2016-17

Assistant Deputy Minister Resource Stewardship Overview

December 2016

BRITISH COLUMBIA

Ministry of
Forests, Lands and
Natural Resource Operations

Sea to Sky Natural Resource District. Photo Credit: Tom Cole

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Photo Credit: BC Parks

INTRODUCTION

Economic prosperity and environmental sustainability is the vision of the Ministry of Forests, Lands and Natural Resource Operations (FLNRO). In British Columbia, perhaps more than most places, long-term economic prosperity is built on a foundation of sustainable resource management. As the ministry responsible for the stewardship of provincial Crown land, and cultural and natural resources, it is critical that we report on the progress towards achieving our vision and mandate.

Stewardship is the deliberate approach to resource management through integration of environmental, economic and social values, and ensures those values are sustainable over time. Through monitoring and trend analysis, FLNRO strives to ensure that decisions are made with the best available information, changing situations are identified, and adaptations are appropriately applied. This ensures a sustainable approach where decisions balance the interests of both current and future generations.

This is the sixth annual Assistant Deputy Minister (ADM) Resource Stewardship Report. Earlier editions can be found at: http://www2.gov.bc.ca/gov/content?id=0B98B1FC63984A1A917AE58E55C17496.

This year's report provides examples of how FLNRO is advancing integrated resource management. Building upon the success of earlier versions that focused on providing monitoring results derived from the Forests and Range Evaluation Program (FREP), this iteration incorporates information from a number of resource stewardship monitoring and trend-analysis sources. Effective integrated resource management requires that the full range of interests and values potentially impacted by a decision be considered. The movement towards developing more comprehensive stewardship reports is a step towards achieving this. Additional information on integrated monitoring and related activities such as cumulative effects can be found at: http://www2.gov.bc.ca/gov/content?id=F97ABF13A0A34D9BB1C2CD2DE09F5C1F.

The purpose of this report is to:

- Build greater awareness of the status and condition of our natural resource values; and
- Provide a document that will help inform the conversation around resource stewardship and the health of British Columbia's natural resources, providing valuable information to the decision-making process.

If, after reading this report, you are interested in more detailed information on any of the initiatives mentioned, please contact the identified ministry lead or visit the web links provided. The initiatives identified in this report are only a sampling of the many important stewardship initiatives undertaken by FLNRO. For more information, please go to: http://www2.gov.bc.ca/gov/content?id=A90244BA9C1B4BC6A63304C413DB75EA.

SPECIAL RESOURCE MANAGEMENT DESIGNATIONS

Integrated resource management requires consideration of a wide range of social, economic and ecological interests and values that could potentially be impacted by a decision. British Columbia's rich and diverse natural resources and geography create a high degree of complexity for resource managers to make informed, balanced and sustainable resource management decisions.

While forest harvesting practices are required to be sustainable in all areas of the province, there are areas where special designations have been placed to provide an enhanced emphasis on the management of one or more non-timber values with specific needs and/or objectives. There is a wide variety of management designations, each with varying levels of protection for the specific value(s) designated for special management. The following maps of the province's eight natural resource regions illustrate examples of special management areas. These areas range from no harvest (e.g., parks) to much less restrictive harvest constraints (e.g., maximum modification visual quality objective). The colour gradient illustrates the relative level of protection. The most protective designations are red, the least protective are dark green. Where there is more than one special designation covering an area (co-location), the most restrictive colour is shown.

References to the designations shown on the following maps can be found throughout this document. For example, the sections on site-level monitoring, wildlife, inventory and drought reflect conditions for areas both inside and outside of special designations; the sections on caribou, moose and the Government Actions Regulation reflect areas of special designation.

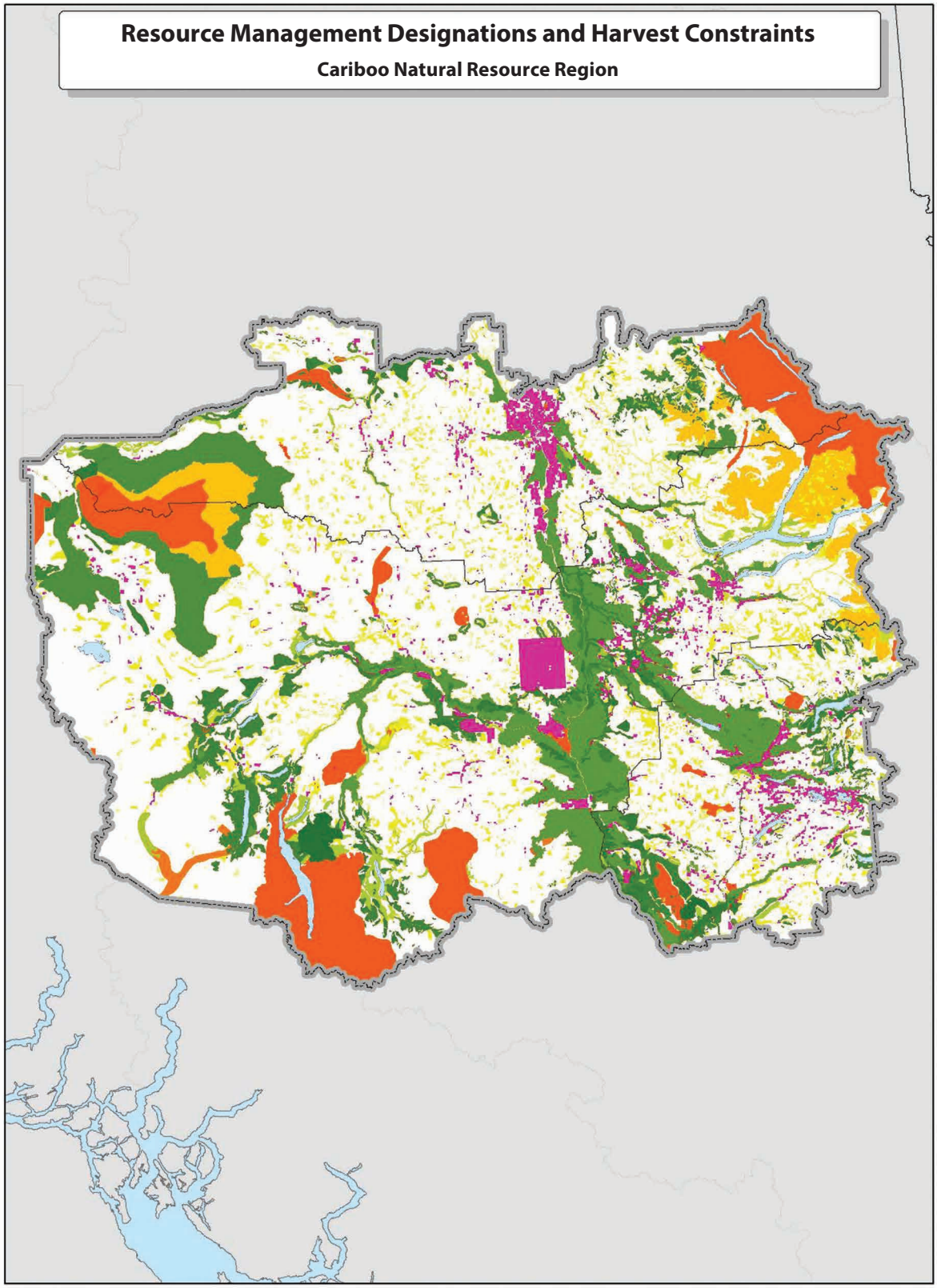
The following legend applies to each map:

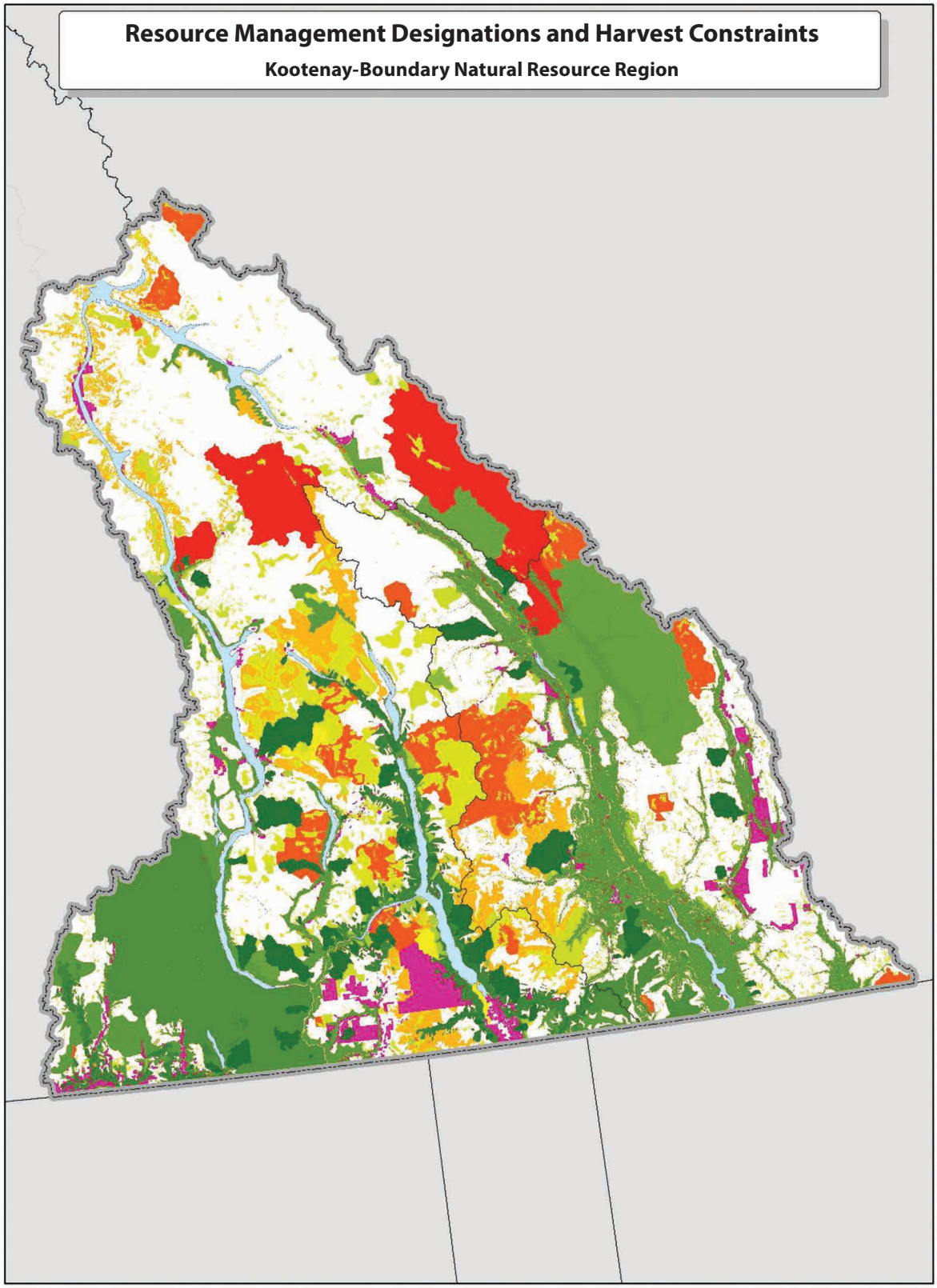
Legend

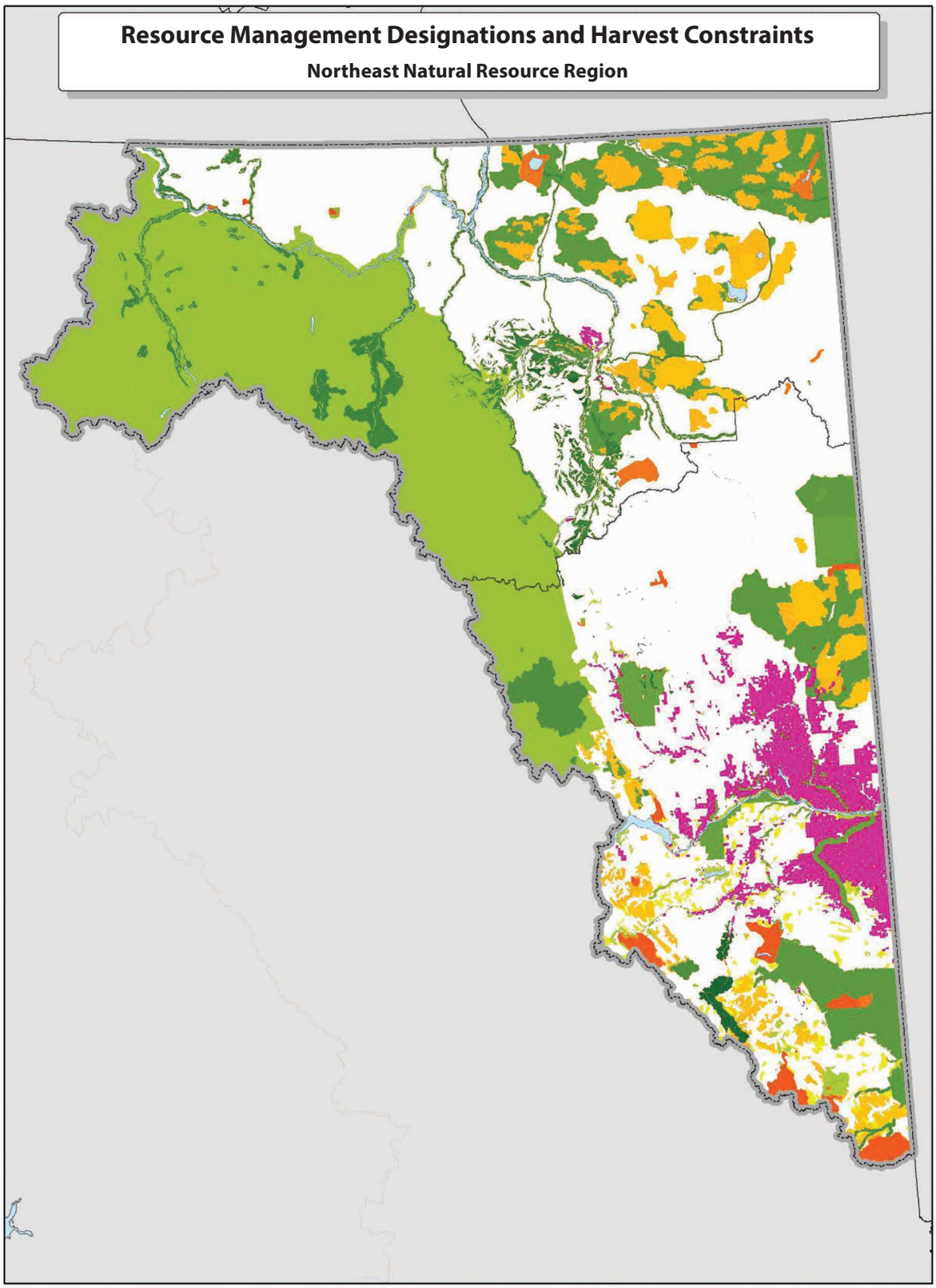
Private Land

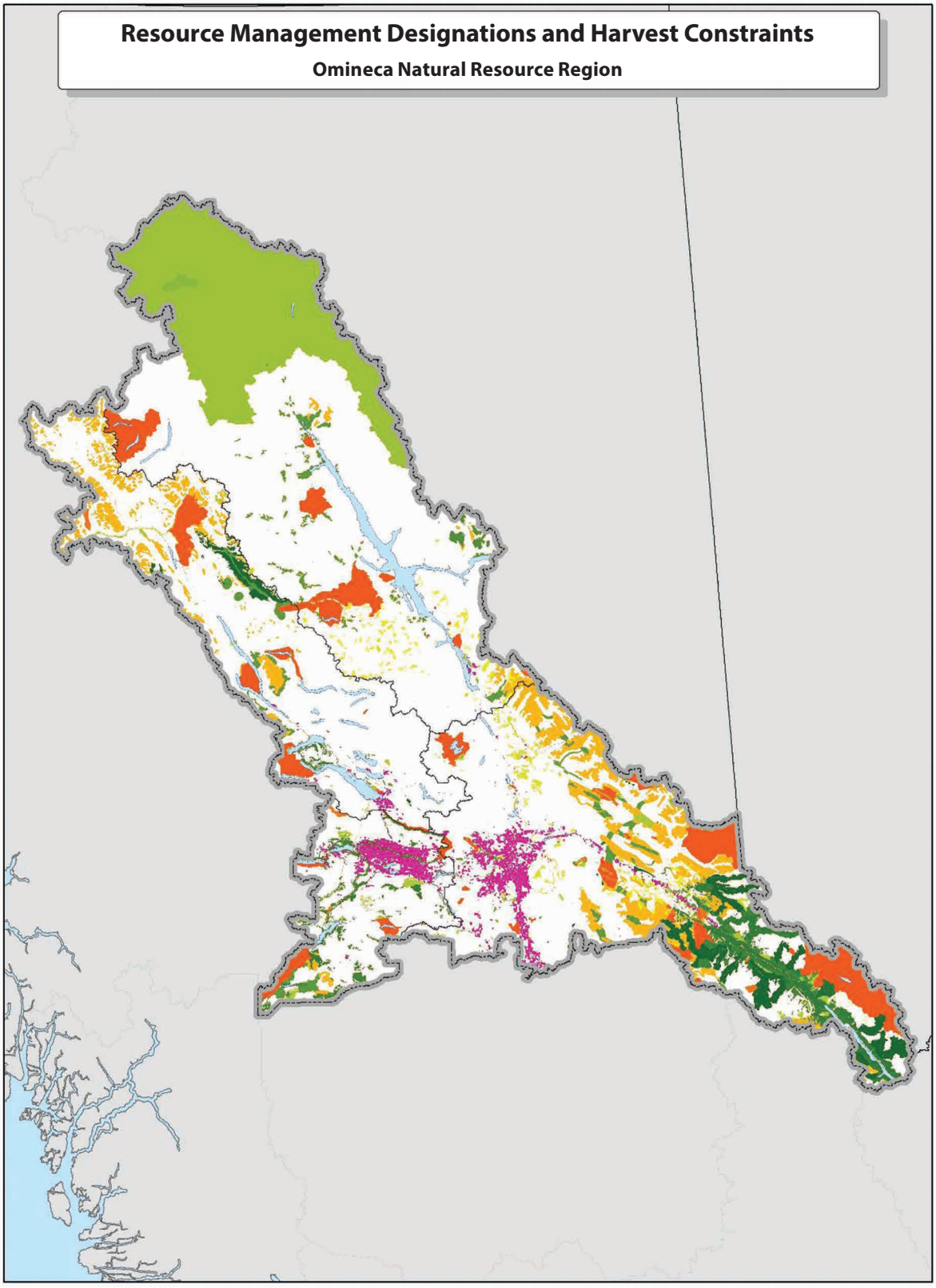
Harvest Constraint Type

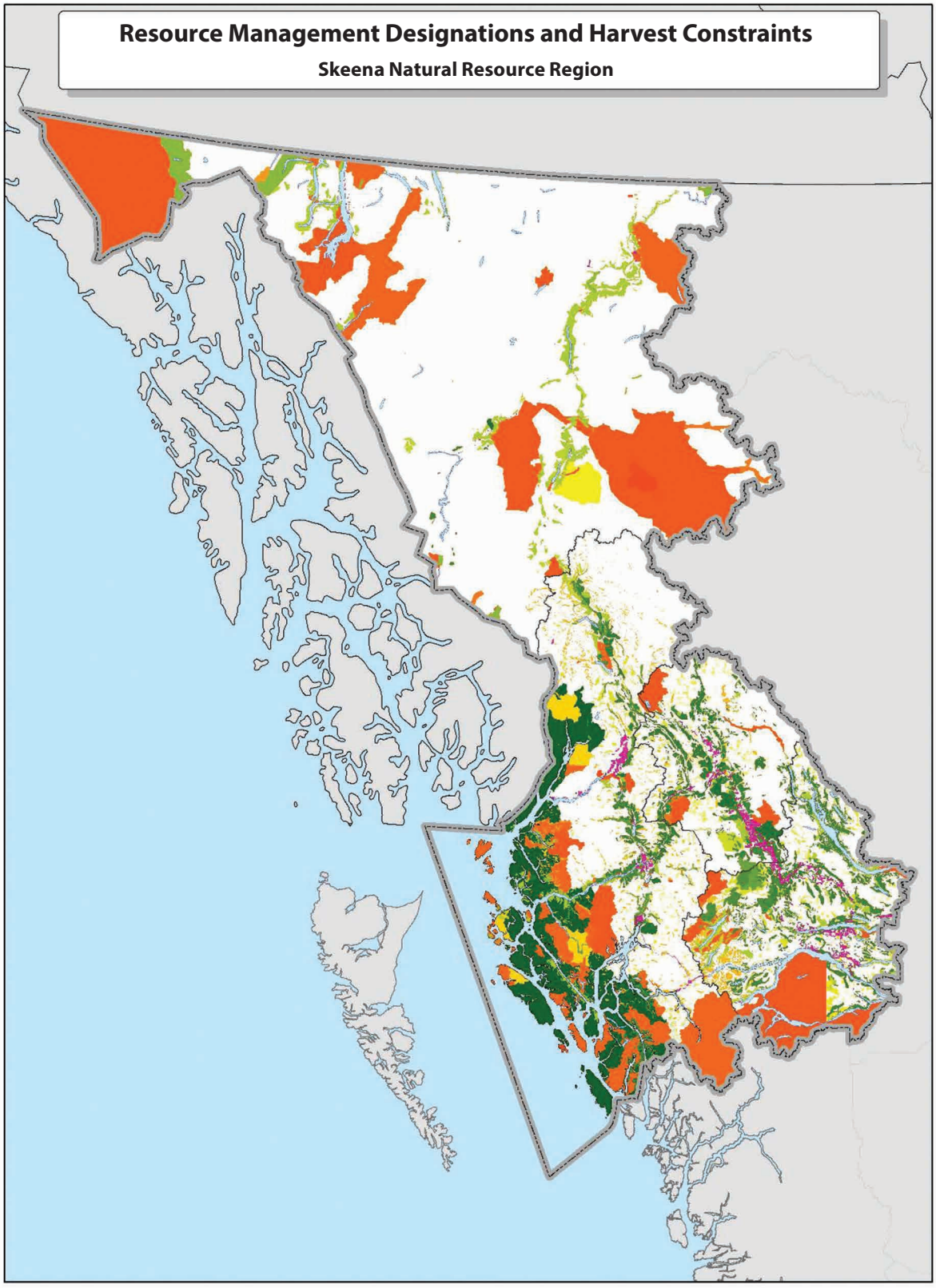
- National Park
- Chilkoot National Historic Site
- Ecological Reserve
- Provincial Park
- Conservancy
- Protected Area
- Heritage Site
- Recreation Area
- Regional Park
- Private Conservation Land, Administered Land
- Ungulate Winter Range, No Harvest
- Wildlife Habitat, No Harvest
- Biodiversity Mining and Tourism Area
- Wildland Zone
- Capital Regional District/Water Supply Area
- Wildlife Management Area
- Old Growth Management Area, Legal
- Old Growth Management Area, Non Legal
- Forest Recreation Site
- Visual Quality Objective, Preservation
- Visual Quality Objective, Retention
- Muskwa Kechika Management Area
- Use, Recreation and Enjoyment of the Public Reserve Area
- Designated Area
- Private Conservation Land, Reserve Land
- Ungulate Winter Range
- Wildlife Habitat, Conditional Harvest
- Visual Quality Objective, Partial Retention
- Visual Quality Objective, Modification
- Community Watershed
- Visual Quality Objective, Maximum Modification
- Haida Gwaii Central Coast North Coast Planning Area

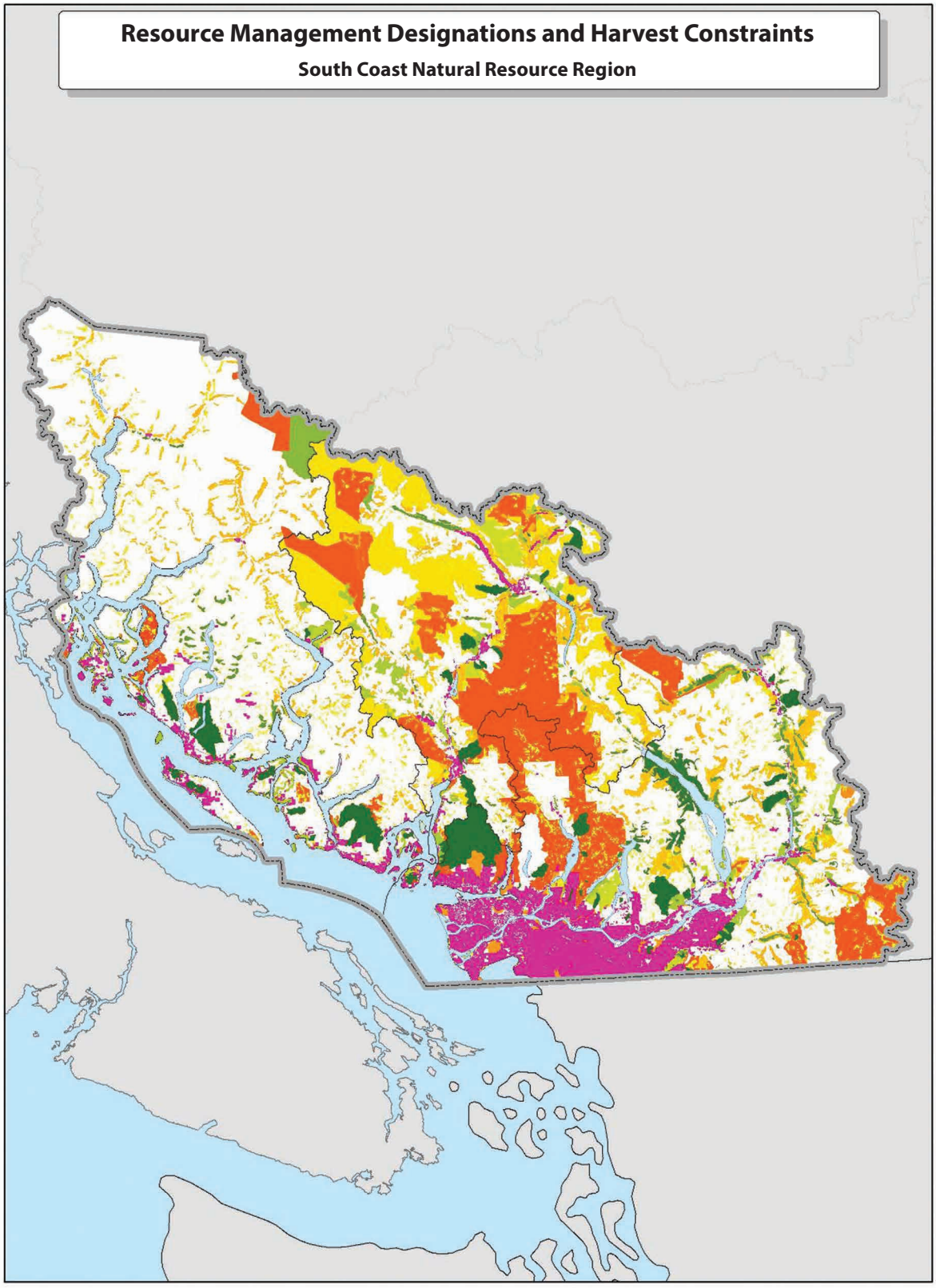

Resource Management Designations and Harvest Constraints
Cariboo Natural Resource Region

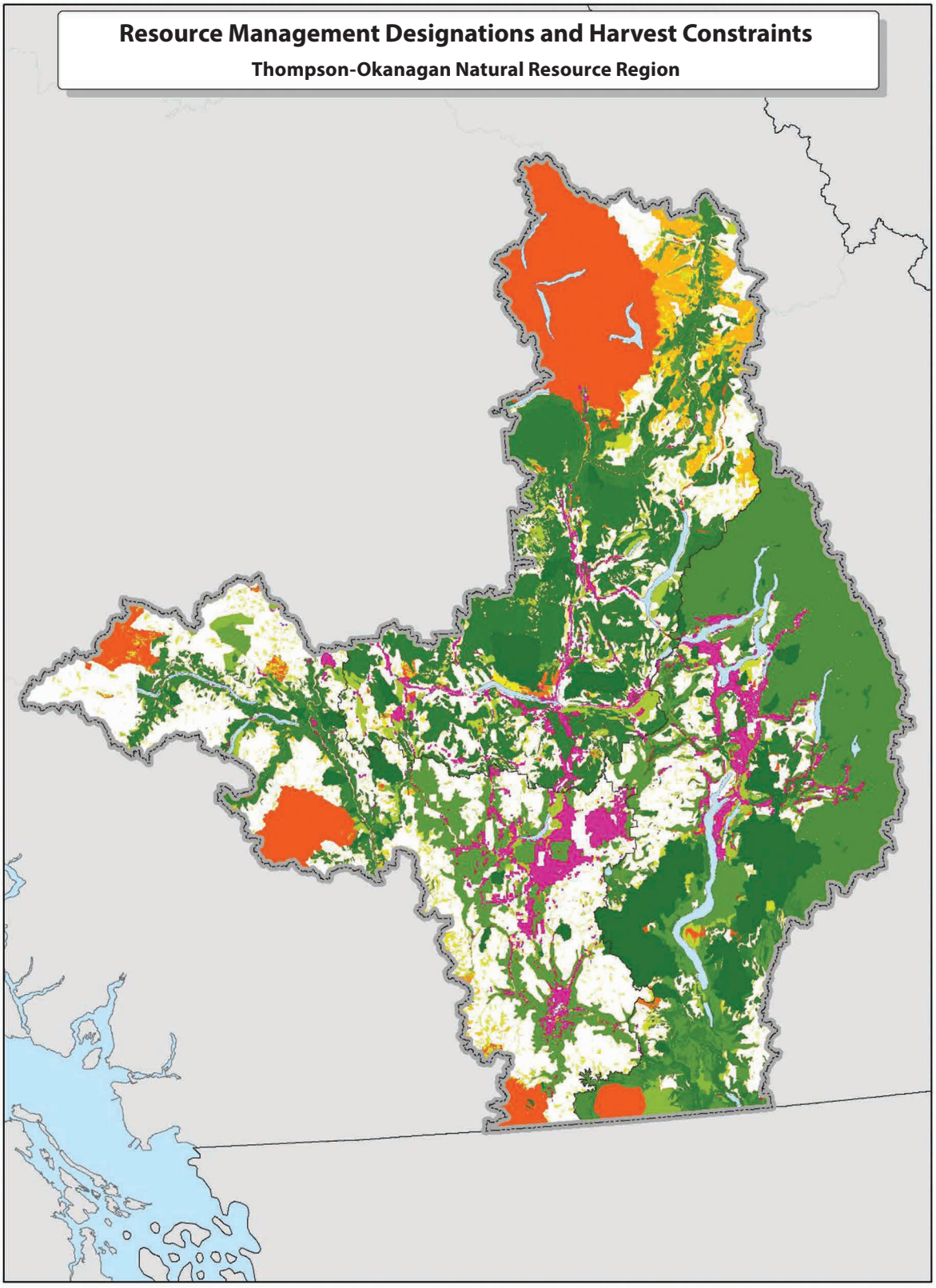

Resource Management Designations and Harvest Constraints
Kootenay-Boundary Natural Resource Region


Resource Management Designations and Harvest Constraints
Northeast Natural Resource Region


Resource Management Designations and Harvest Constraints
Omineca Natural Resource Region


Resource Management Designations and Harvest Constraints
Skeena Natural Resource Region


Resource Management Designations and Harvest Constraints
South Coast Natural Resource Region


Resource Management Designations and Harvest Constraints
Thompson-Okanagan Natural Resource Region

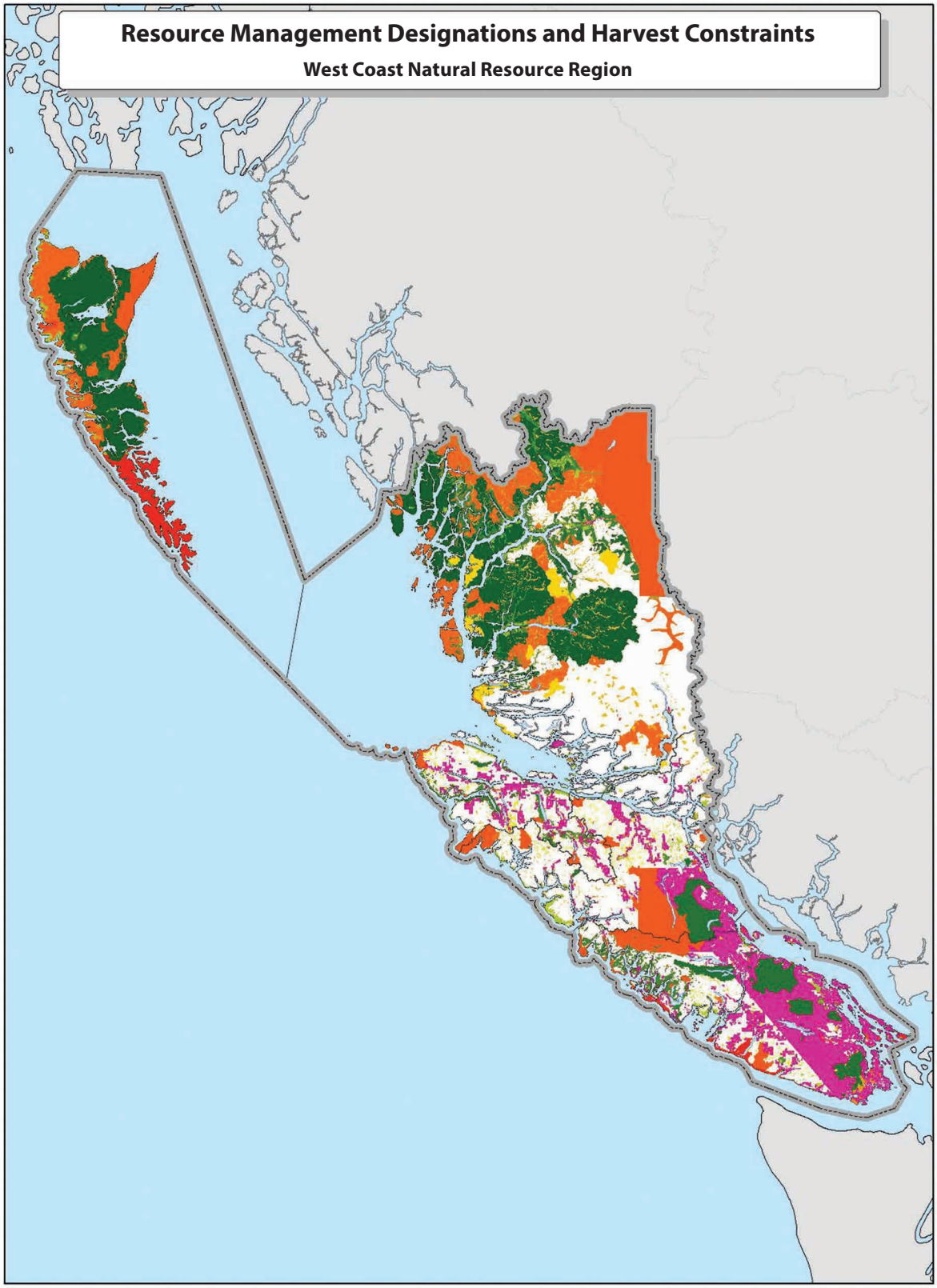

Resource Management Designations and Harvest Constraints
West Coast Natural Resource Region

Photo Credit: BC Parks

MANAGING SPECIFIC VALUES

AREAS DESIGNATED FOR SPECIFIED ENVIRONMENTAL VALUES (Government Actions Regulation)

The complex topography, climate and geology of British Columbia contribute to the rich biological diversity found here.

The purpose of the Government Actions Regulation (GAR) designation is meant to be a "fine filter" that focuses on the particular needs of select species and other environment values (e.g., visual objectives, water quality) that are otherwise not explicitly managed for. These include specific needs that are often time or place sensitive. For example, winter habitat needs to be available during the snow period and in a location where site attributes (e.g., plant cover, aspect, terrain) moderate the severity of winter conditions on a particular animal. The regional variation in species occurrences, the types of forests, and the intensity of development each contribute to differences in management priorities and habitat protection throughout the province. Together, these factors influence the degree and manner to which GAR designations have been implemented in different areas of the province.

In designing GAR areas, there is clear direction to maximize the number of values supported through that GAR order. This is called co-location. To achieve co-location, the full suite of values to be managed, and any constraints on flexibility, need to be known early in the designation process. Designation of values should be done concurrently so that adjustments made to reduce impacts from one designation do not compromise some of the other values under consideration for co-location. When considering a GAR designation, the following tests must be met:

1. Special management provided by the action is not already provided by the *Forest and Range Practices Act* (FRPA) or other legislation;
2. The order is consistent with established objectives in the area;
3. The order will not unduly reduce the supply of timber from B.C.'s forests; and
4. The public benefits derived from the order outweigh any material adverse impacts on delivered wood costs and any undue constraint on the ability of agreement holders under the *Forest Act* and *Range Act* to exercise their rights under agreement.

Implementation of GAR includes:

- **IWMS (Identified Wildlife Management Strategy)**: The goals of this strategy are to minimize the effects of forest and range practices on identified wildlife situated on Crown land, and to maintain their limiting habitats throughout their current ranges and, where appropriate, their historic ranges. Identified wildlife are managed through the establishment of wildlife habitat areas (WHAs), the implementation of general wildlife measures (GWMs) and wildlife habitat area objectives, or through other management practices specified in strategic or landscape-level plans.
- **WHAs (Wildlife Habitat Areas)**: A WHA is a site with specific habitat conditions necessary for the survival of an IWMS species. The WHA design process is an iterative process with the potential for numerous changes to the size and location of proposed designations. The process evaluates the balance between habitat conservation and potential impacts on the timber harvesting land base.
- **GWMs (General Wildlife Measures)**: A WHA may also include operating procedures (prescriptions), which are referred to as the general wildlife measures of a proposed order. Draft GWMs are typically included in a consultation package to allow for review and comment on the operating procedures for a particular WHA. Standard GWMs are written with regard to the particular biology of the wildlife species of interest along with regard to specific operational issues, including timing issues, restrictions or allowances as appropriate.
- **UWRs (Ungulate Winter Ranges)**: A UWR is a site with specific habitat conditions necessary for the winter survival of an ungulate. The UWR design process follows the same principles used for WHAs.

Mule deer. Photo Credit: Jerry Mitchell

- **VQOs (Visual Quality Objectives)**: VQOs are defined in the *Forest Planning and Practices Regulation* as providing qualitative descriptions of expected visual conditions.

Monitoring

- **Visual Quality Management**: see the section on visual quality monitoring (p. 20).
- **Habitat Management**:
  - Initial analysis estimate that habit protection under the IWMS would impact about 1% of the timber supply provincially in both the short and long-term. Impacts of GAR orders are tracked by natural resource districts and compared to that metric.
  - Over the past decade, a primary focus of the habitat management program has been implementation of GAR orders to establish WHAs and UWRs. An approach for monitoring the condition and effectiveness of WHAs and UWRs is currently under development and review. See the section on Wildlife Habitat (p. 35).

OLD GROWTH MANAGEMENT

Conserving old growth is an important part of resource management in British Columbia. Old growth forests are defined based on a combination of factors that include the age of the stand and associated ecological features such as climax tree species, large live trees, standing snags, rotting logs on the ground, and patchy gaps in the understory. Old growth is an important element of biodiversity and is managed in the province at a variety of scales, through more than 30 different conservation designations.

At the landscape scale, parks and protected areas ensure representation of ecologically unique areas, many of which include old growth forests. In 2015, a new Land Use Order for the Great Bear Rainforest, covering 6.4 million hectares, requires 85% of the area to be reserved from harvesting, with more than 2.3 million hectares fully protected. Throughout the province, forest management and logging practices are managed in significant part by the FRPA. FRPA creates legal objectives for the conservation and protection of wildlife, fish, biodiversity, soils, water, forage, visual quality, and cultural heritage resources.

Old growth forests throughout the province are also managed by Provincial Non-spatial Old Growth Orders and/or regionally specific old growth orders. These orders set minimum requirements for old growth representation across all ecosystems in the province. In many areas, old growth management areas (OGMAs) have been mapped and identified to ensure old growth conservation into the future.

Habitat designations for wildlife, including ungulate winter ranges for species such as deer, elk and mountain goat and wildlife habitat areas for species at risk like the marbled murrelet, also protect some old growth forests. At the stand level, forestry operations are required to retain wildlife tree patches and riparian reserves to maintain biodiversity values. All liquefied natural gas and oil pipelines are legally obligated to manage and conserve old forest as part of their environment assessment certificate conditions.

Currently, the Province is developing a new assessment tool to evaluate the cumulative impacts to old growth forests as part of the Cumulative Effects Framework.

Statistics

Approximately 58% of British Columbia is forested land, of which about 22 million hectares (40%) is actually available for use by the forest industry. The remaining forested land base is unlikely to be harvested because the area:

- has been specifically identified as an old growth management area in order to conserve biodiversity (>1.7 million hectares);
- is being reserved along streams and around lakes;
- is included in WHAs for identified wildlife species;
- has sensitive soils or unstable terrain;
- is located where logging or transportation is uneconomical; or
- is protected from logging in conservation designations such as parks or protected areas.

Omineca Region:

Photo Credit: Leslie McKinley

B.C.'s newest Class A provincial park (March 2016) is the Ancient Forest/Chun T'oh Whudujut Park. Approximately 120 kilometres east of Prince George, this park protects almost 12,000 hectares of one of the only inland temperate rainforests in the world. It includes almost 6,000 hectares of old cedar stands with some trees up to 5 metres in diameter and 2000 years old, and more than 400 plant species, some of which are rare and endangered.

Northeast Region:

Photo Credit: Steve Gordon

In 2015, a group of 79 OGMAs were established in the Dawson Creek Timber Supply Area under the *Oil and Gas Activities Act*, covering a total area of 82,841 hectares in the Boreal Foothills, Boreal Plains, Wet Mountain, and Wet Trench ecosystems. Work is underway to establish additional OGMAs to ensure regulatory alignment between industrial sectors and to secure old growth protection into the future.

The Province is also working with Treaty 8 First Nations under the government-to-government agreement on special management measures, such as OGMAs, that will meet mutual objectives.

Skeena Region:

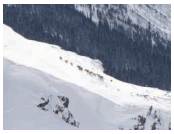


Photo Credit: Len Vanderstar

In 2016, three orders under the Land Use Objectives Regulation established objectives in the Morice, Cranberry and Nass South areas of the Skeena Region to protect old growth forests, seral distribution, wildlife trees, riparian areas, pine mushrooms, water, cultural heritage resources, goshawk and other values. Three orders under the Environmental Protection and Management Regulation also established over 500 old growth management areas in this area, totalling 157,000 hectares. In addition, the Telkwa Caribou Wildlife Habitat Area, an area of 230,000 hectares, was established to protect woodland caribou and the old growth forests the species depends on.

Cariboo Region:

Photo Credit: BC government

In the Cariboo Region, 422,038 hectares have been established as permanent OGMAs, with an additional 146,453 hectares of temporary OGMAs to make up shortfalls in old forest in permanent OGMAs and other no- harvest areas. Where possible, OGMAs include unique values such as First Nations cultural heritage sites. Work is underway to review the spatial OGMA layer in light of mountain pine beetle salvage harvesting to ensure old forest values are maintained while addressing legitimate forest health concerns.

Kootenay-Boundary Region: The Kootenay-Boundary Land Use Plan (KBLUP) Order specifies the amount of old and mature forest that must be maintained within each BEC variant for each landscape unit. Although statutory spatial OGMAs do not exist in the East Kootenays, non-statutory OGMAs are in place, and are being recognized by licensees and BCTS in order to meet KBLUP targets. For areas without OGMAs mature and old forest is managed by the licensees through their tracking of seral stage by landscape unit as required by the provincial old growth order.

Photo Credit: Mike Daigle

West Coast Region:

Photo Credit: Emily Barnewall

The Great Bear Rainforest Land Use Order was established on January 28, 2016 and a series of agreements have been signed with First Nations, forestry companies and environmental groups. The order achieves low ecological risk across the Great Bear Rainforest and covers 6.4 million hectares (an area larger than Switzerland), which will conserve 85% of the forest and 70% of the old growth.

The Coastal Douglas-fir biogeoclimatic zone (CDF) is a unique set of ecosystems that occurs on a narrow strip of southeast Vancouver Island, the Gulf Islands, and the Sunshine Coast. The rain shadow of Vancouver Island and the Olympic Mountains creates a Mediterranean-like climate, which enables a rich flora and fauna to thrive. The zone includes a wide variety of ecosystems, including Garry Oak ecosystems, wetlands, and shorelines, in addition to Douglas-fir dominated forests. Eighty percent (80%) of the CDF zone is private land. The Province supports CDF stewardship and conservation efforts through several initiatives, including the Coastal Douglas-fir Conservation Partnership (www.cdfcp.ca). In 2010, a new land use order increased protection of the Coastal Douglas-fir ecosystem on provincial Crown land to almost 40%.

South Coast Region:

Photo Credit: Andrea Lyall

OGMAs are currently established in 58 of 69 landscape units across three districts in the South Coast Natural Resource Region, totalling 186,198 hectares of Crown forest.

In 2016, all South Coast Natural Resource Region OGMAs were established through the *Oil and Gas Activities Act* to broaden the legal scope of OGMA establishment and demonstrate FLNRO's commitment to maintaining old growth and biodiversity across all resource sectors.

Thompson-Okanagan Region: In 2013, legal OGMAs, covering over 200,000 hectares, were established in the 33 landscape units of the Thompson River Natural Resource District. There have been no changes to the status of OGMAs in the Cascades and Okanagan Shuswap Natural Resource Districts; their OGMAs remain spatial non-legal entities. A 2014 monitoring report indicated that forest licensees are respecting the intent of the non-legal OGMAs and when they are logged or incurred upon by forest licensees, they are being replaced.

Photo Credit: Rob Martin

Figure 1: *Summary of old growth management across natural resource regions.*

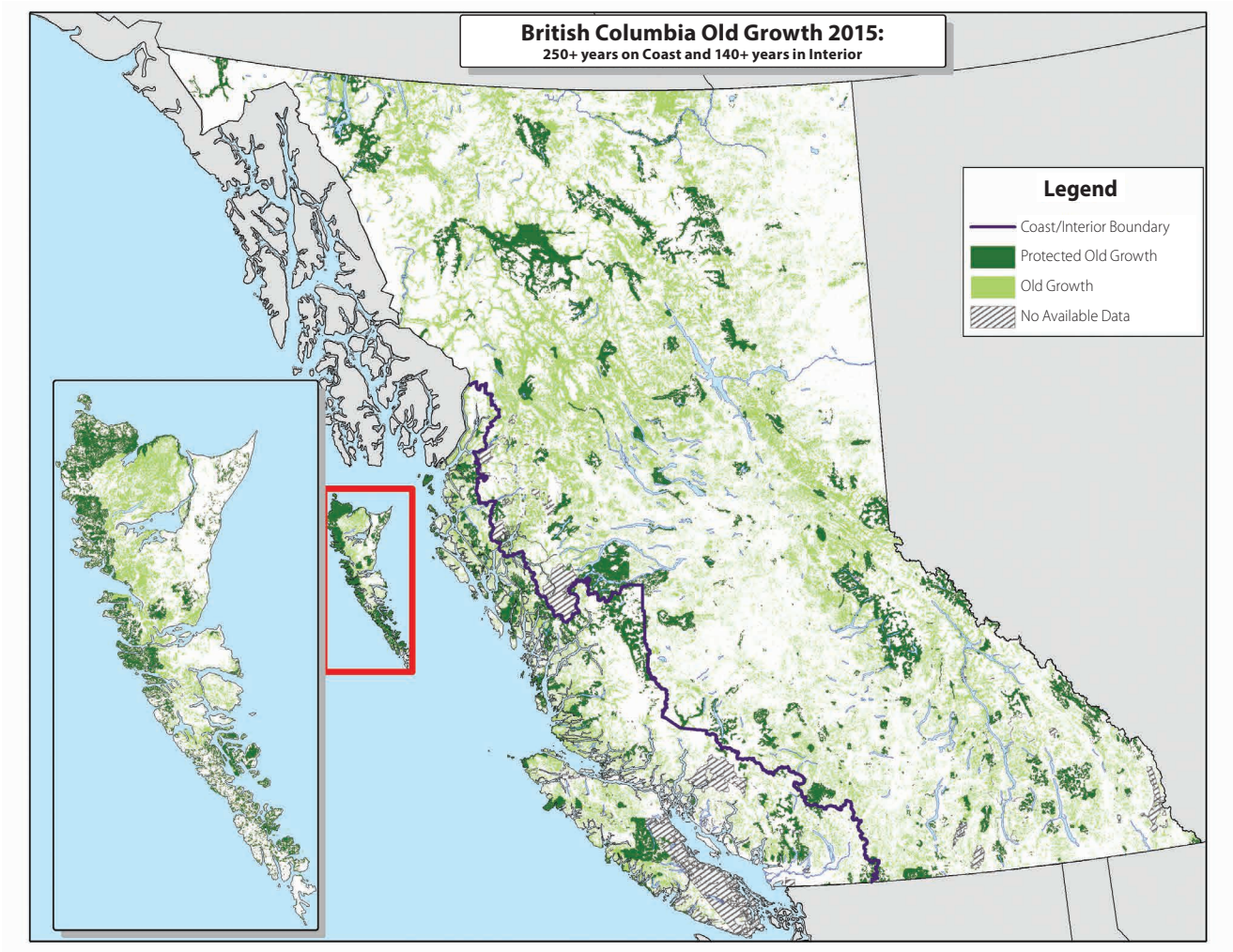


Figure 2: *British Columbia old growth.*

LANDSCAPE-LEVEL BIODIVERSITY

Biodiversity is the totality of genes, species and ecosystems within a region. In British Columbia, it has been assumed biodiversity can be more likely maintained if forest management seeks to retain habitat patterns and seral stages that are similar to those of natural landscapes. In this report, only forested ecosystems and seral stage distribution have been considered. This is not a compliance report against legal orders, but rather an inventory of the current state of landscape-level biodiversity. In management unit-level Multiple Resource Value Assessment (MRVA) reports, landscape-level biodiversity reporting will be used to provide context to stand-level biodiversity reporting.

Seral stage distribution is reported by biogeoclimatic (BGC) zones. BGC zone is the broadest level of the hierarchical BGC ecological classification system (BEC). The BEC system uses a combination of vegetation, geology and climate to define a given ecosystem and sites within a given BGC zone share the same broad macroclimate. In a forested context, seral stage defines broad developmental stages between bare ground (post disturbance) and old growth. The following BGC zones are referred to in this report:

- Boreal White and Black Spruce (BWBS)
- Coastal Douglas-fir (CDF)
- Coastal Western Hemlock (CWH)
- Engelmann Spruce Subalpine Fir (ESSF)
- Interior Cedar Hemlock (ICH)
- Interior Douglas-fir (IDF)
- Mountain Hemlock (MH)
- Montane Spruce (MS)
- Ponderosa Pine (PP)
- Sub Boreal Pine Spruce (SBPS)
- Sub Boreal Spruce (SBS)
- Spruce Willow Birch (SWB)

In addition to landscape-level biodiversity being reported across the full extent of a BGC zone it is also reported for that portion of the BGC zone that resides within 100 kilometres (km) of a major sawmill. A major sawmill is defined as a sawmill that produced at least 40 million board feet of lumber in 2014. Considering both geographic extents allows the impact of the spatial nature of resource development over time on landscape-level biodiversity to be explored. For reference, maps of all BGC zones (figure 3) and BGC zones within 100 km of a major sawmill (figure 4) are provided below.

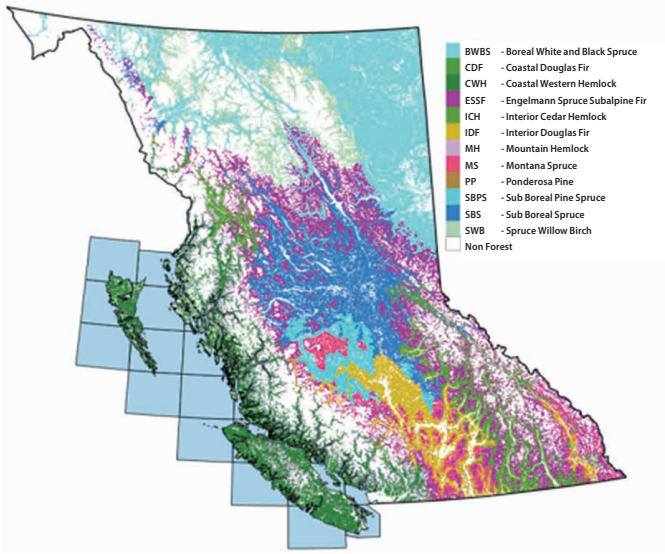


Figure 3: *Forested BGC zones.*

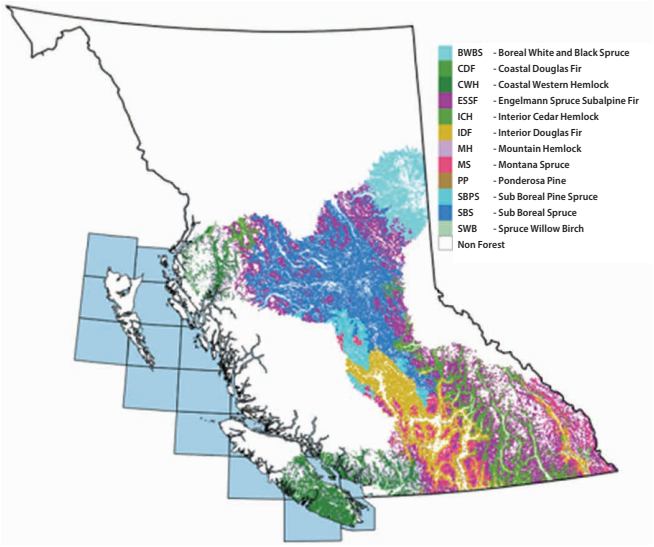


Figure 4: *Components of forested BGC zones within 100 km of a major sawmill.*

Three pairs of graphs are presented below. One graph for each pair is for the BGC zone as a whole. The other is for that portion of the BGC zone that is within 100 km of a major sawmill. Three pairs of graphs are presented on the following pages.

- Current seral stage distribution;
- The percentage of each seral stage that is protected from logging; and
- The actual seral stage as a percentage of the theoretical naturally expected seral stage.

The *1995 Biodiversity Guidebook* seral stage definitions vary by BGC variant, but provincially young is defined as less than 40 years old and across the coast old is defined as greater than 250 years. Across the interior, old is generally defined as greater than 140 years with the exception of those ICH, IDF and PP BGC variants that experience frequent stand maintaining fires. For those variants, old is defined as greater than 250 years. Across the province, the age boundary between intermediate and mature stands varies between 80 and 120 years.

Summary

Current Seral Stage Distribution

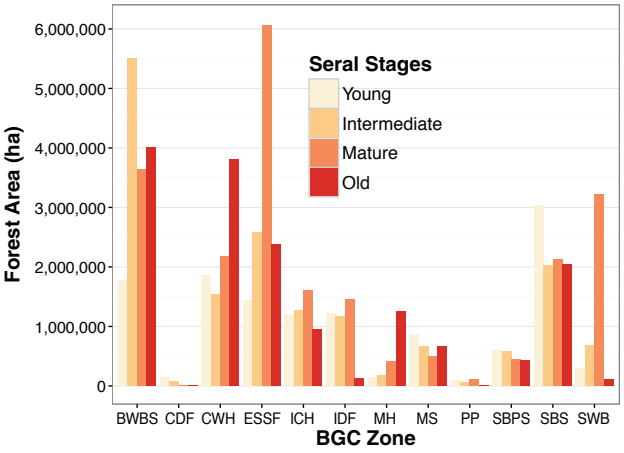


Figure 5: *Amount of forest by seral stage and BGC zone.*

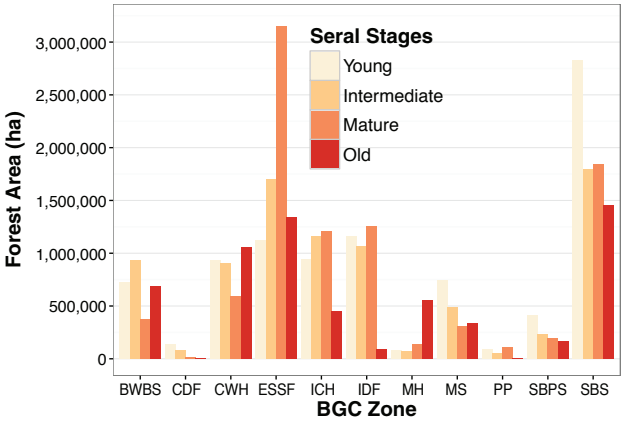


Figure 6: *Amount of forest by seral stage and BGC zone within 100 km of major sawmills.*

Figures 5 and 6 show:

- "Young" is the largest seral stage in the Montane Spruce (MS), Sub Boreal Spruce (SBS) and Sub Boreal Pine Spruce (SBPS) BGC zones, reflecting the salvage of dead timber caused by the mountain pine beetle (MPB) epidemic.
- The proportion of the Boreal White and Black Spruce (BWBS) zone that is "Young" within 100 km of major sawmills is more than twice that across the zone as a whole.
- The proportion of the Interior Douglas-fir (IDF), Ponderosa Pine (PP) and Coastal Douglas-fir (CDF) zones that are "Old" is small to negligible and reflects the proximity of these BGC zones to milling facilities. However, seral stage is difficult to define in the dry-belt portion of the IDF where selection harvesting was historically practiced.
- The proportion of the Coastal Western Hemlock (CWH) zone that is "Old" is significantly greater overall than within 100 km of major sawmills.
- No Spruce Willow Birch (SWB) zone exists within 100 km of a major sawmill.

Degree of Protection from Harvest

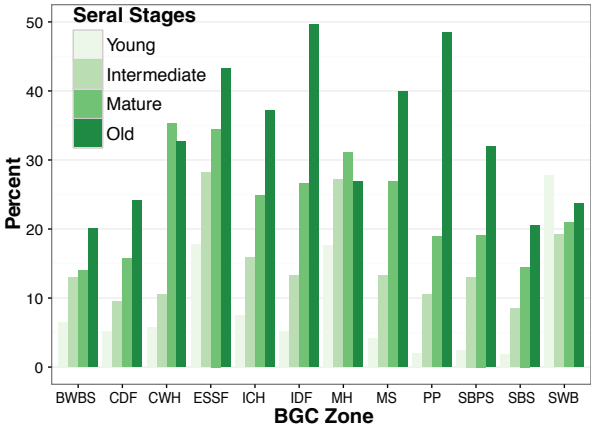


Figure 7: *Percent of seral stage protected from harvest by BGC zone.*

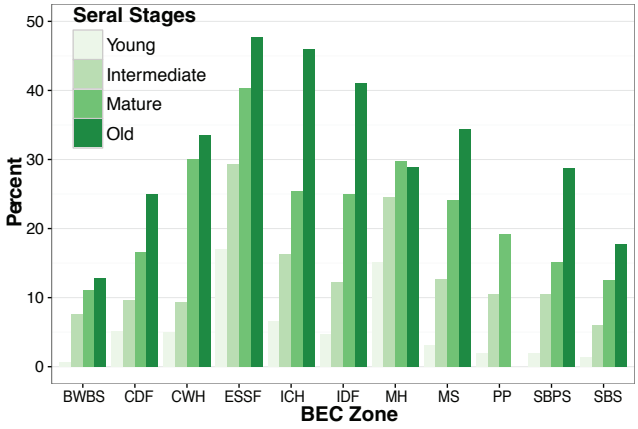


Figure 8: *Percent of seral stage protected from harvest by BGC zone within 100 km of major sawmills.*

Figures 7 and 8 show that the Province's efforts to protect biodiversity have focussed on protection of the "Old" seral stage as government regards this as "one of the most effective ways of conserving biodiversity at the landscape level."[1]

Comparison to the Theoretical Natural Seral Stage Distribution

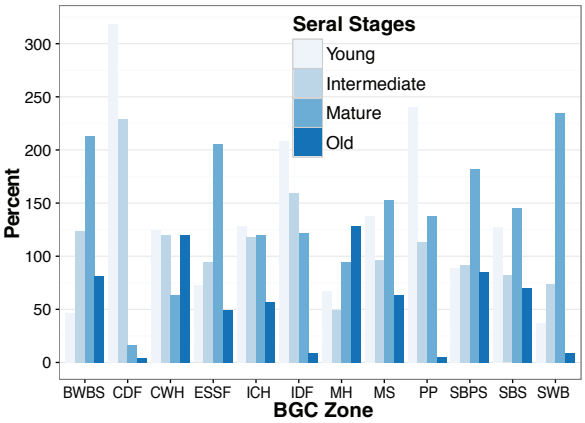


Figure 9: *Percent of theoretical natural seral stage by BGC zone.*

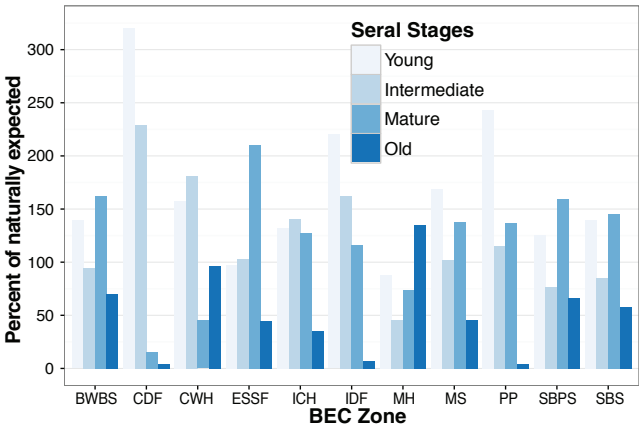


Figure 10: *Percent of theoretical natural seral stage by BGC zone within 100 km of major sawmills.*

Figures 9 and 10 show:

- The Spruce Willow Birch (SWB) zone is far from existing major sawmills and has experienced little harvest across the entire BGC zone. Yet the observed "Old" seral stage is only 9% of the theoretical naturally expected. This suggests that the theoretical naturally expected amount of "Old" in the SWB may be overestimated.
- The actual amount of "Mature" Montane Spruce (MS), Sub Boreal Pine Spruce (SBPS), and Sub Boreal Spruce (SBS) zones on the landscape may still be more than naturally expected (despite mountain pine beetle salvage) which would be consistent with fire suppression efforts over the last century. However, a significant portion of this "Mature" forest is likely dead, but not salvaged. Death is not reflected in the data.

1 FPB/SIR/36 June 2012.

- Similarly, the Boreal White and Black Spruce (BWBS), Engelmann Spruce-Subalpine Fir (ESSF), and SWB zones had significantly more "Mature" forest than naturally expected.
- The amount of "Young" and "Intermediate" forest in the Coastal Western Hemlock (CWH) zone is greater than naturally expected. This observation is magnified within 100 km of major sawmills.
- The Mountain Hemlock (MH) zone is unique in that both overall and within 100 miles of a major sawmill, the amount of "Old" forest is more than naturally expected. This may reflect the economics of harvesting in this BGC zone.

Opportunities for Improvement

The *1995 Biodiversity Guidebook* describes how biodiversity can be maintained through forest management retaining habitat patterns and seral stages that are similar to those of natural landscapes. However, the guidebook also discusses how biodiversity on a managed landscape will be different than if there were no human disturbance of any kind. Figures 8 and 9 illustrate this. Government and resource managers are consistently re-evaluating biodiversity through things like seral-stage distribution and total amounts of old and mature forests. This monitoring and reporting drives management choices, ensuring biodiversity is being managed in perpetuity. For example, how much "Old" forest is required today, and how much "Mature" forest is required for recruitment in order for "Old" forest to persist indefinitely?

VISUAL QUALITY

The B.C. government is entrusted with managing visual impacts on Crown forest land. The Province's visual resource management program conducts a range of activities to ensure that scenic quality expectations are met.

Visual resource management is about identifying scenic areas and managing forestry activities on the landscape to meet the needs of the public, visitors and other resource users. Visual quality objectives (VQOs) guide these forest management activities. Five levels of management are prescribed:

- Preservation (P)
- Retention (R)
- Partial Retention (PR)
- Modification (M)
- Maximum Modification (MM)

On a sliding scale, preservation allows very little visual alteration while maximum modification allows for considerable visual alterations.

The key evaluation question for the visual quality resource value is: *How are we managing views in scenic areas and achieving VQOs?* To answer this question, the impact of resource development on VQOs is assessed relative to an identifiable visual landform. The term "landform" is used to define the unit against which to measure and evaluate forest alterations.

The visual quality monitoring protocol evaluates the achievement of VQOs by assessing cutblock design, the percentage of landform alteration, roads, tree retention, and viewpoint importance. The five VQO achievement categories are:

1. Well Met
2. Met
3. Borderline
4. Not Met
5. Clearly Not Met

The achievement of VQOs is shown separately for cutblocks harvested under the Forest Practices Code (with forest development plans) and cutblocks harvested under FRPA (with forest stewardship plans).

Example of a visual quality visually sensitive forest landscape.

Visual Quality Results

This section provides a high-level summary of results from assessments of landforms with VQOs in the province's eight natural resource regions. Additional detail by region is provided in the ADM's Stewardship Report on Regional FREP Results. In general, for those landforms that did not meet the VQOs, the percent of landform altered by openings was high for the assigned VQOs and not compensated for by design or tree retention.

Table 1: *Visual quality regional results.*

Region	Visual Quality Evaluation Rating					Count of VQOs that did not meet standards
	Well Met	Met	Borderline	Not Met	Clearly Not Met	
Cariboo (*n* = 65)	58%	9%	5%	6%	22%	6 M, 10 PR, 2 R
Kootenay-Boundary (*n* = 53)	42%	15%	15%	6%	23%	4 MM, 10 PR, 1 R
Northeast (*n* = 8)	Insufficient data for analysis					
Omineca (*n* = 75)	64%	5%	15%	0%	16%	2 M, 8 PR, 2 R
Skeena (*n* = 110)	59%	15%	12%	4%	10%	3 M, 11 PR, 1 R
South Coast (*n* = 113)	70%	16%	8%	3%	4%	1 M, 6 PR, 1 R
Thompson-Okanagan (*n* = 79)	46%	14%	10%	8%	23%	2 M, 15 PR, 5 R
West Coast (*n* = 117)	62%	15%	11%	9%	3%	12 PR, 2 R

STAND-LEVEL BIODIVERSITY

The goal of stand-level biodiversity monitoring is to determine whether the present policy of retaining wildlife tree patches and riparian reserves is achieving the desired levels and types of structures to maintain species diversity. The key evaluation question for the stand-level biodiversity resource value is: *Is stand-level retention providing the range of habitat and the structural attributes understood to be necessary for maintaining species dependent on wildlife trees and coarse woody debris?* To answer this question, the impact of harvesting on stand-level biodiversity attributes is assessed.

The stand-level biodiversity monitoring protocol uses a standard timber cruising and line-transect plot methodology to assess the quality and quantity of standing and downed wood on a recently harvested cutblock. Some of the indicators used include:

- Density of large diameter trees and big snags;
- Tree species diversity;
- Coarse woody debris (CWD) volume; and
- CWD quality (i.e., volume of large diameter pieces and density of pieces 10 metres or longer and 20 centimetres or larger in diameter at the point of transect crossing).

Stand-level biodiversity sampling block. Photo Credit: Norma Stromberg-Jones

The resource development impact rating for stand-level biodiversity assesses the following four components and combines them in an algorithm to assign the resource impact ratings of very low, low, medium or high.

1. Percentage of treed retention
2. Retention quality
3. CWD volume
4. CWD quality

Stand-level Biodiversity Results

Between 1997 and 2014, FREP has assessed approximately 2,500 blocks. For this report, the stand-level biodiversity summary provides results from assessments done on blocks with harvesting after 2006 only, within the eight natural resource regions.

Table 4: *Stand-level biodiversity resource impact ratings by region.*

Region	Resource Impact Rating			
	Very Low	Low	Medium	High
Cariboo (*n* = 74)	45%	28%	19%	8%
Kootenay-Boundary (*n* = 58)	24%	31%	31%	14%
Northeast (*n* = 35)	31%	43%	14%	11%
Omineca (*n* = 111)	19%	29%	32%	20%
Skeena (*n* = 118)	27%	32%	27%	14%
South Coast (*n* = 109)	22%	54%	18%	6%
Thompson-Okanagan (*n* = 120)	15%	36%	42%	8%
West Coast (*n* = 159)	29%	50%	18%	3%

Cariboo Region

Eighty-four percent of the cutblocks had more than 3.5% retention and in general the density of large snags, density of big trees, and diversity of live tree species in the retention areas was representative of baseline conditions. CWD volume in the harvested areas was similar or higher than baseline, although CWD quality in terms of large pieces was lower.

Actions for continuous improvement of stand-level biodiversity in this region include leaving at least low levels of retention on every cutblock, with a range of retention over many cutblocks (e.g., 3% to 30%), and leaving higher densities of larger CWD on site.

Kootenay-Boundary Region

Seventy-two percent of the cutblocks had more than 3.5% retention and 10% (six cutblocks) had zero retention. The diversity of retained live tree species compared to baseline was generally low. CWD volume in the harvested areas was similar or higher than baseline, and CWD quality in terms of large diameter pieces was similar to baseline in most BGC zones.

Actions for continuous improvement of stand-level biodiversity in this region include leaving at least low levels of retention on every cutblock, with a range of retention over many cutblocks (e.g., 3% to 30%), and retaining the full range of tree species present pre-harvest.

Northeast Region

Ninety-one percent of the cutblocks had more than 3.5% retention. In general, the density of large snags, density of big trees, and diversity of live tree species found in the retention areas was representative of baseline conditions. CWD volume in the harvested areas was similar or higher than baseline, and CWD quality in terms of large diameter pieces was just slightly lower than baseline.

Actions for continuous improvement of stand-level biodiversity in this region include leaving at least low levels of retention on every cutblock, with a range of retention over many cutblocks (e.g., 3% to 30%), and continuing to retain valuable ecological traits such as large trees and snags in densities similar to pre-harvest conditions.

Omineca Region

Eighty-five percent of the cutblocks had more than 3.5% retention. In general, the density of large diameter trees was representative of baseline conditions for the SBS BGC zone, but lower in the ICH. CWD volume in the harvested areas was slightly lower than baseline, and CWD quality in terms of large diameter pieces was low compared to baseline.

Actions for continuous improvement of stand-level biodiversity in this region include leaving at least low levels of retention on every cutblock with a range of retention (e.g. 3% to 30%) over many cutblocks, retaining a higher density of large diameter trees in the ICH zone, and improving CWD quality by leaving more large diameter pieces in the harvest areas.

Skeena Region

Eighty-five percent of the cutblocks had more than 3.5% retention. The predominant sampled BGC zones were SBS and CWH. The density of retained large diameter trees was low for both these zones compared to baseline. Diversity of live tree species was similar to baseline for SBS, but lower for the CWH. CWD volume in the harvested areas was similar or higher than baseline, and CWD quality in terms of large diameter pieces was similar to baseline for the CWH, but lower for the SBS.

Actions for continuous improvement of stand-level biodiversity in this region include leaving at least low levels of retention on every cutblock with a range of retention (e.g. 3% to 30%) over many cutblocks, retaining the full range of tree species in the ICH, and leaving higher densities of large diameter CWD in the SBS zone.

South Coast Region

Ninety-four percent of the cutblocks had more than 3.5% retention. The density of retained large snags and large diameter trees was low compared to baseline. CWD volume in the harvested areas was similar or higher than baseline, and CWD quality in terms of large diameter pieces was slightly lower than baseline.

Actions for continuous improvement of stand-level biodiversity in this region include retaining the full range of tree species, continuing to retain large diameter trees and large snags in the CWH dry maritime and CWH dry submaritime subzones, and improving outcomes in other subzones, particularly looking for opportunities to safely leave large snags as ecological anchors.

Thompson-Okanagan Region

Eighty-six percent of the cutblocks had more than 3.5% retention. The predominant sampled zones were MS, ICH, ESSF, and IDF. The density of retained large diameter trees was low compared to baseline. The density of large snags and the diversity of live tree species were equal or better than baseline for the MS, but lower elsewhere. CWD volume in the harvested areas was similar or higher than baseline.

Actions for continuous improvement of stand-level biodiversity in this region include leaving at least low levels of retention on every cutblock with a range of retention over many cutblocks (e.g., 3% to 30%), and retaining higher densities of large diameter trees.

West Coast Region

Ninety-seven percent of the cutblocks had more than 3.5% retention. Predominant sampled were CWH very wet, wet hypermaritime (wh), very wet hypermaritime and very dry maritime (xm) subzones. The density of retained large diameter trees and large snags was consistently low compared to baseline. The diversity of live tree species was low other than for the CWHwh. CWD volume in the harvested areas was similar or higher than baseline for all but the CWHxm, and CWD quality in terms of large pieces was similar to baseline.

Actions for continuous improvement of stand-level biodiversity in this region include retaining more large diameter trees and retaining a full representation of pre-harvest tree species.

PROVINCIAL FOREST INVENTORY

This program is managed by Forest Analysis and Inventory Branch.

Stewardship of forest resources requires reliable forest inventory and stand growth models. Supporting stewardship in B.C., FLNRO's Forest Inventory Program provides forest inventory coverage for the entire province, as well as computer models to forecast stand development under alternative management regimes and natural disturbances. Examples of the kind of information that can be generated include the section on special resource management designations on page 2. The following provides some background on the provincial Forest Inventory Program and summarizes program activities in 2015-16 in a few prominent program areas.

Background

At the annual meeting of the Association of B.C. Forest Professionals in February 2013, Minister of Forests, Lands and Natural Resource Operations Steve Thomson released a new strategic plan for the provincial Forest Inventory Program.[2] This plan guides expenditures of $80 million dollars on forest inventory, growth monitoring, and yield prediction over a 10-year period. Three years into the 10-year plan, the ministry is on track to achieve the nine targets set out in the strategic plan.

In the sections below, activities in 2015-16 for a few program areas are profiled.

Inventory Mapping

Maps of forest and land cover types are essential for planning, assessments, and overall stewardship of natural resources. FLNRO maintains a data set of inventory polygons and their attributes that map land cover (and stand type) over the surface of the province. Many different methods can be used to create and update forest inventory maps. Photo-interpretation is the traditional method. In 2015-16, five photo-interpretation projects totalling 8.7 million hectares were underway (Fort St James, Vancouver Island, Morice, Quesnel, Lakes, and Vanderhoof). Approximately three million hectares of photo-interpreted vegetation resource inventory maps were completed. The annual release of the provincial forest inventory data set was significantly delayed by complications arising from changes to the growth model, the integration of inventory from new sources, and adjustments to polygon attributes to reflect the effects of wildfire and mountain pine beetle.

New approaches to mapping include methods based on light detection and ranging (LiDAR) and methods that use Landsat satellite imagery. Several LiDAR-based inventory projects were underway in 2015-16. In the largest, a LiDAR-based forest inventory was completed for a project area in the Kamloops/Okanagan in conjunction with Tolko Industries and BC Timber Sales. This project included measurement of 227 field plots, fitting regression models, and the production of 20-metre raster map coverage for volume/hectare and other attributes for a project area of 317,000 hectares. Also in 2015-16, a Landsat-based approach was used to produce new inventory maps for the Cassiar Timber Supply Area.

2 The ministry's Forest Inventory Strategic Plan is posted at: https://www.for.gov.bc.ca/hts/vri/.

Ground Sampling

Ground samples are field plots in which crews make careful measurements of trees and other ecosystem attributes. There are several different plot types and sampling schemes used in BC. Ground sample data is used in many ways, including assessing the accuracy of inventory map products, monitoring forest growth and change, and calibrating stand growth models. Ground sampling activities are delivered by FLNRO as a co-ordinated inventory/growth and yield ground sampling program. For simplicity, three components of this program will be discussed here: i) inventory monitoring plots, ii) growth and yield experiments, and iii) legacy permanent sample plots (PSPs).

i) Long-term inventory monitoring plots are being established across the province on a 20-km grid. In 2015-16, samples on the 20-km grid were established in the Kamloops, Okanagan and Lillooet timber supply areas (TSAs), expanding coverage to a total of eight TSAs. In addition, young stand monitoring plot networks are being established in many TSAs. In 2015-16, young stand monitoring samples were established over the Prince George, 100 Mile House, Kamloops, Okanagan and Lillooet TSAs, expanding coverage to a total of 10 TSAs.

ii) Growth and yield experiments provide data on the development of managed stands and estimates of treatment response. This data is critical to the development of stand growth models. In 2015-16, the inventory program funded the re-measurement of 21 long-term growth and yield research installations.

iii) Legacy PSPs provide long records of stand growth, primarily in natural origin stands. In 2015-16, the inventory program completed the reconnaissance of 362 PSPs and the re-measurement of 150 PSPs.

Modelling

Stewardship of forest resources requires science-based knowledge of stand dynamics and tools to simulate alternative management scenarios. The inventory program provides stand growth models, associated decision support tools, and expert advice to meet the growth and yield prediction needs of a wide range of clients. Research provides the solid foundation for model building and expert advice. One priority is development of the next generation of the tree and stand simulator (TASS) growth model. TASS III will run on users' desktops and handle species mixes and multi-cohort structures. In 2015-16, a beta test version of TASS III for lodgepole pine/white spruce mixtures was released. A second priority area is the enhancement of growth models to simulate the impact of forest health agents. In 2015-16, the first generation of RustSim, a pine rust simulator, was completed. A third priority is enhancing the natural stand model variable density yield projection to better handle yield predictions for post-beetle stands. In this area, significant improvements were made in 2015-16.

There are many other components of the provincial inventory and growth and yield program. For more information, refer to *The Status of BC's Provincial Forest Inventory for 2015* posted at: https://www.for.gov.bc.ca/hts/vri/.

FOREST HEALTH MANAGEMENT

This program is managed by the Resource Practices Branch and the regional operations forest health specialists.

The provincial forest health program is responsible for: 1) monitoring forest disturbances across the provincial forested landbase and estimating impacts caused by forest health agents to forest resource values, 2) providing guidance and advice to forest practitioners on methods of preventing or minimizing forest health impacts, and 3) actively protecting forests where feasible and practical.

Western pine beetle on ponderosa pine. Photo Credit: BC government

Forest Health Monitoring and Impact Assessment

The cornerstone of forest health monitoring is the provincial aerial overview survey. This annual survey is a low resolution reconnaissance survey documenting the type, location and severity of all forest disturbances. Data generated from the survey adds to the forest disturbance record that began in 1907 and provides the only long-term information on historic forest health conditions over most of the province. Aerial surveys occur from July through September, and the summarized and digitized data is published in early December. An annual report that includes other provincial forest health surveys, studies and projects is published in early March. All of this material is available at: http://www2.gov.bc.ca/gov/content?id=D61D47FA25DB4D5DA9A19AB1806C34DB

Forest Health specialists are working closely with growth and yield specialists and timber supply analysts to improve estimates of pest impacts to timber supply. Examples of projects include the annual mountain pine beetle impact projection, pest impact modules for growth models for spruce weevil and root disease, and the recent TASS modules for western gall rust and comandra blister stem rusts (GRIM and CRIME, respectively). Forest Analysis and Inventory Branch and Resource Practices Branch have also been working together to harmonize data collection standards for young stand monitoring and stand development monitoring to improve our ability to estimate forest health impacts in 15- to 50-year-old stands that contribute to the mid-term timber supply.

Forest Health Practice Guidance

Forest health specialists at Resource Practices Branch and in the regions provide guidance to staff, licensees, consultants and the public on methods of avoiding or minimizing detrimental impacts of forest health agents particularly during reforestation. Advice on selecting the stock type, species, planting densities, and stand management practices is provided where this information is available. Specialists have been providing input on adapting to climate change where it is expected to exacerbate pest damage. Cooperation with the Tree Improvement Branch is ongoing to assist them in developing seedlots that are resistant to significant regeneration pests like spruce weevil, white pine blister rust, and hard pine stem rusts.

Protection of Forest Resources from Forest Health Agents

Active management of bark beetles and defoliating insects is led by the Forest Health Program. Although the large-scale mountain pine beetle outbreak is ending, there are parts of the province, primarily in the Kootenay-Boundary Region, where beetle suppression efforts continue to successfully protect pine stands. Beetle management efforts

for both Douglas-fir beetle and spruce beetle are also being deployed in areas where these beetles pose a significant threat to forest resource values. Defoliating insects, mainly the western spruce budworm, Douglas-fir tussock moth, and western hemlock looper, can cause serious impacts that heavily defoliate stands. Where deemed necessary to protect stands from significant damage, aerial sprays using the bacterial insecticide Btk are carried out.

A major treatment program is carried out by Resource Practices Branch on behalf of all British Columbians for gypsy moth eradication. This invasive moth poses an economic threat to agriculture and forestry, and may seriously impact the endangered Garry Oak ecosystem. Working with the BC Ministry of Agriculture, the Federal Canadian Food Inspection Agency, and the Canadian Forest Service, the gypsy moth has been successfully kept from establishing in BC since 1979.

REFORESTATION (Silviculture)

Silviculture is the art and science of controlling the establishment, growth, composition, health and quality of forests to meet the needs and values of landowners and society on a sustainable basis. This section investigates the trends since 1987 in two measures of silviculture performance:

- **Disturbances and reforestation** – How much is reforested after disturbance?
- **Incremental silviculture** – What additional silvicultural treatments have been done?

Disturbance and Reforestation

Forests disturbed by timber harvesting and other causes will reforest naturally over time. Silviculture investments, such as tree planting, accelerate reforestation and can increase future timber supply and restore ecological condition sooner.

Forests disturbed by timber harvesting can take up to seven years to regenerate,with an average of 1.9 years if planted and 5.5 years if left to reforest naturally. This is referred to as regeneration delay. As seen in Figure 14, regeneration delay accounts for the large difference between the amount of disturbance area and the amount of area that has been reforested in recent years.

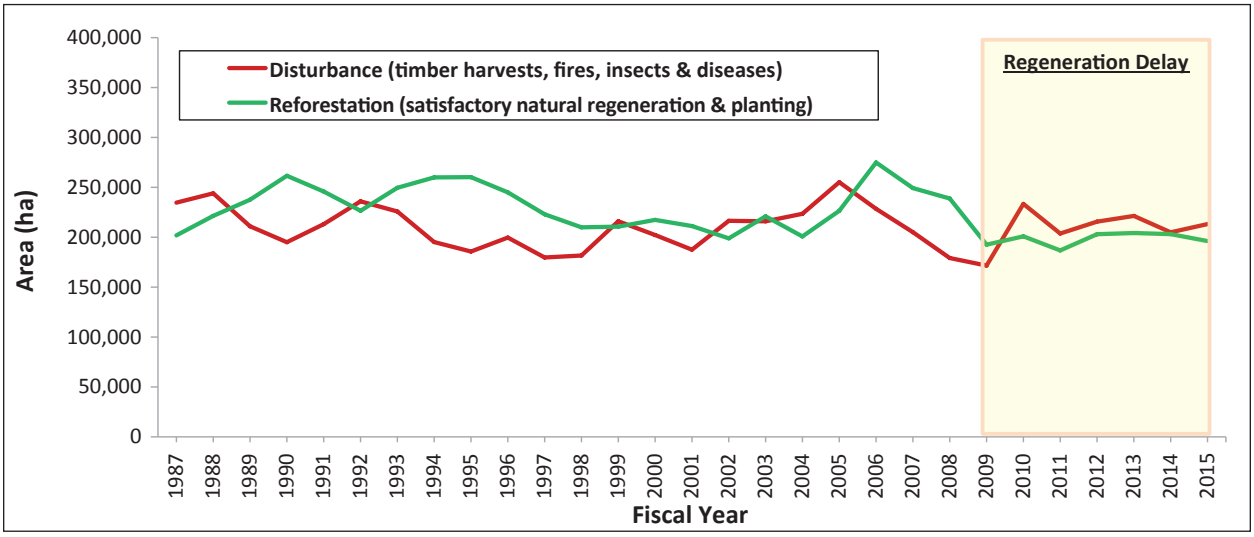


Figure 14: *Forest disturbance and reforestation on Crown land since 1987.*

In 1987, explicit reforestation obligations on public land were introduced requiring holders of harvesting rights to reforest the areas they harvest. This led to planting a greater proportion of harvested areas. In the early 1990s, increased investments in research, site preparation, improved planting methods, rehabilitation planting, and brushing ensured prompt restocking and the growth of desired trees.

Recent catastrophic wildfires and the mountain pine beetle epidemic have contributed to large areas in the province with below acceptable stocking levels. Since 2005, the Forests for Tomorrow program has funded the reforestation of these mountain pine beetle and wildfire impacted lands. (See: http://www2.gov.bc.ca/gov/content?id=EDA5DA85D4EA43BEBC5868ACA132BF2C)

Incremental Silviculture

Incremental silviculture is an investment that supports future timber supply and environmental benefits from our forests. Incremental silviculture can increase timber quantity and quality, manage forest health and fire risks, and improve specific habitats, water quality and visual landscapes. It can also create employment opportunities for communities affected by changes in the forest industry.

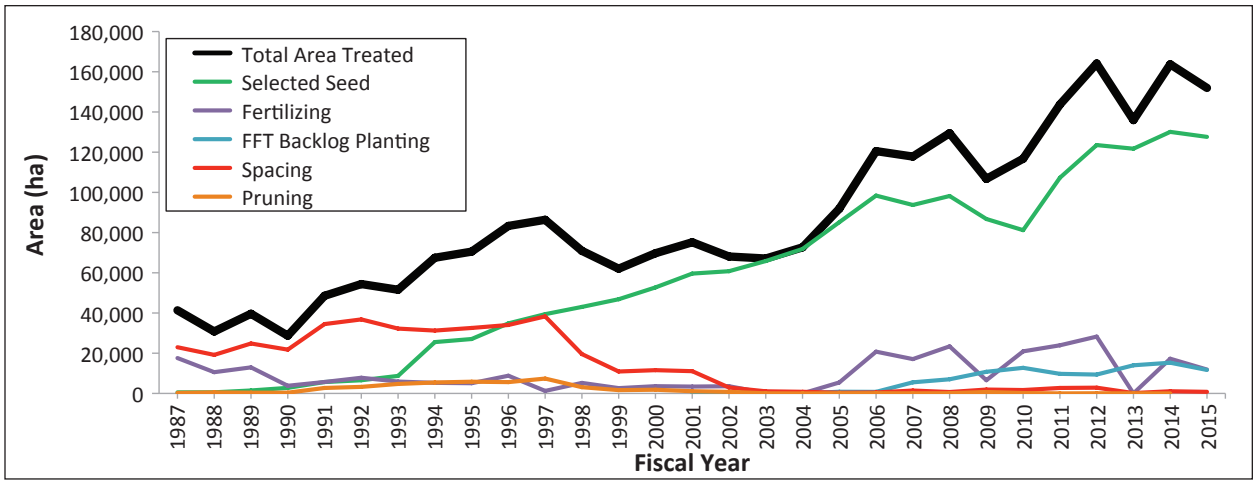


Figure 15: *Crown land incremental silviculture treatments since 1987.*

Between 1987 and 2015, investments in incremental silviculture to improve the growth and quality of future crop trees included fertilizing (279,000 hectares), pruning (46,000 hectares), spacing (400,000 hectares), and using select seed (usually from seed orchards) for planting (1,707,000 hectares).

For more information on provincial silviculture programs and projects, refer to the Resource Practices Branch silviculture website at: http://www.env.gov.bc.ca/soe/indicators/land/silviculture.html.

GENETIC RESOURCE CONSERVATION AND MANAGEMENT

The policies, plans, strategies and programs pertaining to the conservation and management of British Columbia's forest tree genetic resources are led by the Tree Improvement Branch.

Spacing trial near Terrace.
Photo Credit: Resource Practices Branch

Healthy, Resilient and Productive Forests

Conserving, protecting and managing British Columbia's forest tree genetic resources is the foundation for economic, social, cultural and the ecological goods and services that flow from B.C.'s forests. *Why is this important?* Genetic diversity – a fundamental component of biological diversity – is the total amount of genetic variation within individual organisms, within populations, and among populations of the same species. Genetic diversity plays an important role in the survival, adaptability, and productivity of species and populations.

Maintaining genetic diversity through the practice of genetic resource conservation and management ensures forests and ecosystems are healthy, resilient and productive, and able to effectively respond to natural disturbance events such as wildfire, pests and disease infestations, drought and frost, as well as the impacts of climate change.

Lemon Creek watershed west of Keremeos, B.C.
Photo Credit: Jack Woods

The provincial Tree Improvement Program (http://www2.gov.bc.ca/gov/content?id=6919718586C44A20B14EE9A9AE6C8B7D) helps guide reforestation and silviculture investments through forest genetic research, tree breeding, and seed orchard programs. These programs also inform adaptation and genetic conservation strategies that protect, maintain and conserve rare and important forest genetic resource values and natural capital assets (e.g., seed banks).

Tracking how we use our forest tree genetic resources (from source to planting site) is an important tool for the monitoring, assessment and continuous improvement of forest and ecosystem best management practices.

Forest Regeneration

Reforestation using a range of genetically adapted seed sources is an accepted genetic resource management strategy. After a disturbance by forest fire, forest pest or forest harvest, reforestation occurs by natural regeneration (roots or seed) or by planting. Seed used for planting may come from one or more genetic sources, including seed orchards and natural stands.

Select seed, characterized as seed selected for specific traits (growth, pest resistance, wood density), includes seed from orchards and natural stand superior sources (selected and tested).

The area reforested (hectares) by genetic source from 1987 to 2015 is reported in the chart below.

Interior Douglas-fir seed orchard.
Photo Credit: Jack Woods

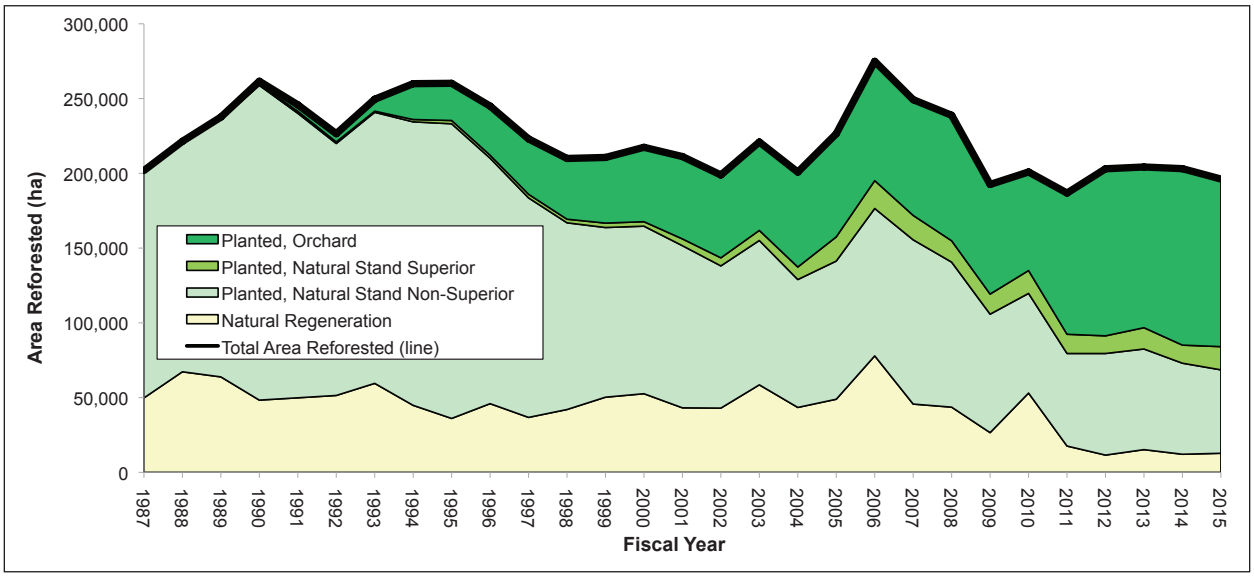


Figure 17: *Forest regeneration by genetic source in B.C. (1987–2015).*

Over the past two decades, the use of select seed has continued to rise as advances are made in forest tree genetic adaptation research and tree breeding, and as a result of new seed orchards coming online.

This result is indicative of the substantial effort underway to meet the target set by the Forest Genetic Council of British Columbia to "increase select seed use to 75 percent of the provincial total sown by 2020."

Climate-Based Seed Transfer

Science-based seed transfer supports effective reforestation by incorporating trees that are better adapted for survival under a changing climate.

The climate-based seed transfer (CBST) project and climate action initiative aims to transition British Columbia's seed transfer system from a geographically based science, policy and decision support framework to one that is climate-based. For resource managers and forest practitioners, this will mean the ability to match seed used for reforestation to climatically suitable planting sites.

The CBST will also provide a science foundation, policy and decision support framework for the use of assisted migration as a climate change adaptation strategy. For more information, see: http://www2.gov.bc.ca/gov/content?id=3B29FA5964254123BE2C482F43E12FA9.

SECOND GROWTH FORESTS (Timber Resource Value)

The health, productivity and diversity of our future forests depend on replacing harvested stands with new growth stands of the same or improved species mix and genetic diversity. The focus of the timber resource value team is to set benchmarks and monitor the regeneration of our productive forest lands. Stand development monitoring (SDM) version 2.0 is a collaborative continuous improvement effort between Forest Analysis and Inventory Branch and Resource Practices Branch. The key outcome of the data collected using this protocol is to determine the health and productivity of young managed stands. The question that SDM2.0 will answer is: *What future productivity, as expressed through timber volume, are we likely to achieve at rotation from managed stands that are currently 15-50 years old?*

This assessment measures key forest health and growth and yield attributes, and provides valuable information for silviculture, forest health and inventory policy decision making. The three primary objectives of SDM 2.0 are:

1. Collect data on the type, incidence and severity of forest health agents;
2. Collect stand attribute data (species, height, diameter, density and height to live crown); and
3. Target specific district/TSA issues/concerns regarding second growth stands.
4. The SDM monitoring protocol is being updated (continuous improvement) in 2016 and will be operationally piloted in the 2017-18 field season.

SOILS

Under the Province's FRPA, soil disturbance is classified into two main types:

1. Areas occupied by permanent access structures; and
2. Areas occupied by soil disturbance in the net area to be reforested.

Soil disturbance in the net area to be reforested is further categorized as the area occupied by corduroyed trails, compacted areas, areas of dispersed disturbance, and un-rehabilitated temporary access structures.

FRPA sets objectives for soil conservation. These objectives are to:

- Limit the extent of soil disturbance caused by harvesting and silviculture activities that negatively affect the physical, chemical, and biological properties of the soil;
- Conduct forest practices in a manner that addresses the inherent sensitivity of a site to soil-degrading processes to minimize detrimental soil disturbance, landslides, soil erosion, and sediment delivery to streams; and
- Limit the area of productive forest land that is occupied by permanent roads, landings, pits, quarries, and trails to the minimum necessary to safely conduct forest practices.

Past reports have looked at whether: *forest practices have been successful in preventing site disturbances that are detrimental to soil productivity and hydrologic function.* In 2015, an assessment of permanent and temporary roads throughout the province was initiated using Google Earth imagery. This assessment is designed to answer questions related to the extent (length and area) of permanent and temporary resource roads throughout B.C. and their potential impacts on hydrology and timber productivity. The assessment will analyze the extent of roads and road rehabilitation at randomly selected sites in each of the Province's resource districts using 4000 ha Google Earth tiles and high resolution imagery.

CLIMATE CHANGE MANAGEMENT AND TRENDS

Understanding the science of climate change, how forests are changing and will change in a future climate, and how forests can be adapted to a changing climate is necessary to ensure forests remain productive and our forest ecosystems remain resilient. Using innovative methods and an interdisciplinary approach, our team of economists, research scientists, professional foresters, and climate change policy experts are creating products to support forest managers to make decisions that are appropriate in a changing climate.

Trends

- **Climate**: As a whole, B.C. has become warmer and wetter over the last century. Winter has warmed the most. Extreme rainfall and dry conditions have increased and snowpacks have decreased. Due to the effects of greenhouse gas emissions already in the atmosphere, climate scientists agree these warming trends will continue. By the end of this century, mean annual temperature in B.C. could be at least 1.7 to 4.6°C warmer than it was in the last few decades. More winter precipitation will likely fall as rain rather than snow, resulting in lower snowpacks, earlier and more rapid snowmelt, and longer fire seasons.
- **Regional Differences**: The interior of B.C. is expected to warm more than coastal B.C., with the greatest warming occurring in the North. Winter precipitation is expected to increase in all regions, but summer precipitation is expected to increase in northern B.C. and decrease in southern and coastal B.C.
- **Ecosystems**: Ecosystems will likely undergo both predictable and unpredictable ecological shifts. Climate envelopes (the climate associated with an ecosystem today) for subalpine and alpine areas will diminish in most locations, while those for grasslands, shrub-steppe and dry forested ecosystems are expected to expand. In response, ecological communities will disassemble and reassemble – sometimes into novel combinations – as populations decline, move or adapt. During this evolution, ecosystems will be strongly influenced by disturbances and invasive plants. Natural disturbance dynamics will change. Likely changes will include increased fire and drought in southern and coastal B.C., increased storms and windthrow on the coast, and more frequent and extensive mortality due to bark beetles, defoliators and diseases throughout the province. Hydrological regimes will shift due to increased evaporation, altered vegetation communities, increased storm frequency and magnitude, decreased snow accumulation, seasonal changes to precipitation, and accelerated ice melt followed by diminished glacier extent.
- **Adaptation**: Strategies to reduce risks to forest ecosystems include:
  - Promoting resilience by:
    - maintaining or increasing diversity at all scales; and
    - increasing reforestation densities to offset forest health threats.
  - Guiding ecological transformation by:
    - reforestation with species and provenances that are suitable to today's and future climates (CBST);
    - maintaining landscape connectivity and assisting migration;
    - combating detrimental change by controlling invasive plants and excessive disturbance; and
    - limiting cumulative effects of multiple land-use activities.

- Strategies to reduce risks to forestry dependent communities include:
  - increasing monitoring of change;
  - strategically harvesting at-risk forests;
  - managing fire in wildland-urban interfaces;
  - increasing capacity of infrastructure to withstand extreme events; and
  - increasing community capacity to respond to change (e.g., by economic diversification).

Regional Forest Extension Notes: Regional extension notes on adapting natural resource management to a changing climate were completed in early 2016. Each extension note includes climate change projections for the region, projected impacts of climate change on ecosystems, and adaptation strategies for natural resource management. The extension notes can be found at: https://www.for.gov.bc.ca/het/climate/knowledge/knowledge.htm.

WILDLIFE HABITAT

Stand-level Wildlife Habitat Monitoring

A FREP protocol for monitoring stand-level wildlife habitat is under development. This protocol will help answer the question: *Are current harvesting practices maintaining important wildlife habitat attributes at the stand-level?* This protocol will complement other FREP monitoring procedures such as the stand-level biodiversity and riparian protocols. Draft methods for monitoring habitat for cavity nesters (e.g., woodpeckers), mustelids (e.g., marten and fisher) and ungulates (e.g., deer, moose and elk) were developed in the spring of 2016. Preliminary field testing was completed in several districts during the summer field season. Revisions to the protocol will be made based on feedback from species and habitat experts, district staff, and First Nations. Operational piloting of the revised methods is planned for spring 2017, with full implementation expected to begin in 2018.

Effectiveness of Wildlife Habitat Areas and Ungulate Winter Ranges

FREP is also developing an approach for assessing the condition and effectiveness of WHAs and UWRs to help answer: *Do WHAs and UWRs maintain the habitats, structures and functions necessary to meet the goals of the area and is the amount, quality and distribution of these areas contributing effectively with protected areas and management designations to ensure the survival of the species now and over time?* The proposed approach considers condition and effectiveness at two scales – landscape and site – and at three tiers distinguished by level of effort, focus and methods. For instance, an office assessment of disturbances and condition might provide a cursory assessment for the majority of WHAs (tier 1), whereas more detailed field measurements of habitat attributes and species occupancy may be required at a subset of sites (tier 2), and still further, more focused studies (tier 3) of species outcomes (e.g., successful breeding) may be required in some cases.

Three pilot areas were selected for developing and testing office-based analysis methods (tier 1) for assessing WHAs in 2015-16. This included development of species-specific habitat models to report the amount of habitat protected in WHAs and other habitat conservation designations at a landscape level, as well as an assessment of the condition of WHAs at the site level. The pilot report will be completed during winter 2016/17.

CARIBOU MANAGEMENT

British Columbia is home to two populations of woodland caribou (*Rangifer tarandus caribou*); the boreal population found in the northeast and the southern mountain caribou found in the Interior. Both populations have been assessed as threatened by the Committee on the Status of Endangered Wildlife in Canada. While the status is under review for the southern mountain caribou, careful stewardship of caribou herds in B.C. is nonetheless required as most populations are small and declining.

Common Caribou Management Activities

Habitat Protection

Caribou require large tracts of suitable habitat for survival. Key areas of caribou habitat are permanently protected through federal and provincial park designations, and active stewardship under FRPA through the establishment of Ungulate Winter Ranges and Wildlife Habitat Areas has protected more than two million hectares of caribou habitat since 2009. Resource review areas covering 550,000 hectares in northeastern British Columbia were established in 2010 under the *Petroleum and Natural Gas Act* to help protect boreal caribou habitat. This is being proposed for renewal under a revised boreal caribou implementation plan.

Predator Control

Predation by wolves, cougars and bears is a critical factor influencing the sustainability of many caribou herds. Direct removal of some predators has occurred in the South Peace (201 wolves removed) and South Selkirk (nine wolves removed) in 2016. Although, the level of wolf reduction that occurred in the South Peace did not halt the caribou decline, there are indications that it may have improved calf recruitment.

Maternal Penning

Predation is viewed as the main factor limiting population growth of mountain caribou. Where predation of calves is occurring, mainly in spring within six weeks of birth, capturing pregnant caribou in late winter and holding them until their newborns are older than six weeks can improve population recovery. Maternal penning projects are underway in the Klin-se-za (Moberly) and Columbia North herd areas, with seven surviving from the Columbia North pen in 2016 (adding to the nine calves released in 2014 and 11 in 2015), and 11 released from the Klin-se-za herd in 2016 (adding to the nine calves released in 2014 and five in 2015). The survival of Klin-se-za released calves has improved with an intensified wolf control program.

Human Disturbance

Caribou are susceptible to disturbance and displacement by winter recreation. Recreational snowmobile access has been closed in many areas of mountain caribou range (approximately one million hectares), including some northern herds. Monitoring compliance and undertaking enforcement activities occurs each winter by aerial and ground-based methods, with stakeholders asking for steeper fines and vehicle confiscation to increase protection. Stewardship management agreements have been signed with snowmobile clubs in three regions, a great indicator of the snowmobile sector's strong interest in caribou protection measures. Heli-ski tenure holders are subject to conditions in a memorandum of understanding to reduce the effects from helicopters, and there is a moratorium on granting additional commercial recreation tenures in mountain caribou areas.

Other Caribou Information

The provincial caribou website is: http://www.env.gov.bc.ca/wld/speciesconservation/index.html. It contains the Peace Northern Caribou Plan, Boreal Caribou Implementation Plan, and many related documents.

Actions taken under the Mountain Caribou Recovery Implementation Plan is overseen by a progress board that meets annually. This multi-sectorial group reviews the status and management activities in most southerly caribou ranges in the province and makes recommendations to all sectors and the Province to improve recovery prospects.

Given the number of caribou herds in B.C. (52), the diversity and number of threats, and the large area of caribou habitat, planning is an ongoing and important part of the Province's stewardship program. Currently, the Boreal Caribou Implementation Plan is being renewed. Work is underway to prepare a plan or plans for the many southern mountain caribou herds without a plan, and implementation objectives are being written for the province's most southerly herds.

MOOSE STATUS AND MANAGEMENT

This program is primarily managed by the Fish, Wildlife and Habitat Management Branch and regional operations.

Status

Moose are widely distributed throughout B.C. and fulfill an integral role ecologically in the maintenance of predator-prey systems. Moose are culturally important to First Nations for food, social and ceremonial purposes. They are also an important hunted species for residents and non-residents, providing economic benefits to the guiding industry and rural British Columbia.

Moose declines have been reported in many jurisdictions throughout North America. Despite this, moose have been expanding their range over the past several decades. Moose are a resilient species and under the right conditions can experience relatively quick population recovery. Moose surveys over the last decade indicate moose numbers have declined substantially in parts of the Central Interior of B.C., which has raised significant concern for wildlife managers, First Nations and stakeholders.

The most recent moose population surveys estimate the total moose population at between 120,000 and 205,000, with the largest populations located in the Cariboo, Skeena, Omineca and Peace regions.

In February 2015, the Province released the *Provincial Framework for Moose Management in British Columbia*, which provides overarching policy direction for moose management in B.C. FLNRO staff use this framework to maintain provincial consistency in management approaches and as guidance when consulting with stakeholders. The provincial goal for moose management is to ensure moose are maintained as integral components of natural ecosystems throughout their range, and to maintain sustainable moose populations that meet the needs of First Nations, licensed hunters, and the wilderness tourism and guiding industries.

Photo Credit: Dexter Hodder

Management

In B.C., moose are managed for conservation first. Once conservation goals are met, the allocation priority is for First Nations hunting for food, social and ceremonial purposes. Once these have been met, licensed hunting is allocated. The majority of moose hunting in B.C. is for bull moose only, but some cow and calf harvest is allowed where the overall population can safely and sustainably allow for it.

For the past five years, the Province has aggressively reduced licenced cow and calf moose hunts from 1,792 authorizations in 2011 to 445 in 2015. In early 2016, antlerless moose hunts were further reduced to 200 authorizations.

Since 2011, the Province has published all hunting regulation changes and the rationales on the angling, hunting and trapping engagement website at: http://apps.nrs.gov.bc.ca/pub/ahte/.

Moose Population Enhancement

The Province has committed to a comprehensive moose enhancement strategy. This strategy is exploring ways to augment moose numbers, particularly in areas where populations are experiencing declines, as well as conducting research and inventory work to better understand the causes behind the declines.

In support of this goal, FLNRO commissioned an independent report titled, *Strategy to Help Restore Moose Populations in BC* and allocated $1.2 million for 2016-17 for delivery of actions in this report. This funding is in addition to the approximately $750,000 already committed to moose management this year. The funds will be used for a variety of projects supporting moose recovery such as increased research, inventory, First Nations engagement, access management, habitat enhancement, a review of predator-prey relationships, and stakeholder engagement.

The funding will support a variety of specific wildlife management initiatives that support moose enhancement, including:

- Regional moose management plans being prepared for the Cariboo, Omineca and Peace/Liard regions to help inform future population management objectives.
- A comprehensive five-year moose study (2013-2018) to investigate recent moose population declines in B.C.'s Interior. Over 200 cow moose are being radio collared, their movements tracked, and all mortalities investigated to determine cause of death. This study is being reviewed for opportunities to expand the research to include study of calf survival.
- On Feb. 12, 2016, the Province and the Tsilhqot'in National Government (TNG) signed the Nenqay Deni Accord. A key element to the accord empowers the TNG to develop a moose harvest protocol and reporting structure for First Nation harvests.
- Staff in the Cariboo are working with a number of First Nations, including the Northern Shuswap, to develop educational materials on the importance of targeting bulls rather than cows when hunting for sustenance purposes.
- In the Omineca, staff work closely with the Society for Ecosystem Restoration in Northern B.C. (SERN) on ecosystem restoration activities, including prescribed burning to enhance ungulate populations. In 2014, SERN completed approximately 1,650 hectares (four projects) of habitat enhancement through prescribed burns – 20,000 more hectares are planned for future years.
- Citizen science is also employed. The winter tick surveillance program uses local hunters and citizen observation to collect baseline data on the distribution and severity of tick infestation, which has a direct impact on moose health, and the MooseApp, is a smartphone application launched this year that allows hunters to record sightings and location of moose in real time.

One of the key reasons the Ministry of Forests, Lands and Natural Resource Operations was formed was to better integrate land management decisions. In relation to moose, some key examples of this work include:

- The Province oversees the FRPA forest stewardship plan approval process. Improvements were made to forest stewardship plans in 2016 that include:
  - Ministerial and chief forester direction that forestry operations fully meet the integrated stewardship expectations, including wildlife;
  - District manager 'letters of expectation' for forest stewardship plans for integrated resource management, including for moose where appropriate; and
  - Guidance that states forest stewardship plans should be thoroughly updated to reflect current management issues, including issues of habitat management.
- The Province is currently developing integrated resource operation strategies (formally called integrated silviculture strategies) (https://news.gov.bc.ca/factsheets/integrated-silviculture-strategies) which take into account the much broader range of goals for the Province's forests, and incorporate landscape-level planning to manage forest harvesting, reforestation, wildlife habitat and ecosystem needs. Projects are underway in the Mackenzie TSA, Merritt TSA, and a portion of the Prince George TSA.

- Moose are also being addressed in the Forests for Tomorrow Program. Projects associated with Forests for Tomorrow must meet a number of investment criteria. While economic return is a primary focus, the program must also be delivered with an integrated resource management lens. Once key areas for moose are identified, the Forests for Tomorrow programs in those areas can look at a number of moose-enhancement components.
- As noted earlier, FREP is developing a wildlife monitoring protocol (includes ungulate/moose habitat) that is a site-level assessment of post-harvest habitat structure. This information will be used to inform forest practice improvements and monitor overall trends in habitat characteristics. The FREP wildlife habitat protocol is in the final design stage.
- Related to FREP, FLNRO is reporting monitoring outcomes through natural resource sector multiple resource value assessments (NRS MRVA). NRS MRVA reports incorporate FREP data (above) along with additional information collected through other monitoring initiatives. Information on moose populations or trends will become a standard component included in the NRS MRVA reports.
- The Cumulative Effects Framework (CEF) has identified moose as one of the limited number of resource values for more in-depth monitoring and assessment. Development of the CEF Assessment Protocol for Moose is in its final stages and will be completed soon.

STEELHEAD STATUS AND MANAGEMENT

This program is managed by the Fish, Wildlife and Habitat Management Branch and regional operations.

Status

Steelhead are found throughout much of coastal British Columbia. B.C.'s steelhead sport fisheries are world renowned, particularly in the Skeena, Dean and Fraser (Thompson) watersheds.

After a period of maximum abundance in the 1980s, steelhead numbers have declined in most areas of the province over the past two decades. As an example, the Chilcotin steelhead are now at approximately 10% of their historic abundance, and number only a few hundred. Thompson steelhead numbers have declined to approximately 430 fish; however, this estimate is uncertain and there may be fewer than 150 fish. By contrast, Skeena River wild populations are doing well.

Steelhead have a complex life history, living several years in fresh water (2-3) and several years in the ocean (2-4). This long freshwater rearing time makes the species very susceptible to habitat alteration.

Threats to steelhead habitat include increased water temperatures and loss or degradation of river habitats. Human activities that impact steelhead include agriculture, cattle grazing, and transportation corridors in or near their watersheds. Climate change and water diversions for irrigation contribute to reduced stream flows, higher summer water temperatures, and reductions in available habitat.

Various factors influence wild steelhead during the marine phase of the life cycle, such as fishing mortality (commercial and recreational), predation mortality, and ocean conditions. Factors influencing steelhead in the marine environment, to a large extent, are not under provincial management authority.

Stock assessment and trend monitoring are essential when evaluating steelhead objectives. Steelhead populations in key river systems are monitored in a variety of ways, including snorkel surveys (where divers count individual fish), electrofishing (which temporarily stuns fish), resistivity counters (a light current that counts passing fish without harming them), and monitoring of commercial fisheries through bycatch. Over 30 steelhead stocks (or stock aggregates) are assessed on a regular basis.

Each year, the Province mails approximately 15,000 surveys to steelhead anglers to help ascertain catch rates, which are valuable in analyzing population trends over time.

Management Approach

The Province released the Provincial Framework for Steelhead Management in B.C. in April 2016. The framework provides overarching direction for strategic management of steelhead.

Wild, self-sustaining steelhead populations are the focus of the recreational fishery in B.C. Reliance on the natural production of fish addresses conservation requirements, takes advantage of investments in habitat protection, and maintains a high social and economic benefit for the fishery.

Steelhead management levers include a variety of regulatory options, such as classified waters (where the number of anglers is limited to maintain quality fishing experiences) and limited entry for non-residents (e.g., Dean River). Steelhead fishing opportunities exist in almost every month of the year, at least in some part of the province. Wild steelhead are catch-and-release only. When local conditions or water temperatures are poor, the fishery can be closed.

Additionally, a limited number of steelhead hatchery programs are maintained to increase angling opportunities. There are currently 16 hatchery-augmented steelhead stocks in the province, including those in systems on Vancouver Island, the Lower Mainland, and the North Coast. However, because hatchery operations can negatively impact wild steelhead populations, they are only used where impacts can be avoided or mitigated, and where expected societal benefits exceed the costs of the program.

Retention fisheries for steelhead are allowed only for hatchery-bred steelhead. These steelhead (easily identified by anglers by their removed adipose fin) are bred and released only in select waterways to limit impact on wild stocks.

Habitat Enhancement

Maintaining productive habitats is critical to sustain healthy populations and facilitate the recovery of depressed stocks. The Province plays a key role in setting objectives; developing legislation, regulations and best management practices; and conducting compliance and monitoring. Habitat protection and restoration uses a shared stewardship model that includes governments, First Nations, industry, stakeholder and special interest groups, and the public at large. Ongoing actions include:

- In 2016, the *Water Sustainability Act* came into force, allowing easier implementation of stream closures for fish protection in times of drought.
- Critical watersheds (e.g., Nicola, Coldwater, Spius and Deadman) are being reviewed to determine if additional actions are needed to protect areas that are particularly sensitive in terms of fish habitat or high temperature.
- The Riparian Areas Regulation ensures the adequate protection of riparian habitat within all residential and commercial development governed by municipal bylaws.
- The federal government has ultimate responsibility for federal fishery practices. Steelhead by-catch during salmon fisheries continues to be a challenge, and the Province works with federal staff to ensure provincial concerns are considered and addressed.

- The Thompson-Okanagan Region is building drought resiliency through drought response planning, developing environmental flows for fish, filling key information gaps (e.g., irrigation water demand and fish lifecycle instream flow needs) on key rivers such as the Nicola, groundwater licensing, and temperature/flow modelling. All of these activities will improve the region's ability to manage instream flows for fish during times of water scarcity. Collaboration with the Government of Canada and First Nations is ongoing, principally through the multilateral Fraser Basin Council.

While marine survival is the major influence on adult production, for many decades the Province has undertaken various works to increase freshwater steelhead habitat, including:

- Increasing access of steelhead further upstream (fishways, ladders, etc.);
- Fencing stream sides to prevent cattle access into sensitive riparian habitat, and replanted stream banks to reduce erosion and counter the impacts of agriculture;
- Working with agricultural producers to improve pasture irrigation to reduce water requirements and prevent the inadvertent diversion of fish; and
- Creating dams to specifically help steelhead (e.g., saving up water so that in times of scarcity it can be released later to assist spawners in getting upriver).

RIPARIAN MONITORING

The goal of monitoring the condition of stream channels and their adjacent riparian management areas is to determine whether FRPA standards and practices are achieving the desired result of protecting fish values by maintaining channel and riparian functions. Riparian monitoring is one of the protocols of FREP undertaken by the Resource Practices Branch and stewardship staff throughout the province. The key evaluation question for the fish/riparian resource value is: *Are riparian forestry and range practices effective in maintaining the structural integrity and functions of stream ecosystems and other aquatic resource features over both the short term and long term?* To answer this question, the impacts of both resource development and natural conditions are assessed at sampled stream reaches.

The riparian protocol assesses the functioning condition of stream reaches by determining the state of 15 aspects of riparian and stream function and comparing them to the range of natural variation from pre-harvest or pre-disturbance baseline conditions. Assessment of these 15 aspects results in the stream reach being categorized into one of four functioning condition ratings.

1. Properly functioning condition
2. Properly functioning limited impact
3. Properly functioning with impacts
4. Not properly functioning

An example of a properly functioning stream. Photo Credit: Christine Galliazzo

For this report, the riparian summary provides results from assessments done on streams associated with harvesting from 2007-2014 (n = 717) only, within the eight natural resource regions.

Table 1: *Riparian condition for blocks harvested from 2007-2014.*

Region	Riparian Functioning Condition			
	Properly Functioning	Properly Functioning Limited Impact	Properly Functioning With Impacts	Not Properly Functioning
Cariboo (*n* = 47)	38%	34%	23%	4%
Kootenay-Boundary (*n* = 37)	24%	24%	43%	8%
Northeast (*n* = 33)	30%	18%	24%	27%
Omineca (*n* = 143)	53%	28%	12%	7%
Skeena (*n* = 105)	46%	38%	10%	6%
South Coast (*n* = 95)	28%	29%	25%	17%
Thompson-Okanagan (*n* = 111)	50%	20%	22%	8%
West Coast (*n* = 146)	39%	21%	21%	19%

Table 2: *Source of impacts to riparian function.*

Region	Source of Impact					
	Logging	Natural Events	Upstream Factors	Roads	Cattle	Other Manmade
Cariboo (*n* = 47)	36%	29%	15%	12%	6%	2%
Kootenay-Boundary (*n* = 37)	50%	34%	4%	10%	1%	1%
Northeast (*n* = 33)	47%	51%	0%	2%	0%	0%
Omineca (*n* = 143)	30%	44%	12%	14%	0%	0%
Skeena (*n* = 105)	39%	44%	7%	9%	0%	0%
South Coast (*n* = 95)	66%	9%	8%	16%	0%	1%
Thompson-Okanagan (*n* = 111)	47%	27%	8%	14%	3%	1%
West Coast (*n* = 146)	69%	17%	5%	7%	0%	2%

In general, opportunities to improve or maintain stream and riparian function include:

- Minimizing increases to in-stream sediment and woody debris;
- Minimizing bank disturbance and bare erodible ground;
- Minimizing stream or riparian blockages (slash and/or sediment);
- Minimizing impacts on riparian vegetation; and
- Reducing the potential for windthrow.

For a more detailed summary of regional results, please see the ADM's Stewardship Report on Regional FREP Results.

WATER QUALITY MONITORING

Fine Sediment Generation

Under FRPA, there is explicit direction to monitor the input of sediment into lakes, streams and wetlands from forestry operations. Specifically, this sediment can come from surface erosion occurring from resource roads and skid trails. Science is indicating that the most detrimental particle size to fish and water quality are two millimetres or smaller in diameter (i.e., fine sediment). Water quality monitoring, with regard to potential fine sediment generation, is one of the protocols of FREP, undertaken by the Resource Practices Branch and stewardship staff across the province. The key evaluation question for the water quality resource value is: *Are forest practices effective in protecting water quality (fine sediments)?* To answer this question, roads and natural events (e.g., slope failure) are assessed for their potential to input fine sediment into drinking water and/or fish habitat.

The water quality monitoring protocol for fine sediments assesses the "sediment generation potential" for road segments near streams or stream crossings. The five sediment generation potential categories are:

1. Very low sediment generation potential
2. Low sediment generation potential
3. Moderate sediment generation potential
4. High sediment generation potential
5. Very high sediment generation potential

Since 2008, FREP has assessed almost 6,000 stream crossings. For this report, the water quality summary provides results from recently sampled crossings (2013-2015) within the eight natural resource regions.

Very low sediment generation potential road surface. Photo Credit: Brian Carson

Table 3: *Water quality monitoring – fine sediment generation potential.*

Region	Sediment Generation Potential				
	Very Low	Low	Moderate	High	Very High
Cariboo (*n* = 105)	55%	33%	10%	2%	0%
Kootenay-Boundary (*n* = 59)	39%	44%	10%	7%	0%
Northeast (*n* = 82)	22%	28%	29%	17%	4%
Omineca (*n* = 198)	57%	31%	31%	10%	1%
Skeena (*n* = 283)	33%	32%	29%	6%	1%
South Coast (*n* = 396)	34%	36%	27%	3%	1%
Thompson-Okanagan (*n* = 111)	21%	45%	27%	5%	1%
West Coast (*n* = 586)	35%	45%	18%	2%	1%

Opportunities for improvement and/or continuation of practices that help in minimizing the fine sediment generation potential include:

- Protecting bare soil quickly after disturbance by armouring or seeding;
- Using cross ditches or kickouts to move sediment off the road;
- Constructing sediment traps;
- Increasing the number of strategically located culverts;
- Avoiding long road gradients approaching streams;
- Using good quality materials for road building; and
- Removing or breaking berms that channel water towards streams.

For a more detailed summary of regional results, please see the ADM's Stewardship Report on Regional FREP Results. For those interested in more detail about the application of the water quality protocol please visit http://www2.gov.bc.ca/gov/content?id=1A902ED2C6A04A13880FC2EDE3BC5785

FORAGE AND ASSOCIATED PLANT COMMUNITIES (Rangeland Health)

Range Program staff monitor and report on the health of rangelands using the *Rangeland Health Field Guide* (2007).[3] FREP monitoring is conducted on land under Crown grazing tenures to determine the impact of livestock grazing on uplands, wetlands and streams. To assess functionality, range evaluations focus on answering questions in relation to hydrology and soils, biotic/vegetation, erosion/deposition, the mineral cycle, nutrient inputs and channel structure, function, and diversity. Other questions such as: *What are the impacts of forest and range practices and other land uses on altering the dynamics of the system, on the quality and quantity of forage, and the plant community species composition and structure?* Specific sampling sites are often linked to licence and range use plan renewals or changes, and Land Based Investment Strategy allocations. Sites are rated in one of five categories of functioning condition as shown in Tables 7 and 8, which show a summary of rangeland health monitoring conducted in 2014 and 2015.

Table 7: *Summary of rangeland health monitoring sites by functionality for 2014.*

	PFC	Slightly at Risk	Moderately at Risk	Highly at Risk	Non-Functional
Uplands (328)	147 (45%)	82 (25%)	61 (19%)	30 (9%)	8 (2%)
Streams (90)	35 (39%)	17 (19%)	15 (17%)	15 (17%)	8 (9%)
Wetlands (105)	69 (66%)	21 (20%)	15 (14%)	0	0

Table 8: *Summary of rangeland health monitoring sites by functionality for 2015.*

	PFC	Slightly at Risk	Moderately at Risk	Highly at Risk	Non-Functional
Uplands (292)	124 (42%)	57 (20%)	50 (17%)	50 (17%)	11 (4%)
Streams (52)	29 (56%)	10 (19%)	8 (15%)	5 (10%)	0 (0%)
Wetlands (116)	75 (65%)	11 (9%)	11 (9%)	12 (10%)	7 (6%)

The results can be interpreted in three main groupings:

- "Properly functioning condition" and "slightly at risk" sites are in a healthy condition and provide the goods and services expected from healthy ecosystems.
- "Moderately at risk" sites have several attributes that make them at risk to soil loss, erosion and damage from high runoff events or prolonged drought.
- "Non-functional" to "highly at risk" sites are lacking key attributes associated with normal riparian or upland function. Streams function as drainage ditches. Wetlands lack sufficient vegetation bands and riparian soil conditions to filter nutrients, contaminants and microorganisms, or provide forage for herbivores and habitat for wildlife. Uplands have low vigour, low live ground cover, low litter, shallow rooting, disrupted carbon and nitrogen cycles, soil compaction (and possibly soil loss), and invasive plant species.

3 Fraser, D.A. 2007. Rangeland health field guide. B.C. Ministry of Forests and Range, Range Branch, Kamloops, B.C. http://www.for.gov.bc.ca/hfd/pubs/docs/mr/Mr117.htm

Collectively, 16% of uplands, 20% of streams, and 9% of wetlands are functioning below acceptable levels and require some form of remediation or change in how we manage the land base.

The distribution of livestock, grazing to safe use levels, allowing enough rest during the growing season, and grazing at the right time and for the right duration are the four main principles of range management. Following these principles can allow uplands to recover by leaving more residual cover and surface litter to promote germination of new grass seedlings and improved soil conditions. Sufficient rest promotes a more vigorous plant community and can enhance forage availability. Where forage analysis indicates a shortfall, livestock numbers can be adjusted based on the available forage and a safe level of use.

Wetland levels vary across the province. Areas that have received low snowpack and runoff are experiencing drawdown. This leaves bare soils at risk of trampling if livestock attempt to forage and access drinking water. Annual and seasonal snow and rainfalls are particularly important in recharging these wetlands.

There have been areas where small streams and non-classified drainages were impacted by the collective effects of timber harvesting and livestock grazing where no riparian reserve is left intact. There is an ongoing risk of this occurring again. Livestock are attracted to these areas due to the presence of water and desirable forage, especially later in the grazing season.

The Range Program continues to put an emphasis on riparian protection using exclusion fencing, coarse woody debris placement, and off-stream water developments to promote the health and function of riparian systems. Best management practices have been adopted in community watersheds where supplying safe drinking water is the highest priority. Improvements are continuously being made on rangelands to enhance the distribution of livestock and promote healthy plant and riparian communities.

Cattle grazing. Photo Credit: Rick Tucker

DROUGHT

Despite B.C.'s reputation in Canada as the "wet west coast", the province regularly experiences drought.

Drought is a recurrent feature of climate involving a deficiency of precipitation over an extended period of time, resulting in a water shortage. In British Columbia, drought may be caused by combinations of insufficient snow accumulation, hot and dry weather, or a delay in rainfall.

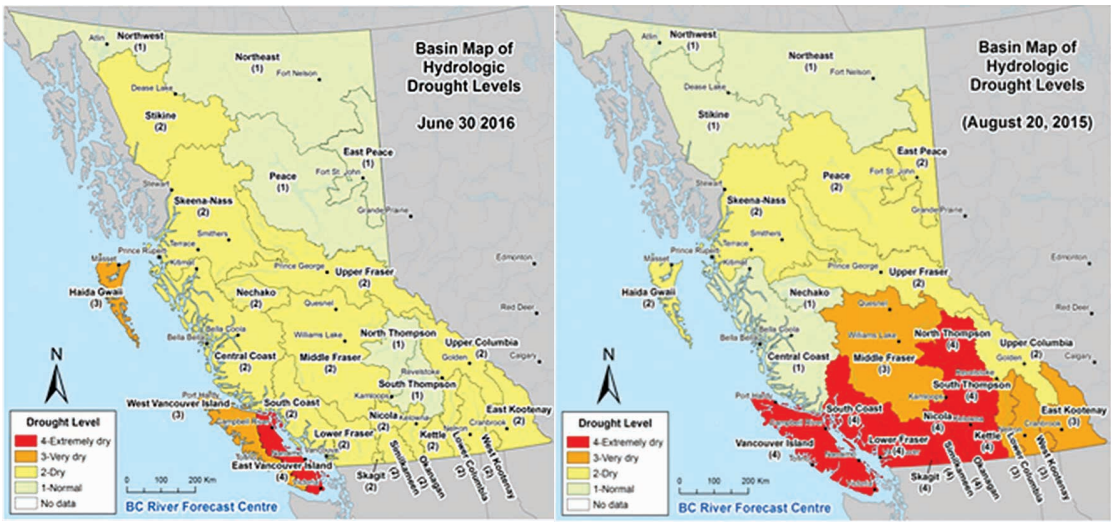
Drought conditions can affect communities and individuals in many different ways. Drought can lead to reduced water availability for agriculture, household and business use. Lower streamflows may cause warmer river temperatures, affecting fish and other aquatic life. Low streamflows can also have an impact on groundwater levels.

Drought can reduce crop growth and quality, leading to smaller harvests. Hotter temperatures that often occur alongside drought may lead to early crop maturity or ripening. Less water may be available for irrigation and animal care, and livestock production suffers and pests increase. The Ministry of Agriculture provides advice and drought management tools to farmers and ranchers who may be affected by drought and/or loss of water.

Drought Levels

Drought 2015 was the worst in recent memory, affecting most of the southern half of the province. There were many impacts – social, economic and environmental. Agriculture experienced the most impacts. During this period, there were widespread water restrictions; some communities came within two weeks of running out of water.

Drought 2016 was anticipated to be similar to 2015 as temperatures in April, May and early June broke records, resulting in a rapid melt of snowpack. However, by mid-summer, showery conditions were experienced throughout much of the province. This eased drought conditions and contributed to the flooding in the northeast parts of the province in June. The following maps show the peaks of the droughts in 2015 and 2016.



Angling Closures

To protect fish and their habitat during drought, one management tool is to restrict fishing in specified areas. Many times, this is done in order to protect the fish themselves, as warmer than normal water temperatures resulting from reduced water levels in their natural systems puts a large amount of stress on their bodies.

Monitoring

- Monitoring for drought conditions and impacts from drought occur primarily from late spring until early fall, depending on snow pack conditions and weather.
- During the summer of 2015, the Province developed a publicly accessible drought information portal. This site provides up-to-date information on drought levels for each major watershed in the province, current information on the seven-day average streamflow, 2015 and 2016 drought levels at-a-glance, as well as links to other drought information and related sites.
- The Drought Information Portal is located at: http://bcgov03.maps.arcgis.com/apps/MapSeries/index.html?appid=9042807690964463b268dfd91949d65b.

Coldwater River near Claybanks in July of 2015.

DAM SAFETY PROGRAM

The Dam Safety Program is managed by the Ministry of Forests, Lands and Natural Resource Operations.

Photo Credit: Scott Morgan

In British Columbia, dam owners are responsible for the safety of their dams. In 2015-2016, the Dam Safety Program regulated approximately 1,660 water supply dams in the province. Major dams (>9m high) are regulated by the Dam Safety Section in Victoria, while the majority of the remaining smaller dams are regulated by regional dam safety officers. Regulated dams, which divert and/or store surface water, require a water licence issued under the *Water Sustainability Act* and are subject to the Dam Safety Regulation. These structures include dams associated with hydro-electric power generation, agricultural irrigation, industrial use, municipal water supply and domestic use, as well as structures that regulate lake or river levels.

In 2015-16, FLNRO staff engaged in the development of the new Dam Safety Regulation for implementation with the *Water Sustainability Act* in February of 2016, replacing the former *Water Act* and B.C. Dam Safety Regulation. FLNRO staff were trained in appropriate areas of the new act and regulation in early 2016, and communication efforts were extended to dam owners.

To ensure an effective dam safety program, and to monitor and track regulated dams, a number of activities are undertaken by provincial dam safety officers, including:

- Education of dam owners about dam safety and owner responsibilities under the regulation;
- Audits of significant, high, very high and extreme failure consequence classification dams;
- Annual reporting by owners of high, very high and extreme failure consequence classification dams; and
- Retaining current information on each regulated dam in a central database.

Educating dam owners and their representatives is an important part of the Dam Safety Program. In 2015-16, several workshops and presentations were made by dam safety staff to 85 dam owners and operators at various locations around the province. Dam safety officers also completed 133 dam safety audits, meeting the provincial target for the year while taking these opportunities to ensure dam owners are knowledgeable about dam safety and compliant with the regulation.

Annually, owners of 354 dams with a failure consequence classification of high, very high or extreme are required to complete and submit a report outlining the activities undertaken that year as required by the regulation. Ninety-nine percent of owners returned the annual dam status reports, and 95% of dams reported having annual inspections. With support from natural resource officers, dam safety officers will follow-up with non-compliant dam owners to ensure compliance with these and other requirements.

Dam safety officers continue to update and add more information to the dam registry ensuring that important information about regulated dams is current and available. The dam registry has also been upgraded to include requirements of the new regulation. The database enhancements will assist FLNRO staff during an emergency response to identify a contact or emergency plan should the need arise.

For more information about the Dam Safety Program and to review copies of the BC Dam Safety Program Annual Report, please visit: http://www2.gov.bc.ca/gov/content?id=133DEE9E982C4E00BBB43C2765830C82.

WILDFIRE THREAT ANALYSIS – Fire Management Planning

This program is managed by the BC Wildfire Service, Ministry of Forests, Lands and Natural Resource Operations.

Fire is a natural and essential ecological process. Balancing the potential benefits and risks of wildland fire is complex and becoming more challenging as a result of climate change, forest health concerns (e.g., the mountain pine beetle or other insects and pathogens), and increased development in the wildland-urban interface. Wildfire impacts multiple values, areas of responsibility, and levels of government in B.C. These can range from species at risk to public health, tourism and the overall provincial economy. The nature of wildfire management discipline is changing rapidly, and understanding the relationship between wildfire and its impact on resource values is an important component of stewardship in B.C.

In 2015, the BC Wildfire Service released the Provincial Strategic Threat Assessment (PSTA) Wildfire Threat Analysis Component. The PSTA is designed to assess and map potential wildfire threats to values on the B.C. landscape, including communities, infrastructure, and natural resources. Values, in this context, refer to natural resources or man-made structures or features that have measurable or intrinsic worth and that could be impacted by wildfire. Cultural heritage, species and ecosystems at risk, community watersheds, old growth management areas, WHAs, and timber are all natural resource values that may be negatively impacted. However, certain types of ecosystems benefit from different kinds of fire such as surface, crown, or low intensity wildfire.

Wildfire risk assessment within B.C. considers both the likelihood of a wildfire and the potential consequence associated with that likelihood. The PSTA addresses some of the inherent uncertainty associated with risk through the systematic identification of values and quantifying the relative wildfire threat. Identification of different combinations of values and wildfire threat creates a framework for informing natural resource management strategies appropriate to the level of values at risk.

Fire management planning provides an opportunity to co-ordinate a wide array of management actions to mitigate the potential impacts of wildfire on communities and other values at risk. The PSTA assists land managers with fire management planning by identifying, at a high level, areas of high risk that should be examined in further detail.

The analysis was developed using geographic modelling tools and data to assess wildfire threat elements, including vegetation types, historical wildfire data, forest fuel classification, fire behaviour patterns, geography and other factors. Wildfire threat was determined by evaluating three distinct elements: fire occurrence (density), suppression difficulty and fire impacts under severe fire weather conditions, and spotting potential (travelling embers that start new fires).

It is important to note that this analysis only presents an approximation of wildfire threat at a provincial scale and has limitations associated with accuracy of the source data and modeling tools. The BC Wildfire Service is working on methods to continuously upgrade the PSTA to refine the utility of the tool.

The 2015 PSTA overview document and associated maps are available at the following link:
http://www2.gov.bc.ca/gov/content?id=9B5F43F2C3C241AAA8ADE99C4AA0F8D5.

CULTURAL HERITAGE (First Nations)

The *Forest Act* defines a cultural heritage resource as "an object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to British Columbia, a community or an aboriginal people." The objective of government is to conserve or, if necessary, protect cultural heritage resources that are:

1. The focus of a traditional use by an Aboriginal people and of continuing importance to that people; and
2. Not regulated under the *Heritage Conservation Act*.

Resource Practices Branch is responsible for monitoring resource practices and their impact to cultural heritage values. The key evaluation question for the cultural heritage resource value is: *Are cultural heritage resources being conserved and, where necessary, protected for First Nations cultural and traditional activities?* To answer this question, the resource development impact of forest harvesting on known cultural heritage resources is assessed.

Cultural heritage resource value assessments are primarily focused on evaluating impacts on cultural features such as culturally modified trees, cultural trails, traditional use sites, and other areas of specific interest and ongoing importance to First Nations. Sites assessed by FREP include those managed under FRPA and the *Heritage Conservation Act* (i.e., archaeological sites).

The resource development impact ratings for cultural heritage are based on evaluations of individual cultural features and an overall assessment of cutblock management, including any evidence (and extent) of damage to features, operational limitations, and strategies used to conserve values. This analysis results in a resource development impact rating of very low, low, medium or high impact to cultural features.

Examples of a cultural trail (L) and a culturally modified tree (R). Photo Credit: Peter Bradford

Table 6: *Cultural heritage monitoring outcomes for areas monitored from 2009-2015.*

Region	Resource Development Impact Rating			
	Very Low Impact	Low Impact	Moderate Impact	High Impact
Omineca (*n* = 75)	47%	16%	15%	23%
Skeena (*n* = 135)	66%	20%	3%	11%
Thompson-Okanagan (*n* = 53)	57%	21%	6%	17%

Sources of impacts to cultural heritage resource values included:

- Damage to trails;
- Harvesting of culturally modified trees;
- Activities related to road building; and
- Windthrow.

Best practices and opportunities for improvement include:

- Reviewing cultural heritage resource documentation during planning and operations;
- Avoiding cultural heritage features through the use of windfirm reserves such as wildlife tree patches, machine-free zones, and block boundary changes;
- Stubbing dead culturally modified trees above cultural marks to avoid future windfall or breakage;
- Avoiding skidding across cultural trails (or, in some cases, limiting use to designated crossings);
- Identifying cultural features with flagging tape during the pre-harvest site inspection for easy recognition during operations;
- Considering harvesting during winter to protect cultural plants;
- Locating burn or slash piles well away from cultural features and reserves; and
- Using culturally modified tree management zones with higher levels of retention.

MARINE PLAN PARTNERSHIP

This program is managed by the Resource Management Objective Branch.

The Marine Plan Partnership (MaPP) is a co-led partnership between the Province of British Columbia and 17 member First Nations, represented by the Coastal First Nations Great Bear Initiative, Central Coast Indigenous Resource Alliance, Council of the Haida Nation, Nanwakolas Council, and North Coast-Skeena First Nation Stewardship Society. Through MaPP, marine plans were developed to provide a common vision between the Province and First Nations, with input from stakeholders and the public, for the use and future opportunity of the North Pacific Coast. The plan area encompasses approximately 102,000 square kilometers and covers two-thirds of the North Pacific Coast.

MaPP was formalized in 2011 through a letter of intent and a memorandum of understanding between the Province and the member First Nations. Over the course of four years, the MaPP partners developed marine plans for each for the sub-regions in the plan area: Central Coast, Haida Gwaii, North Coast, and North Vancouver Island. Unique in scale and scope, these plans cover the marine and coastal areas adjacent to the Great Bear Rainforest, from Quadra Island/ Bute Inlet in the south to the Canada-Alaska border in the north.

Photo Credit: Charlie Short

The MaPP plans use an ecosystem based management (EBM) approach to foster a balance between stewardship and economic development to make recommendations for marine management, uses and activities. The plans consider and weigh provincial and First Nations priorities, policies, perspectives and capacity, while bearing in mind other related programs and initiatives. Throughout development, the MaPP plans were informed by the best available scientific data, First Nations knowledge, and input from local community members and stakeholders through a rigorous and participatory engagement process.

The MaPP marine plans were completed and announced in 2015, followed by the release of the Regional Action Framework (RAF) in 2016. The RAF outlines actions related to marine management that the Province and First Nations agree will be most effectively implemented at a regional scale. In August 2016, the MaPP partners announced the signing of four implementation agreements for the MaPP sub-regional marine plans (www.mappocean.org). Taken together, these plans will inform First Nations and provincial decision making in the respective coastal and marine areas. Example implementation activities include the implementation of marine zoning systems, geographic response plans, and EBM monitoring.

Marine Ecosystem Based Management Monitoring

The MaPP sub-regional marine plans and the RAF commit MaPP partners to develop and implement an EBM indicator program. An EBM indicator is a measurable part of a system (or component of a system) that can be used to represent a pressure on, or the status of, that system (or component). For example, an EBM indicator may be a particular species or habitat used to help evaluate the health of an ecosystem. EBM indicators are used to simplify the evaluation of complex systems, and to make assessment and management more efficient and strategic. The EBM indicator program will monitor changes in the state of ecological and human well-being in the MaPP region over time through the use of selected indicators.

By selecting, monitoring and reporting on indicators tied to the broad MaPP goals, information on overall ecosystem health and human well-being at different scales will become available to MaPP partners, collaborators, decision makers, and the wider public, including funders and stakeholders. Trends in EBM indicators will help point to whether the MaPP EBM goals are being achieved, provide warning signs about potential or growing threats to marine values, and inform adaptive resource management decision making.

Sixteen potential regional indicators within seven themes (as shown in Table 10 below) have been identified through an iterative process and will be re-evaluated over time. Data for 13 of the pilot indicators are currently being collected by groups or agencies with existing monitoring protocols. Monitoring protocols are being developed for the other three pilot indicators (contaminant levels and microplastic loads, valuing culture, and not-for-profit seafood harvesting).

Photo Credit: Charlie Short

Table 10: *Potential regional indicators for ecosystem based management.*

Theme	Indicator
Species and Habitats	Pacific salmon abundance and distribution of adults by species
Species and Habitats	Eelgrass distribution and biomass
Climate Change and Oceanography	Sea surface temperature
Climate Change and Oceanography	Sea surface salinity
Climate Change and Oceanography	Ocean acidification
Clean Water	Marine spill events in B.C. coastal waters
Clean Water	Trends in water quality (specifically fecal coliform)
Clean Water	Contaminant levels and microplastic loads in bivalves (mussels) and sediment
Stewardship and Governance	Compliance with regulations among resource users
Stewardship and Governance	Enforcement effort
Seafood	CPUE and regional seafood landings (wild caught and aquaculture)
Seafood	Regional seafood processed locally (wild caught and aquaculture)
Coastal Development and Livelihoods	Work, employment; participation in workforce
Coastal Development and Livelihoods	Regional financial wealth
Sense of Place and Well-being	Valuing culture
Sense of Place and Well-being	Seafood harvesting (not-for-profit)

As most of the monitoring will occur at the sub-regional level, each sub-region has held or is holding a sub-regional EBM indicators workshop to assess community-level priorities with respect to indicator monitoring. The approach and timelines for reporting out on indicators is under discussion.

Plan Performance Measures

Along with EBM indicators, MaPP will be reporting on plan performance measures (PPMs) annually. These are an adaptive set of measures to track how well the marine plans and the RAF are being implemented. Specifically, the PPMs will be used to assess progress against the strategies in the sub-regional plans and actions in the RAF, with tracking and reporting of priority strategies and actions outlined in annual work plans. The MaPP PPMs align with best practices in performance reporting for similar planning initiatives, and are designed to be easily communicated and understood.

Implementation of the MaPP plans will complement related plans and planning initiatives in the region, such as the Pacific North Coast Integrated Management Area planning process and the development of a Marine Protected Area Network for the Northern Shelf Bioregion.

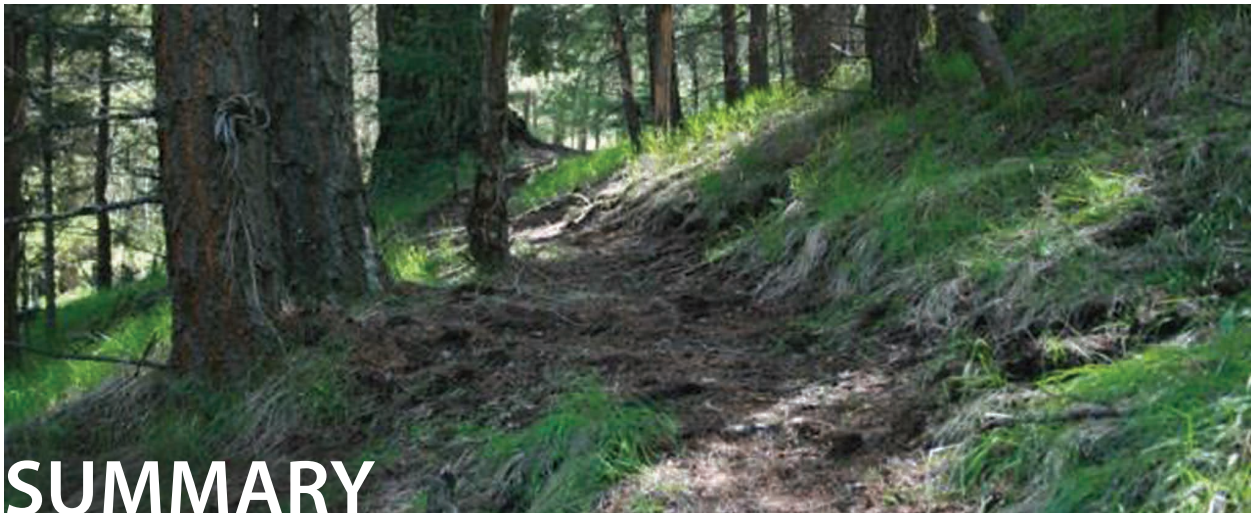


Photo Credit: Peter Bradford

SUMMARY

This is the first of what is intended to become an annual report that collates information on a number of the key resource stewardship initiatives and programs. The programs discussed in this document, and others across FLNRO and other natural resource sector ministries, help provide the information we need as citizens, resource managers, and stakeholders to ensure we know the state of our resources and can make informed decisions on how these resources should be managed to ensure long-term economic prosperity and a sustainable environment.

Readers can obtain additional information through the links provided in this report. All resource managers should use this, and other information in their resource management planning to continually improve upon the achievement of both sustainable natural resource and economic development.

As this is the first of these reports, any feedback and/or suggestions for improvement that can be used in developing the next report would be appreciated. If you have any suggestions, please contact Forests.ForestPracticesBranchOffice@gov.bc.ca. Any media-related inquiries should be directed to 250 356-5261.