

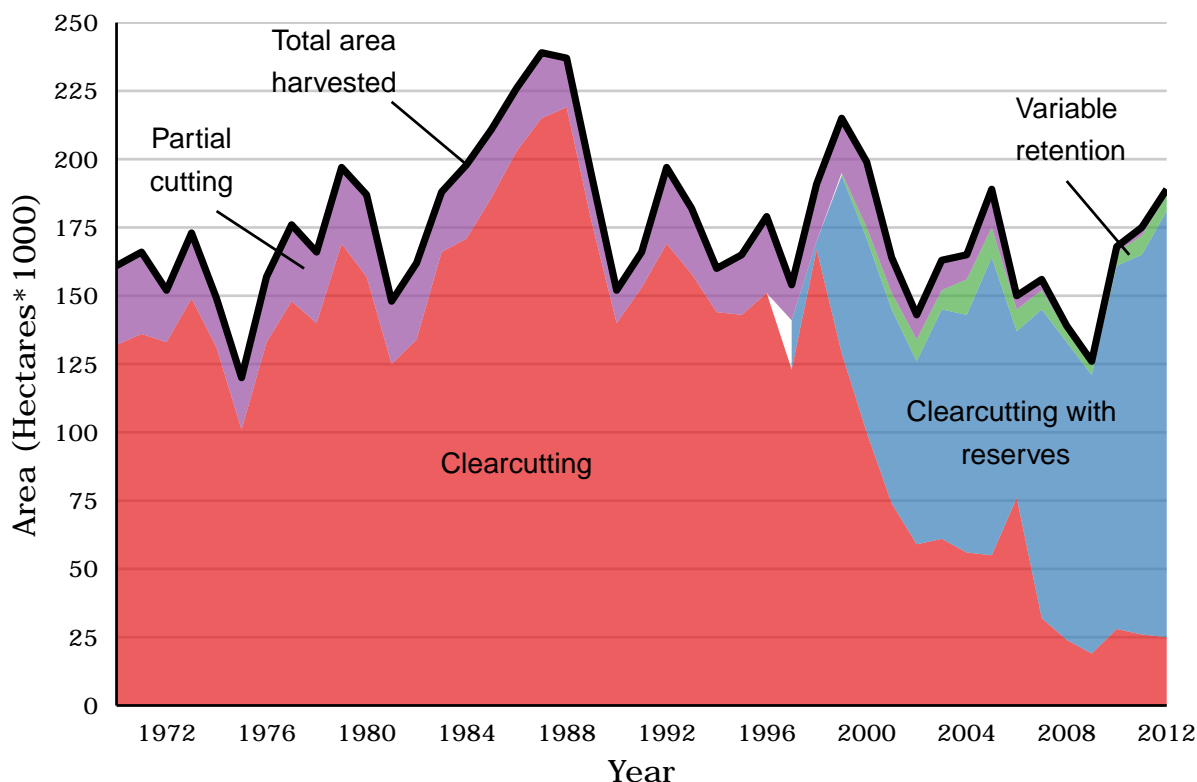


Forests

Trends in Silviculture in B.C. (1970 - 2012)

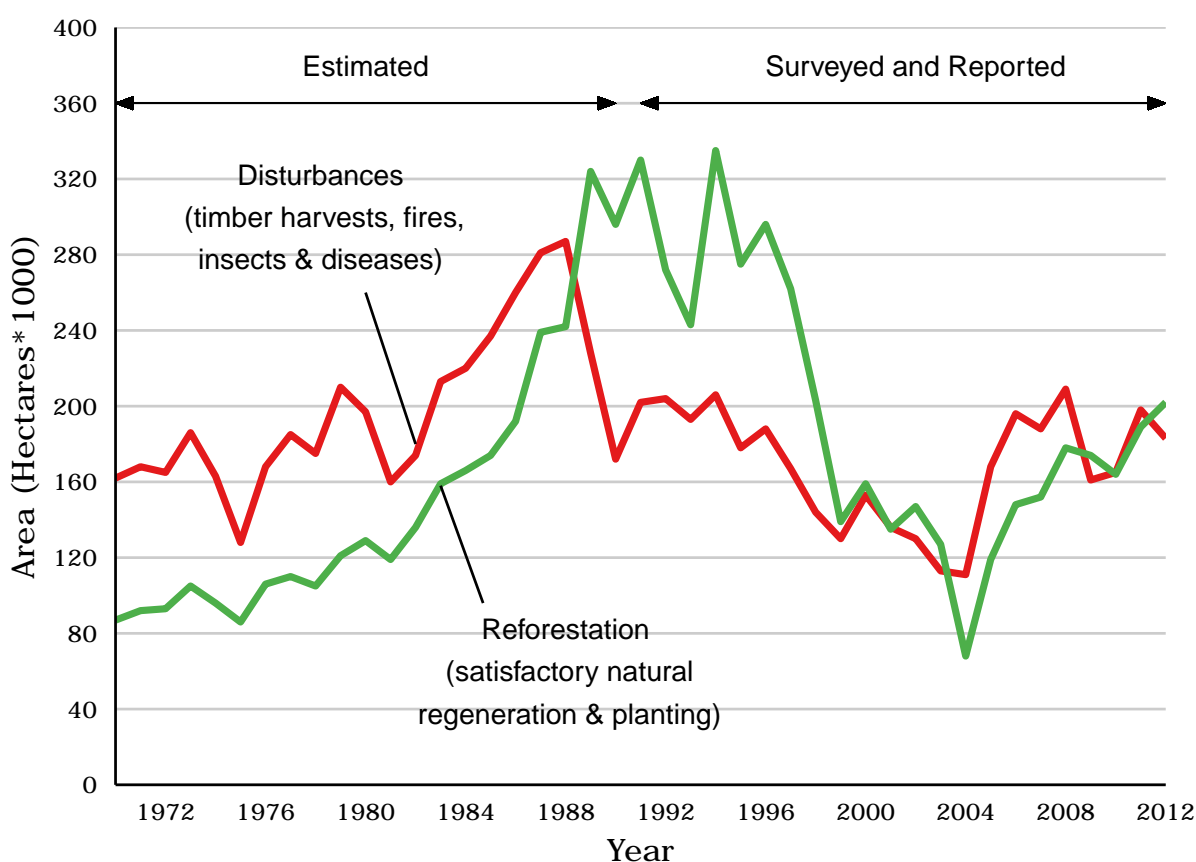
- **Silviculture** is the practice of growing and cultivating trees in forests to meet certain objectives, such as timber production, biodiversity, wildlife habitat or visual quality.
- Silviculture activities occur within a silvicultural system, which is a planned cycle of forest or tree harvest, regeneration and tending over time. Silvicultural systems used in British Columbia are **clearcutting**, partial cutting (**seed tree**, **shelterwood**, **selection**), **clearcutting with reserves** and **variable retention**. Each name reflects the type of forest structure remaining after the initial harvest.
- Changes in silvicultural practices over the past 40 years have increased reforestation, increased the volume and value of future timber supplies.
- Silvicultural choices are often influenced by natural disturbances, public expectations and market demands.

Silvicultural Systems



- Since 1970, the area of Crown forest harvested annually has ranged from 120,000 hectares to 240,000 hectares, with an average of roughly 175,000 hectares each year.
- From 1970-1996, clearcutting systems were applied on 87% of the area harvested on public land; and partial cutting (seed tree, shelterwood, and Selection) systems on 13%. By 2012/13 clearcutting with reserves and clearcutting accounted for 96% of the area harvested on public land with variable retention and partial cutting systems accounting for 4%.

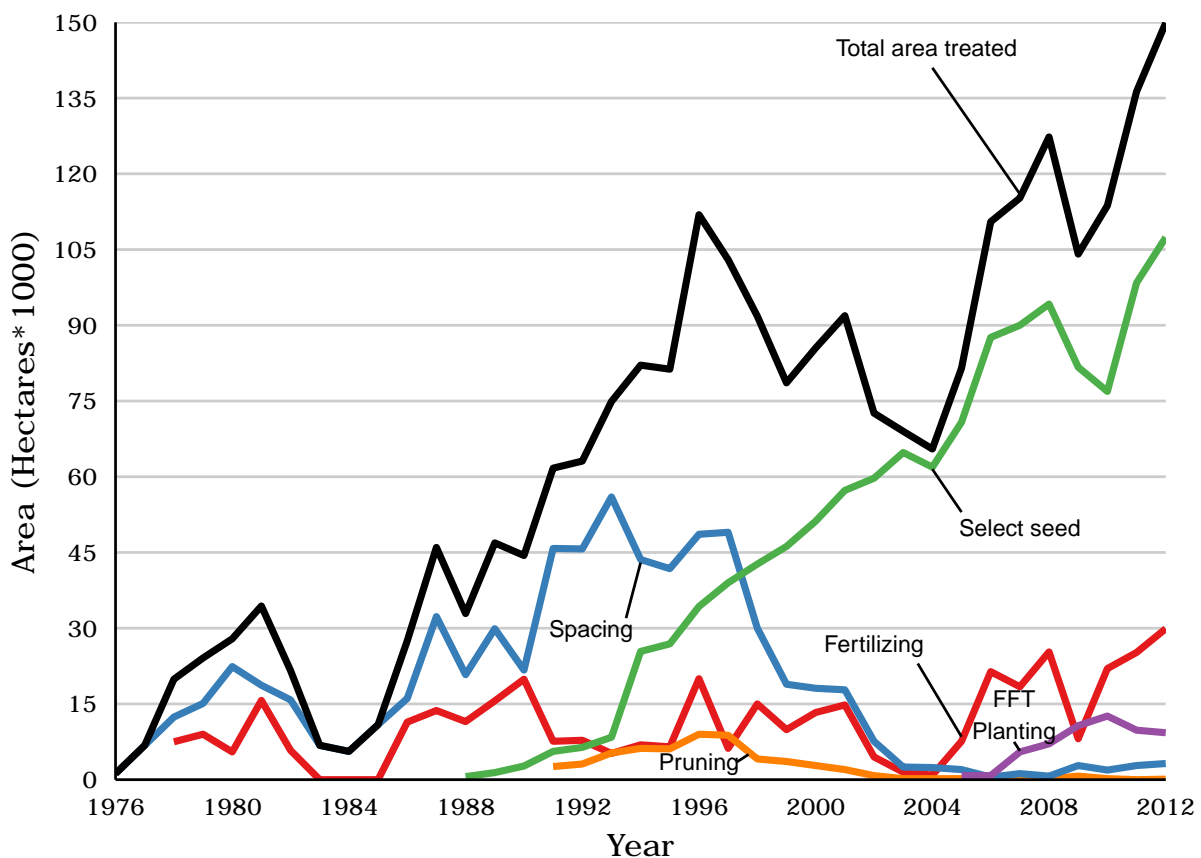
Disturbances and Reforestation



- Silvicultural investments can accelerate reforestation and thereby increase timber supplies and restore [ecological services](#) sooner.
- In the 1970s and 1980s on Crown forest land, the area disturbed exceeded the area reforested. As a result, the area deemed [not satisfactorily restocked \(NSR\)](#) after timber harvesting and other disturbances increased over several decades.
- This gap was closed during the 1980s with increasing investments in [site preparation](#), research that led to better planting methods, [planting](#), [backlog planting](#) and [brushing](#) to ensure prompt restocking and the growth of desired trees.

- In 1987, explicit reforestation obligations on public land were introduced. Since 1987, holders of harvesting rights are required to reforest the areas they harvest. This led to planting of a greater proportion of current harvest areas.
- In recent years harvesting and reforestation are in step with each other. Since 2005, over 76 million seedlings have been planted on over 56,000ha of Mountain Pine Beetle and wildfire impacted land not currently under legal reforestation obligations.

Silvicultural Treatments

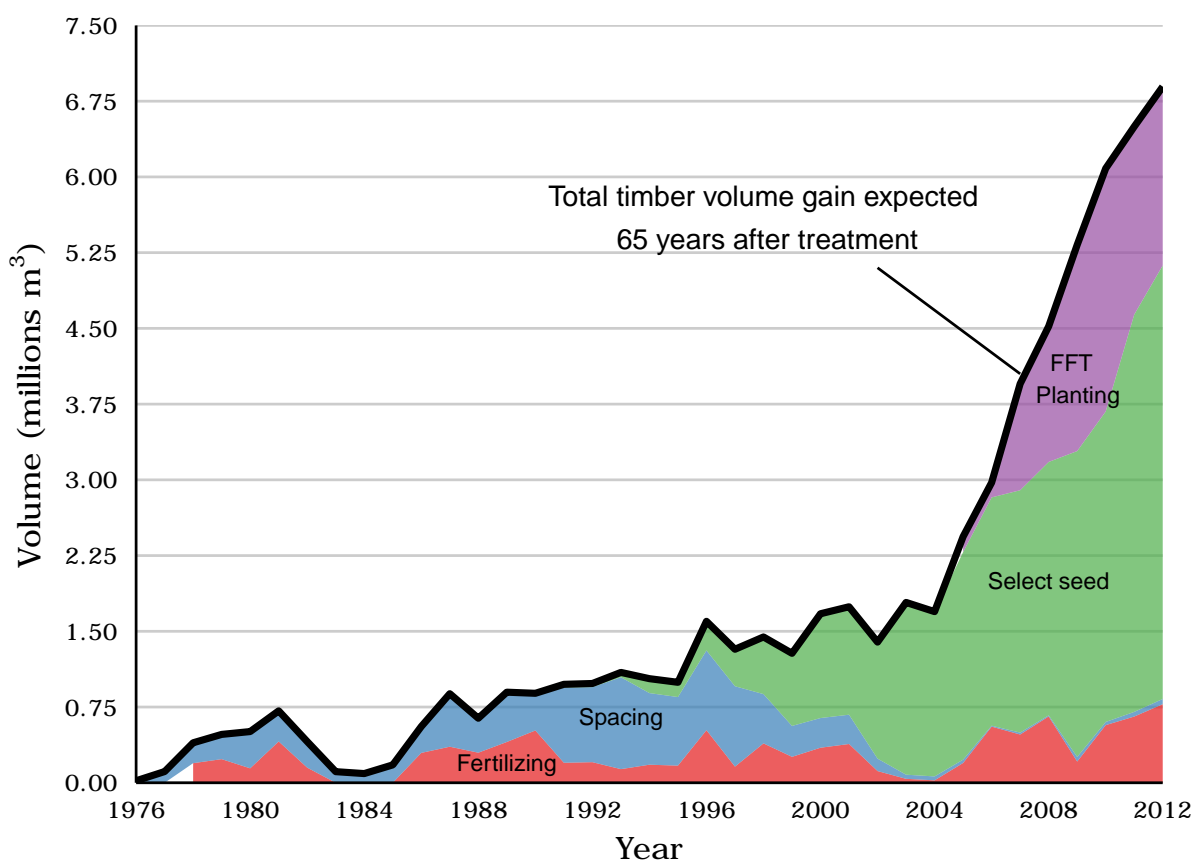


- Silvicultural treatments are investments in future timber production and environmental benefits from forests. Silvicultural treatments can also increase timber quantity and quality, manage forest health and fire risks, and improve specific habitats, water management and visual landscapes. Silvicultural treatments also create employment opportunities for First Nations and others affected by changes in the forest industry.
- Between 1976 and 2012, investments in [incremental silviculture](#) to improve the growth and quality of future crop trees included [fertilizing](#) (394,000 hectares), [pruning](#) (57,000 hectares), [spacing](#) (678,000 hectares) and the use of [select seed](#) for planting (1,240,000 hectares). Over this period, silviculture treatments totalled

approximately 2.4 million hectares.

- Public funding of fertilization, pruning, and spacing has been significantly reduced in recent years, however, funding is continuing for research, production, storage and monitoring of select seed use on public land. Fertilization has seen significant increases since the inception of the [Forests for Tomorrow](#) program in 2004.
- By increasing the rate of tree growth, use of select seed can increase future timber volume, reduce constraints on harvesting adjacent areas and reduce the need for, and cost of, brushing.

Timber Volume Gains in 65 Years



- Investments in silviculture depend on expected gains in ecological services, volume and return on investment.
- Compared with [natural regeneration](#), planting increases harvestable volume by about 15%, and about 25% with the use of select seed.
- Cumulative volume gains 65 years after making investments in incremental silviculture since 1976 are estimated at 65 million cubic metres (m³), based on fertilization (10 million m³), Spacing (11 million m³), select seed (33 million m³), and reforestation through the [Forests for Tomorrow](#) program (11 million m³).

- Other gains from silvicultural treatments include increased short and [mid-term timber supply](#) through spacing and fertilization, accelerated development of mature or old growth forest characteristics where needed for wildlife or biodiversity, higher wood quality through pruning, more pleasing visual landscapes and planting to make up the long-term timber supply.

References and other useful links

- Ministry of Forests, Lands and Natural Resource Operations Annual Reports: <http://www.for.gov.bc.ca/mof/annualreports.htm>
- Reporting Silviculture Updates and Land Status Tracking System (RESULTS): <http://www.for.gov.bc.ca/his/results/>
- Silviculture Program Page: <http://www.for.gov.bc.ca/hfp/silviculture/index.htm>
- Seed Planning and Registry Application (SPAR): <http://www.for.gov.bc.ca/HTI/spar/>
- Forests for Tomorrow (FFT) reforestation program: <http://www.for.gov.bc.ca/hcp/fia/landbase/fft/>

Data

*By accessing these datasets, you agree to the license associated with each file, as indicated below.

- Chart data: Silviculture Systems <http://catalogue.data.gov.bc.ca/dataset/forest-area-harvested-by-silviculture-systems>
 - License: B.C. OGL: <http://www.data.gov.bc.ca/local/dbc/docs/license/OGL-vbc2.0.pdf>
- Chart data: Disturbances and Reforestation <http://catalogue.data.gov.bc.ca/dataset/trends-in-forest-disturbances-and-reforestation>
 - License: B.C. OGL: <http://www.data.gov.bc.ca/local/dbc/docs/license/OGL-vbc2.0.pdf>
- Chart data: Silvicultural Treatments <http://catalogue.data.gov.bc.ca/dataset/trends-in-silvicultural-treatments-in-b-c>
 - License: B.C. OGL: <http://www.data.gov.bc.ca/local/dbc/docs/license/OGL-vbc2.0.pdf>
- Chart data: Timber Volume Gains <http://catalogue.data.gov.bc.ca/dataset/expected-timber-volume-gains-from-silvicultural-treatments>
 - License: B.C. OGL: <http://www.data.gov.bc.ca/local/dbc/docs/license/OGL-vbc2.0.pdf>

Glossary

Silviculture The art and science of controlling the establishment, growth, composition, health and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

Clearcutting The process of removing all trees, large and small, in a stand in one cutting operation. Clear-cutting with reserves is the removal of the majority of the trees saving some within or outside the cut boundary for other purposes such as wildlife habitat.

Seed tree Trees left after reproduction cutting to provide seeds for natural regeneration. Trees are chosen for desired species, being healthy and having good growth form.

Shelterwood Harvesting trees in two or more cuttings that creates conditions where a new generation of seedlings can be established under the remaining timber without planting. This system is implemented in forests with species that can establish themselves in partial shade under the remaining mature trees.

Selection Harvesting trees in a way that moves a forest stand towards an uneven-aged condition.

Clearcutting with reserves The removal of the majority of the trees saving some within or outside the cut boundary for other purposes such as wildlife habitat.

Variable retention Retaining forest structural elements for at least one rotation in order to preserve environmental values.

Ecosystem services benefits to humankind and wildlife such as the production of food, provisioning of clean water, decomposition of wastes, control of micro-climate, regulating nutrient cycles, pollination, spiritual and recreational sites.

Not satisfactorily restocked (NSR) productive forest land that has been denuded and has failed, partially or completely, to regenerate either naturally or by planting or seeding to the specified or desired free growing standards for the site.

Site preparation any action, related to reforestation, to create an environment favourable for survival of suitable trees during the first growing season. It may alter the ground cover, soil or microsite conditions, using biological, mechanical, or manual clearing, prescribed burns, herbicides, or a combination of methods. Both natural regeneration and planting may be improved through site preparation.

Planting establishing a forest by setting out seedlings, transplants or cuttings in an area.

Back-log planting planting that is overdue. In general, planting is considered backlog planting if more than 7 years have elapsed since a site was cleared (by harvesting, fire, insects or disease) in the Interior, and more than 3 years have elapsed on the Coast of British Columbia.

Brushing a silvicultural activity done by chemical, manual, grazing, or mechanical means to control competing forest vegetation and reduce competition for space, light, moisture, and nutrients with crop trees or seedlings.

Incremental Silviculture Application of cultural measures which will allow an increase in the value or volume of the cut over and above the establishment of a fully stocked

stand after harvest.

Fertilizing the addition of fertilizer to promote tree growth on sites deficient in one or more soil nutrients. Also used to improve the vigor of crop trees following juvenile spacing or commercial thinning.

Forests for Tomorrow A silviculture program, established by the B.C. Provincial Government in March 2005 to respond to catastrophic wildfires and the mountain pine beetle epidemic.

Pruning the manual removal, close to or flush with the stem, of side branches, live or dead, and of multiple leaders from standing, generally plantation-grown trees. Pruning is carried out to improve the market value of the final wood product by producing knot-free wood for the improvement of the tree or its timber.

Spacing the removal of undesirable trees within a young stand to control stocking, to maintain or improve growth, to increase wood quality and value, or to achieve other resource management objectives.

Select seed seed that exhibits a higher level of one or more desired genetic traits (such as growth rate, form, wood density, and resistance to insects and disease) than wild seed collected from an average natural stand. This includes seed from tested parents growing in seed orchards and seed collected from natural stand superior provenances. Vegetative material for propagation, from production facilities using tested parents and from superior provenances, is included in the term select seed.

Natural regeneration a change in forest structure and composition caused by fire, insects, wind, landslides and other natural processes.

Mid-term timber supply the mid-term timber supply is a term that refers to that portion of the timber inventory that would be available for harvest within the middle of the normal management cycle.

METHODS - Trends in Silviculture in B.C. (1970-2012)

Silviculture Systems:

Detailed silviculture records are stored in the Reporting Silviculture Updates and Land Status Tracking System (RESULTS; <http://www.for.gov.bc.ca/his/results/>). Reported disturbances and reforestation on public land are published in Ministry of Forests, Lands and Natural Resources Operations annual reports (since 1989/90).

Data was taken from Ministry of Forests Lands and Natural Resource Operations annual reports - Area Harvested by Silvicultural Systems on Crown Land, by Forest Region (table 7.3) available here: <http://www.for.gov.bc.ca/hfp/silviculture/statistics/statistics.htm>. Private land accounts for 10% of the total area harvested in the province between 1983/84 and 2008/09. Earlier data are not available.

Fiscal years were rounded down to calendar years in order to standardize data display (e.g., 1980/1981 was considered to be 1980).

For the purposes of data rollup, partial cutting includes coppice, intermediate cut, patch cut, seed tree, selection, shelterwood and unspecified.

The areas for 1970 are estimated using the ratio of volumes harvested in 1970 and 1971, applied to the areas harvested in 1971.

Disturbances and Reforestation:

Detailed silviculture records are stored in the Reporting Silviculture Updates and Land Status Tracking System (RESULTS; <http://www.for.gov.bc.ca/his/results/>).

Data was taken from Ministry of Forests Lands and Natural Resource Operations annual reports - Changes in the Not Satisfactorily Restocked (NSR) Crown Land (pdf) available here: <http://www.for.gov.bc.ca/hfp/silviculture/statistics/statistics.htm>.

Fiscal years were rounded down to calendar years in order to standardize data display (e.g., 1980/1981 was considered to be 1980).

Disturbances or 'Additions to NSR' are areas that become not satisfactorily restocked (NSR) with timber due to harvesting, fire, insects, diseases and other causes. Data for 1989/90 onwards are based on surveyed and reported changes to NSR areas of public (Crown) land, from ministry annual reports. For earlier years, estimates are based on areas harvested and planted, and estimated rates of losses to fires, insects, diseases and restocking failures.

Reforestation or 'Reductions to NSR' are areas successfully reforested by natural regeneration or planting. Data for 1989/90 onwards are based on surveyed and reported changes to NSR areas of public (Crown) land, from ministry annual reports. For earlier years, estimates are based on areas harvested and planted, and estimated rates of natural regeneration, losses to fires, insects, diseases and restocking failures.

Silvicultural Treatments:

Detailed silviculture records are stored in the Reporting Silviculture Updates and Land Status Tracking System (RESULTS; <http://www.for.gov.bc.ca/his/results/>).

1. Data for fertilization, pruning and spacing treatments was taken from Ministry of Forests Lands and Natural Resource Operations annual reports - Silviculture Accomplishments on Crown Land Funded by All Funding Sources by Forest Region (table 2.8) available here: <http://www.for.gov.bc.ca/hfp/silviculture/statistics/statistics.htm>.
2. Forests for Tomorrow (FFT) planting information was taken from FFT annual accomplishment reporting published here: <http://lbis.forestpracticesbranch.com/LBIS/accomplishments>.

3. Data for select seed was calculated using the following methodology:
 1. Source data from 2 tables via DataBC: (1) RESULTS - Activity Treatment Units (<http://www.data.gov.bc.ca/dbc/catalogue/detail.page?config=dbc&P110=recordid:174422>) and (2) RESULTS - Planting (<http://www.data.gov.bc.ca/dbc/catalogue/detail.page?config=dbc&P110=recordid:173789>). These data are licensed under the BC Open Government License (<http://www.data.gov.bc.ca/local/dbc/docs/license/OGL-vbc2.0.pdf>);
 2. Join Table 2 based on the field `activity_treatment_unit_id` (selecting only records where `ATU_COMPLETION_DATE >= 2006-04-01`) and Table 1, retaining only matching records;
 3. Using the joined file, exclude records where `ACTUAL_TREATMENT_AREA = null` and `ACTUAL_PLANTED_NUMBER = 0`;
 4. Calculate pro-rated AREA for each planting:
 $(\text{NUMBER_PLANTED} / \text{ACTUAL_PLANTED_NUMBER}) * \text{ACTUAL_TREATMENT_AREA}$;
 5. Calculate Fiscal Year based on `ATU_COMPLETION_DATE`;
 6. Narrow to select seed only using categories in `GENETIC_CLASS_CODE` and `SUPERIOR_PROVIDENCE_IND`: (`Genetic_class = 'A'`) or (`Genetic_class = 'B'` and `SUPERIOR_PROVIDENCE_IND = 'Y'`);
 7. Summarize pro-rated AREA by Fiscal Year.

An individual site may be treated more than once. Site preparation, brushing and planting of B class seed is not included. Private landowners are not required to report treatments. Fiscal years were rounded down to calendar years in order to standardize data display (e.g., 1980/1981 was considered to be 1980).

Timber Volume Gains Expected from Silvicultural Treatments:

Timber volume gains (millions of cubic metres of wood) were estimated using data submitted by licensees and the Ministry of Forests, Lands and Natural resource operations to Reporting Silviculture Updates and Land Status Tracking System (RESULTS; <http://www.for.gov.bc.ca/his/results/>) and Seed Planning and Registry System (SPAR; <http://www.for.gov.bc.ca/HTI/spar/>). Genetic gain data are contained in the Ministry of Forests, Lands and Natural Resources Operations Seed Planning and Registry System (SPAR; <http://www.for.gov.bc.ca/HTI/spar/>).

Timber volume gains (cubic metres per hectare per year) were calculated by multiplying the number of hectares treated, from Silvicultural Treatments (see above), by the average annual growth rate multiplied by 65 (assumed rotation age) divided by 1,000,000. Site preparation, brushing and planting of B class seed are not included as enhanced silviculture treatments as they are considered to be the required treatments post-harvest to achieve free growing conditions, these activities are not considered to

create incremental volume, and thus gains from these treatments are considered to be baseline.

Annual growth rates per hectare:

- 0.50 m³ planting one to three years after logging (relative to satisfactory natural regeneration)
- 2.93 m³ backlog planting (relative to a NSR site, overgrown by competing vegetation)
- 0.40 m³ fertilizing
- 0.25 m³ spacing
- 0.41 m³ select seed (average gain in 2004/05, adjusted for lower and higher genetic quality in earlier and later years, respectively). In 2009/2010 the select seed average gain was upped to 0.57m³ and in 2010/2011 it was upped to 0.615 m³ based on the forest genetics council annual report actual and forecast genetic worth.

Published and Available On-Line at Environmental Reporting BC (July 2014): <http://www.env.gov.bc.ca/soe/indicators/forests/silviculture.html>

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