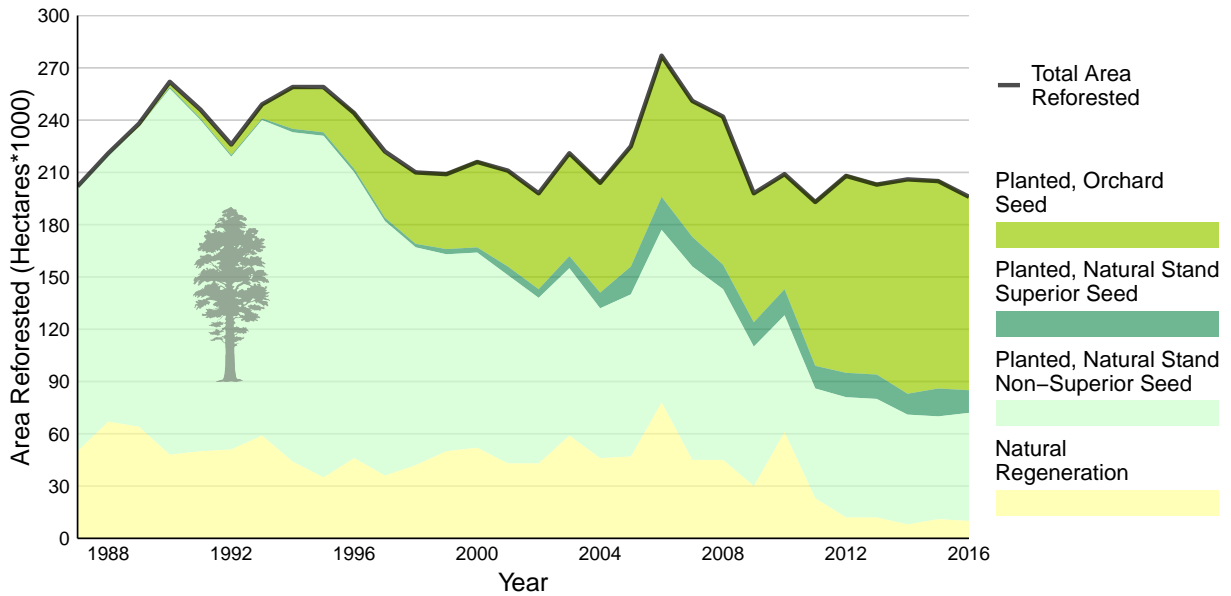# Land & Forests

Trends in Forest Tree Seed Use in B.C. (1987-2016)

Conserving, protecting and managing forest tree genetic resources is the foundation for economic, social, cultural and ecological goods and services that flow from British Columbia's forests. Tracking forest tree seed use—from source to planting site—is an important tool for monitoring and assessment of B.C.'s forest tree genetic resources. This information supports the continuous improvement of genetic conservation and resource management plans, strategies and actions, including seed use best management practices used in reforestation. This indicator investigates the trends in forest tree seed use in regenerating B.C.'s forests from 1987 to 2016.

- Maintaining genetic diversity, a fundamental component of biodiversity, ensures forests and ecosystems are healthy, resilient and productive. It also plays an important role in adaptation so that forests and ecosystems are able to effectively respond to natural disturbance events—such as wildfire, pests and disease infestations—as well as the impacts of climate change.
- The area of B.C's crown land reforested through planting has remained consistent—with an average over the past ten years of approximately 186,000 hectares per year (2007-2016), a slight increase over the previous 10 year average of approximately 170,000 hectares per year (1997-2006).
- Select seed—seed selected for specific genetic traits such as growth, pest resistance, and wood density— includes seed sourced from orchards and natural stand superior provenances. Over the past two decades, the proportion of crown land planted with select seed has steadily increased to 70 percent in 2016.

Visit Tree Seed to learn more about tree seed use in B.C., and the provincial Tree Improvement Program, which helps guide reforestation and silviculture investments through forest genetic research, tree breeding and seed orchard programs.
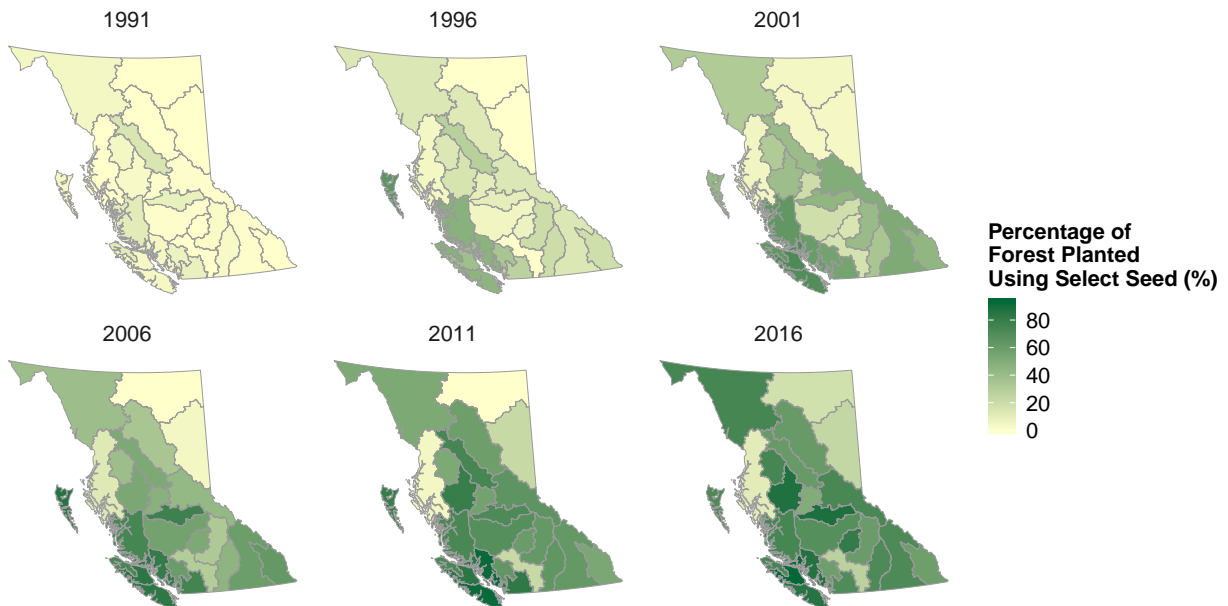
Forest Regeneration by Tree Seed Source in B.C. (1987–2016)

Total Area Reforested

Planted, Orchard Seed

Planted, Natural Stand Superior Seed

Planted, Natural Stand Non–Superior Seed

Natural Regeneration

**Note: Data for the 2010–2016 period is incomplete pending reporting of planting and natural regeneration field surveys

- The chart above displays the change in reforestation patterns—planted versus natural regeneration—and the change in area of forest planted by tree seed source from 1987 to 2016.
- After a disturbance by forest fire, forest pest or forest harvest, reforestation occurs by natural regeneration, meaning from roots or seed, or by planting. Seed used for planting may be from one or more genetic sources: orchard, natural stand superior provenance, and natural stand non-superior provenance.
- Both orchard and natural stand superior provenance seed sources have a known level of improvement based on extensive forest genetic adaptation research trials and tree breeding for the selection of desired traits—such as growth, pest resistance and wood density.

Select Seed Use by Natural Resource District in B.C.

- The chart above displays the percentage of select seed use by natural resource district reported in 5-year snapshots from 1991 to 2016.
- Select seed use has increased provincially at a steady rate since the early nineties: 1991 – 3%, 1996 – 18%, 2001 – 35%, 2006 – 50%, 2011 – 63% and 2016 – 67%.
- Select seed use at the natural resource district level is more variable, in part due to variances in the number and geographic range of tree species for which there are orchards. Annual or periodic fluctuations in orchard cone crops and seed inventories also influence select seed use at local levels.
- Overall, the increased use of select seed is indicative of the substantial effort underway to meet the target set by the Forest Genetic Council of British Columbia to, by 2020, increase select seed use to 75 percent of the total provincial seed use for reforestation.

References and Other Useful Links

- Learn more about Tree Seed
- Learn about trends in silviculture in B.C.
- Operational Tree Improvement Program
- Seed Planning and Registry Application (SPAR)
- Forest Genetics Council of British Columbia

Data

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

- Indicator Summary Data: Forest Regeneration by Tree Seed Source in B.C. (1987-2016) (Licence: Open Government Licence - British Columbia)
- Indicator Summary Data: Select Seed Use by Natural Resource District in B.C. (1987-2016) (Licence: Open Government Licence - British Columbia)

For more information on this indicator or on Forest Tree Seed Use in British Columbia contact the Forest Improvement and Research Management Branch at FORHTIP.SEEDHELP@gov.bc.ca.

Published and Available On-Line at Environmental Reporting BC (May 2018): http://www.env.gov.bc.ca/soe/indicators/land/tree-seed-use.html

Email correspondence to: envreportbc@gov.bc.ca

Glossary

- **Genetic diversity** is the genetic variation within individual organisms, within populations and among populations of a species. Genetic diversity, a fundamental component of biological diversity, plays an important role in the survival, adaptability and productivity of species and populations.
- **Natural stand non-superior provenance seed** is wild seed collected from a natural stand seed source having no "known" level of genetic improvement.
- **Natural stand superior provenance seed** is wild seed collected from a natural stand seed source identified as a superior provenance with a "known" level of genetic improvement for a specific trait (e.g. growth) over that of local wild stand populations.
- **Orchard seed** is collected from parent trees growing in a managed seed orchard that is selected and tested as part of a tree breeding program.
- **Select seed** is collected from either orchards or natural stand superior provenances. Select seed exhibits a higher level of improvement in one or more desired genetic traits (such as growth, form, wood density, and resistance to insects and disease) than wild seed collected from an average natural stand.

METHODS

The **R** code for creating the graphs presented on this page is available on GitHub.

Source Data

The Forest Tree Seed Use analysis uses data from:

1. Reporting Silviculture Updates and Land Status Tracking System (RESULTS) and

2. Seed Planning and Registry System (SPAR)

Wherever possible, the analysis used public data layers from the B.C. Geographic Warehouse[1] released under either the Open Government Licence—British Columbia or the B.C. Crown Copyright Licence:

- **Activity Treatment Unit**: WHSE_FOREST_VEGATATION_RSLT_ACTIVITY_TREATMENT_UNIT (Licence: Open Government Licence - British Columbia)

- **Opening_VW**: WHSE_FOREST_VEGATATION_OPENING_VW (Licence: Open Government Licence - British Columbia)

- **Seedlot**: WHSE_FOREST_VEGATATION_SEED_SEEDLOT (Licence: B.C. Crown Copyright)

- **Veglot**: WHSE_FOREST_VEGETATION.SEED_VEG_LOT (Licence: B.C. Crown Copyright)

- **Planting**: WHSE_FOREST_VEGATATION_RSLT_PLANTING_RSLT (Licence: Access Only)

- **Standards Unit**: WHSE_FOREST_VEGATATION_RSLT_STOCKING_STNDRD_UNIT (Licence: Access Only)

- **Seedlot Genetic Worth**: SEEDLOT_GENETIC_WORTH (Licence: Access Only)

- **Veglot Genetic Worth**: SEEDLOT_GENETIC_WORTH (Licence: Access Only)

The intent is to move the data that are currently not publicly available into the B.C. Geographic Warehouse so that interested parties can repeat the analysis.

Planting

RESULTS openings may have one or more planting treatment report that contains the area treated, species planted, SPAR seedlot/veglot (lot) and the number of trees planted. To determine the genetic source by area, the number of trees planted by lot is prorated to the treatment area and is reported based on the date planted. The reporting for planted trees by genetic source is based on the planting date. Classification for the genetic source is:

- A: GENETIC_CLASS_CODE = "A"

- B+: GENETIC_CLASS_CODE = "B" and SUPERIOR_PRVNC_IND = "Y"

- B: GENETIC_CLASS_CODE = "B" and SUPERIOR_PRVNC_IND = "N"

- B: GENETIC_CLASS_CODE = "B" and SUPERIOR_PRVNCE_IND is null

- B: GENETIC_CLASS_CODE is null

Note: Reporting of current trends and patterns in reforestation may be incomplete due to delays in surveying after a disturbance event (typically a 1-3 year delay in areas planted and a 3-7 year delay in areas managed for natural regeneration).

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[1]Detailed descriptions and downloads of the source layers are available from the B.C. Data Catalogue at: http://catalogue.data.gov.bc.ca/dataset

Natural Regeneration

Natural Regeneration is not reported in RESULTS. Instead, this is inferred by the existence of planting records. If the sum of the planting area is <= 10% of the opening, the opening is classified as natural regenerated and the total Net Area to be Reforested (NAR) of the opening is used as the area of natural regeneration. The year displayed for natural regeneration is based on the disturbance end date, if not available, the disturbance start date is used.

Note: Reporting of current trends and patterns in reforestation may be incomplete due to delays in surveying after a disturbance event (typically a 1-3 year delay in areas planted and a 3-7 year delay in areas managed for natural regeneration).

Fiscal Year

Fiscal year will be display as follows:

- Formula used: Fiscal Yr:IIf(Month([DATE])<4,Year([DATE])-1,Year([DATE]))
- Example: 1987-04-01 and 1988-03-31 Fiscal Year = 1988

QUERY STEPS – Baseline Make Table Queries

All queries are built in Microsoft Access 2007. Make Table queries are used to create baseline data tables for increased efficiency and data auditability. Note that all data reported after April 1, 1970 is added to the baseline but the data are subset to more recent years in the final queries.

Make Tables – Planting Area: A, B+, B

1a-Make Planting Activities (outcome: 1a-Planted Activities)

Joins the Opening_VW and ATU source tables to create a list of openings with planting activities completed after March 1970.

Field	Criteria	Details
ATU.ATU_COMPLETION_DATE	>=1970-04-01	
ATU.SILV_BASE_CODE	PL	
ATU.ACT_PLANTED_NO	>0	Isolates only those completed activities with planted trees

1b-Make Planted Trees (outcome: 1b-Planted Trees)

Joins the Opening, ATU and Planting source tables to create a list of tree species planted after March 1970.

Field	Criteria	Details
ATU.ATU_COMPLETION_DATE	>=1970-04-01	
ATU.SILV_BASE_CODE	PL	
ATU.ACT_PLANTED_NO	>0	Isolates only those completed activities with planted trees

1c-Make Unique Opening (outcome: 1c-Unique Opening)

Groups the 1a-Planted Activity table by Opening_ID to create a unique list of openings where one or more planting

activities have occurred.

1d-Make Opening (outcome: 1d-Opening)

Joins the 1c-Unique Opening table with the Opening_VW and Opening source tables to add general overview opening information such as management unit, opening category and disturbance dates. The Opening source table will not be needed in this query once the Opening_VW ORG_UNIT attribute is correctly referenced – this fix is expected to be applied to the BC Data Catalogue layers in the summer of 2016.

QUERY STEPS – Data Summary

Planting Area: A, B+, B

2b-Planting Details with Seedlot

Joins the 1a-Planted Activities, 1b-Planted Trees, 1d-Opening, Org Unit and Seedlot tables to summarize activity-based details for each species/seedlot planted.

Field	Criteria	Details

Planted Yr	`Planted Yr:`
	`IIf(Month([ATU_COMPLETION_DATE])<4,`
	`Year([ATU_COMPLETION_DATE])-1,`
	`Year([ATU_COMPLETION_DATE]))`
		Converts date to fiscal year

SeedClass	`A=GENETIC_CLASS_CODE= "A"`
	`B+=GENETIC_CLASS_CODE="B" and`
	`SUPERIOR_PRVNC_IND="Y"`
	`B=GENETIC_CLASS_CODE="B" and`
	`SUPERIOR_PRVNCE_IND ="N"`
	`B=GENETIC_CLASS_CODE is null`	

ProratePLArea	`ProratePLArea: Round((([1b-Planted`
	`Trees]![NUMBER_PLANTED]/[1b-Planted`
	`Trees]![ACT_PLANTED_NO])*[1b-Planted`
	`Trees]![TREATMENT_AMOUNT]),2)`
		This gives a prorated area for each of the individual species seedlot planted

2c-Summary Seed Class

Sums the ProratePLArea from the results of query 2b-Planting Details with Seedlot by Planted Yr and SeedClass for the Province.

2d-Summary Seed Class BC

Sums the ProratePLArea from the results of query 2b-Planting Details with Seedlot by Planted Yr, SeedClass, District and Region.

Natural Regeneration

3a-Make Opening Natural Regen (outcome 3a-Opening Natural Regen)

Joins the Opening_VW and Opening source tables to provide a unique list of openings to add general overview opening information such as management unit, opening category and disturbance dates to be used in the natural regeneration queries.

Field	Criteria	Details
Best Date	IIf([DISTURBANCE_START_DATE] Is Null,[DISTURBANCE_END_DATE], [DISTURBANCE_START_DATE])	Uses the Disturbance End Date, if it is not available, then use the Disturbance Start Date
OPENING_ VW.OPENING_ GROSS_AREA	>0.1	Excludes shell openings

3b-Make SU (outcome – 3b-SU)

Joins the Opening_VW and SU source tables to summarize the Net Area to be Reforested (NAR) by OPENING_ID. NAR is used as a baseline to calculate the less than 10% planted percentage to be considered a natural regeneration opening.

Field	Criteria	Details
OPENING_VW.OPENING_GROSS_AREA	<>0.1	Excludes shell openings

3c-PL Area

Summarizes the 1a-Planted Activities query Planted Area by Opening_ID where the Technique is "PL".

Field	Criteria	Details
SILV_TECHNIQUE_CODE	PL	
TREATMENT_AREA		Sums the total PL/PL Area by Opening_ID

3d-Combine Opening SU and PL Area

Joins the 3a-Opening Natural Regen, 3b-SU, 3c-PL Area and Org Unit to summarize all Planted and NAR areas in one query.

Field	Criteria	Details
Disturb Start Yr	IIf(Month([Best Date])<4,Year([Best Date])-1,Year([Best Date]))	Converts the Best Date to Fiscal Year

3e-Fix Missing NAR and PL Values

Calculates the 3d-Combine Opening SU and PL Area null values for NAR or PL Area to zero in order to do subsequent calculations.

Field	Criteria	Details
NewNAR	IIf([NAR] is null,0,[NAR])	
NewPL	IIf([PL Area] is null, 0,[PL Area])	

3f-Calculate Regen Ratio

Summarizes the 3e-Fix Missing NAR and PL Values NewNAR by opening. Note that planting is the sum of the PL/PL. This area is compared against opening's NAR. Generally, records with missing NAR are historical records.

Field	Criteria	Details
Ratio	`IIf([NewNAR]=0,0,iif([NewNAR]>0,` `Round([NewPL]/[NewNAR],2),"")`	This defaults 0 value if there is no NAR, otherwise calculate the ratio of planting. Note that records with no NAR will not be accounted for in the total values for natural regen. There are approximately 23K records that is missing NAR

3g-Assess Regen Type – Set Threshold

Uses 3f-Calculate Regen Ratio to define the Regen Type of Natural or Planted. A threshold of 10% or less of the NAR area planted is defined as Natural while all openings with > 10% of the NAR area planted are considered planted.

Field	Criteria	Details
Regen Type	`IIf(;Ratio]<=0.1,"Natural","Planted")`	

3h-Final Natural vs Planted BC

Summarizes the NAR area in 3g-Assess Regen Type-Set by Regen Type. Note that the Natural Column is what is defined as the total area naturally regenerated. Planted column is ignored as it is reflected by the prorated of species trees planted – actuals vs. derived process.

3i-Final Natural vs Planted Org Unit

Takes 3g-Assess Regen Type-Set Threshold that has assigned natural and planted ratio set and groups the sum of NAR area that is by Regen Type. Note that the Natural Column is what is defined as the total area naturally regenerated. This data is summarized by Region and District. Planted column is ignored as it is reflected by the prorated of species trees planted – actuals vs. derived process.