Province of British Columbia

Reporting British Columbia Forest Resource and Its Changes from the National Forest Inventory Photo-Plot Database

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Executive Summary

Conventional reporting of the forest resource and its changes over time in British Columbia (BC) from the existing forest inventory database such as Vegetation Resource Inventory encounters issues and challenges that make it difficult to meet the requirements of today's sustainable forest management and new national and international monitoring initiatives.

This report presents examples of the utility of the new Canada's National Forest Inventory (NFI) for the provincial reporting and monitoring needs. It provides statistics on BC's forest resource in 2007 and periodic changes during the periods 2000-2005 and 2005-2007 generated based on the data from the 2419 NFI photo plots falling in BC. It is the first time that such periodic change estimates of the province's forest resource have been obtained using a valid sample.

The statistics include estimates of area and volume totals and their approximate relative standard errors and confidence intervals for selected classifiers and classifier-classes. The classifiers are land-cover, land type, vegetation type, leading species and age-class.

Despite the high relative standard errors and confidence intervals of change estimates for some classifiers, estimation of forest resource state and change over time using the NFI is more efficient and effective, and avoids issues associated with past approaches that compiled existing inventories at different time periods. The NFI sampling design permits estimation of the precision of the state and change estimates, and, as well, it is flexible and robust enough to be modified or expanded to accommodate various provincial monitoring needs.

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List of Acronyms

ALR	Agricultural Land Reserve
BC	British Columbia
CFS	Canadian Forest Service
FAIB	Forest Analysis and Inventory Branch
FC	Forest Cover
FIP	Forest Inventory Planning
IHS	Intensity, Hue and Saturation, an image colour enhancement
ETM/TM	Enhanced Thematic Mapper/Thematic Mapper, Landsat 7/5
LRDW	Land Resource Data Warehouse
MFR	Ministry of Forests and Range
NAD	North American Datum
NFI	National Forest Inventory
NTA	No Type Available
PFC	Pacific Forestry Centre
PSYU	Public Sustainable Yield Unit
SS	No Typing Available
TFL	Tree Farm License
TRIM	Terrain Resource Information Management
TSA	Timber Supply Area
VRI	Vegetation Resource Inventory

Acknowledgements

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Introduction

Accurate and timely reporting of the forest resource in the province of British Columbia (BC) is a fundamental function of the provincial forest inventory program. This role of the forest inventory program is particularly critical for the province to meet provincial, national and international obligations, and initiatives relating to sustainable forest management and climate change.

Past approaches to provincial reporting of the forest resource involved compiling the existing provincial forest inventories at different points in time. There were several problems and challenges with this past approach, including mixed inventory vintages, inconsistent inventory standards, and missing inventory data across the province. For example, 7.4 million ha (7.8%) of the land in British Columbia does not have inventory data; 64.6 million ha (68.2%) is in the old Forest Inventory Planning (FIP) standard that was used prior to 1998 and 22.7 million ha (24.0%) is in the Vegetation Resource Inventory (VRI) standards which was implemented after 1998. For the land where the forest inventory data is available, 79 % of it has an inventory age of more than 10 years old, and 38% has an inventory age of more than 25 years old [1].

The above-mentioned problems and challenges make it difficult to provide a consistent and statistically defensible provincial report on the forest resource. They also make it impossible to monitor the changes and trends over time of the forest resource in BC. A provincial sampling approach, such as using Canada's National Forest Inventory (NFI) sample plots, is a more viable option.

The NFI is an initiative designed and implemented jointly by the federal, provincial and territorial jurisdictions working in partnership, with the purpose of assessing and monitoring the extent, state and sustainable development of Canada's forests [2]. The Ministry of Forests and Range (MFR), Forest Analysis and Inventory Branch (FAIB), has been working in partnership with Canadian Forest Service (CFS) on this project since year 2000. The first NFI photo database was established for the year 2000, and the first analysis report was completed in 2006 [1]. Since 2000, the NFI photo plot database has been updated numerous times. This provides a unique opportunity for the province to utilize it to report new statistics and changes not only for meeting national and international obligations but also for meeting provincial monitoring needs.

This report provides a summary of the British Columbia forest resource statistics in 2007 and the periodic changes during the periods 2000-2005 and 2005-2007. These statistics are based on the

data from the NFI photo plots inside BC. It is the first time that estimates of such changes over time are obtained based on a valid statistical sample.

The changes estimates presented in this report are only for the changes caused by tree growth and harvesting depletion. They do not include changes caused by fire and insect and disease which are captured by other programs or projects within the MFR.

National Forest Inventory Photo Plot Data

NFI design and implementation

The NFI consists of photo plots and ground plots that are located on a national 20 km x 20 km grid. All the plots are permanent and hidden, but not protected. The photo plots are the primary source of the NFI data, and the ground plots provide additional attribute data. The provinces and territories install NFI plots, and upload the raw plot data to a national database maintained by the NFI Project Office of the Canadian Forest Service (CFS). There are a total of about 25,646 photo plots in the country, of which 2,419 are located in British Columbia. Photo plot data are obtained from aerial photos or satellite imagery. There are about 1,135 ground plots located in forested areas, of which 268 are located in British Columbia.

The first NFI photo plots database in British Columbia was established for the year 2000 using a 'drilling' through the 2000 provincial forest inventory database (FIP) followed by a update on depletion due to harvesting and fire and a report of the provincial statistics based on this database was generated in June 2006 (MFR FAIB 2006). Since 2000, there have been numerous updates and upgrades to the photo plot database. These updates were for volume growth, area updates for harvesting and fire disturbances, updates using satellite remote sensing update for harvesting changes, the VRI that was available since year 2000, and some new photo interpretation for the NFI remeasurement pilot project. These updates and upgrades to the database have provided an opportunity for the MFR FAIB to report on the state of the forest resource to the ends of 2005 and 2007, as well as to demonstrate the capability of producing provincial change statistics from the NFI photo plot data for the periods 2000 – 2005 and 2005 - 2007.

Data collection

There are three NFI photo plot databases created for years 2000, 2005, and 2007, respectively, for this analysis as follows.

The year 2000 NFI photo plot database was created by first 'drilling ' the provincial FIP inventory database that originated from interpretation of aerial photos, according to specified attributes including land cover classes, ownership and stand attributes. This drilled database was then updated for depletion changes due to harvesting manually interpreted from year 2000 Landsat TM imagery. All the data gaps (a total of 43 photo plots) were fixed using a new photo interpretation of old photography (around 1998). Finally, the photo database was projected by

volume to the end of 2000 using the yield model (Variable Dependent Yield Projection - VDYP6)[1]. Methods for the preparation and processing of this database are described in detail in the MFR FAIB report [1]. A brief summary of the process as described in this MFR FAIB report is reproduced in Appendix II.

The 2000 NFI photo plot database was upgraded in 2005 by cutting all the polygons done since 1998 with the new Vegetation Resource Inventory (VRI) standards into the old photo plots (about 1/5 photo plots). This upgraded photo database was then updated again using the Landsat TM imagery for depletion due to harvesting and re-projected to the end of 2005 to form the 2005 NFI photo plot database.

The 2007 NFI photo plot database was constructed by updating the 2005 NFI photo plot database using the same remote sensing method and the same projection model. In addition, approximately 100 NFI photo plots were re-measured through a new interpretation of 2005 colour photographs using the NFI standards. Methods for the preparation and processing of these databases are similar to those used in 2000 (Appendix II).

The NFI photo plot database and conversion to the NFI standards

The NFI photo plot database consists of 2 components, the spatial polygons/plots/layers in ArcGIS shape files, and the attributes in MS Access format.

There are a total of five spatial layers in the NFI photo plot database: NFI photo plots, Land Cover, Land Use, Ownership, and Protection Status (NFI Photo Data Standards). Forest polygon data is included in the Land Cover layer, and polygon ID is the primary link between the spatial layers and the attribute tables.

Each attribute database in MS Access format consists of three linked data tables: *Key-area*, *Polygon*, and *Layer*. The key-area table consists of general plot attributes, including polygon area. The polygon table consists of general polygon attributes, including the land cover classification. The layer table consists of stand layer attributes including volume per hectare by tree species. These tables were linked by the NFI plot number, provincial plot identification and polygon identification. The data of interest were polygon areas, land cover classification, and rank 1 layer

[1] See www.for.gov.bc.ca/hts/vdyp.

volume per hectare, projected age, site index and leading species. Rank 1 layer is the layer with the dominant tree species; it is the one that represents polygon tree volume. Definitions of these and other relevant attributes are given in Appendix III. These attribute tables include many items that are not part of the standard NFI photo database and they are used as the data source for statistical analysis and summary for provincial applications. These tables can be converted to the NFI standards for submission to CFS for national compilation and analysis purposes.

The ground plot data are not used in this report, but they will be used in the future for potentially improving and for comparison with the photo-plot based estimates of tree related attributes. As well, the ground plot data can be used for producing estimates of the attributes that are not available in the photo plot database such as biomass.

Data classification

For analysis and reporting purposes, the individual polygons are classified according to some pre-set criteria. Although the data can be classified in many ways, there are two critical factors in selecting classifiers that affect the precision of estimates: the area of interest (AOI) and likelihood of occurrence of the classifier-classes of interest in the AOI. For example, it is not feasible to report on a TFL basis with reasonable precision because of the relatively small number of plots in a TFL. For this analysis, the following classifiers are used: land-cover type, land type, vegetation type, leading species and age-class. Each of these classifiers has several classes. Definitions of the classifier-classes of these classifiers are given in Appendix I. These classifiers were chosen because they are used in the state of the forest reporting. The classifier-classes are chosen such that we can obtain class estimates with reasonable precision. Note that reporting of rare events with acceptable precision is not possible with the NFI plots because of the relatively small sample size.

Statistical Analysis

Overview

The statistics produced are provincial area and volume totals and their associated confidence intervals (95% probability) and relative standard errors, by classifier-class. The total volume is net volume at the primary utilization level estimated using the VDYP6 yield model. The primary utilization level on the Coast is diameter at breast height (dbh) 17.5 cm+ (22.5 cm+ for lodgepole pine) and 12.5 cm+ in the Interior. The classifiers, which are categories for which separate statistics are needed, included land cover, land type, leading species, vegetation type, and age-class.

The estimated classifier-class area or volume total is obtained as the product of the per-hectare area or volume estimate in a classifier-class and the provincial total land area. The per-hectare values are estimated using the generalized ratio-of-means (ROM) estimator [3]. Estimation of change follows a similar approach. These estimation procedures are similar to those developed by the NFI Project Office for point-in-time estimation [4]. Note that for the change estimation there was no panelling; all the 2419 photo plots were used. For all the estimation, a total land area (including fresh water) for the province was assumed to be 94,657,697 ha. This provincial total area was obtained from the 1:50 000 Watershed Atlas, which is a computerized base map of aquatic features in the province (see www.env.bc.ca/fish/watershed_atlas_maps/index.html).

Procedures for estimation of area and volume totals

The procedures for the estimation of provincial area and volume totals by classifier-class in 2007 include the following steps:

1. Obtain the *Key_area*, *Polygon*, and *Layer* data tables for 2007 from the photo-plot database.
2. Sum the volume per hectare of all trees species in the rank 1 layer in the *Layer* table, and multiply the total volume per hectare by the polygon area, to obtain the polygon total volume.
3. Classify each polygon into classifier-classes of interest (e.g., land cover classes).
4. Calculate a_{ki}, the total area (or total volume) in the *k*th classifier-class in the *i*th photo plot (i = 1, 2, 3, …, n = 2419), by summing the total area (or total volume) of all

polygons in the *k*th classifier-class in the *i*th plot. If a classifier-class does not appear in a photo plot, then area (or volume) is assigned a value of 0 for that plot.

5. Calculate a_{Tki}, the total area of all polygons in the *i*th photo plot, by summing the total area of all polygons in the *i*th photo plot (i = 1, 2, 3, …, n = 2419).
6. Calculate the provincial average area proportion (or volume per hectare) of the *k*th classifier-class, $\hat{y}_k$, and associated statistics (variance, relative standard error, and confidence interval, respectively):[2]

[1] $$\hat{y}_k = \frac{\sum_{i=1}^{n} w_i a_{ki}}{\sum_{i=1}^{n} w_i a_{Tki}}$$

[2] $$\hat{\text{var}}(\hat{y}_k) \doteq \frac{1}{(\sum_{i=1}^{n} w_i a_{Tki} \Big/ \sum_{i=1}^{n} w_i)^2} \left(\frac{\left[\sum_{i=1}^{n} (w_i a_{ki})^2 + \hat{y}_k{}^2 \sum_{i=1}^{n} (w_i a_{Tki})^2 - 2\hat{y}_k \sum_{i=1}^{n} w_i^2 a_{ki} a_{Tki} \right]}{(\sum_{i=1}^{n} w_i)(\sum_{i=1}^{n} w_i - 1)} \right)$$

[3] $$SE\%(\hat{y}_k) = \frac{\sqrt{\hat{\text{var}}(\hat{y}_k)}}{\hat{y}_k} 100$$

[4] $$\hat{y}_k \pm t_{\alpha/2,n-1} \sqrt{\hat{\text{var}}(\hat{y}_k)}$$

where $t_{\alpha/2,n-1}$ is the *t*-value at the α level and n-1 degrees of freedom.

7. Estimate the provincial total area (or total volume) in the *k*th classifier-class, $\hat{Y}_k$, and associated statistics (variance, relative standard error and confidence interval, respectively):

[5] $$\hat{Y}_k = 94657697 \times \hat{y}_k$$

[6] $$\hat{\text{var}}(\hat{Y}_k) = (94657697)^2 \times \hat{\text{var}}(\hat{y}_k)$$

[7] $$SE\%(\hat{Y}_k) = \frac{\sqrt{\hat{\text{var}}(\hat{Y}_k)}}{\hat{Y}_k} \times 100$$

[8] $$\hat{Y}_k \pm t_{\alpha/2,n-1} \sqrt{\hat{\text{var}}(\hat{Y}_k)}$$

[2] We set w_i=1 for all the plots, i.e., no weighting, because, as most of the photo plots were of the approximately the same size, the weighting had little impact on the estimates. The general formula is provided in the event that weighting is needed.

8. Output the statistics for provincial reporting.

An example, and the input files, SAS computer programs and output files, used to implement these procedures are given in Appendix IV.

Procedures for estimation of periodic change in area and volume totals

The procedures for the estimation of changes in provincial total area and volume totals by classifier-class during the period 2000- 2005 (or 2005-2007) include the following steps:

1. Obtain the *Key_area*, *Polygon*, and *Layer* data tables for 2005 and 2000 from the photo-plot database.
2. Sum the volumes per hectare of all trees species in the rank 1 layer in the *Layer* tables, and multiply the total volume per hectare by the polygon area to obtain the polygon total volume, for 2000 and 2005.
3. Classify each polygon into classifier-classes of interest (e.g., land cover classes) in 2000 and in 2005.
4. Calculate $a_{2000,ki}$ and $a_{2005,ki}$, the total area (or total volume) in the *k*th classifier-class in the *i*th photo plot in 2000 and 2005, respectively, by summing the total area (or total volume) of all polygons in the *k*th classifier-class in the *i*th plot. If a classifier-class does not appear in the photo plot, then area (or volume) is assigned a value of 0 for that plot.
5. Calculate $a_{2000,Tki}$ and $a_{2005,Tki}$, the total area of all polygons in the *i*th photo plot in 2000 and 2005, respectively (i = 1, 2, 3, …, n = 2419).
6. Merge the polygon total area and total volume for 2000 and 2005 by photo plot.
7. Calculate Δa_{ki}, the periodic change in total area (or total volume) over the period 2000-2005 in the *k*th classifier-class in the *i*th photo plot (i = 1, 2, 3, …, n = 2419). That is, $\Delta a_{ki} = a_{2005,ki} - a_{2000,ki}$.
8. Adjust the 2000 attribute values, $a_{2000,ki}$, by the factor,

   $\frac{a_{2005,Ti}}{a_{2000,Ti}} = \frac{964148.52465}{963265.67710} = 1.000954$, to bring them to a common total photo-plot sample area in 2005. The sum of the photo plot areas was slightly higher in 2005 than in 2000 due to the rounding of plot areas in 2000.

9. For the periodic change estimate over the period 2005-2007, adjust the 2005 attribute values, $a_{2005,ki}$, by the factor, $\frac{a_{2007,Ti}}{a_{2005,Ti}} = \frac{964148.58601}{964148.52465} = 1.000000064$, to bring them to a common total photo-plot sample area in 2007.
10. Proceed with the estimation of area and volume change using the same formulae as for the area and volume totals in 2005 (Eq. [1] to [8]), replacing a_{ki} with Δa_{ki}, and setting $a_{Tki} = a_{2005,Tki}$. Note that where the change estimate is negative, we take the absolute value of the relative standard error (SE%).
11. Output the statistics for provincial reporting.

An example, and the input files, SAS computer programs and output files used to implement these procedures, are given in Appendix IV.

Results

Overview

The provincial total volume in 2007 was about 10.85 billion m^3 (SE% = 1.9%), a decrease of about 47 million m^3 (SE% = 12.9%) since 2005. Most of the decrease in total volume over this period was in lodgepole pine leading stands (97%); this is presumably due to the accelerated harvesting of this species during this period and beyond. The provincial total volume in 2005 was about 10.90 billion m^3 (SE% = 1.9%), an increase of about 439 million m^3 (SE% = 13.3%) since 2000. Detailed provincial area and volume statistics by classifier-classes are given in Appendix V. The following sections summarize the provincial area and volume statistics by classifier-classes. The classifiers considered are land-cover, land type, vegetation type, leading species and age-class.

Land cover

Land cover is based on Level 2 of the BC Land Cover Classification Scheme (BCLCCS) [5]. There are four Level 2 classes: vegetated treed (VT), vegetated non-treed (VN), non-vegetated land (NL), and non-vegetated water (NW). The most dominant land cover type at the end of 2007 was the vegetated treed area covering approximately 52.1 million ha (or 55% of the provincial land area) (Figure 1). Note that approximately 19,000 ha were of unknown classification. The total volume in the province at the end of 2007 was about 10.85 billion m^3, most of it being in the vegetated treed areas (Figure 2). The total volume in the vegetated non-treed areas was about 6.04 million m^3.

Between 2000-2005, the VT area increased by about 2.5 million ha (or 5%) and the NL area decreased by 2.7 million ha (or 12%) (Figure 3). The total volume in the VT areas increased by 451 million m^3 (or 4%) and in the VN areas the total volume decreased by 11.6 million ha (or 66%) (Figure 4).

Between 2005-2007, the VT area decreased by 613,338 ha (or 1%) and the VN area increased by 614,556 ha (or 4%) (Figure 5). There was little or no change in area in the remaining land cover classes. Over the same period, total volume decreased by about 47.2 million m^3 (or <1%) in the VT areas, and decreased by about 24,000 m^3 (or <1%) in the VN areas (Figure 6).

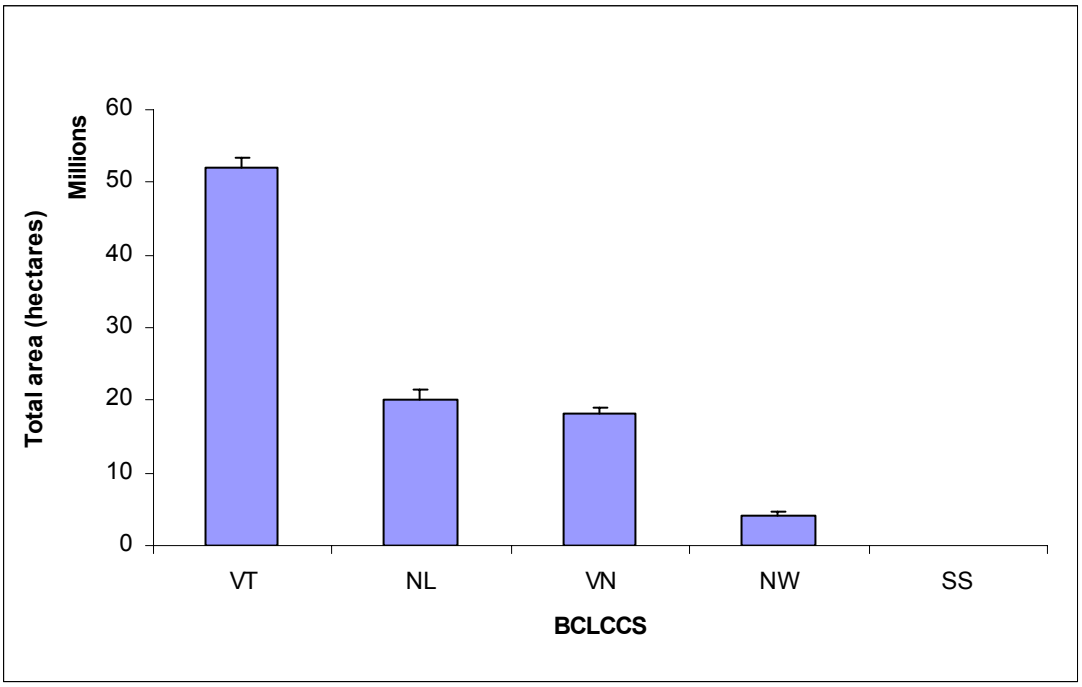

Figure 1. Total area in 2007 by land cover (BCLCCS Level 2): vegetated treed (VT), vegetated non-treed (VN) non-vegetated land (NL), and non-vegetated water (NW). The error bars are at the 95% probability level. Approximately 19,000 ha of the land area were of unknown classification (SS).

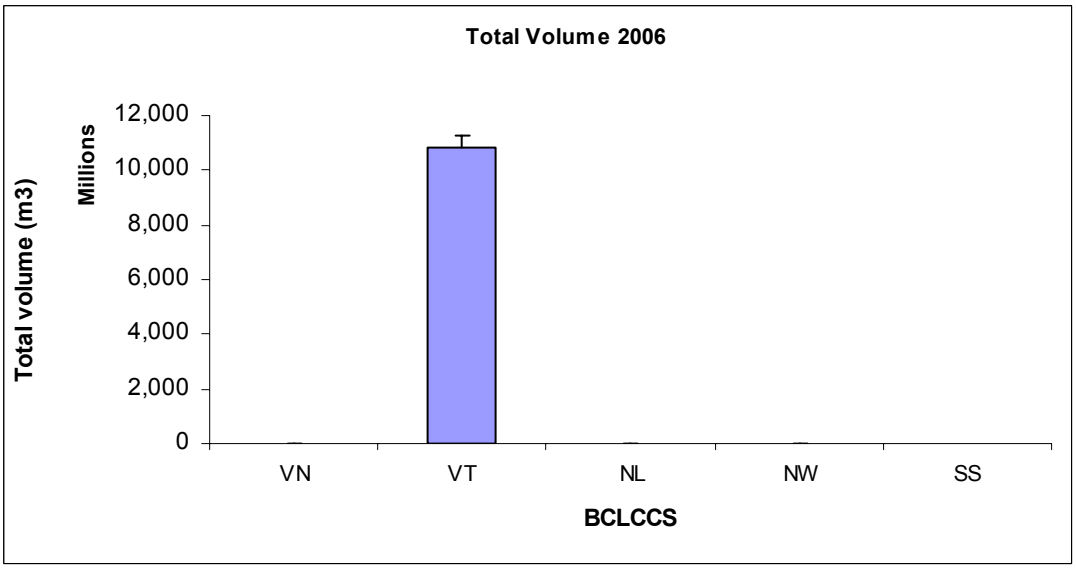

Figure 2. Total volume in 2007 by land cover (BCLCCS Level 2): vegetated treed (VT), vegetated non-treed (VN) non-vegetated land (NL), and non-vegetated water (NW). The error bars are at the 95% probability level. Approximately 19,000 ha of the land area were of unknown classification (SS).

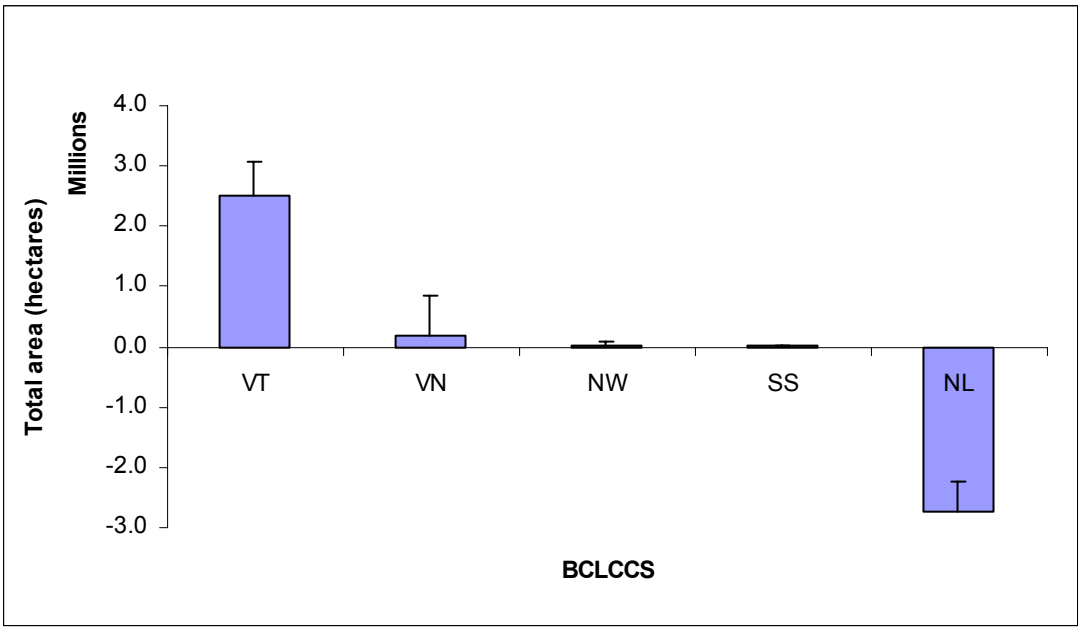

Figure 3. Change in total area by land cover (BCLCCS Level 2) during the period 2000-2005: vegetated treed (VT), vegetated non-treed (VN) non-vegetated land (NL), non-vegetated water (NW) and SS (unknown classification), for the period 2000-2005. The error bars are at the 95% probability level.

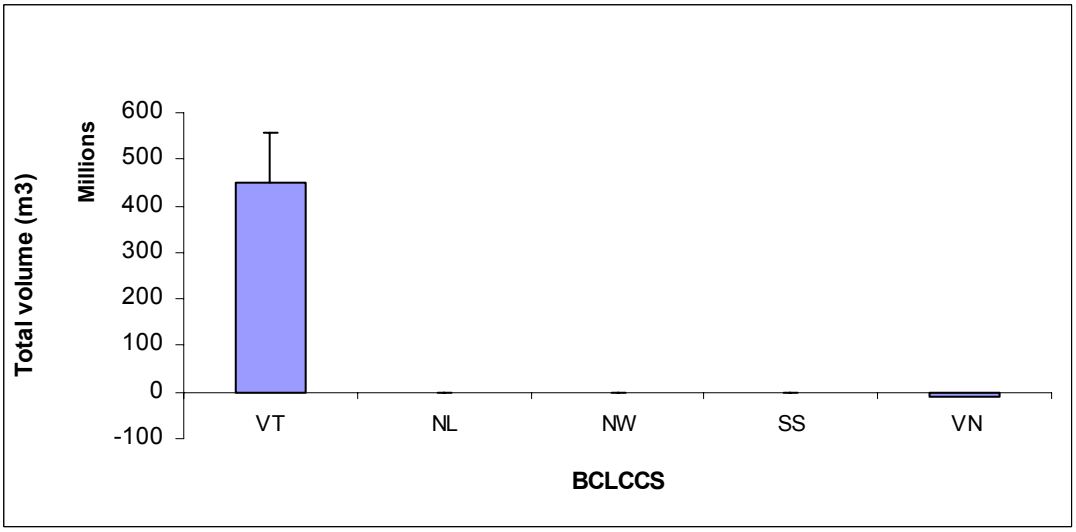

Figure 4. Change in total volume by land cover (BCLCCS Level 2) during the period 2000-2005: vegetated treed (VT), vegetated non-treed (VN) non-vegetated land (NL), non-vegetated water (NW) and SS (unknown classification), for the period 2000-2005. The error bars are at the 95% probability level.

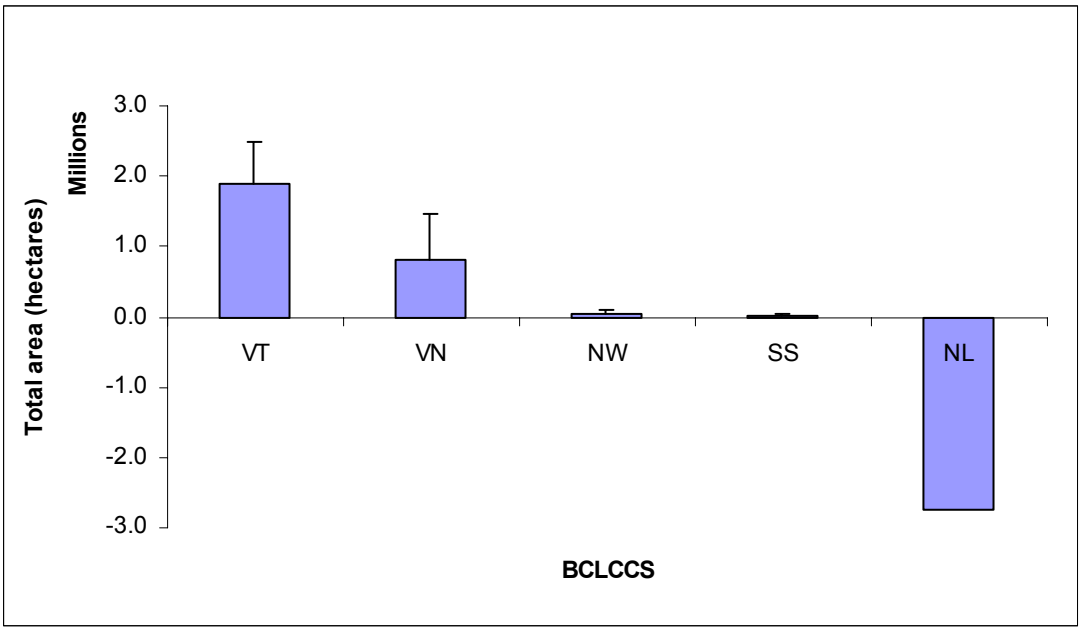

Figure 5. Change in total area by land cover (BCLCCS Level 2) during the period 2005-2007: vegetated treed (VT), vegetated non-treed (VN) non-vegetated land (NL), non-vegetated water (NW) and SS (unknown classification), for the period 2000-2005. The error bars are at the 95% probability level.

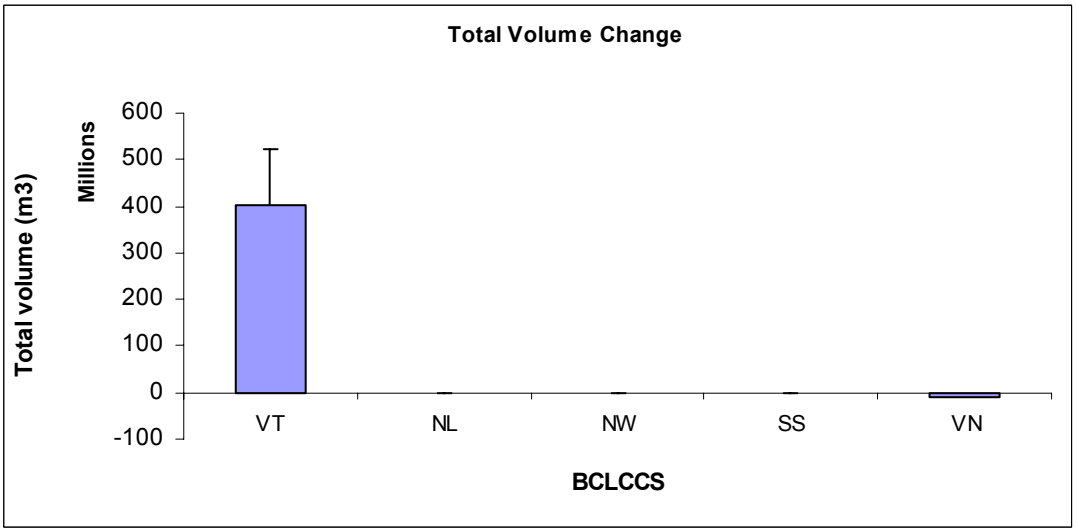

Figure 6. Change in total volume by land cover (BCLCCS Level 2) during the period 2005-2007: vegetated treed (VT), vegetated non-treed (VN) non-vegetated land (NL), non-vegetated water (NW) and SS (unknown classification), for the period 2000-2005. The error bars are at the 95% probability level.

Land type

The land type classes are forest, other-wooded land, other land and fresh water. Forests are comprised of productive vegetated treed areas, non-productive vegetated treed areas with total

age greater than 80 years and site index greater that 3 m at 50-years breast height age, and temporarily non-stocked areas. Other-wooded land is areas with woody shrubs, stunted trees or scattered trees. These definitions are an approximation of those used by the United Nations Food and Agriculture Organization (FAO). Other land includes areas such as agricultural land and urban areas.

The total forest area at the end of 2007 was about 65.6 million ha (or 69%), and other-wooded land was about 4.4 million ha (or 5%) (Figure 7). The total volume at the end of 2005 in the forest areas was about 10.89 billion m^3 , in other-wooded land was about 12.6 million m^3, and in the other land was 147, 817 m^3 (Figure 8)

Between 2000-2005, the forest area increased by about 7.0 million ha (or 12%) and the other-wooded land area decreased by 1.3 million ha (or 23%) (Figure 9). The volume in the forest areas increased by about 427 million m^3 (or 4%), in the other-wooded land the volume increased by about 13 million m^3, and in the other lands it increased by 147,817 m^3 (Figure 10) Note, however, that there was no volume in the 2000 database for the other-wooded and other land areas; thus the increases in these classes may be a database artefact.

Between 2005-2007, there was very little change in total area (< 0.1%) in all the land types (Figure 11). Total volume in the forest areas decreased by 47.7 million m^3 (or 0.4%), and the total volume in the other wooded areas increased by 454,485 m^3 (or 4%) (Figure 12).

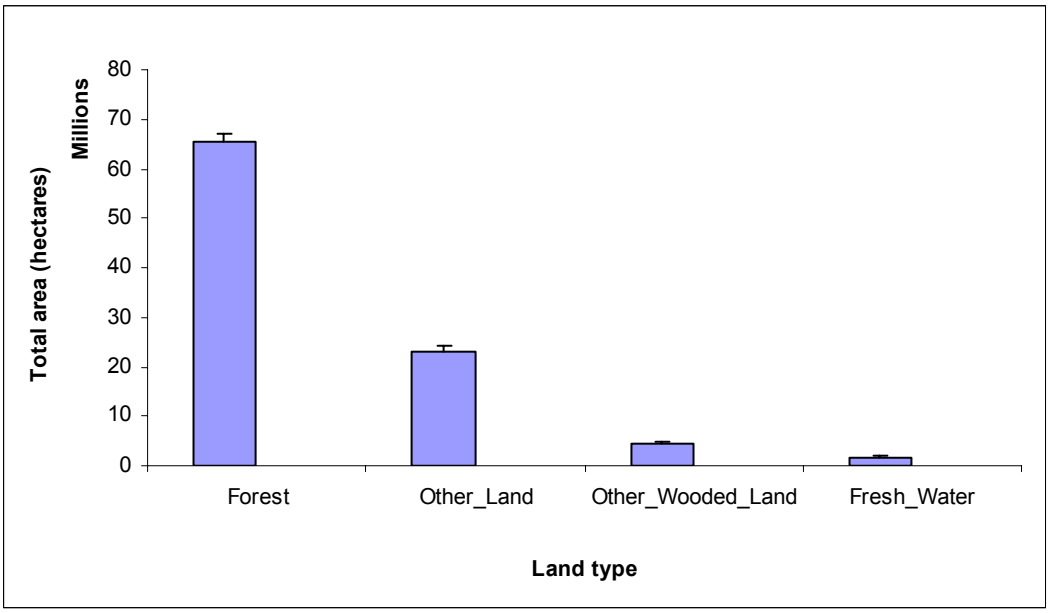

Figure 7. Total area by land type in 2007. The error bars are at the 95% probability level.

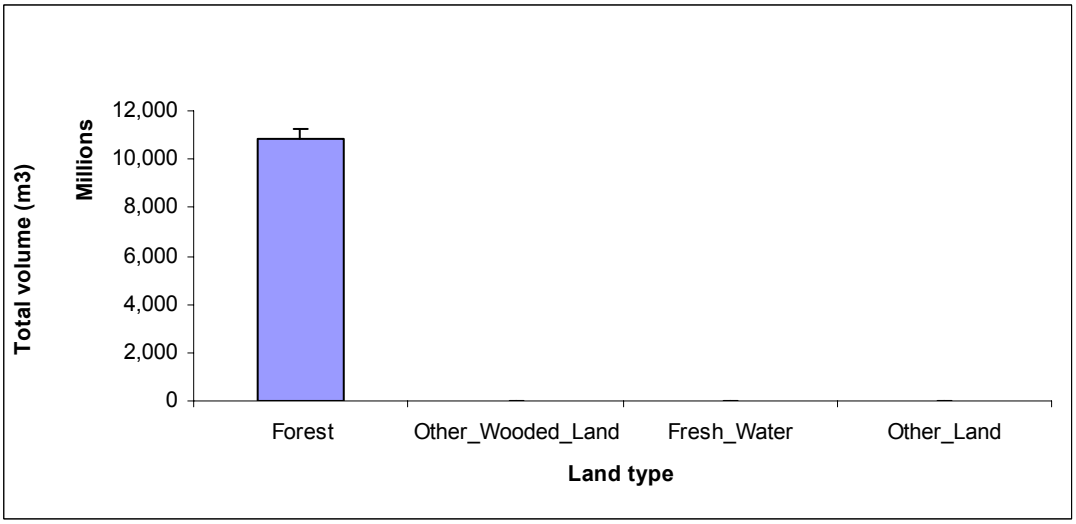

Figure 8. Total volume by land type in 2007. The error bars are at the 95% probability level.

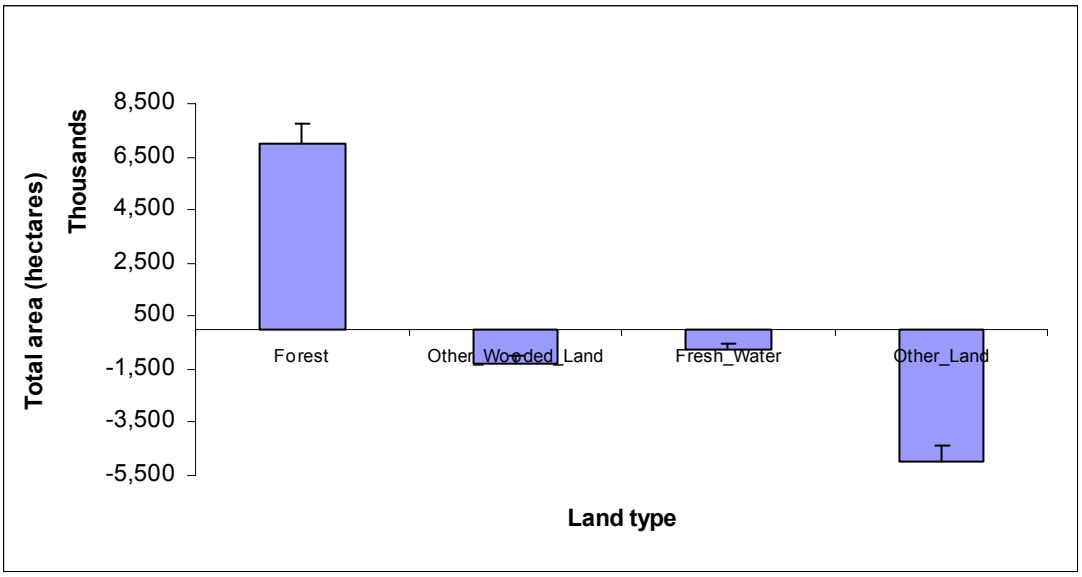

Figure 9. Change in total area by land type for the period 2000-2005. The error bars are at the 95% probability level.

Figure 10. Change in total volume by land type during the period 2000-2005. The error bars are at the 95% probability level.

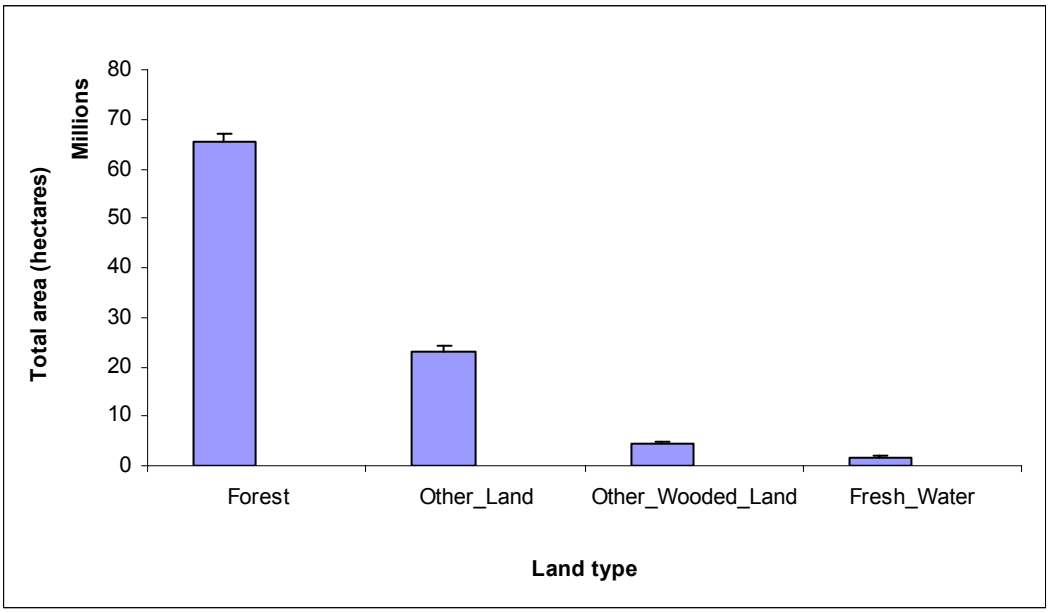

Figure 11. Change in total area by land type during the period 2005-2007. The error bars are at the 95% probability level.

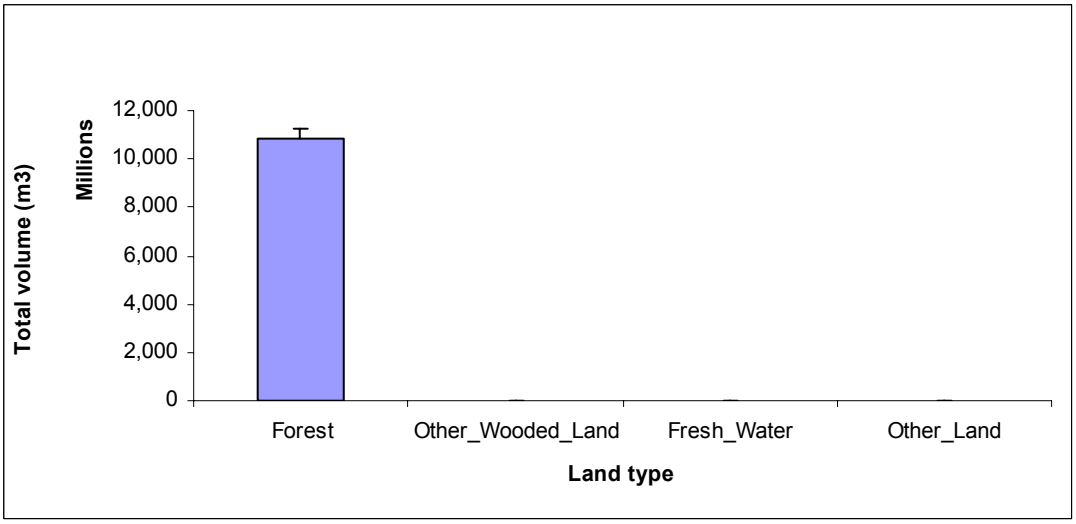

Figure 12. Change in total volume by land type during the period 2005-2007. The error bars are at the 95% probability level.

Leading species

Leading species are tree species having more than 50% of volume in a polygon. The most common leading tree species were reported separately (Douglas-fir, Hemlock, Larch, Lodgepole pine, Spruce, Western red cedar, Yellow cedar, Aspen, Cottonwood, and True-fir), and the remaining (minor) leading species were grouped into either 'other conifer' or 'other broadleaf'. Total area and total volume by leading tree species at the end of 2007 are given in Figures 13 and 14, respectively. Note that these area and volume totals include all the vegetated areas with tree-species labels. Lodgepole pine and spruce are the most dominant species, covering most of the vegetated treed area (14 million ha, or 15%, each), and having the most volume (2.2 billion m^3 each, or 20% and 21%, respectively). Hemlock had almost the same volume as spruce or lodgepole pine (2.1 billion m^3, or 20%), despite it covering a significantly smaller area (6 million ha).

Between 2000-2005, there was a significant decrease in lodgepole pine total area (0.7 million ha, or 5%) (Figure 15). There was little or no change in total area for the remaining species. The decrease in lodgepole pine area may be due to the accelerated harvesting of Mountain Pine Beetle (MPB) infected stands and other disturbances. Over the same period, there was a significant increase in the total volume of True-fir (197 million m^3 or 16%) and Douglas-fir (89 million m^3 or 8%) (Figure 16). There was little or no change in total volume for the remaining species.

Between 2005-2007, the total area of all species decreased, especially for lodgepole pine (Figure 17). The total volume increased slightly for some species and decreased slightly for others (Figure 18).

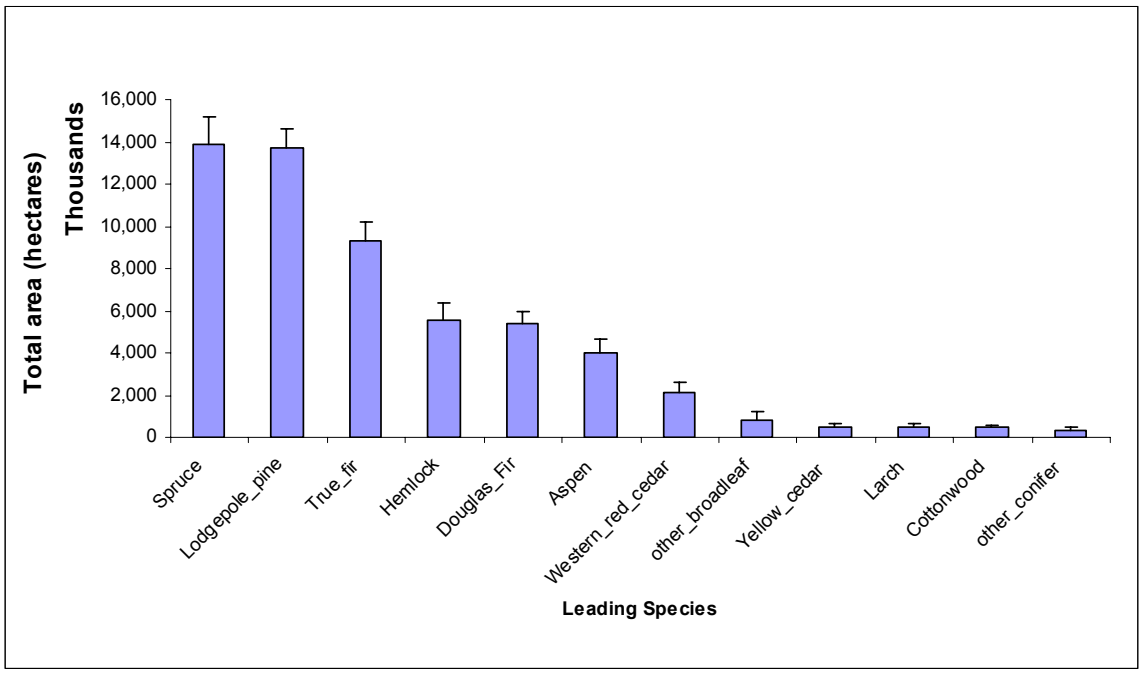

Figure 13. Total area in 2007 by leading species. The error bars are at the 95% probability level.

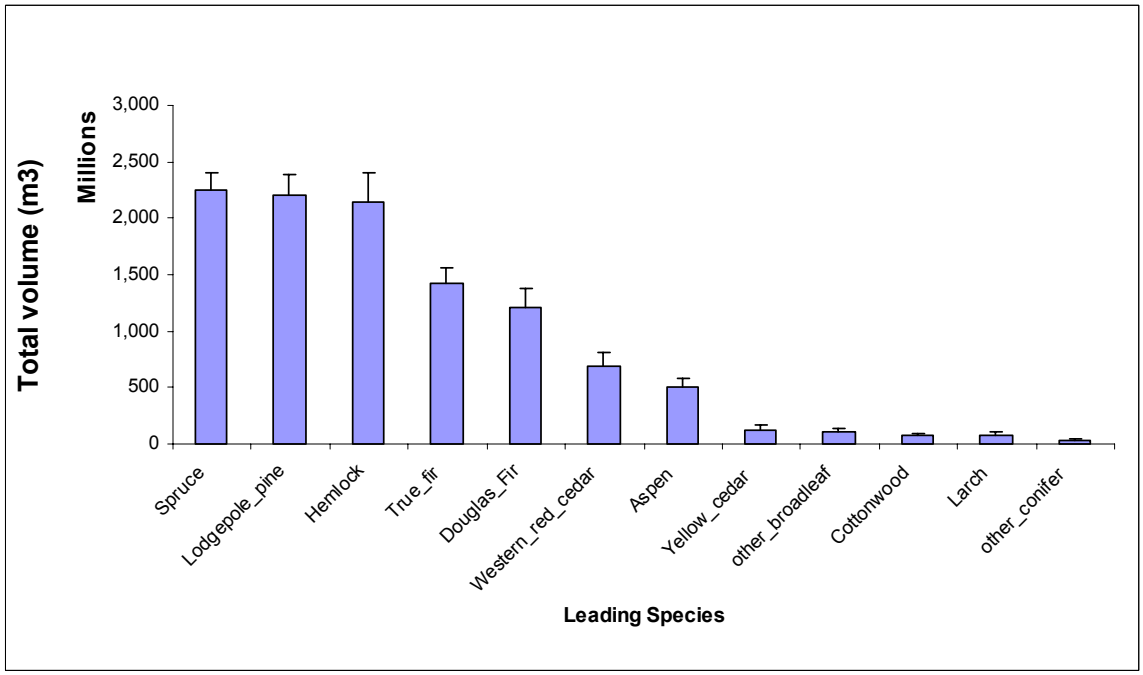

Figure 14. Total volume in 2007 by leading species. The error bars are at the 95% probability level.

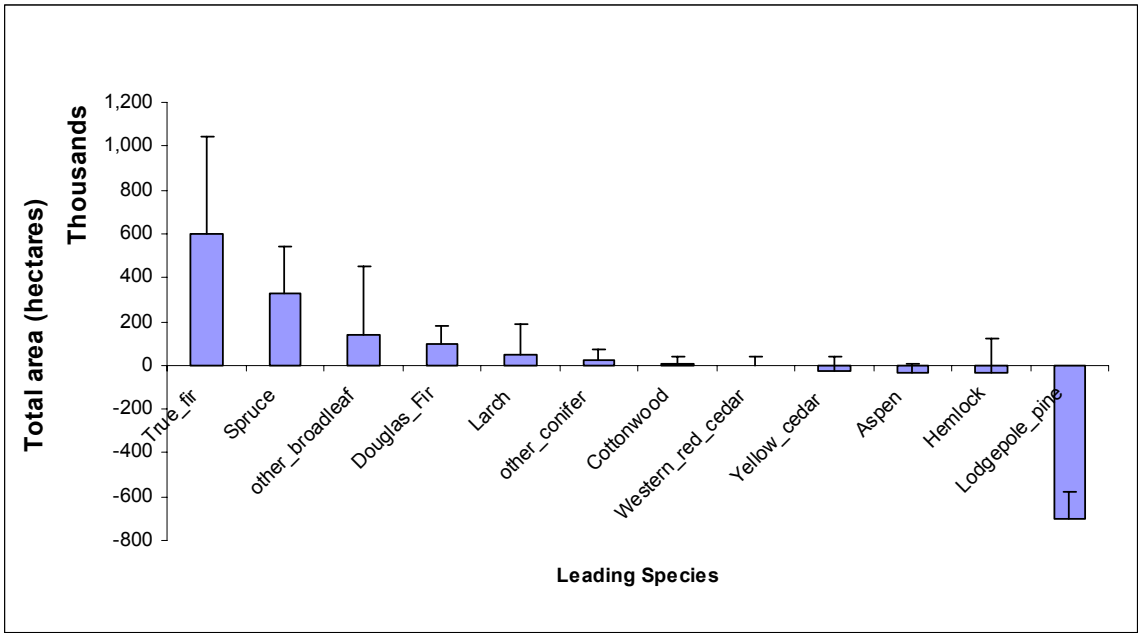

Figure 15. Change in total area by leading species for the period 2000-2005. The error bars are at the 95% probability level.

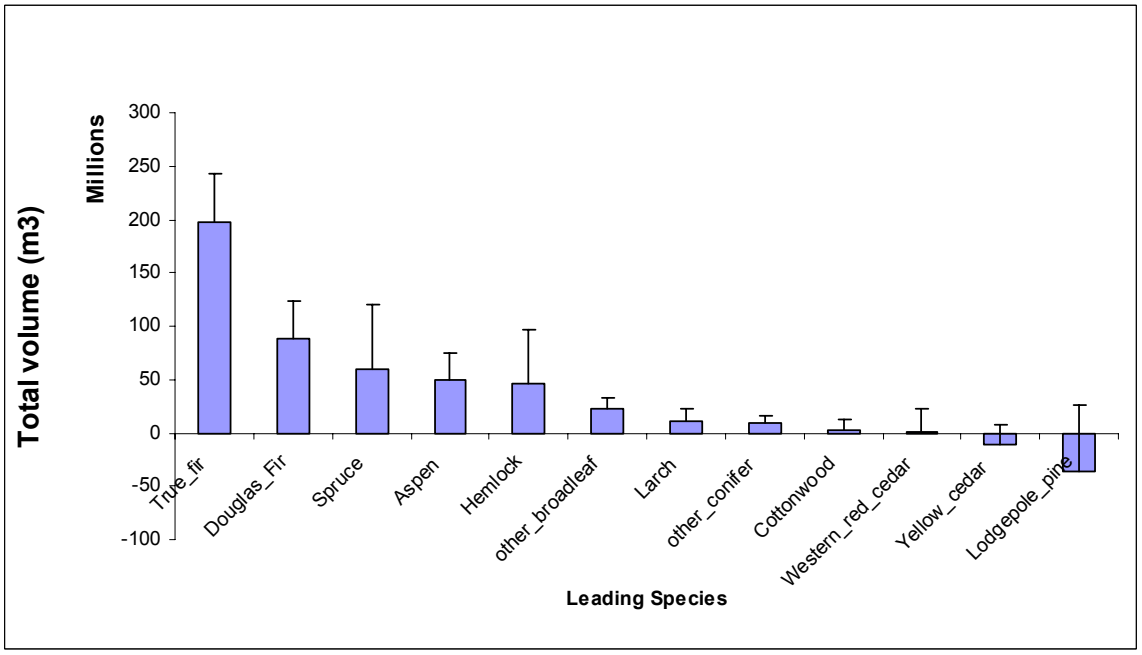

Figure 16. Change in total volume by leading species for the period 2000-2005. The error bars are at the 95% probability level.

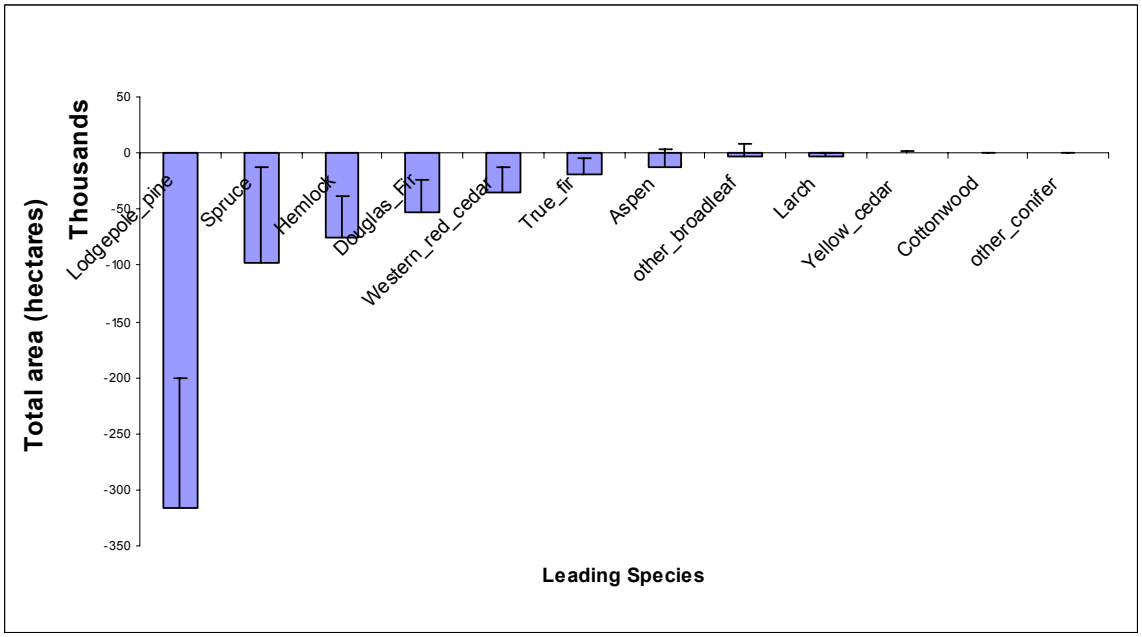

Figure 17. Change in total area by leading species for the period 2005-2007. The error bars are at the 95% probability level.

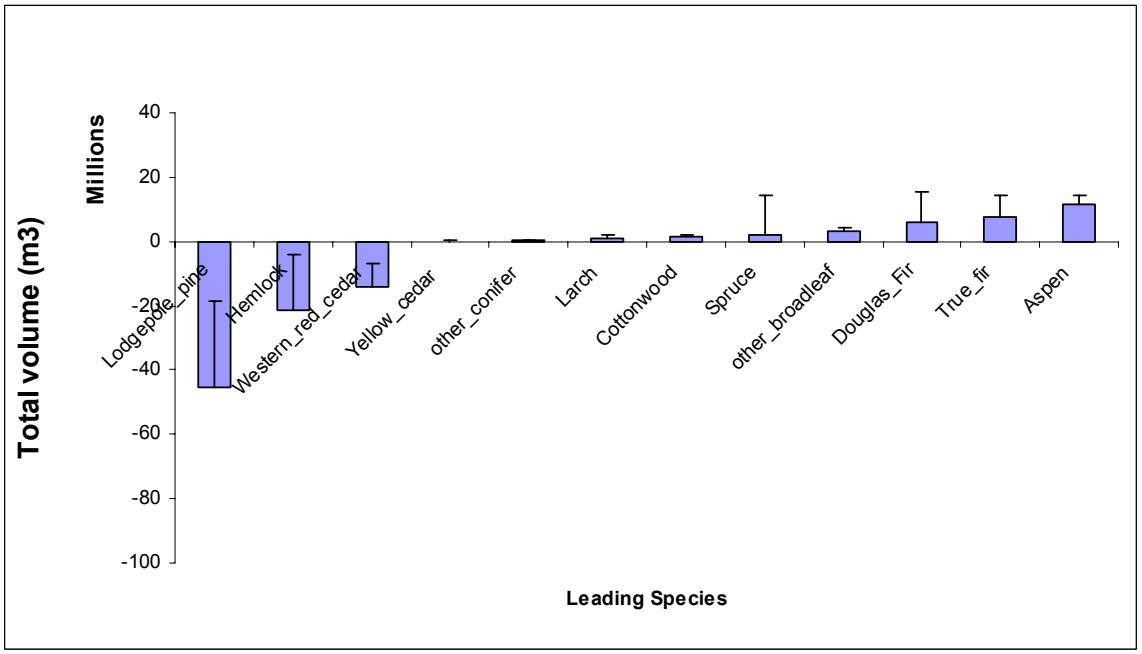

Figure 18. Change in total volume by leading species for the period 2005-2007. The error bars are at the 95% probability level.

Vegetation type

There were three vegetation types: broadleaf, conifer and mixed. Broadleaf types are vegetated treed areas (air crown closure at least 10%) with broadleaved trees constituting at least 75% of the total volume. Coniferous types are vegetated treed areas with conifers constituting at least 75% of the total volume. Mixed types are vegetated treed areas with neither coniferous nor broadleaf trees accounting for at least 75% of the total volume.

Most of the vegetated treed area was dominated by conifers (45 million ha, or 86% of the VT area), with 3.8 million ha (or 7%) mixed, and 3.4 million (or 7%) broadleaf at the end of 2007 (Figure 19). The conifer total volume was about 9.9 billion m^3 (or 91%) (Figure 20). Over the period 2000-2005, total area and volume increased in all the vegetation types, most notably in the conifers. The increases in area and volume in the conifer areas were 2.4 million ha (or 6%) and 370 million m^3 (or 4%), respectively (Figures 21 and 22).

Between 2005-2007, there were slight changes in area and volume in the vegetation types. Total area increased by 1% in the conifers and increased by less than 1% in the broadleaf and mixed (Figure 23). The conifer volume decreased by 69.6 million m3 (1%). The broadleaf and mixed total volume increased by 11.4 million m3 and 11.0 million m3 (or 2% and 3%), respectively (Figure 24).

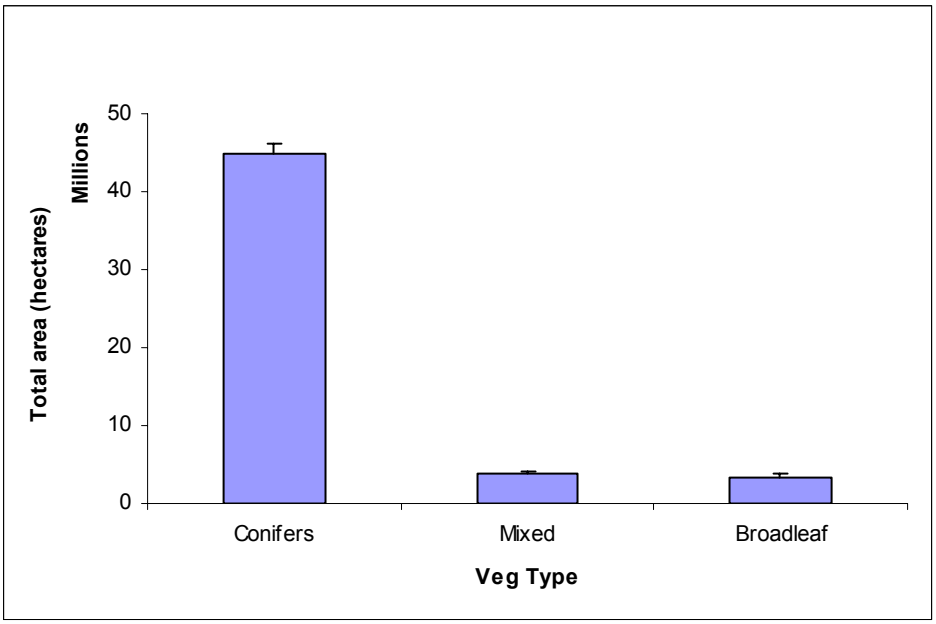

Figure 19. Vegetated treed total area in 2007 by vegetation type. The error bars are at the 95% probability level.

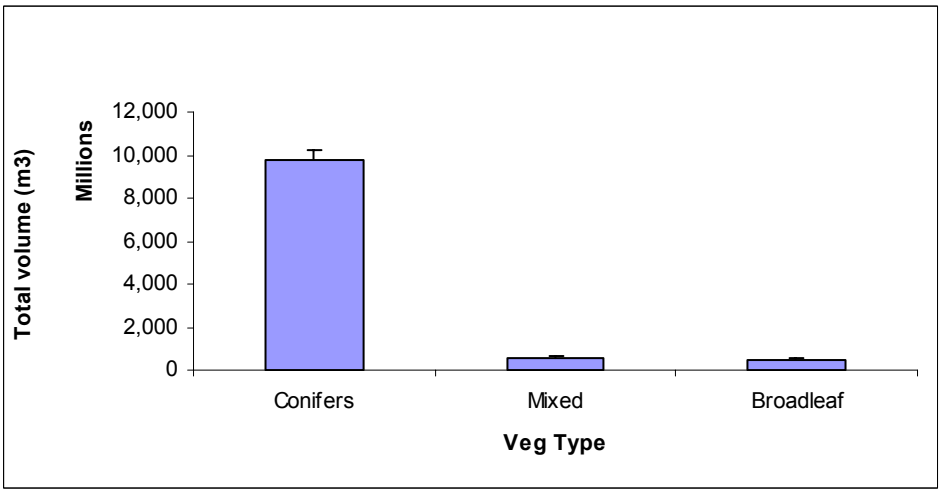

Figure 20. Vegetated treed total volume in 2007 by vegetation type. The error bars are at the 95% probability level.

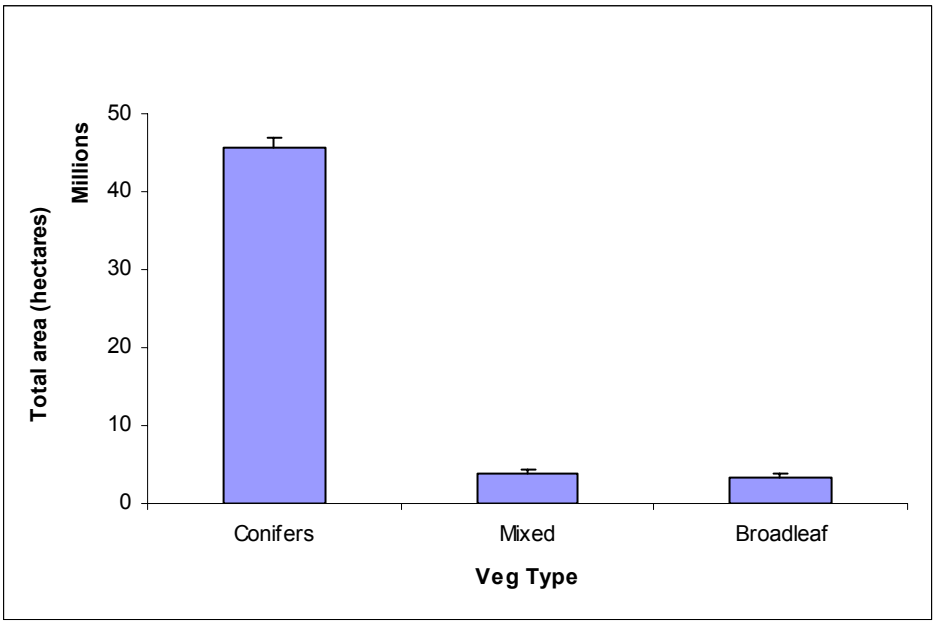

Figure 21. Change in vegetated treed total area by vegetation type during 2000-2005. The error bars are at the 95% probability level.

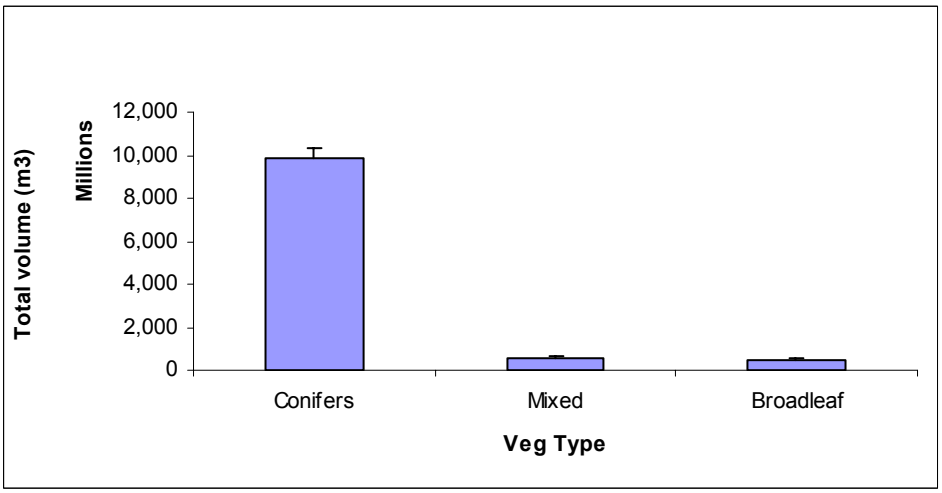

Figure 22. Change in vegetated treed total volume by vegetation type during 2000-2005. The error bars are at the 95% probability level.

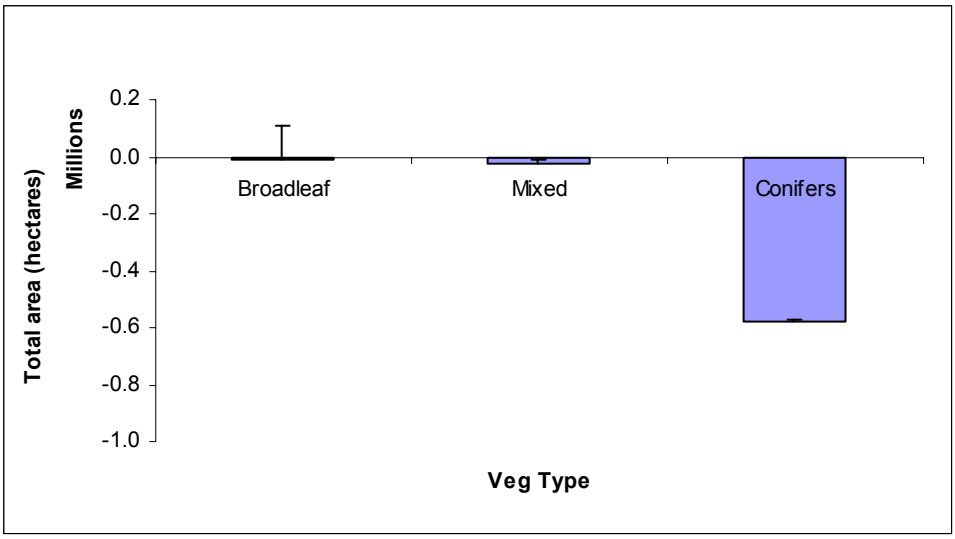

Figure 23. Change in vegetated treed total area by vegetation type during the period 2005-2007. The error bars are at the 95% probability level.

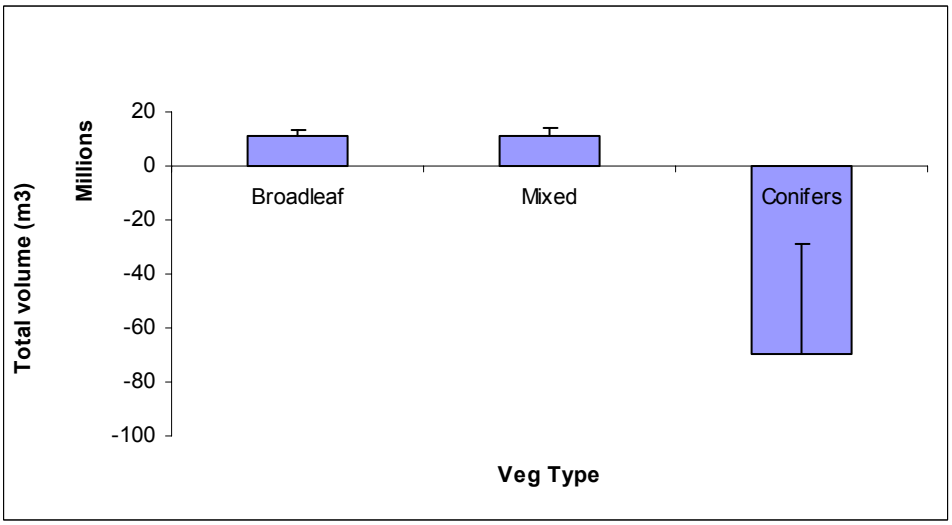

Figure 24. Change in vegetated treed total volume by vegetation type during the period 2005-2007. The error bars are at the 95% probability level.

Age-class distribution

The total area and volume in the vegetated treed areas were grouped into six total age-classes: 1-40, 41-80, 81-120, 121-160, 161-250 and >250 years. Many of British Columbia's vegetated treed areas are relatively old. The total area of the vegetated treed mature age-classes (121+ years) at the end of 2007 was approximately 30 million ha (or 57% of the VT areas) (Figure 25).

The total volume in these mature age-classes was approximately 7.8 billion m^3 (or 72%) (Figure 26).

During the period 2000-2005, total area increased in the 121-160 and 161-250 age-classes, with little or no change in total area in the remaining age-classes (except age-class 1-41 where the area deceased) (Figure 27). The total volume in the mature age-classes increased, with little or no change in total area in the remaining age-classes (Figure 28).

Between 2005-2007, there was a significant decrease in area in the immature age-classes 1-40 and 41-80 (8% and 8%, respectively), and there was a slight increase in area in the mature age-classes (Figure 29). Total volume decreased by about 7% in the 41-80 age-class, and there was little change in volume in the remaining age-classes (Figure 30).

Figure 25. Total area in 2007 by age-class. The error bars are at the 95% probability level.

Figure 26. Total volume in 2007 by age-class. The error bars are at the 95% probability level.

Figure 27. Change in total area by age-class during 2000-2005. The error bars are at the 95% probability level.

Figure 28. Change in total volume by age-class during 2000-2005. The error bars are at the 95% probability level.

Figure 29. Change in total area by age-class during 2005-2007. The error bars are at the 95% probability level.

Figure 30. Change in total volume by age-class during 2005-2007. The error bars are at the 95% probability level.

Discussion

This report has presented the provincial forest resource statistics by classifiers for 2007 and the periodic changes during the period 2000-2005 and 2005-2007. These change estimates are reasonably good measures of real changes on the ground due to growth (the same yield model was used in each year) and depletion from harvesting that are captured from satellite imagery. It is the first time that provincial estimates of change over time are obtained based on a valid statistical sample.

Caution should, however, be exercised in interpreting the change estimates obtained through future re-measurements of the NFI photo plots. For example, area and volume change estimates could be due to actual change owing to growth or mortality, volume growth projection errors, differences in photo interpreters, and measurement errors due to different photo interpretation standards and techniques. In addition, the confidence intervals of the change estimates of some classifier-classes are quite large. Relative standard errors for some classifier-classes are very high because of the very high variation in area or volume change relative to the very small changes in area or volume that occurred over the change period. Nonetheless, these sample-based change estimates are more preferable to those based on past approaches because they avoid the problems of compiling existing inventories at different points in time and estimates of precision are available. To obtain a level of comfort on the precision of the photo interpreted estimates, it is desirable to check a subset of the photo plots on the ground (possibly using the NFI ground plots), or using higher resolution photography (e.g., 70 mm) or imagery.

In addition to the overall point and interval statistics presented here, we can also produce spatial representation of the photo-plot sample data using spatial interpolation methods such as krigging, and possibly also incorporating existing data from the provincial inventories. The existing provincial inventories could potentially also be used to increase the precision of NFI-based forest resource statistics. This could be achieved by using the ratio-of-means relationship between the NFI photo plot estimates and the corresponding existing provincial inventory estimates to adjust the NFI-based sample average obtained from photo plots alone. The adjusted estimated sample average is then expanded to the population total in the usual manner.

Classification of individual polygons is also a critical process because it not only provides necessary categories for reporting purposes but also it affects the precisions of the estimates. The area of interest (AOI) and likelihood of occurrence of the classifiers of interest directly determine the precision of the estimates. For future analysis, it is suggested that a list of core classifiers and classifier-classes be established for consistent provincial monitoring and reporting with acceptable precision over time.

The estimates of change in this report do not include disturbances such as deforestation, MPB, and fire. This is because the data for these disturbances were not available at time of this analysis. These data will be incorporated into the NFI photo plot database when they become available and used for future reporting.

The forest resource statistics generated from the NFI photo plot database may be used by the MFR to prepare the next state of British Columbia's forest report [6]. As well, the NFI sampling design (grid-based systematic design) is flexible and robust and can, thus, be modified or expanded to accommodate various provincial or sub-provincial inventory and monitoring needs (e.g. Future Forest Ecosystem Initiatives, FREP, and State of Environment Reporting). For example, the road length and stream crossings state and change (2000-2005) statistics have been produced from the NFI data and used by the Ministry of Environment to report the state of the environmental trends in British Columbia in 2006 [7].

Summary

This report presents examples of the utility of the newly implemented Canada's National Forest Inventory (NFI) for the provincial reporting and monitoring needs. This report provides statistics on BC's forest resource in 2007 and periodic changes during the periods 2000-2005 and 2005-2007 generated based on the data from the 2419 NFI photo plots falling in BC. It is the first time that such periodic change estimates of the province's forest resource have been obtained using a valid sample.

The statistics include estimates of area and volume totals and their approximate relative standard errors and confidence intervals by selected classifiers. Despite the high relative standard errors and confidence intervals of change estimates for some classifiers, estimation of forest resource state and change over time using the NFI is more efficient and effective, and avoids issues associated with past approaches that compiled existing inventories at different time periods. The NFI sampling design permits estimation of the precision of the state and change estimates, and, as well, it is flexible and robust to be modified or expanded to accommodate various provincial monitoring needs.

The state of the forest and change estimates in this report do not reflect fully the actual provincial state and change of the forest resource because the impact of other disturbances such as MBP, fire and deforestation have not been included in the photo plot database. This is because these data were not available in time for the analysis in this report. In the future, data from these other disturbances should be incorporated into the NFI photo plot database so that the provincial state and change estimates can be more fully reported. The intent of this report was mainly to demonstrate the utility of the NFI for provincial monitoring based on a provincial sampling approach.

It is planned that in future NFI reporting, additional reporting items (e.g. biomass and carbon), use of NFI ground data to adjust the photo estimates, and various classifier-classes (e.g., land height classes, and land use) for various classifiers of interest (e.g., ecozones, eco-provinces, protected areas, and ownership) will be used. In addition, integration of the NFI with other existing inventories such as the VRI will be explored.

The NFI sampling design is flexible and robust and, thus, can be modified or expanded to accommodate various provincial or sub-provincial inventory and monitoring needs (e.g. Future

Forest Ecosystem Initiatives, FREP, State of Environment Reporting, etc.). However, continued plot remeasurement and database maintenance over time is critical for any future provincial monitoring and reporting based on the NFI.

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References

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Appendix I: Definitions of classifiers and classifier-classes

The definitions used in this report include land cover, land type, leading species, age-class and vegetation type. The definitions of the classifier-classes and the database classification rules for these classifiers are given in Table 1.

Table 1. Classifier-class definitions and database classification rules. BCLCCS refers to British Columbia Land Cover Classification Scheme

Classifier	*Classifier-class (k)*	*Descriptions (classification rules)**
1. Land Cover (BCLCCS Level 2)	VN	LC_LEVEL1 = "V" , LC_LEVEL2="N"
	VT	LC_LEVEL1 = "V" , LC_LEVEL2="T"
	NL	LC_LEVEL1 = "N" , LC_LEVEL2="L"
	NW	LC_LEVEL1 = "N" , LC_LEVEL2="W
	SSS	LC_LEVEL1 = "S" , LC_LEVEL2="S"
2. Land type	FOREST	NP_CD = ' ', '0'
		NP_CD = '10' or '12'; and Projected_age >80 yr, and Site_index >3m
	OTHER-WOODED LAND	NP_CD = '11', '63'; NP_CD = '10 ', '12' and Projected_age <=80, and Site_index <=3 m
	WATER	NP_CD = '15' or '25'
	OTHER LAND	None of the above
3. Leading Species	DOUGLAS FIR	TREE_SPECIES_CD_1 = 'F*' (first leading species code)
	HEMLOCK	TREE_SPECIES_CD_1 = 'H*'
	LARCH	TREE_SPECIES_CD_1 = 'L*'
	LODGEPOLE PINE	TREE_SPECIES_CD_1 = 'PL', 'PLI'
	SPRUCE	TREE_SPECIES_CD_1 = 'S*'
	TRUE FIR	TREE_SPECIES_CD_1 = 'B*'
	WESTERN RED CEDAR	TREE_SPECIES_CD_1 = 'CW'
	YELLOW CEDAR	TREE_SPECIES_CD_1 = 'YC'
	ASPEN	TREE_SPECIES_CD_1 = 'AT'
	COTTONWOOD	TREE_SPECIES_CD_1 = 'A', 'ACT', 'AC'
	OTHER CONIFER	TREE_SPECIES_CD_1 = 'PY', 'PW', 'PA'
	OTHER BROADLEAF	TREE_SPECIES_CD_1 = 'D', 'DR', 'E*', 'M', 'R', 'Q'
4. Vegetation Type (BCLCCS Level 4) (VT only)	CONIFEROUS	AIR_CROWN_CLOSURE_PCT >= 10% and TREE_SPECIES_PCT_1 >= 75% (conifer species)
	BROADLEAF	AIR_CROWN_CLOSURE_PCT >= 10% and TREE_SPECIES_PCT_1 >= 75% (broadleaf species)
	MIXED	AIR_CROWN_CLOSURE_PCT >= 10% and TREE_SPECIES_PCT_1 < 75% (either conifer or broadleaf species)
5. Age-class (VT only)	1-40	PROJECTED_AGE >0 and < 41
	41-80	PROJECTED_AGE >40 and < 81
	81-120	PROJECTED_AGE >80 and < 121
	121-160	PROJECTED_AGE >120 and <161
	161-250	PROJECTED_AGE >160 and <251
	>250	PROJECTED_AGE >250

* Please refer to Appendix III for definition of the attributes.

Appendix II: Construction of the provincial national forest inventory photo-plot database

The following information is excerpted from the report by the Forest Analysis and Inventory Branch Ministry of Forests and Range (2006): *British Columbia forest resource reporting from the national forest inventory photo database.*

Source Data

The NFI photo data was created from compilation of the following datasets:

- NFI photo plot location and boundary data provided by CFS
- The Year 2000 Inventory FIP
- Year 2000 Inventory FC1, ALR, PSYU, TRIM Roads including trails
- Year 2000 TFL FIP/FC1
- Year 2000 Park FIP/FC1
- Year 2000 Recreation
- Year 2000 Ownership
- Year 2000 TRIM Road
- Year 2005 Protected Area, Ecoprovinces, TSA's, TFL's, NFI Ecozones,
- Landsat 7 ETM Image (1999, 2000, 2001, 2005, orthorectified and enhanced)

There were approximately 43 photo plots that have NTA (No Typing Available) polygons (i.e. no forest cover attribute data available in the above sources). These polygons were filled with new data from the following sources:

- Existing data stored by the data owners such as TFL, Parks, etc
- New vegetation inventory data in the Land Resource Data Warehouse (LRDW) available after year 2000
- New photo interpretation (using existing aerial photos prior to 1996)

Data drilling

NFI photo plots (2km x 2km) were constructed by drilling through the year 2000 forest inventory base (the source data mentioned above). All the spatial coverage and attribute data was extracted, formatted, and stored separately by 1:20,000 scale NTS map sheets.

In addition, 3km x 3km road plots and 4km x 4km Landsat image chips covering the NFI photo plots were created from the Terrain Resource Information Management (TRIM) database and

Landsat images, respectively. The road plots were updated twice, the first time was done using 1999/2000/2001 Landsat 7 ETM images, and the second time was done using year 2005 Landsat 5 TM images. These 3km x 3km road plots were then drilled into the standard NFI 2km x 2km plots, resulting in 2 sets of road data for 2000 and 2005. All the new roads built between 2003 and 2005 that were captured by Forest Tenure and Engineering Branch were also included in the year 2005 road data set.

Verification and update

Out of the total 2419 photo plots, 2327 plots were verified, and 702 plots were updated for changes due to harvesting. About 92 plots were not verified due to no image coverage (not available or extensive cloud coverage).

FIP/VRI to NFI attribute conversion

A number of SAS programs/macros were written to accommodate the conversion of the forest cover attributes to the NFI attributes according to the NFI standards and specifications.

Spatial overlaying to create data for estimation

In order to obtain separate estimates for attributes that were not in the original NFI photo database, the following spatial layers stored in LRDW and the NFI spatial layers are merged with the NFI photo land cover spatial layer and attribute table:

- Protected Area (LRDW layer name: WHSE_Parks.PA_Protected_area_poly)
- Eco-Provomces (LRDW layer name: WHSE_Terrestrial_Ecology.ERC_Ecoprovinces_SP)
- Timber Supply Area (LRDW layer name: WHSE_ADMIN_BOUNDARIES.FADM_TSA)
- Tree Farm License (LRDW layer name: WHSE_ADMIN_BOUNDARIES.FADM_TFL)
- NFI Ecozones (layer name: NFI_Ecozone)
- Ownership (layer name: NFI_own)

Final NFI photo database

Spatial (Arc layers, provincial, Albers, NAD83)

- Province Boundary
- Regions/Districts Boundary

- Provincial Recreation
- NFI FC/VRI Polygons
- NFI Roads (3km x 3km)
- NFI Eco Zones
- NFI Eco-provinces
- NFI Protected Areas
- NFI Administrative Area (TSA/TFL, MFR regions/districts)
- NFI Ownership
- NFI Point Location and Boxes
- NFI Land Cover Polygon
- NFI Land type Polygon
- NFI Protection Status

Attribute (MS Access and SAS)

- FIP/VRI Tables (poly, layer, history, resultant, etc.)
- NFI Summary Table (provincial, summarized by photo plots)
- All converted NFI tables (photo plot, land type, exotic tree species, ownership, protection status, land cover and stand layer)

Image Chips (Landsat 7 ETM, GeoTiff, Albers, NAD83, 1999-2001)

- 4 km x 4 km, IHS enhanced colour composites

Appendix III: Raw data tables and definition of relevant attributes

Table name	Attribute name	Attribute label
KEY_AREA	district	District code
KEY_AREA	map_id	Map sheet
KEY_AREA	mof_id	FC_tag or Feature_id
KEY_AREA	mof_id_type	source of mof id
KEY_AREA	nfi_plot	NFI plot
KEY_AREA	poly_area	NFI area
KEY_AREA	poly_id	current NFI poly id
POLYGON	ci_cd	Coast Interior code
POLYGON	lc_level1	Land Base
POLYGON	lc_level2	Land Cover
POLYGON	lc_level3	Land Position
POLYGON	lc_level4	Veg type
POLYGON	lc_level5	Density Class
POLYGON	map_id	Map #
POLYGON	mof_id	fc_tag
POLYGON	nfi_plot	nfi_plot
POLYGON	np_cd	Non productive code
POLYGON	polygon	Polygon Id
POLYGON	pri_util	Primary Utilization level code
LAYER	crown_cl	AIR_CROWN_CLOSURE_PCT
LAYER	district	dist_cd
LAYER	layer	FOR_COVER_LAYER_CD
LAYER	map_id	Map #
LAYER	mof_id	fc_tag
LAYER	nfi_plot	nfi_plot
LAYER	npf_desc	NON_FOREST_DESCRIPTOR
LAYER	polygon	Polygon Id
LAYER	proj_age	PROJECTED_AGE
LAYER	proj_ht	PROJECTED_HEIGHT
LAYER	rank_cd	FOR_COVER_RANK_CD
LAYER	site_index	SITE_INDEX
LAYER	spc_1	TREE_SPECIES_CD_1
LAYER	vol_sp1_p	VOL_PER_HA_SPP_1_PRI_UTIL_LVL
LAYER	vol_sp2_p	VOL_PER_HA_SPP_2_PRI_UTIL_LVL
LAYER	vol_sp3_p	VOL_PER_HA_SPP_3_PRI_UTIL_LVL
LAYER	vol_sp4_p	VOL_PER_HA_SPP_4_PRI_UTIL_LVL
LAYER	vol_sp5_p	VOL_PER_HA_SPP_5_PRI_UTIL_LVL
LAYER	vol_sp6_p	VOL_PER_HA_SPP_6_PRI_UTIL_LVL

Appendix IV: Statistical Estimation Example

Forest area total

As an example, we use the **land type** classifier and provide estimates of the provincial total **forest area** (*k*th) classifer class as follows. The test data are available from MFR FAIB in the Microsft Excel spreadsheet file: **classifier_forest_Example.xls**.

1. Obtain from the photo plot database, a_{ki}, the total forest area in the *i*th photo plot of total area a_{Tki} (i = 1, 2, 3, …, 2419) at the end of 2005. Set w_i=1 for all the plots, i.e., no weighting.
2. Calculate the provincial average forest area proportion and associated statistics:

$$\hat{y}_k = \frac{\sum_{i=1}^{n} w_i a_{ki}}{\sum_{i=1}^{n} w_i a_{Tki}} = 0.693455 \text{ ha/ha}$$

$$\hat{\text{var}}(\hat{y}_k) \doteq \frac{1}{(\sum_{i=1}^{n} w_i a_{Tki} / \sum_{i=1}^{n} w_i)^2} \left(\frac{\left[\sum_{i=1}^{n} (w_i a_{ki})^2 + \hat{y}_k{}^2 \sum_{i=1}^{n} (w_i a_{Tki})^2 - 2\hat{y}_k \sum_{i=1}^{n} w_i^2 a_{ki} a_{Tki} \right]}{(\sum_{i=1}^{n} w_i)(\sum_{i=1}^{n} w_i - 1)} \right)$$

$$= 0.00005855$$

$$SE\%(\hat{y}_k) = \frac{\sqrt{\hat{\text{var}}(\hat{y}_k)}}{\hat{y}_k} 100 = 1.1\%$$

3. Estimate the provincial total forest area and the associated statistics:

$$\hat{Y}_k = 94657697 \times \hat{y}_k = 65{,}640{,}856 \text{ ha}$$

$$\hat{\text{var}}(\hat{Y}_k) = (94657697)^2 \times \hat{\text{var}}(\hat{y}_k) = 52459985699$$

$$SE\%(\hat{Y}_k) = \frac{\sqrt{\hat{\text{var}}(\hat{Y}_k)}}{\hat{Y}_k} \times 100 = 1.1\%$$

$$\hat{Y}_k \pm t_{\alpha/2,n-1} \sqrt{\hat{\text{var}}(\hat{Y}_k)} = 58{,}610{,}121 \pm 1420297 \text{ ha}$$

Change in forest area

As an example, we use the **land type** classifier and provide change estimates of the provincial total **forest area** (*k*th classifer class) as follows. The test data are available from MFR FAIB in the Microsoft Excel spreadsheet file: **classifier_forest_Example.xls**.

1. Calculate Δa_{ki}, the periodic change in the forest area in the *i*th photo plot of area a_{Tki} (i = 1,2,3, …, 2419) during the period 2000 - 2005. That is, $\Delta a_{ki} = a_{2005,ki} - a_{2000,ki}$. The 2000 attribute

values, $a_{2000,ki}$,were slightly adjusted by the factor, $\frac{a_{2007Ti}}{a_{2000Ti}} = \frac{964148.5246}{963265.6771} = 1.000954$, to bring them to a common total photo-plot sample area in 2005. The sum of the photo plot areas was slightly higher in 2005 than in 2000 due to better polygon area estimation.

2. Proceed with the estimation of area change using the same formulae as for the area and volume totals above (Steps 2 and 3), replacing a_{ki} with Δa_{ki} :

$$\Delta\hat{y}_k = \frac{\sum_{i=1}^{n} w_i \Delta a_{ki}}{\sum_{i=1}^{n} w_i a_{Tki}} = 0.074275 \text{ ha/ha}$$

$$\hat{\text{var}}(\Delta\hat{y}_k) \doteq \frac{1}{(\sum_{i=1}^{n} w_i a_{Tki} \Big/ \sum_{i=1}^{n} w_i)^2} \left(\frac{\left[\sum_{i=1}^{n} (w_i \Delta a_{ki})^2 + \hat{p}_k{}^2 \sum_{i=1}^{n} (w_i a_{Tki})^2 - 2\hat{p}_k \sum_{i=1}^{n} w_i^2 \Delta a_{ki} a_{Tki} \right]}{(\sum_{i=1}^{n} w_i)(\sum_{i=1}^{n} w_i - 1)} \right)$$

$$= 0.000016484$$

$$SE\%(\Delta\hat{y}_k) = \frac{\sqrt{\hat{\text{var}}(\Delta\hat{y}_k)}}{|\Delta\hat{y}_k|} 100 = 5.47\%$$

3. Estimate the change in provincial total forest area and the associated statistics:

$$\Delta\hat{Y}_k = 94657697 \times \Delta\hat{y}_k = 7030735 \text{ ha}$$

$$\hat{\text{var}}(\Delta\hat{Y}_k) = (94657697)^2 \times \hat{\text{var}}(\Delta\hat{y}_k) = 147694344057$$

$$SE\%(\Delta\hat{Y}_k) = \frac{\sqrt{\hat{\text{var}}(\Delta\hat{Y}_k)}}{|\Delta\hat{Y}_k|} \times 100 = 5.47\%$$

$$\Delta\hat{Y}_k \pm t_{\alpha/2,n-1} \sqrt{\hat{\text{var}}(\Delta\hat{Y}_k)} = 7{,}030{,}735 \pm 753{,}610 \text{ ha}$$

Input files, computer programs and output files

Input files

The input data were in form of tables in SAS format for 2000 and for 2005. These data are in the \data sub-directory. The names of these tables are:

2000
Key_area.sas7bdat
Polygon.sas7bdat
Layer.sas7bdat

2005
Key_area_dec_05.sas7bdat
Polygon_05.sas7bdat
Layer_05.sas7bdat

2007
Key_area_07.sas7bdat
Polygon_07.sas7bdat
Layer_07.sas7bdat

Computer programs

The data were analyzed using SAS. Separate SAS programs were written for each classifier, for 2007 and change estimates. These programs are in the \programs subdirectory. These various programs are listed below:

Merger_ageclass00xxx.sas (2000 totals)
Merger_ageclass5New2.sas (2005 totals)
Merger_ageclass7New2.sas (2007 totals)
Merger_ageclass_change5New2.sas (2000-2005 change)
Merger_ageclass_change7New2.sas (2000-2007 change)
Merger_ageclass_change57New2.sas (2005-2007 change)

Merger_BCLCCS00xxx.sas (2000 totals)
Merger_BCLCCS5New2.sas (2005 totals)
Merger_BCLCCS5New2.sas (2007 totals)
Merger_BCLCCS_change5New2.sas (2000-2005 change)
Merger_BCLCCS_change7New2.sas (2000-2007 change)
Merger_BCLCCS_change57New2.sas (2005-2007 change)

Merger_forest00xxx.sas (2000 totals)
Merger_forest5New2.sas (2005 totals)
Merger_forest7New2.sas (2007 totals)
Merger_forest_change5New2.sas (2000-2005 change)
Merger_forest_change7New2.sas (2000-2007 change)
Merger_forest_change57New2.sas (2005-2007 change)

Merger_leadspecies00xxx.sas (2000 totals)
Merger_leadspecies5New2.sas (2005 totals)

Merger_leadspecies7New2.sas (2007 totals)
Merger_leadspecies_change5New2.sas (2000-2005 change)
Merger_leadspecies_change7New2.sas (2000-2007 change)
Merger_leadspecies_change57New2.sas (2005-2007 change)

Merger_VegType00xxx.sas (2000 totals)
Merger_VegType5New2.sas (2005 totals)
Merger_VegType7New2.sas (2007 totals)
Merger_VegType_change5New2.sas (2000-2005 change)
Merger_VegType_change7New2.sas (2000-2007 change)
Merger_VegType_change57New2.sas (2005-2007 change)

Output files

The SAS programs output results into Excel workbooks. These workbooks are in the \output subdirectory. Excel was then used to produce bar charts and display the statistics. These various output files (workbooks) for each classifier-class are listed below.

AreaVolSummaryStatisticsChange_ageclass5New2.xls
AreaVolSummaryStatisticsChange_ageclass7New2.xls
AreaVolSummaryStatisticsChange_ageclass57New2.xls

AreaVolSummaryStatisticsChange_BCLCCS5New2.xls
AreaVolSummaryStatisticsChange_BCLCCS7New2.xls
AreaVolSummaryStatisticsChange_BCLCCS57New2.xls

AreaVolSummaryStatisticsChange_forest5New2.xls
AreaVolSummaryStatisticsChange_forest7New2.xls
AreaVolSummaryStatisticsChange_forest57New2.xls

AreaVolSummaryStatisticsChange_leadspecies5New2.xls
AreaVolSummaryStatisticsChange_leadspecies7New2.xls
AreaVolSummaryStatisticsChange_leadspecies57New2.xls

AreaVolSummaryStatisticsChange_vegtype5New2.xls
AreaVolSummaryStatisticsChange_vegtype7New2.xls
AreaVolSummaryStatisticsChange_vegtype57New2.xls

Appendix V: Total area and total volume statistics

This Appendix provides detailed provincial statistics for area and total volume in 2005 (Table 2) and 2007 (Table 3), and the change over the period 2000-2005 (Table 4), 2005-2007 (Table 5) and 2000-2007 (Table 6), for various classifiers and classifier-classes. Relative standard error (SE%) is a measure of the precision of the estimated totals: the lower the SE%, the more precise the estimated total. Confidence interval (CI) is the product of SE% and a *t*-value corresponding to the 95% probability level (or $\alpha = 0.05$) and 2,418 degrees of freedom. The confidence interval expresses the range within which we expect the true population total of the attribute to lie with a given probability (95%). The sample size for each classifier-class is 2,419 photo plots.

Table 2. Total area and total volume in 2005 statistics by classifier (α is the confidence level).

Classifier	Classifier-class	Area in 2005				Volume in 2005			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total
Land Type	Forest	65,640,548	1,420,288	1.1	69.3	10,888,722,483	411,861,671	1.9	99.9
	Other Wooded Land	4,392,321	514,488	6.0	4.6	12,643,540	5,253,337	21.2	0.1
	Fresh Water	1,689,033	309,794	9.4	1.8	-	-		0.0
	Other Land	22,935,795	1,350,511	3.0	24.2	147,817	289,860	100.0	0.0
	Total (Province)	**94,657,697**				**10,901,513,840**			
Leading Species	Douglas-fir	5,432,577	630,357	5.9	5.7	1,201,961,220	163,423,304	6.9	11.0
	Hemlock	5,662,915	625,476	5.6	6.0	2,168,825,872	260,923,942	6.1	19.9
	Larch	485,754	141,193	14.8	0.5	73,893,554	25,772,577	17.8	0.7
	Lodgepole_pine	14,017,501	965,862	3.5	14.8	2,255,649,564	174,898,547	4.0	20.7
	Spruce	13,995,425	878,334	3.2	14.8	2,243,464,141	163,051,637	3.7	20.6
	True-fir	9,298,086	742,505	4.1	9.8	1,415,739,413	140,716,641	5.1	13.0
	Western redcedar	2,161,223	352,454	8.3	2.3	706,782,415	119,707,210	8.6	6.5
	Yellow cedar	503,746	158,099	16.0	0.5	116,228,456	46,534,752	20.4	1.1
	Aspen	4,006,769	460,667	5.9	4.2	498,811,593	67,157,619	6.9	4.6
	Cottonwood	466,160	127,512	13.9	0.5	74,566,807	20,681,505	14.1	0.7
	Other conifer	329,036	103,231	16.0	0.3	34,371,034	12,110,158	18.0	0.3
	Other broadleaf	858,900	159,671	9.5	0.9	111,219,772	25,529,525	11.7	1.0

Classifier	Classifier-class	Area in 2005				Volume in 2005			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total
	Non-tree species	37,439,605	1,327,298	1.8	39.6	0	0	-	0.0
	Total (Province)	**94,657,697**				**10,901,513,840**			
Vegetation Type (Vegetated Treed areas only)	Conifer	45,520,463	1,280,794	1.4	86.3	9,880,570,109	410,083,127	2.1	90.7
	Mixed	3,829,755	405,934	5.4	7.3	565,141,051	64,811,499	5.8	5.2
	Broadleaf	3,399,278	431,306	6.5	6.4	449,737,135	63,643,863	7.2	4.1
	Total (Vegetated Treed)	**52,749,496**				**10,895,448,295**			
Age-class (years)	1-40	3,778,665	426,717	5.8	4.0	75,137,392	19,537,693	13.3	0.7
	41-80	8,577,680	705,375	4.2	9.1	1,068,760,817	125,317,418	6.0	9.8
	81-120	11,142,583	742,741	3.4	11.8	2,029,299,749	157,771,928	4.0	18.6
	121-160	9,490,959	656,687	3.5	10.0	2,094,972,646	163,703,093	4.0	19.2
	161-250	12,574,540	764,048	3.1	13.3	2,785,250,979	189,245,167	3.5	25.5
	>250	7,185,069	670,805	4.8	7.6	2,842,026,711	299,403,620	5.4	26.1
	Non_VT	41,908,201	1,309,234	1.6	44.3	6,065,545	4,328,631	36.4	0.1
	No age	0	0	-	0.0	0	0	-	0
	Total (Province)	**94,657,697**				**10,901,513,840**			
BCLCCS (Level 2)	Vegetated treed (VT)	52,749,496	1,309,234	1.3	55.7	10,895,448,295	413,193,069	1.9	99.9
	Non-vegetated land (NL)	20,066,481	1,330,104	3.4	21.2	0	0	0	0
	Vegetated non-treed (VN)	17,584,901	897,370	2.6	18.6	6,065,545	4,328,631	36.4	0.1
	Non-vegetated water (NW)	4,237,530	564,853	6.8	4.5	0	0	0	0
	~~Unknown (SS)~~			~~100.0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~

Classifier	Classifier-class	Area in 2005				Volume in 2005			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total
		19,289	37,825						
	Total (Province)	**94,657,697**				**10,901,513,840**			

Table 3. Total area and total volume in 2007 statistics by classifier (α is the confidence level).

Classifier	Classifier-class	Area in 2007				Volume in 2007			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total
Land Type	Forest	65,646,988	1,420,388	1.1	69.4	10,841,061,432	407,493,490	1.9	99.9
	Other Wooded Land	4,389,405	514,358	6.0	4.6	13,098,025	5,576,953	21.7	0.1
	Fresh Water	1,688,380	309,772	9.4	1.8	-	-	-	0.0
	Other Land	22,932,923	1,350,562	3.0	24.2	147,862	289,948	100.0	0.00
	Total (Province)	**94,657,697**				**10,854,307,318**			
Leading Species	Douglas-fir	5,379,501	626,268	5.9	5.7	1,207,865,450	164,672,627	7.0	11.1
	Hemlock	5,587,873	617,410	5.6	5.9	2,147,202,578	257,492,516	6.1	19.8
	Larch	483,413	140,659	14.8	0.5	75,049,545	26,197,608	17.8	0.7
	Lodgepole pine	13,701,732	948,395	3.5	14.5	2,210,038,476	171,288,812	4.0	20.4
	Spruce	13,897,660	874,977	3.2	14.7	2,245,749,564	163,036,496	3.7	20.7
	True-fir	9,278,218	741,224	4.1	9.8	1,423,543,183	141,043,956	5.1	13.1
	Western redcedar	2,126,413	348,374	8.4	2.2	692,939,031	117,583,525	8.7	6.4
	Yellow cedar	503,262	158,059	16.0	0.5	116,181,675	46,561,331	20.4	1.1
	Aspen	3,993,676	459,347	5.9	4.2	510,567,658	68,436,811	6.8	4.7
	Cottonwood	465,767	127,508	14.0	0.5	75,921,846	21,080,824	14.2	0.7
	Other Conifer	328,834	103,223	16.0	0.3	34,700,220	12,239,943	18.0	0.3
	Other Broadleaf	856,259	159,346	9.5	0.9	114,548,092	26,044,546	11.6	1.1
	Non-tree species		1,317,720	1.8	40.2	0			0.0

Classifier	Classifier-class	Area in 2007				Volume in 2007			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total
		38,055,089							
	Total (Province)	**94,657,697**				**10,854,307,318**			
Vegetation Type (Vegetated Treed areas only)	Broadleaf	3,390,109	430,494	6.5	6.5	461,145,722	65,029,282	7.2	4.3
	Conifer	44,938,328	1,269,738	1.4	86.2	9,811,016,975	405,504,729	2.1	90.4
	Mixed	3,807,722	404,553	5.4	7.3	576,102,979	66,007,338	5.8	5.3
	Total (Vegetated Treed)	**52,136,158**				**10,848,265,676**			
Age-Class (years)	1-40	3,491,602	411,705	6.0	3.7	74,346,870	20,162,940	13.8	0.7
	41-80	7,885,875	673,833	4.4	8.3	995,495,568	119,349,407	6.1	9.2
	81-120	11,128,565	742,117	3.4	11.8	1,994,121,534	155,403,819	4.0	18.4
	121-160	9,701,265	664,729	3.5	10.2	2,153,881,577	166,029,445	3.9	19.8
	161-250	12,666,849	766,332	3.1	13.4	2,778,947,408	188,070,538	3.5	25.6
	>250	7,262,002	670,013	4.7	7.7	2,851,472,720	296,341,726	5.3	26.3
	Non_VT	42,521,539	1,299,456	1.6	44.9	6,041,643	4,326,699	36.5	0.1
	No age	0	0	-	0.0	0	0	-	0
	Total (Province)	**94,657,697**				**10,854,307,318**			
Land Cover (BCLCCS, Level 2)	Vegetated treed (VT)	52,136,158	1,299,456	1.3	55.1	10,848,265,676	406,995,635	1.9	99.9
	Non-vegetated land (NL)	20,065,933	1,330,115	3.4	21.2	0	0	0	0
	Vegetated non-treed (VN)	18,199,457	905,808	2.5	19.2	6,041,643	4,326,699	36.5	0.1
	Non-vegetated water (NW)	4,236,859	564,846	6.8	4.5	0	0	0	0
	~~Unknown (SS)~~			~~100.0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~

Classifier	Classifier-class	Area in 2007				Volume in 2007			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of Total
		19,289	37,825						
	Total (Province)	**94,657,697**				**10,854,307,319**			

Table 4. Change in total area and total volume during the period 2000-2005 by classifier (α is the confidence level).

Classifier	Classifier-class	Change in Area 2000-2005				Change in Volume 2000-2005			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2000 Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2000 Total
Land type	Forest	7,030,427	753,615	5.5	12.0	426,604,685	108,557,168	13.0	4.1
	Other Wooded Land	-1,275,459	258,743	10.3	-22.5	12,643,540	5,253,337	21.2	0.0
	Other Land	-4,996,527	659,591	6.7	-17.9	147,817	289,860	100.0	0.0
	Fresh Water	-758,441	226,422	15.2	-31.0	0	0	-	0.0
	Total (Province)	**0**				**439,396,041**			
Leading Species	Douglas-fir	95,385	139,994	74.8	1.8	88,850,510	35,484,307	20.4	8.0
	Hemlock	-34,570	116,023	171.1	-0.6	45,870,163	50,040,389	55.6	2.2
	Larch	46,198	53,601	59.2	10.5	11,498,394	10,696,083	47.4	18.4
	Lodgepole_pine	-697,893	283,437	20.7	-4.7	-36,726,541	63,415,124	88.1	-1.6
	Spruce	326,086	315,371	49.3	2.4	60,143,274	60,353,127	51.2	2.8
	True-fir	595,951	217,825	18.6	6.8	197,183,673	45,132,257	11.7	16.2
	Western redcedar	-3,922	64,664	840.8	-0.2	151,413	23,364,655	7869.2	0.0
	Yellow cedar	-22,778	41,951	93.9	-4.3	-11,004,196	17,950,889	83.2	-8.6
	Aspen	-31,559	158,942	256.8	-0.8	48,886,280	25,100,879	26.2	10.9
	Cottonwood	8,454	41,306	249.2	1.8	2,387,734	9,935,691	212.2	3.3
	Other conifer	20,234	30,487	76.8	6.6	10,000,810	5,670,792	28.9	41.0
	Other broadleaf	134,697	80,954	30.6	18.6	22,154,525	10,540,286	24.3	24.9
	Non-tree species	-436,281	443,647	51.9	-1.2	0	0	0	0
	Total (Province)	**0**				**439,396,041**			
Vegetation Type (Vegetated Treed areas only)	Conifer	2,410,507	525,979	11.1	5.6	369,647,518	103,292,236	14.2	3.9
	Broadleaf	154,202	160,040	52.9	4.8	60,832,739	25,355,924	21.3	15.6
	Mixed	-54,035	185,150	174.7	-1.4	20,535,689	34,635,242	86.0	3.8
	Total (Vegetated Treed)	**2,510,674**				**451,015,946**			

Classifier	Classifier-class	Change in Area 2000-2005				Change in Volume 2000-2005			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2000 Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2000 Total
Age-Class (years)	1-40	-613,065	320,513	26.7	-14.0	4,386,638	18,646,985	216.8	6.2
	41-80	340,467	541,658	81.1	4.1	-31,223,649	67,302,656	109.9	-2.8
	81-120	460,974	567,377	62.8	4.3	-17,937,814	114,487,209	325.5	-0.9
	121-160	1,270,293	539,415	21.7	15.5	234,279,571	124,370,564	27.1	12.6
	161-250	898,048	404,354	23.0	7.7	163,469,294	107,841,539	33.6	6.2
	>250	158,239	209,739	67.6	2.3	98,041,906	73,120,254	38.0	3.6
	Non_VT	-2,510,674	556,437	11.3	-5.7	-11,619,905	17,843,277	78.3	-65.7
	No age	-4,283	8,399	100.0	-100.0	-	-	-	-
	Total (Province)	**0**				**439,396,041**			
Land Cover (BCLCCS, Level 2)	Vegetated treed (VT)	2,510,674	553,379	11.2	5.0	451,015,946	105,531,888	12.0	4.3
	Non-vegetated land (NL)	-2,738,482	485,675	9.0	-12.0	0	0	-	0
	Vegetated non-treed (VN)	186,238	650,405	178.1	1.1	-11,619,905	17,843,277	78.3	-65.7
	Non-vegetated water (NW)	31,138	58,612	96.0	0.7	0	0	-	0
	Unknown (SS)	10,433	20,458	100.0	117.8	0	-	-	-
	Total (Province)	**0**				**439,396,041**			

Table 5. Change in total area and total volume during the period 2005-2007 by classifier (α is the confidence level).

Classifier	Classifier-class	Change in Area 2005-2007				Change in Volume 2005-2007			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2005 Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2005 Total
Land type	Forest	6,440	3,729	29.5	0.01	-47,661,051	41,809,140	44.7	-0.4
	Other Wooded Land	-2,916	2,564	44.8	-0.07	454,485	375,701	42.2	3.6
	Fresh Water	-653	898	70.2	-0.04	0	-		
	Other Land	-2,872	2,119	37.6	-0.01	45	88	100.0	0.0
	Total (Province)	**0**				**-47,206,521**			
Leading Species	Douglas-fir	-53,076	21,385	20.5	-1.0	5,904,230	9,496,477	82.0	0.5
	Hemlock	-75,042	29,533	20.1	-1.3	-21,623,294	17,648,838	41.6	-1.0
	Larch	-2,341	2,214	48.2	-0.5	1,155,992	686,613	30.3	1.6
	Lodgepole pine	-315,769	85,380	13.8	-2.3	-45,611,088	27,295,065	30.5	-2.0
	Spruce	-97,764	36,390	19.0	-0.7	2,285,423	11,948,668	266.6	0.1
	True-fir	-19,868	16,756	43.0	-0.2	7,803,771	6,502,072	42.5	0.6
	Western redcedar	-34,810	14,487	21.2	-1.6	-13,843,383	6,943,172	25.6	-2.0
	Yellow cedar	-484	606	63.9	-0.1	-46,781	325,583	354.9	0.0
	Aspen	-13,093	10,480	40.8	-0.3	11,756,065	2,449,588	10.6	2.4
	Cottonwood	-393	591	76.7	-0.1	1,355,039	625,441	23.5	1.8
	Other Conifer	-202	377	95.3	-0.1	329,186	242,548	37.6	1.0
	Other Broadleaf	-2,641	2,168	41.9	-0.3	3,328,321	965,358	14.8	3.0
	Non-tree species	615,483	115,449	9.6	1.2	0	0	0	0
	Total (Province)	**0**				**-47,206,521**			

Classifier	Classifier-class	Change in Area 2005-2007				Change in Volume 2005-2007			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2005 Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2005 Total
Vegetation Type (Vegetated Treed areas only)	Broadleaf	-9,169	8,589	47.8	-0.3	11,408,587	2,158,565	9.6	2.5
	Conifer	-582,135	111,271	9.7	-1.3	-69,553,134	40,919,997	30.0	-0.7
	Mixed	-22,033	10,912	25.3	-0.6	10,961,928	3,290,696	15.3	1.9
	Total (Vegetated Treed)	**-613,338**				**-47,206,521**			
Age-Class (years)	1-40	-287,063	82,565	14.7	-7.6	-790,522	8,417,850	543.0	-1.1
	41-80	-691,805	202,243	14.9	-8.1	-73,265,249	39,908,406	27.8	-6.9
	81-120	-14,018	243,146	884.5	-0.1	-35,178,216	56,594,810	82.0	-1.7
	121-160	210,306	197,742	47.9	2.2	58,908,931	49,460,951	42.8	2.8
	161-250	92,309	114,673	63.4	0.7	-6,303,571	31,715,933	256.6	-0.2
	>250	76,933	66,734	44.2	1.1	9,446,008	27,497,776	148.5	0.3
	Non_VT	613,338	115,026	9.6	1.5	-23,902	40,724	86.9	-0.4
	No age	0	-	-	-	-	-	-	-
	Total (Province)	**0**				**-47,206,521**			
Land Cover (BCLCCS, Level 2)	Vegetated treed (VT)	-613,338	115,026	9.6	-1.2	-47,182,619	41,805,790	45.2	-0.4
	Non-vegetated land (NL)	-548	527	49.1	0.0	0	0	-	0
	Vegetated non-treed (VN)	614,556	115,204	9.6	3.5	-23,902	40,724	86.9	-0.4
	Non-vegetated water (NW)	670	910	69.2	0.0	0	0	-	0
	Unknown (SS)	0	0	-	-	0	-	-	-
	Total (Province)	**0**				**-47,206,521**			

Table 6. Change in total area and total volume during the period 2000-2007 by classifier (α is the confidence level).

Classifier	Classifier-class	Change in Area 2000-2007				Change in Volume 2000-2007			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2000 Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2000 Total
Land type	Forest	7,036,868	753,528	5.5	12.0	378,943,634	12,1651,892	16.4	100.0
	Other Wooded Land	-1,278,375	258,734	10.3	-22.6	13,098,025	5,576,953	21.7	0.0
	Fresh Water	-759,094	226,420	15.2	-31.0	0	0		0.0
	Other Land	-4,999,399	659,560	6.7	-17.9	147,862	289,948	100.0	0.0
	Total (Province)	**0**				**392,189,520**			
Leading Species	Douglas-fir	42,309	142,282	171.5	0.5	94,754,740	38,463,777	20.7	8.5
	Hemlock	-109,612	119,850	55.8	0.8	24,246,869	53,122,148	111.7	1.1
	Larch	43,857	53,515	62.2	-1.9	12,654,386	10,964,754	44.2	20.3
	Lodgepole pine	-1,013,663	307,626	15.5	10.0	-82,337,628	73,692,696	45.6	-3.6
	Spruce	228,322	317,985	71.0	-6.9	62,428,697	62,065,886	50.7	2.9
	True-fir	576,084	218,468	19.3	1.7	204,987,444	46,328,373	11.5	16.8
	Western redcedar	-38,732	66,463	87.5	6.6	-13,691,970	24,508,167	91.3	-1.9
	Yellow cedar	-23,262	42,068	92.2	-1.8	-11,050,977	17,998,490	83.1	-8.7
	Aspen	-44,653	159,302	181.9	-4.4	60,642,346	26,111,241	22.0	13.5
	Cottonwood	8,061	41,311	261.4	-1.1	3,742,773	10,096,565	137.6	5.2
	Other Conifer	20,032	30,490	77.6	1.8	10,329,996	5,732,265	28.3	42.4
	Other Broadleaf	132,056	80,986	31.3	6.5	25,482,846	10,942,677	21.9	28.6

Classifier	Classifier-class	Change in Area 2000-2007				Change in Volume 2000-2007			
		Total (ha)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2000 Total	Total (m^3)	Confidence Interval (±, α=0.05)	Relative Standard Error (%)	% of 2000 Total
	Non-tree species	179,202	470,785	134.0	0.5	0	0	0	0
	Total (Province)	**0**				**392,189,520**			
Vegetation Type (Vegetated Treed areas only)	Broadleaf	145,032	160248	56.3	4.5	72241326	26,426,684	18.7	18.6
	Conifer	1828,371	548991	15.3	4.2	300094384	116,123,892	19.7	3.2
	Mixed	-76,068	185256	124.2	-2.0	31497617	35,387,568	57.3	5.8
	Total (Vegetated Treed)	**1,897,336**				**403,833,327**			
Age-Class (years)	1-40	-900,129	331,095	18.8	-18.1	3,596,116	19,805,950	280.9	5.1
	41-80	-351,338	567,275	82.3	-0.5	-104,488,898	79,155,847	38.6	-9.5
	81-120	446,956	608,492	69.4	5.7	-53,116,030	125,312,373	120.3	-2.6
	121-160	1,480,599	554,296	19.1	17.8	293,188,502	129,929,957	22.6	15.8
	161-250	990,358	407,284	21.0	8.8	157,165,723	108,599,816	35.2	6.0
	>250	235,173	210,663	45.7	3.7	107,487,915	76,227,605	36.2	3.9
	Non_VT	-1,897,336	579,652	15.6	-5.7	-11,643,807	17,843,638	78.1	-65.8
	No age	-4,283	8,399	100.0	-100.0	0	-	-	-
	Total (Province)	**0**				**392,189,520**			
Land Cover (BCLCCS, Level 2)	Vegetated treed (VT)	1,897,336	576,788	15.5	3.8	403,833,327	119,905,593	15.1	3.9
	Non-vegetated land (NL)	-2,739,482	485,672	9.0	-12.0	0	0	-	0
	Vegetated non-treed (VN)	800,794	667,065	42.5	4.6	-11,643,807	17,843,638	78.1	-65.8
	Non-vegetated water (NW)	30,467	58,619	98.1	0.7	0	0	-	0
	Not classified (SS)	10,433	20,458	100.0	117.8	0	-	-	-
	Total (Province)	**0**				**392,189,520**			