.gov.bc.ca), BC Wilderness Association Tourism Association (www.wilderness-tourism.bc.ca), Tourism British Columbia (www.tourismbc.com), and Forest Practices Board. 2004. Integrating non-timber forest products into forest planning and practices in British Columbia. Victoria, B.C. SR 19. www.fpb.gov.bc.ca/
3. For more information, see Statistics Canada (www.statcan.gc.ca)
4. For more information, see BC Stats. 2009. British Columbia local area economic dependencies, 2006. Victoria, B.C. www.bcstats.gov.bc.ca/pubs/econ_dep.asp
5. For more information, see www.worksafebc.com/

First Nations involvement

1. Extensive supplementary information on this topic is included in the sections Endnotes and Data Sources and Notes B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. For more information, see www.for.gov.bc.ca/haa/FN_Agreements.htm
3. For more information, see www.for.gov.bc.ca/haa/FN_Agreements.htm
4. For more information, see www.for.gov.bc.ca/MOF/Forestry_Roundtable/
5. For more information, see www.for.gov.bc.ca/haa
6. For more information, see www.treaties.gov.bc.ca/treaties.html
7. For more information, see BC Treaty Commission (www.bctreaty.net/), Ministry of Aboriginal Relations and Reconciliation (www.gov.bc.ca/arr/), and Indian and Northern Affairs Canada (www.ainc-inac.gc.ca)

Public involvement

1. For more information on the history of land use planning in B.C., see www.ilmb.gov.bc.ca/slrp/history.html. For a recent discussion of land use plans, see Forest Practices Board. 2008. Provincial land use planning: which way from here? Victoria, B.C. www.fpb.gov.bc.ca
2. For more information, see Association of BC Forest Professionals. 2009. Public opinion poll results, 2009. Vancouver, B.C. www.abcfp.ca/publications_forms/publications/surveys_polls.asp

Law

1. Extensive supplementary information on this topic is included in the sections Endnotes and Data Sources and Notes B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. For more information, see Related Publications in B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
3. For legislation and regulations pertaining to forests, see www.for.gov.bc.ca/tasb/legsregs/comptoc.htm. For an overview of forest legislation and policy, see Association of BC Professional Foresters. 2009. Forest legislation and policy reference guide. Vancouver, B.C. www.abcfp.ca/practice_development/continuing_ education/ policy_seminars.asp
4. For more information, see the Forest Practices Board website at www.fpb.gov.bc.ca.
5. For more information on the Ministry's compliance and enforcement program, see the website at www.for.gov.bc.ca/hen. For more information on the Forest Practices Board, see endnote #4, above.
6. See B.C. Ministry of Forests and Range. 2008. Compliance and enforcement program annual report, 2008. Compliance and Enforcement Branch, Victoria, B.C. www.for.gov.bc.ca/hen
7. See the Forest Appeals Commission website at www.fac.gov.bc.ca
8. For more information on the Ministry's compliance and enforcement program, see the website at www.for.gov.bc.ca/hen
9. For FREP reports, see the FREP website www.for.gov.bc.ca/hfp/frep
10. For more information, see Related Publications in B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof

Management capacity

1. See B.C. Ministry of Forests and Range. 2006. Timber tenures in British Columbia: managing public forests in the public interest. Resource Tenures and Engineering Branch, Victoria, B.C. www.for.gov.bc.ca/hth/timten/documents/timber-tenures-2006.pdf
2. For more information, see PricewaterhouseCoopers. 2008. Global forest, paper and packaging survey. Vancouver, B.C. www.pwc.com/gx/en/forest-paper-packaging/index.jhtml

3. For Ministry of Forests and Range Economics and Trade Branch, see www.for.gov.bc.ca/het. For Council of Forest Industries, see www.cofi.org. For PricewaterhouseCoopers, see www.pwc.com/gx/en/forest-paper-packaging/index.jhtml
4. For information on the Association of BC Forest Professionals, see www.abcfp.ca/. For information on the Division of Engineers and Geoscientists in the Forest Sector, see www.degifs.com/index.php3. For information on the College of Applied Biology, see www.cab-bc.org. For information on the BC Institute of Agrologists, see www.bcia.com
5. For a list of the individuals who led the development of each chapter of this report, and provided the information adequacy ratings, see Appendix 1.

Knowledge

1. Source: Map produced by the Ministry of Forests and Range, Forest Analysis and Inventory Branch in 2008.
2. For more information on the National Forest Inventory (NFI), see the website https://nfi.nfis.org/index_e.shtml and the B.C. Ministry of Forests and Range website www.for.gov.bc.ca/hts/nfi
3. For more information on the B.C. Ministry of Forests and Range, Forest Analysis and Inventory Branch, see www.for.gov.bc.ca/hts. For more information on the B.C. government's GeoBC, see www.geobc.gov.bc.ca. For more information on the National Forest Inventory, see http://nfi.nfis.org
4. Data source for Figure 23-2: Allen, S.D., Watts, S.B., and Innes, J.L. 2007. Status of forestry related research in British Columbia and Canada, 2005. Unpublished report for the FIA-FSP Forest Science Board, Table 5.
5. For information on Statistics Canada, see www.statcan.gc.ca. For information on the Forest Investment Account, Forest Science Program, see www.fia-fsp.ca
6. The Ministry of Forests and Range library can be accessed at www.for.gov.bc.ca/hfd/library
7. FORREX, the Forum for Research and Extension in Natural Resources, can be accessed at www.forrex.org/default.asp
8. Forest-related research is conducted by government- and industry-supported institutions, private institutions, provincial and federal governments, and universities. These many organizations include MFR's Forest Science Program, University of B.C., University of Northern B.C., Canadian Forest Service, FPInnovations, University of Victoria, Simon Fraser University, Thompson River University, private consultants, and local organizations such as the Bulkley Valley Centre for Natural Resources Research and Management and the Columbia Mountain Institute of Applied Ecology.
9. Access the BC Journal of Ecosystems and Management at www.forrex.org/publications/jem/jem.asp

10. Source: FORREX user surveys in 199 and 2007. For example, see Morford, S., and Hollstedt, C. 2007. Revisiting a forest extension strategy for British Columbia: a survey of natural resource practitioners and information providers. B.C. Ministry of Forests and Range, Research Branch, Victoria, B.C. Tech. Rep. 042. www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr042.htm

Certification

1. Extensive supplementary information on this topic is included in the sections Endnotes and Data Sources and Notes B.C. Ministry of Forests and Range. 2007. The state of British Columbia's forests. 2nd ed. Forest Practices Branch, Victoria, B.C. www.for.gov.bc.ca/hfp/sof
2. For more information on these SFM certification standards, see Canadian Standards Association (www.csa.ca/cm/home), Forest Stewardship Council (www.fsc.org/), and Sustainable Forestry Initiative (www.sfiprogram.org/).
3. For more information on the Programme for the Endorsement of Forest Certification, see www.pefccanada.org/PEFC_International.html
4. For more information on ISO 14001, see www.iso.org/iso/management_standards.htm
5. See www.certificationcanada.org/english/status_intentions
6. For Metafore Forest Certification Resource Center, see www.certificationcanada.org/english/index.php. For certification information from the Forest Products Association of Canada, see www.fpac.ca. For certification information from BC Timber Sales, see www.for.gov.bc.ca/bcts/forestCertification/sfm_certification.htm.
7. For the CSA Z809-08 Sustainable Forest Management standard, see www.shopcsa.ca/onlinestore/GetCatalogItemDetails.asp?mat=2419617
8. For the SFI 2005-2009 standard, see www.sfiprogram.org/sustainable_forestry_initiative_standard.php
9. For the FSC's B.C. standard, see www.fsccanada.org/BritishColumbia.htm For the boreal standard, see www.fsccanada.org/nationalboreal.htm
10. As a result, the reported areas differ slightly from the areas reported in Metafore Forest Certification Resource Center. 2009. Certification status report, British Columbia – SFM, 2008 year-end. Forest Products Association of Canada. www.certificationcanada.org/english/status_intentions/provincial.php
11. See references for endnote #6, above.
12. Differences in the date and methods of data compilation result in the reported volume differing slightly from those reported in Metafore Forest Certification Resource Center. 2009. Certification status report, British Columbia – SFM, 2008 year-end. Forest Products Association of Canada. www.certificationcanada.org/english/status_intentions/provincial.php
13. See endnote #6 (above) and the apportionment system at www.for.gov.bc.ca/HTH/apportionment/apportionment.htm
14. See endnote #13, above.

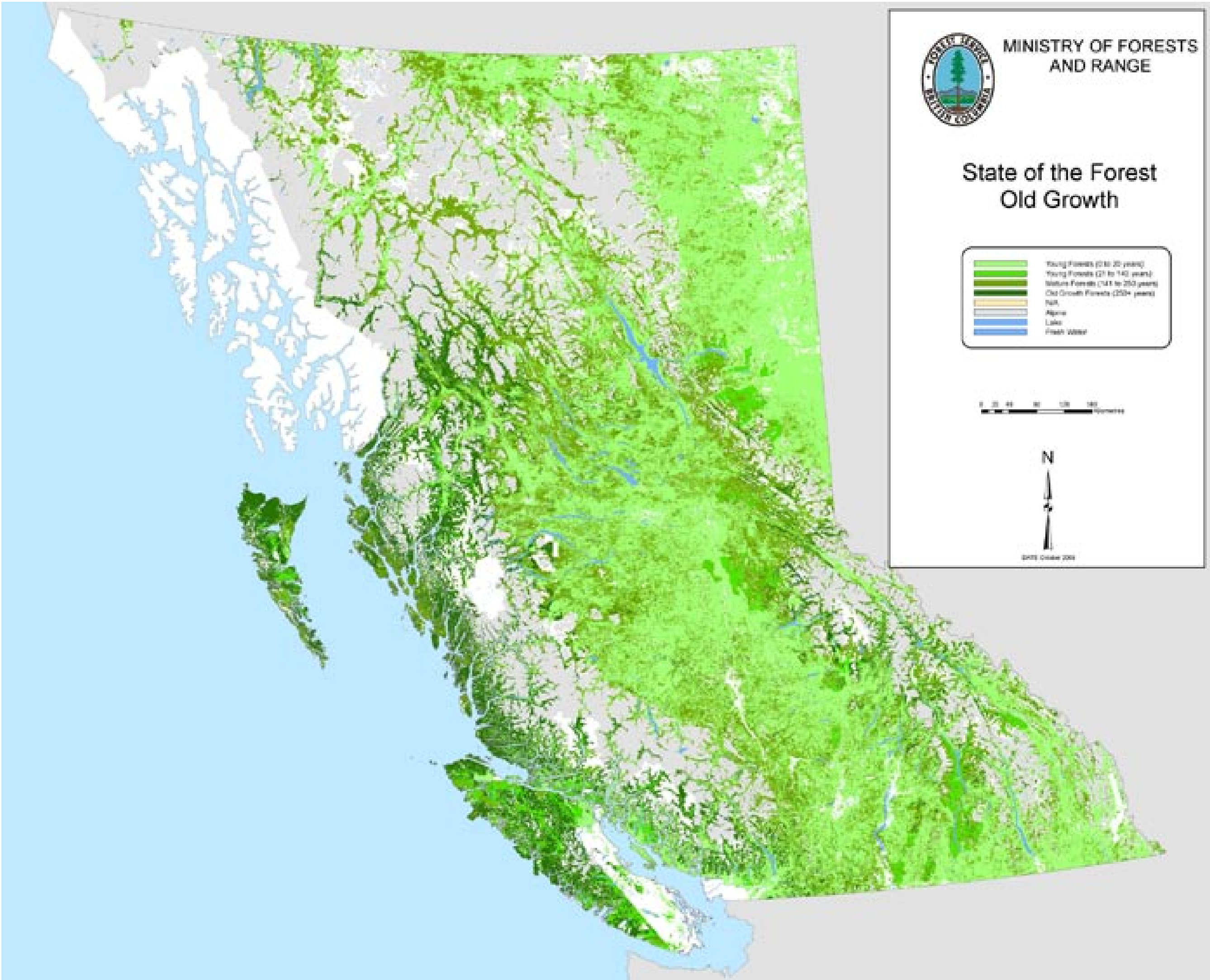
Appendix 2: Montréal Process criteria and indicators

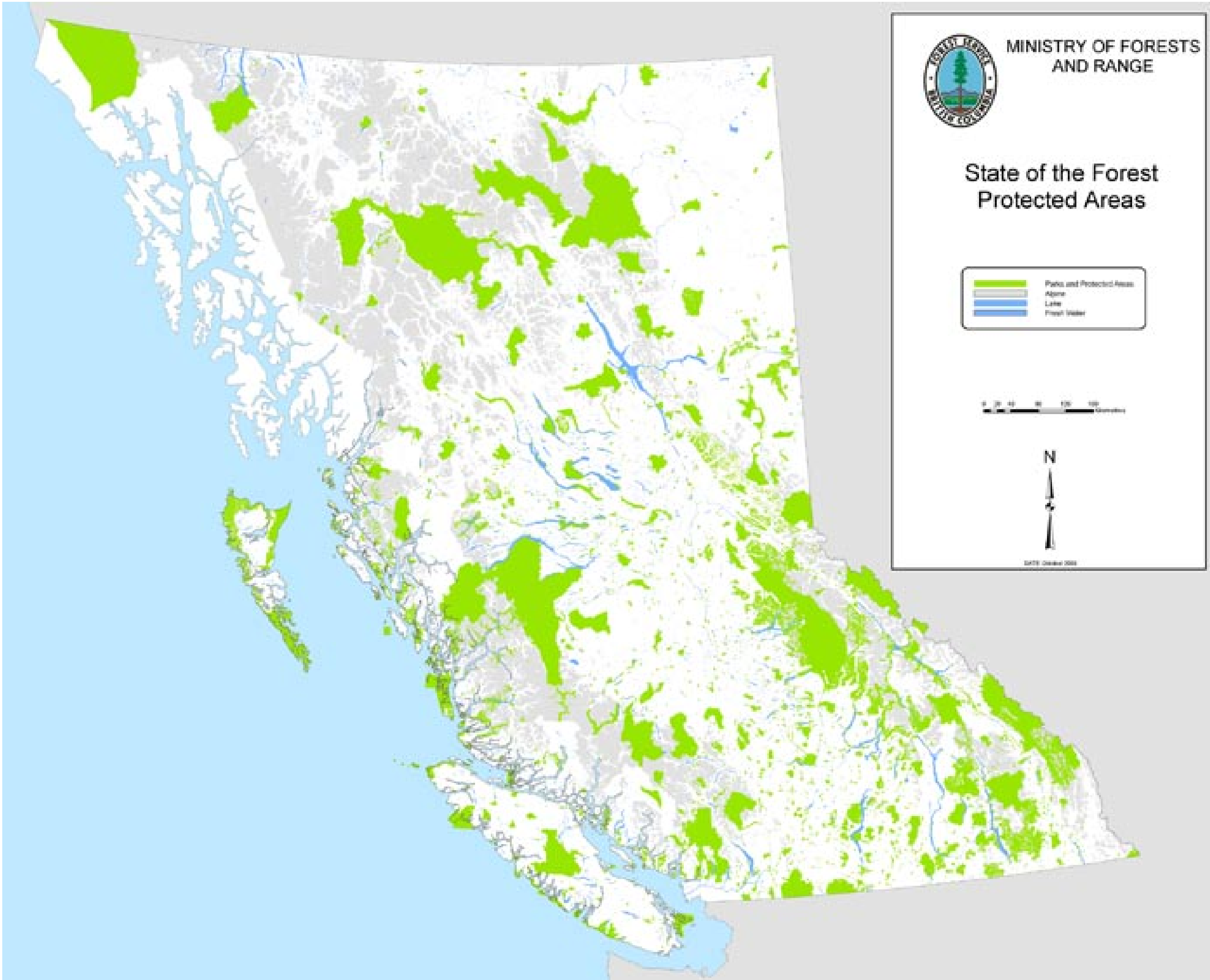
1. See Montréal Process Working Group. 2007. Criteria and indicators for the conservation and sustainable management of temperate and boreal forests. 3rd ed., December 2007. www.rinya.maff.go.jp/mpci/

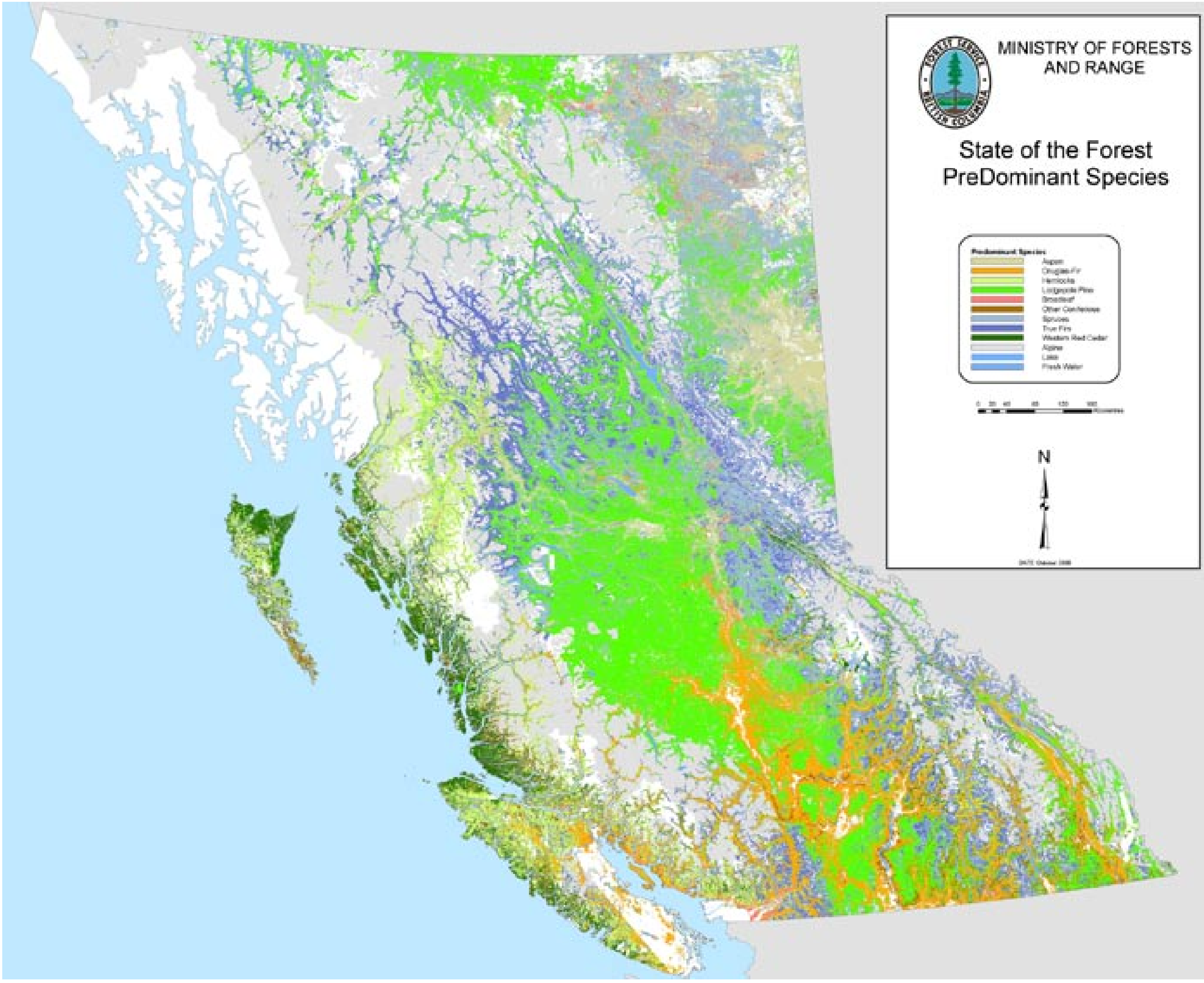
Appendix 3: The Canadian Council of Forest Ministers criteria and Indicators

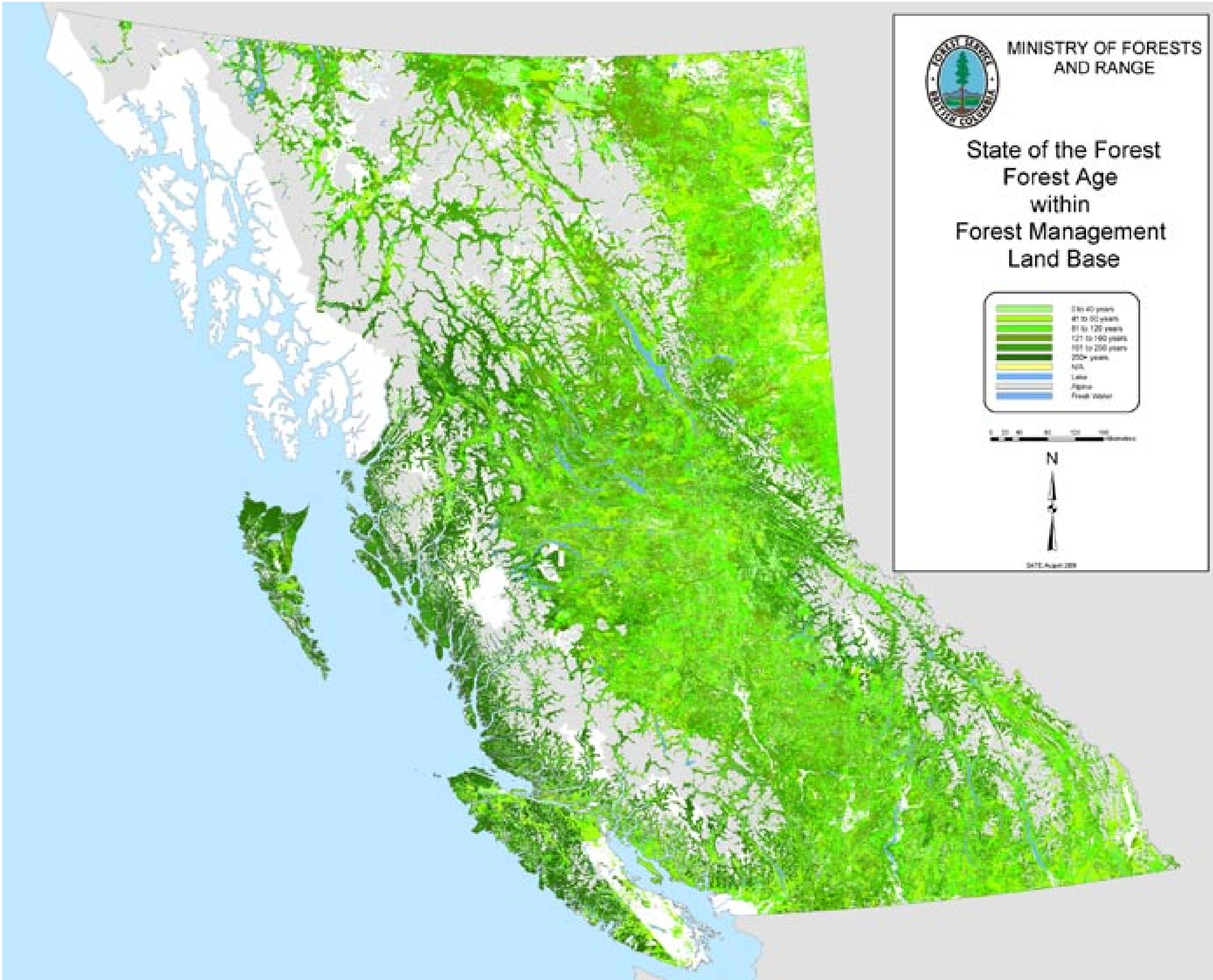
1. See Canadian Council of Forest Ministers. 2003. Defining sustainable forest management in Canada: criteria and indicators. www.ccfm.org/english/coreproducts-criteria_in.asp

Appendix 5 Maps


MINISTRY OF FORESTS
AND RANGE
State of the Forest
Old Growth
Young Forests (0 to 20 years)
Young Forests (21 to 140 years)
Mature Forests (141 to 250 years)
Old Growth Forests (250+ years)
N/A
Alpine
Lake
Fresh Water
N


MINISTRY OF FORESTS
AND RANGE
State of the Forest
Protected Areas
Parks and Protected Areas
Alpine
Lake
Fresh Water
N


MINISTRY OF FORESTS
AND RANGE
State of the Forest
PreDominant Species
Predominant Species
Aspen
Douglas-Fir
Hemlocks
Lodgepole Pine
Broadleaf
Other Coniferous
Spruces
True Firs
Western Red Cedar
Alpine
Lake
Fresh Water
N


MINISTRY OF FORESTS
AND RANGE
State of the Forest
Forest Age
within
Forest Management
Land Base
N

Appendix 6 Abbreviations

AAC	Allowable annual cut
ABCFP	Association of British Columbia Forest Professionals
AT	Alpine Tundra Zone
ATVs	All-terrain vehicles
BBS	North American Breeding Bird Survey
B.C. (or BC)	British Columbia (as part of another acronym or name)
BEC	Biogeoclimatic ecosystem classification
BG	Bunchgrass Zone
BTM	Baseline thematic mapping
BCTC	BC Treaty Commission
BCTS	BC Timber Sales
BWBS	Boreal White and Black Spruce Zone
CBM-CFS2	Carbon Budget Model of the Canadian Forest Sector
CCFM	Canadian Council of Forest Ministers
CDC	Conservation Data Centre
CDF	Coastal Douglas-fir Zone
C&E	Compliance and enforcement
C&I	Criteria and indicators
CFCG	Centre for Forest Conservation Genetics
CFS	Canadian Forest Service
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSA	Canadian Standards Association
CWH	Coastal Western Hemlock Zone
CWS	Canada-wide Standard
DFO	Fisheries and Oceans Canada
ER	Ecosystem restoration
ESSF	Engelmann Spruce–Subalpine Fir Zone
FDP	Forest development plan
FGC	Forest Genetics Council
FL	Forest licence
FMLB	Forest management land base
FRPA	*Forest and Range Practices Act*
FREP	Forest and Range Evaluation Program
FSC	Forest Stewardship Council
FSP	Forest stewardship plan
GDP	Gross domestic product
GHG	Greenhouse gas
GRM	Genetics resource management
ha	Hectare
ICH	Interior Cedar–Hemlock Zone
IDF	Interior Douglas-fir Zone
ILMB	Integrated Land Management Bureau
IMS	Information management system
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature

IWMS	Identified Wildlife Management Strategy
LRDW	Land and resource data warehouse
LRMP	Land and resource management plan
m^3	Cubic metre
MARR	Ministry of Aboriginal Relations and Reconciliation
MAL	Ministry of Agriculture and Lands
MH	Mountain Hemlock Zone
MFR	Ministry of Forests and Range
MOE	Ministry of Environment
MP	The Montréal Process
MPB	Mountain pine beetle
MS	Montane Spruce Zone
NFI	National forest inventory
NGO	Non-government organization
NPF	Not properly functioning
NSR	Not satisfactorily restocked
NTFP	Non-timber forest product
PEFC	Programme for the Endorsement of Forest Certification
PFC	Proper functioning condition
PM2.5	Fine particulate matter
PP	Ponderosa Pine Zone
ROCE	Return on capital employed
RESULTS	Reporting Silviculture Updates and Land status Tracking System
RISC	Resource Information Standards Committee
RPF	Registered Professional Forester
RSM	Resource stewardship monitoring
SAR	Species at risk
SBS	Sub-Boreal Spruce Zone
SBPS	Sub-Boreal Pine–Spruce Zone
SEE	BC Species and Ecosystems Explorer
SFI	Sustainable Forestry Initiative
SFMP	Sustainable forest management plan
SPAR	Seed Planning & Registry System
SRR	Sustainable rangeland roundtable
SWB	Spruce–Willow–Birch Zone
THLB	Timber harvesting land base
TFL	Tree farm licence
TSA	Timber supply area
TSL	Timber sale licence
UBC	University of British Columbia
UWR	Ungulate winter range
UNCED	United Nations Conference on the Environment and Development
VOCs	Volatile organic compounds
VQOs	Visual quality objectives
VRI	Vegetation resources inventory
WHA	Wildlife habitat area
WTC	Wildlife Tree Committee

Appendix 7 Glossary

Aboriginal rights

- Refer to practices, traditions, or customs ("activity[ies]") that are integral to the distinctive culture of an Aboriginal society and were practiced prior to European contact, meaning they were rooted in the pre-contact society. (The date is no longer prior to 1846, the date British sovereignty was asserted in B.C.);
- Must be practiced for a substantial period of time to have formed an integral part of the particular Aboriginal society's culture;
- Must be an activity that is a central, defining feature that is independently significant to the Aboriginal society;
- Must be distinctive (not unique), meaning it must be distinguishing and characteristic of that culture;
- Must be based on an actual activity related to a resource: the significance of the activity is relevant but cannot itself constitute the claim to an Aboriginal right;
- Must be given a priority after conservation measures (not amounting to an exclusive right);
- Must meet a continuity requirement, meaning that the Aboriginal society must demonstrate that the connection with the land in its customs and laws has continued to the present day;
- May be the exercise in a modern form of an activity that existed prior to European contact;
- May include the right to fish, pick berries, hunt, and trap for sustenance, social and ceremonial purposes (for example, ceremonial uses of trees and wildlife locations);
- May include an Aboriginal right to sell or trade commercially in a resource where there is evidence to show that the activity existed prior to European contact "on a scale best characterized as commercial" and that such activity is an integral part of the Aboriginal society's distinctive culture;
- May be adapted in response to the arrival of Europeans if the activity was an integral part of the Aboriginal society's culture prior to European contact;
- Do not include an activity that solely exists because of the influence of European contact; and
- Do not include aspects of Aboriginal society that are true of every society such as eating to survive.
- Aboriginal rights arise from the prior occupation of land, but they also arise from the prior social organization and distinctive cultures of Aboriginal peoples on that land. Treaty negotiations will translate Aboriginal rights into contemporary terms.
- (MARR, Glossary of Treaty-Related Terms. www.gov.bc.ca/arr/rpts/glossary/default.htm)

Afforestation

Afforestation is the human-induced conversion of land that has not been forested since December 31, 1989 to forested land through planting, seeding, and/or the human-induced promotion of natural seed sources. Page 42 in B.C. Ministry of Environment. 2009. British Columbia greenhouse gas inventory report 2007. Victoria, B.C. www.env.gov.bc.ca/epd/climate/ghg-inventory/pdf/pir-2007-full-report.pdf

Agroforestry

Agroforestry is a collective name for land use systems and technologies, where woody perennials are deliberately used on the same land management unit as agricultural crops and/or animals, either in some form of spatial arrangement or temporal sequence.

Allowable annual cut (AAC)

The rate of timber harvest permitted each year from a specified area of land. AACs for timber supply areas (TSAs) and tree farm licences (TFLs), which account for most of the provincial harvest, are set by the government's Chief Forester in accordance with the *Forest Act*. (Adapted from MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

At risk

A wildlife species is deemed "at risk" when an evaluation shows some likelihood of extinction or extirpation given the current circumstances. (Adapted from COSEWIC. www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl5)

Backlog planting

Planting that is overdue. In general, planting is considered backlog planting if more than seven years have elapsed since a site was cleared (by harvesting, fire, insects, or disease) in the Interior, and more than three years have elapsed on the Coast of British Columbia. (Adapted from MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Current operational use of the term "backlog" or "backlog planting" is usually restricted to areas harvested before 1988 that are of Good or Medium site productivity. This is based on the *Forest Practices Code of British Columbia Act* of 1995, which redefined a backlog area as "an area from which the timber was harvested, damaged or destroyed before October 1, 1987; and, which in the district manager's opinion, is insufficiently stocked with healthy, well-spaced trees of a commercially acceptable species."

Best management practices

Approaches based on known science that, if followed, should allow the client to meet the required standard(s) or achieve the desired objective(s).

Biogeoclimatic zone

A geographic area having similar patterns of energy flow, vegetation, and soils as a result of a broadly homogenous macroclimate. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

British Columbia's low-elevation biogeoclimatic zones are:

- Coastal Douglas-fir (CDF)
- Coastal Western Hemlock (CWH)
- Bunchgrass (BG)
- Ponderosa Pine (PP)
- Interior Douglas-fir (IDF)
- Interior Cedar–Hemlock (ICH)
- Sub-Boreal Spruce (SBS)
- Boreal White and Black Spruce (BWBS)
- Sub-Boreal Pine–Spruce (SBPS)
- Montane Spruce (MS)

The high-elevation zones are:

- Mountain Hemlock (MH)
- Engelmann Spruce–Subalpine Fir (ESSF)
- Spruce–Willow–Birch (SWB)
- Boreal Altai Fescue Alpine (BAFA)
- Coastal Mountain-heather Alpine (CMA)
- Interior Mountain-heather Alpine (IMA)

Descriptions of each zone are at www.for.gov.bc.ca/hre/becweb/resources/classificationreports/provincial. An interactive map showing all zones is at www.for.gov.bc.ca/hfd/library/documents/treebook/biogeo/biogeo.htm.

Biomass

The total mass of living organisms in a given area or volume. Forest biomass consists primarily of above-ground and below-ground tree components (stems, branches, leaves, and roots), other woody vegetation, and mosses, lichens, and herbs. Animal biomass typically comprises only a very small portion of total forest biomass. (Canadian Forest Service. Carbon budget model of the Canadian forest sector. Available at: http://carbon.cfs.nrcan.gc.ca/cbm/index_e.html)

Broad-leaved

All trees classified botanically as Angiospermae. Also called "hardwoods." Forest areas are classified as broad-leaved if trees accounting for more than 75% of the tree volume (or number of stems in young forest) are broad-leaved. (Adapted from the definition used for temperate and boreal forest in: United Nations. 2001. The global forest resources assessment 2000. www.fao.org/docrep/004/y1997e/y1997e1m.htm#bm58)

Brushing

A silvicultural activity done by chemical, manual, grazing, or mechanical means to control competing forest vegetation and reduce competition for space, light, moisture, and nutrients with crop trees or seedlings. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Carbon dioxide equivalent (CO_2e)

Carbon dioxide equivalent (CO_2e) is the universal unit of measurement to indicate the global warming potential (GWP) of each of the different greenhouse gases, expressed in terms of one unit of carbon dioxide. It is used to estimate emissions of different greenhouse gases against a common basis. For example, methane has 21 times the impact on global warming as CO_2 over 100 years. Nitrous oxide is even higher at 310 times. (Pages 4 and 5 in B.C. Ministry of Environment. 2009. British Columbia provincial greenhouse gas inventory report 2007. Victoria, B.C. www.env.gov.bc.ca/epd/climate/ghg-inventory/pdf/pir-2007-full-report.pdf)

Clearcutting

The process of removing all trees, large and small, in a stand in one cutting operation. As a silvicultural system, clearcutting removes an entire stand of trees from an area of one hectare or more, and greater that two tree heights in width, in a single harvesting operation. A new even-aged stand is obtained by planting, natural or advanced regeneration, or direct seeding. The opening size and dimensions created are generally large enough to limit significant microclimatic influence from the surrounding stand. (Adapted from MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Clearcutting with reserves

A variation of the clearcutting silvicultural system in which trees are retained, either uniformly or in small groups, for purposes other than regeneration. (Adapted from MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Coarse woody debris

Sound and rotting logs and stumps that provide habitat for plants, animals, and insects, and a source of nutrients for soil development. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Community forest

Specifically, a "community forest agreement" is a tenure agreement under the *Forest Act* that describes an area of Crown forest land to be managed by a community, under general supervision of the MFR, for a sustainable timber harvest as determined by an allowable annual cut.

More generally, community forest may refer to any forestry operation managed by a local government, community group, or First Nation for the benefit of the entire community. The majority of community forests in B.C. are on Crown land under a timber tenure such as a forest licence, tree farm licence, or community forest agreement. (Adapted from MFR, Community forests. www.for.gov.bc.ca/hth/community)

Coniferous

All trees classified botanically as Gymnospermae. Also called "softwoods." Forest areas are classified as coniferous if trees accounting for more than 75% of the tree volume (or number of stems in young forest) are coniferous.
(Adapted from the definition used for temperate and boreal forest in United Nations. 2001. The global forest resources assessment 2000. www.fao.org/docrep/004/y1997e/y1997e1m.htm#bm58)

Criterion

A category of conditions or processes by which sustainable forest management may be assessed. A criterion is characterized by a set of related indicators that are monitored periodically to assess change. (The Montréal Process. www.mpci.org/rep-pub/1995/santiago_e.html#2)

Dead organic matter (DOM)

A generic term for all dead organic compounds in the ecosystem. These include standing dead trees, downed trees, coarse and fine woody debris, litter, soil carbon, and peat. (Canadian Forest Service. Carbon budget model of the Canadian forest sector. http://carbon.cfs.nrcan.gc.ca/cbm/index_e.html)

Deforestation

Deforestation is the direct human-induced conversion of forested land to non-forested land. Harvesting when followed by regeneration is not deforestation. Forestry operations, however, can cause deforestation (e.g., permanent roads). (Page 42 in B.C. Ministry of Environment. 2009. British Columbia greenhouse gas inventory report 2007. Victoria, B.C. www.env.gov.bc.ca/epd/climate/ghg-inventory/pdf/pir-2007-full-report.pdf)

Desertification

The transformation of arable or habitable land to desert, as by a change in climate or destructive land use.

Direct employment

Jobs in a particular industry of interest, such as the forest industry or the ranching industry.

Ecoregion

Major ecosystem resulting from large-scale predictable patterns of solar radiation and moisture, which in turn affect the kinds of local ecosystems and animals and plants found there. (Bailey, R.G. 1998. Ecoregions: the ecosystem geography of the oceans and continents. Springer-Verlag: New York). In British Columbia, ecoregion is defined differently, and used with the term ecosection. An ecoregion is an area with major physiographic and minor macroclimatic or oceanographic variation. There are 43 ecoregions in British Columbia of which 39 are terrestrial. Ecoregions are meant to be mapped at 1:500,000 for regional strategic planning. (MOE, Ecoregions of British Columbia. www.env.gov.bc.ca/ecology/ecoregions)

Ecosection

Ecosections are terrestrial or marine areas that are subdivisions of ecoregions, with minor physiographic and macroclimatic or oceanographic variations. The more than 100 ecosections in British Columbia are mapped at 1:250,000 and used for resource emphasis planning. (Adapted from MOE, Ecoregions of British Columbia. www.env.gov.bc.ca/ecology/ecoregions)

Ecosystem

A functional unit consisting of all the living organisms (plants, animals, and microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size—a log, pond, field, forest, or the earth's biosphere—but it always functions as a whole unit. Ecosystems are commonly described according to the major type of vegetation, for example, forest ecosystem, old-growth ecosystem, or range ecosystem. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Effective population size

The size of an ideal population, which when contrasted to the population under study, would possess the same rate of increase in inbreeding or decrease in genetic diversity due to genetic drift. (Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Endangered

A wildlife species facing imminent extirpation or extinction.
(COSEWIC. www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl5)

Established alien invasive pests

Diseases, insects, or plants that are present in British Columbia and which have established as a breeding and spreading population.

Ex situ

Transfer of organisms (plant or animal) from one site (e.g., in the wild) to another site (e.g., seed banks, zoos) for the purpose of maintenance or breeding as a means of conserving the organism. (Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Extinct

A wildlife species that no longer exists.
(COSEWIC. www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl5)

Extirpated

A wildlife species no longer existing in the wild in B.C., but occurring elsewhere. (Adapted from COSEWIC. www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl5)

Fertilizing

The addition of fertilizer to promote tree growth on sites deficient in one or more soil nutrients. Also used to improve the vigour of crop trees following juvenile spacing or commercial thinning. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

First Nation

An Aboriginal governing body, organized and established by an Aboriginal community, or the Aboriginal community itself. (MARR, Glossary of Treaty-Related Terms. www.gov.bc.ca/tno/rpts/glossary/default.htm)

Forest

Forest land

Forest cover

Forest refers to one or both of land (forest land) and its associated plant community (forest cover), where the land area exceeds 0.5 hectares and 10% of the land area is covered by the crowns of trees able to reach a height of 5 m at maturity. Land that temporarily does not meet these criteria due to human intervention or natural causes, is considered forest if it is expected to revert to forest. (Adapted from the definition used for temperate and boreal forest in United Nations. 2001. The global forest resources assessment 2000. www.fao.org/docrep/004/y1997e/y1997e1m.htm#bm58)

Forest-associated

A forest-associated species has a measurable dependence on a forest ecosystem(s) for any aspect of its life history, including indirect dependence, such as consuming forest-based or forest-derived resources. A forest-associated species may be:

1. forest dependent and forest dwelling: A species requiring forest conditions for all or part of its requirements for food, shelter, or reproduction.
2. forest dependent but not forest dwelling: A species not using or living in forest habitats, but which is significantly affected by disturbance or changes in adjacent forests.
3. forest using but not forest dependent: A species that is not forest dependent but makes marginal use of forest habitats.
4. known to be forest-associated but information is insufficient to categorize it as (1), (2), or (3).

(Adapted from a workshop for the National status 2005 report on criteria and indicators. Canadian Council of Forest Ministers. www.ccfm.org/)

Fragmentation

The process of creating an increasingly complex mosaic of patches as a result of disturbances, including human activity (Li, H., J.F. Franklin, F.J. Swanson, and T.A. Spies. 1993. Developing alternative forest cutting patterns: a simulation approach. Landscape Ecology 8(1):63–75)

Genetic diversity

Genetic diversity refers to differences at the gene level among individuals of the same species. Genetic diversity can be observed at several levels, such as: (1) differences between trees within a local area, and (2) differences between areas or stands of trees across the species range. (Adapted from Genes, trees, and forests, Brochure 9. 1983. MFR, Research Branch. www.for.gov.bc.ca/hfd/pubs/Docs/Bro/Bro09.htm and Yanchuk, A.D., M. Carlson, and J. Woods. 1992. Genetic diversity in forest management. B.C. Ministry of Forests, Research Branch, Victoria, B.C. Information Leaflet)

Genetic gain

An improvement in the mean genotypic value of a selected character, obtained as a result of breeding. The gain is the product of the degree of heritability and the selection differential for that character. (Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Genetic resource archive

For genetic conservation: ex-situ collections of germplasm.
(The Forest Genetics Council of British Columbia, Glossary of forest genetics terms. www.fgcouncil.bc.ca)

Genetic resource management

Genetic resource conservation and management seeks to protect and conserve the genetic foundation of forest and rangelands to provide for their continued evolution, improvement, and adaptation to meet human and environmental demands. Specifically, genetic resource conservation and management (GRM) in British Columbia is centred on three primary components: value, resilience, and conservation. Value refers to activities aimed at maintaining or increasing the value of regenerated (planted) forests through tree breeding programs, orchard seed production and management, and seed extraction, cleaning, storage, and testing. Resilience refers to activities associated with maintaining genetic adaptation through the appropriate matching of seedlots (genotypes) to planted sites (environment). Conservation refers to activities associated with the maintenance of natural levels of genetic diversity for tree species indigenous to British Columbia, such as cataloguing *in situ* (reserves, protected areas) species ranges and natural populations, *ex situ* (seed collections) and *inter situ* (provenance, breeding and orchard) populations.

Genetic worth

Genetic worth is a measure of the genetic quality of a seed or vegetative lot over wild stand material, measured for a specific trait (i.e., growth, wood density, pest, and disease resistance). (Source: Forest Genetics Council – glossary).

Greenhouse gases

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. Moreover there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montréal Protocol. Besides CO_2, N_2O, and CH_4, the Kyoto Protocol deals with the greenhouse gases sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). (Intergovernmental Panel on Climate Change third assessment report, Glossary of terms. www.ipcc.ch/pub/syrgloss.pdf)

Heterozygosity

An individual having two different alleles or forms of the same gene in all diploid cells. Different alleles determine alternative characteristics of inheritance, so an organism with different alleles in a pair of genes (e.g., Aa rather than the same alleles, AA or aa) can pass on either of the two genes (A or a). Consequently, it may not always breed true to type and maintains higher genetic diversity than an organism with the same alleles.

(Adapted from: Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Hybrid poplar

A fast-growing hybrid tree currently used for both wood and paper pulp, hybrid poplar has also been explored for use as a dedicated energy crop.

Indicator

A quantitative or qualitative variable used to describe a state or condition. When observed periodically, it shows a trend. It provides information that is factual, usually for a specific time and place. (Adapted from the definition used by The Montréal Process. www.mpci.org/rep-pub/1995/santiago_e.html#2)

Indirect employment

Jobs in other businesses or industries supplying goods and services to a selected industry that provides direct employment. Jobs providing goods and services to the direct employees and indirect employees, known as induced employment, are not included. For example, a sawmill providing direct employment in the forest industry also provides indirect employment to retailers, accountants, and various trades for special jobs which the sawmill employees are not trained to handle, to produce the direct outputs of the sawmill. The directly and indirectly employed workers buy goods and services for their own use, creating induced employment. Induced employment is not included in indirect employment to avoid double counting.

In situ

Maintaining the genetic variability of a population in approximately the same geographic and ecological conditions under which it evolved through on-site retention with the use of artificial or natural regeneration. (Adapted from State University of New York College of Environmental Science and Forestry. Faculty of Forestry. Forest genetics glossary. www.esf.edu/for/maynard/GENE_GLOSSERY.html#Germplasm%20conservation and Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Interim measures agreements

These include Forest and Range Agreements and other similar agreements between the Ministry of Forests and Range and eligible First Nations designed to provide for "workable accommodation" of Aboriginal interests that may be impacted by forestry decisions during the term of the agreement, until such time as those interests are resolved through treaty. These agreements provide the Ministry with operational stability and assist First Nations to achieve their economic objectives by providing revenue and direct award of timber tenure. (MFR, Aboriginal Affairs Branch. www.for.gov.bc.ca/haa/Docs/Public_Q&A_Oct27_2004.htm#general1)

IUCN categories of protected areas

The International Union for Conservation of Nature and Natural Resources (IUCN, now known as The World Conservation Union) defines a protected area as "an area of land and/or sea especially dedicated to the protection of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means." It divides them into six categories, depending on their objectives:

- Category I – Protected area managed mainly for science or wilderness protection (Strict Nature Reserve/Wilderness Area);
- Category II – Protected area managed mainly for ecosystem protection and recreation (National Park);
- Category III – Protected area managed mainly for conservation of specific natural features (National Monument);
- Category IV – Protected area managed mainly for conservation through management intervention (Habitat/Species Management Area);
- Category V – Protected area managed mainly for landscape/seascape conservation and recreation (Protected Landscape/Seascape); and
- Category VI – Protected area managed mainly for the sustainable use of natural ecosystems (Managed Resource Protected Area).

The categories reflect a gradient of management intervention. In Categories I–III, strict protection is the rule and natural processes are paramount. Category II and III sites combine this with facilities for visitors. In Category IV, in effect the managed nature reserve, the manager intervenes to conserve or if necessary, restore species or habitats. Category V is about protecting cultural, lived-in landscapes, with farms and other forms of land use. The new Category VI, the sustainable use reserve, is a protected area deliberately set up to allow use of natural resources, mainly for the benefit of local people. (IUCN. 2000. Protected areas: benefits beyond boundaries—WCPA in action. www.iucn.org/themes/wcpa/pubs/other.htm#action)

Keystone species

Species that are dominant in function and possibly (but not necessarily) in structure within any one ecosystem. They hold a crucial role in supporting the integrity of the entire ecosystem, and therefore affect the survival and abundance of many other species in the same ecosystem. (Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Large organic debris

Also called large woody debris. Entire trees or large pieces of trees found on the forest floor or within stream channels. Large organic debris in stream channels typically has a diameter greater than 10 centimetres and longer than 1 metre, and provides channel stability and/or creates fish habitat diversity. (Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Legislated invasive alien plant species

Those plants that appear in the regulations in the *Weed Control Act* and the *Forest and Range Practices Act*

Managed forest land

Forest land that is being managed under a forest management plan using the science of forestry. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

In British Columbia, private land classified as “managed forest land” under the *Assessment Act* is given favourable tax treatment to encourage private land-owners to manage their lands for long-term forest production. To maintain the classification, management of the land must meet the requirements under the *Private Managed Forest Land Act*. (Private Managed Forest Land Council, Managed Forest Program. www.pmflc.ca/program.html)

Merchantable

A tree or stand of trees is considered to be merchantable once it has reached a size, quality, volume, or a combination of these that permits harvesting and processing. Merchantability is independent of economic factors, such as road accessibility or logging feasibility. (Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Mixed forest/other wooded land

Forest/other wooded land on which neither coniferous nor broad-leaved trees account for more than 75% of the tree volume (or number of stems in young forest). (Adapted from the definition used for temperate and boreal forest in United Nations. 2001. The global forest resources assessment 2000. www.fao.org/docrep/004/y1997e/y1997e1m.htm#bm58)

Natural disturbance

A change in forest structure and composition caused by fire, insects, wind, land-slides, and other natural processes. (Adapted from MFR, Glossary of Forestry Terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Natural regeneration

The renewal of a forest stand by natural seeding (on-site or from adjacent stands; seeds may be deposited by wind, birds, or mammals), sprouting, suckering, or layering. (Adapted from MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Non-timber forest products

Botanical and mycological products and associated services of the forest other than timber, pulpwood, shakes, or other wood products. Examples include wild mushrooms, floral greenery, craft products, herbs, ethnobotanical teaching, and forest tourism. (Royal Roads University, Centre for Non-Timber Resources, 2006. www.royalroads.ca/programs/faculties-schools-centres/non-timber-resources/ntfp/)

Not satisfactorily restocked

Productive forest land that has been denuded and has failed, partially or completely, to regenerate either naturally or by planting or seeding to the specified or desired free growing standards for the site. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Old growth

Old growth is a forest that contains live and dead trees of various sizes, species, composition, and age-class structure. Old-growth forests, as part of a slowly changing but dynamic ecosystem, include climax forests but not sub-climax or mid-seral forests. The age and structure of old growth varies significantly by forest type and from one biogeoclimatic zone to another. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

The following working definition based on location, species, and age information available from forest cover inventories is used for quantitative analysis in this and other publications:

Old growth is defined as all Coast region forests more than 250 years old, Interior forests dominated by lodgepole pine or deciduous species more than 120 years old, and all other Interior forests more than 140 years old.

Other wooded land

Land with tree crown cover of 5–10% of trees able to reach a height of 5 m at maturity, or with tree crown cover of more than 10% of trees not able to reach a height of 5 m at maturity and shrub or bush cover. (Adapted from the definition used for temperate and boreal forest in United Nations. 2001. The global forest resources assessment 2000. www.fao.org/docrep/004/y1997e/y1997e1m.htm#bm58)

Partial cutting

Refers generically to stand entries, under any of the several silvicultural systems, to cut selected trees and leave desirable trees for various stand objectives. Partial cutting includes harvest methods used for seed tree, shelterwood, selection, and clearcutting with reserves systems. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Phytosanitary measures

Any regulation, policy, or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests

Planting

Establishing a forest by setting out seedlings, transplants, or cuttings in an area. (Adapted from MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Predominant species

Tree species or species group with the greatest volume per hectare (or number of stems in young forests).

Protected area

The protected areas network of British Columbia includes national and provincial parks, ecological reserves, and other areas designated by statute to protect natural and cultural heritage. Proposed protection areas identified in the preliminary land use plan for the Central Coast are also included. Regional parks, municipal parks, wildlife management areas, and private conservation lands are not included. (Adapted from MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Provenance

The geographical area and environment to which the parent trees and associated vegetation are native, and within which their genetic constitution has been developed through natural selection. (Adapted from MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Provincial forest

Forest land designated under Section 4 of the *Forest Act*. The Lieutenant Governor in Council may designate any forest land as a provincial forest. The uses of provincial forests include timber production, forage production, forest recreation, and water, fisheries, and wildlife resource purposes. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Pruning

The manual removal, close to or flush with the stem, of side branches, live or dead, and of multiple leaders from standing, generally plantation-grown trees. Pruning is carried out to improve the market value of the final wood product by producing knot-free wood for the improvement of the tree or its timber. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Ranking

Ranking is the process of assigning a risk of extinction "score" (i.e., rank) to each species. The purpose is to identify species most at risk, as well as to establish baseline ranks for each. (MOE, Species ranking in British Columbia. http://wlapwww.gov.bc.ca/wld/documents/ranking.pdf)

In British Columbia, the Conservation Data Centre ranks species into three lists: Red = extirpated, endangered or threatened in B.C. (red-listed species and subspecies have, or are candidates for, official Extirpated, Endangered, or Threatened Status in B.C.), Blue = special concern, Yellow = not at risk. www.env.gov.bc.ca/atrisk/red-blue.htm#purpose

Resilience

The ability of an ecosystem to recover and maintain the desired condition of diversity, integrity, and ecological processes following disturbances. (Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

RESULTS

Reporting Silviculture Updates and Land status Tracking System

Riparian area

An area of land adjacent to a stream, river, lake, or wetland that contains vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Second-growth forest

Relatively young forests that have developed following a disturbance (e.g., wholesale cutting, extensive fire, insect attack) of the previous stand of old-growth forest. Restricted in application to those parts of the world where clearly discernible, old-growth forests still exist or did exist not long ago. (Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Seed planning unit (SPU)

Seed planning units are geographically distinct areas that form the basis for gene resource management, including tree improvement (breeding, orchard crop production), seed transfer (areas of use), and monitoring and gene conservation. SPUs are based on species, ecological zone, elevation and, in some cases, latitude band. (Adapted from MFR, Tree Improvement Branch. www.for.gov.bc.ca/hti/speciesplan)

Select seed

Seed that exhibits a higher level of one or more desired genetic traits (such as growth rate, form, wood density, and resistance to insects and disease) than wild seed collected from an average natural stand. This includes seed from tested parents growing in seed orchards and seed collected from natural stand superior provenances. Vegetative material for propagation, from production facilities using tested parents and from superior provenances, is included in the term select seed.

Silvicultural system

A planned program of treatments throughout the life of the stand to achieve stand structural objectives based on integrated resource management goals. A silvicultural system includes harvesting, regeneration, and stand-tending methods or phases. It covers all activities for the entire length of a rotation or cutting cycle. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Silviculture

The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Site preparation

Any action, related to reforestation, to create an environment favourable for survival of suitable trees during the first growing season. It may alter the ground cover, soil or microsite conditions, using biological, mechanical, or manual clearing, prescribed burns, herbicides, or a combination of methods. Both natural regeneration and planting may be improved through site preparation. (Adapted from Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Spacing

The removal of undesirable trees within a young stand to control stocking, to maintain or improve growth, to increase wood quality and value, or to achieve other resource management objectives. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Special management zones

A land use designation used to identify areas where enhanced levels of management are required to address sensitive values such as fish and wildlife habitat, visual quality, recreation, and cultural heritage features. The management intent is to maintain or enhance these values while allowing compatible human use and development. (Adapted from the Glossary definition for "special management area" in the Fort St. John Land and Resource Management Plan. ilmbwww.gov.bc.ca/lup/lrmp/northern/ftstjohn/plan/appc.htm#r)

Species

A singular or plural term for a population or series of populations of organisms that are capable of interbreeding freely with each other but not with members of other species. Includes a number of cases:

- endemic species: a species originating in, or belonging to, a particular region. Both "endemic" and "indigenous" are preferred over "native."
- exotic species: a species introduced accidentally or intentionally to a region beyond its natural range. "Exotic" is preferred over "alien," "foreign," and "non-native."
- subspecies: a subdivision of a species. A population or series of populations occupying a discrete range and differing genetically from other subspecies of the same species. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

The species counts in the species diversity indicator are for naturally occurring species and subspecies found in B.C. or now presumed extirpated in B.C. Extinct species are counted separately. Distinct populations are not counted as separate species. The species counts are generally consistent with COSEWIC's use of the term "wildlife species," limited to B.C.:

- "A species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years." (COSEWIC. www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl5)

Species diversity

An assessment of the number of species present, their relative abundance in an area, and the distribution of individuals among the species.
(Adapted from Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Stability

The ability of a system to return to an equilibrium state after a temporary disturbance (Holling, C.S. 1973. Resilience and stability of ecological systems. Annual Review of Ecology and Systematics 4:1–23.)

Stand

A community of trees sufficiently uniform in species composition, age, arrangement, and condition to be distinguishable as a group from the forest or other growth on the adjoining area, and thus forming a silvicultural or management entity. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Tenure

The relationships established among humans regarding their various rights to own, use, and control land, or the resources on that land.
(Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

The holding, particularly as to manner or term (i.e., period of time), of a property. Land tenure may be broadly categorized into private lands, federal lands, and provincial Crown lands. The *Forest Act* defines a number of forestry tenures by which the cutting of timber and other user rights to provincial Crown land are assigned. (MFR Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Terrestrial vertebrate

A member of the subphylum Vertebrata, a primary division of the phylum Chordata that includes fishes, amphibians, reptiles, birds, and mammals, all of which are characterized by a segmented spinal column and a distinct well-differentiated head, whose primary habitat for growth, reproduction, and survival is on or in the land. (Adapted from "Terrestrial" in Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Threatened

A wildlife species likely to become endangered if limiting factors are not reversed. (COSEWIC. www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl5)

Timber harvesting land base (THLB)

The portion of the total area of a management unit considered to contribute to, and be available for, long-term timber supply. The harvesting land base is defined by reducing the total land base according to specified management assumptions. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Timber supply area (TSA)

An area of public (provincial Crown) land designated under the *Forest Act* that is managed for sustainable timber harvest, as determined by an allowable cut. TSAs were originally defined by an established pattern of wood flow from management units to the primary timber-using industries. (Adapted from MFR, Annual report 2003/04. www.for.gov.bc.ca/hfd/pubs/docs/mr/annual/ar_2003-04/for.pdf and MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Traditional ecological knowledge

Indigenous peoples' knowledge of their environment, its processes, and inter-relationships. (Clayoquot Sound Scientific Panel. 1995. Report 3: First Nations' perspectives relating to forest practices standards in Clayoquot Sound. p. 11)

Traditional use

- A use of land or water that is associated with the beliefs, customs, and practices passed down through the generations of a community of indigenous people. Traditional use is usually identified with a site. The site may lack physical evidence of human-made artefacts or structures yet maintain cultural significance to a living community of people for example:
  - a location associated with traditional beliefs of an Aboriginal group about its origins, cultural history, or world view;
  - the location of a trail, sacred site, or resource gathering site such as berry grounds;
  - a location where a community has traditionally carried out economic, artistic, or other cultural pursuits important to maintaining its identity; or
  - the traditional home of a particular cultural group.
- (Adapted from B.C. Ministry of Forests. 1996. Traditional use study program: funding proposal instructions)

Tree farm licence (TFL)

An agreement under the *Forest Act* that describes an area to be managed, under general supervision of the MFR, for a sustainable timber harvest as determined by an allowable annual cut. TFLs typically combine public (provincial Crown) land with private land and timber licences. A TFL has a term of 25 years. (Adapted from: MFR Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Variable retention

A relatively new silvicultural system that follows nature's model by always retaining part of the forest after harvesting. Standing trees are left in a dispersed or aggregated form to meet objectives such as retaining old-growth structure, habitat protection, and visual quality. Variable retention retains structural features (snags, large woody debris, live trees of varying sizes, and canopy levels) as habitat for a host of forest organisms. There are two types of variable retention:

- dispersed retention—retains individual trees scattered throughout a cutblock; and
- aggregate (group) retention—retains trees in clumps or clusters.

The main objectives of variable retention are to retain the natural range of stand and forest structure and forest functions. With retention systems, forest areas to be retained are determined before deciding which areas will be cut. This system offers a range of retention levels. The system also provides for permanent retention of trees and other structures after regeneration is established. Variable retention can be implemented with a range of harvesting systems and can be combined with traditional silvicultural systems such as shelterwood or selection. (MFR, Glossary of forestry terms www.for.gov.bc.ca/hfd/library/documents/glossary)

Vascular plant

Plants having well-developed vascular components (xylem and phloem) capable of transporting water, sugars, nutrients, and minerals between the absorbing tissue in the roots and the photosynthesizing tissue in the leaves. (Dunster, J.A. 1996. Dictionary of natural resource management. UBC Press, Vancouver, B.C.)

Wildlife tree

A tree or group of trees that are identified in an operational plan to provide present or future wildlife habitat. A wildlife tree is a standing live or dead tree with special characteristics that provide valuable habitat for the conservation or enhancement of wildlife. Characteristics include large diameter and height for the site, current use by wildlife, declining or dead condition, value as a species, valuable location, and relative scarcity. (MFR, Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)

Woodlot licence

An agreement under the *Forest Act* that describes an area to be managed, under general supervision of the MFR, for a sustainable timber harvest as determined by an allowable annual cut. It is similar to a tree farm licence but on a smaller scale, and typically combines public (provincial Crown) land with private land. A woodlot licence has a term not exceeding 20 years. (Adapted from MFR Glossary of forestry terms. www.for.gov.bc.ca/hfd/library/documents/glossary)