Forest Inventory and Monitoring Program: Growth and Yield Standards and Procedures

Chapter 3: Remeasuring Experimental Plots in Natural Stands

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Preface

The standards and procedures described in this chapter of *the Forest Inventory Manual (Volume 3 – Growth and Yield/ Decay and Volume)* are based upon the *Minimum Standards for the Establishment and Remeasurement of Permanent Sample Plots in British Columbia*.

The latter publication was developed for the Forest Productivity Council (FPC) to recommend minimum standards for measurement of permanent sample plots for the purpose of measuring growth and estimating future yield. It was last revised in March 1999. See the following web-site for further information: http://srmwww.gov.bc.ca/forestproductivity/ .

With the inactivity of the FPC, the Ministry of Sustainable Resource Management (previously Ministry of Forests) continues to upgrade the *Forest Inventory Manual* in response to client needs. The chapter following reflects that updated methodology and supersedes the FPC Minimum Standards document. The Ministry of Sustainable Resource Management recommends that this methodology be followed for all establishments and remeasurements of permanent sample plots.

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The Resources Information Standards Committee evolved from the Resources Inventory Committee which received funding from the Canada-British Columbia Partnership Agreement of Forest Resource Development (FRDA II), the Corporate Resource Inventory Initiative (CRII) and by Forest Renewal BC (FRBC), and addressed concerns of the 1991 Forest Resources Commission.

For further information about the Resources Information Standards Committee, please access the RISC website at: http://srmwww.gov.bc.ca/risc/.

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Introduction

From 1921 until 1949, the Research Branch established permanent plots to evaluate the growth and yield of different forest types. To protect this large investment from any type of disturbance, a reserve was placed around each plot. In 1957, the Research Branch transferred responsibility for 65 experimental plots, all of them still in a natural state, to the Resources Inventory Branch.

Since then, the Growth and Yield Section has continued to remeasure them at 10-year intervals. Some of the original 65 plots were abandoned owing to increased pressure on the area for other uses, or to the fact that sufficient data had been collected.

The standards of measurement for permanent samples are listed in Appendix 1.

If not already done, ecologically classify, according to Research Branch specifications, all experimental samples due for remeasurement.

Since permanent samples are cost intensive, protecting them is of the utmost importance. To ensure their protection, the protection buffers illustrated in Appendix 18 are recommended.

Preparing for Field Work

Before starting field work, prepare and collect:

Copies of the original field sheets

Maps to show you how to get to the sample – example, 1:250 000 contour maps – and photocopies of parts of forest cover maps, which have an approximate scale of 1:20 000 and show the plot's location in detail.

Photos showing original tie points, either those used when the sample was established, or, preferably, the latest photos on which tie points and sample locations were replotted.

Equipment. See Appendix 4 for the equipment needed.

Field Training

All personnel involved in remeasurement work must attend a field procedures course.

Relocating the Plot

Checking Location and Access

The notes on the location of the plot and access to the plot usually begin with a description of an easily identifiable point.

1. Follow the access notes to the tie point.
2. Correct the notes where necessary.

The reference or tie point generally is a prominent topographic feature distinguishable on the photos and on the ground. **Examples:** a road junction, road bend, creek junction or bridge.

The blazed and/or painted tie tree should be located nearby, as described in the access notes. Aluminum sample markers were nailed to the tie tree, and strands of plastic flagging tape should still be noticeable on or near the tree.

The aluminum marker contains pertinent sample information such as:

- region number;
- compartment number;
- sample type (R);
- sample number and plot number (1 assumed);
- bearing and distance to the plot centre;
- date the sample was established.

For more information on sample markers, see Appendix 5.

New Tie Point Needed

If a new tie point is needed:

1. Select a new tie point recognizable on the photos and the ground.
2. From the map, measure and record the new bearing and distance to the plot centre.
3. Paint both sides of the tie tree in the direction of the tie line.
4. Nail an aluminum sample marker above the paint.
5. Inscribe the pertinent information on the middle and bottom sections of the 2 markers. **Note:** "Date" on the marker always refers to the date the sample was originally established. See Appendix 5.
6. Flag the tie tree with two strands of flagging tape, one above and one below the markers.
7. To aid future measurement crews, prepare a sketch showing the tie point, the sample location, and other significant topographic features. Attach the sketch to the access notes.

If you establish a new tie point, you must run a new tie line.

Checking the Tie Line

The tie line is run from the tie point with a hand compass, a clinometer and a measuring tape. When you rerun the original tie line, it is sufficient to paint the blazes, and to renew the tape markings.

Checking Corner Posts and Centre Stake

Once at the experimental plot:

1. Locate all 4 corner posts and centre stake. Each of the corners or centre was marked with a cedar post or aluminum stake driven into the ground. Sometimes cairns were built around them.
2. Check that each post is solid enough to last another 10 years. When necessary, replace a post with a tubular aluminum stake.
3. Mark each post or aluminum stake with flagging tape.

To prevent future problems locating the corners and plot centre:

4. Build a cairn around each post or stake.
5. Stem map each (unless already done) of the 4 corners and plot centre to 3 trees nearby in the plot. For each of the 4 corners and plot centre, measure:
   - the bearings to the 3 trees;
   - slope percent to the 3 trees;
   - slope distance to the 3 trees (place a nail at the centre of each tree for consistency in measuring distance).

Remeasuring the Plot and Sub-plot

Accurate work is required when you compare new measurements with previous ones. Check measurements that appear to be out of the expected range, that is measurements showing a very large increase compared with those showing little or no increase.

Correct any errors and note them in the remarks. **Example:** "dbh checked."

Converting the Breast Height in Experimental Permanent Samples

If necessary, see Appendix 21 for procedures to convert, experimental sample plots from imperial (1.37 m) to metric (1.3 m) breast height. The conversion is done only once.

Sectors in the Plot

Experimental samples are either square or rectangular in shape.

To simplify tagging, the plot was divided into sectors. Tagging started in one corner of the plot and continued up and down each sector, beginning with sector 1. Sector numbers increased toward the opposite end. The number of sectors in a plot varies among the experimental samples.

In order to aid in the choosing of top height and site trees, the plot must also be divided into 0.01 ha site sectors using the same procedure previously used - that is starting with sector 1. See Appendix 24.

Tagging Trees

Determine the breast height of trees with missing tags, as well as of ingrowth trees. Prior to 1991, breast height determination used the point of germination. Therefore, continue using point of germination.

During the remeasurements from 1980 to 1989 inclusive, the dbh height and dbh were changed to 1.3 m above germination in one of two ways (see Appendix 21). If **Method 1** was used, you will have to remove the nail at 1.3 m and replace it with the nail and tag that is at 1.37 m.

Note: If a plot is being remeasured that has not had the dbh changed from 1.37 m to 1.3 m, do it now following Method 2 in Appendix 21.

Missing Tags

For all previously measured living trees with missing tags:

1. Determine breast height at 1.3 m above germination.
2. Nail a tag which has the same tag number as the missing one.

Measuring DBH

For all **numbered living trees**, measure above the nail to the nearest millimetre, the diameter at 1.3 m.

To more accurately measure the diameter of trees that are or will soon be joined together at dbh, use the "1/2 wrap" method. To do this, measure or estimate, as accurately as you can, the diameter of each affected tree. Then, from the nail with the tag, measure half of the diameter around the bole of the tree and place a second nail. Note in the remarks that these are "1/2 wrap" measurements. In the future, the distance between the two nails will be measured and multiplied by two to arrive at the diameter of the tree.

After remeasuring the diameter:

- Pull out the nail holding the number enough to allow for tree growth until the next remeasurement.

For all **previously numbered living trees now dead**:

1. Measure the diameter above the nail at 1.3.
2. If you can't find the dead tree, assign it the same diameter as in the previous measurement. If the tree was cut down, record it as Tree Class 6 and assign the same diameter as in previous measurement.

For all **previously dead unnumbered trees that are ≥10.0 cm dbh and ≥1.3 m in height:**

1. If standing or down, collect the appropriate '*Dead tree Attributes'*. See Appendix 22.
2. If you cannot find the tree, record it as (**F**)allen.

For all previously dead, standing, unnumbered trees that are ≥10.0 cm dbh and ≥1.3 m in height:

1. Tag the tree with a unique number.
2. Collect the '*Dead tree Attributes'*. See Appendix 22.

Assessing whether a tree is still alive may be difficult in certain situations. Ensure that all needles/leaves are dead if the tree is being called dead, and if uncertain, err on the side of caution by calling it alive.

Classifying Trees

Classify each tagged tree according to its pathological indicators. To classify a tree properly, view it from all sides. The person measuring dbh should move far enough away from the tree to be able to classify the lower third of the stem. The recorder should move around the tree to classify the upper two thirds.

In the pathological remarks section, record each decay indicator occurring on the lower, middle or upper third of the total height of the tree. Do this by entering the correct numerical position code as follows:

Code	Position on Tree (tree is divided into thirds)
1	Lower third
2	Middle third
3	Upper third
4	Lower and middle third
5	Middle and upper third
6	Lower and upper third
7	All thirds

Tree Classes

Each tagged tree is classed in one of the following categories:

1. Tree Class 1: Residual;
2. Tree Class 2: Suspect;
3. Tree Class 3: Dead potential;
4. Tree Class 4: Dead useless;
5. Tree Class 5: Veteran;
6. Tree Class 6: Dead, cut down.

Tree Class 1: Residual

Record Tree Class 1 if:

- the tree is alive, not a veteran and free of any decay indicators.

Tree Class 2: Suspect

Record Tree Class 2 if:

- the tree is alive;
- the tree is not a veteran, and;
- the tree has one or more decay indicators.

Tree Class 3: Dead Potential

Record Tree Class 3 if:

- the tree is dead, either standing or down;
- the tree contains at least an estimated 50% of sound wood by volume, and;
- the tree is greater than or equal to 10 cm dbh and greater than or equal to 3 m in height or length.

If you can determine the tree died as a result of an insect or a disease, record the primary insect or disease responsible for the death. See Appendix 14 for damage agents and severity codes.

Tree Class 4: Dead Useless

Record Tree Class 4 if:

- the tree is dead, either standing or downed, and;
- the tree is not potentially useful. See Tree Class 3.

If you can determine the tree died as a result of an insect or a disease, record the primary insect or disease responsible for the death. See Appendix 14 for damage agents and severity codes.

Tree Class 5: Veteran

For simple stands, record Tree Class 5 if:

- a tree is at least 40 years older than the mean age of the main stand, and
- the veteran component has an estimated crown closure of less than 6% for the sample.

In complex stands, a tree is considered a veteran only when it:

- is a remnant of a much older stand;
- is at least 100 years older than the oldest sample trees of the main stand;
- has a much larger diameter than trees in the main stand. This criterion is necessary because of the subjectivity in determining what constitutes the main stand owing to the wide range of ages possible in it.

Veterans are not recognized in stands 121 years or older, except in lodgepole pine stands, which may have a veteran component of Douglas fir or larch.

Record pathological indicators for veteran trees the same way as for other trees.

Tree Class 6: Dead, Cut Down

Record Tree Class 6 if the tree is dead as a result of being cut down.

Pathological Indicators

The indicators of decay (pathological indicators) are:

Fork or Crook the result of damage to the main leader.

Scar must be weathered and may be open or closed.

Frost Crack may resemble a scar but always follows the grain.

Dead Top is a dead leader on a living tree.

Broken Top (record height to break, to the nearest metre) is a broken leader.

Conk the fruiting body of decay fungi.

Mistletoe a parasitic flowering plant.

Blind Conk pronounced swelling of depression around knots.

Rotten Branch obviously decayed large branches with a DIB of over 10 cm.

See Appendix 11 for definitions and illustrations of these pathological indicators.

The following abnormalities are not decay indicators.

- butt rot
- flute
- candelabra branch
- branch fan
- black knot
- burl and gall
- sapsucker hole
- insect boring.
- sweep
- exposed root
- spiral grain
- dry side

Assessing Damage Agents and Severity

We collect insect, disease and injury data to quantify their effect on tree growth.

For each tree affected:

1. Identify, if possible, the two most damaging agents (see Appendix 14 for damage agents and codes).
2. Assess the damage severity.
3. Record the damage agent code to a level that you are confident.
   - The damage agent codes are hierarchical and enable coding from very general (type or category) to specific (species). The first letter indicates the type of the damage while the second and third indicate the specific agent.
   - If you are unable to identify the damage agent species, a short, incomplete label is still useful. Example: You may identify a defoliating insect and assess the percent defoliation for the tree as 30 percent. Record this as ID_30.

For the sample affected:

1. Identify the two most damaging agents in the sample.
2. Calculate the percent assessment of each agent for the sample. Determine the damage severity to the nearest one percent up to ten percent, and to the nearest five percent for severities greater than ten percent.
3. Record this assessment in the header. If known, also record the year in which the damage took place.

Assigning a Crown Class Code

Crown class refers to the position of the crown of a tree relative to all other trees within the general plot area, not the whole stand.

There are six crown classes:

1. Crown Class 1: Dominant;
2. Crown Class 2: Codominant;
3. Crown Class 3: Intermediate;
4. Crown Class 4: Suppressed;

5. Crown Class 5: Veteran;
6. Crown Class 6: Understory.

For more details on crown classes, see Appendix 12.

Assign a crown class code of 1 through 4 and 6 to each tagged tree classed as Tree Class 1, 2 or 6. For tree class 5, assign crown class 5. See "Classifying Trees" in this chapter.

Note: Crown Class 6 should be used sparingly; do not confuse it with Crown Class 4. Use Crown Class 6 only in stands 60 years or older where the understory trees, usually shade tolerant, are clearly much younger than the main stand.

Estimating Live-crown Length

Live-crown length is the distance between the treetop, if the top is alive, or from the top of the live portion, if the treetop is dead, and the base of the lowest contiguous live crown. The estimate is expressed as a percentage of the total height of the tree.

Estimate, to the nearest 10 percent, the live-crown length of all living tagged trees.

1. When determining the base of the lowest contiguous live crown, do not consider forks or epicormic branches;
2. The tops of defoliated trees may appear dead at the time of the assessment. Make sure it is or you may underestimate the live crown length.

Tagging Ingrowth Trees

The term ingrowth trees refers to commercial and non-commercial trees that were below the tagging limit during the last measurement but that now exceed that limit.

When all previously numbered trees have been remeasured, tag all commercial and non-commercial living trees now 4 cm dbh and greater, by consecutive number for the plot.

Dealing with Forked Trees

Special rules govern the tagging of forked trees:

- If the fork occurs **above 1.3 m**, tag the stem as a single tree, provided it has a dbh of at least 4 cm;
- If the fork occurs **below 1.3 m**, and two or more stems of the fork are 4 cm or greater in dbh tag each stem separately using consecutive numbers. Record, in the remarks, that these stems are forked together;
- If the fork occurs **below 1.3 m, and only one of the stems is 4 cm or greater**, tag it as a single tree.

Tagging Procedure for Ingrowth Trees

1. If a **large number of ingrowth trees** are present, use consecutive, pre-numbered blue plastic tags. If a **few trees** are present, use aluminum tags and inscribe the consecutive tree numbers for the plot.

2. Nail the tag to the tree 1.3 m above the germination point.
3. Do not use a previously used number within the plot.

Recording Data About the Sample:

For each tagged tree (4.0 cm + if alive or 10 cm + if dead) ensure that the following information is recorded:

- the tree number;
- the species;
- the tagging sector number;
- the site sector number;
- the dbh;
- the tree class;
- any pathological indicators or dead tree attributes;
- the crown class (living trees only);
- suitability for height measurement, (Y)es, (N)o, (C)ould be, (F)lagged, (V)ery difficult to measure, (E)asy to measure;
- the live-crown length;
- pest or injury codes, if applicable;
- the tree number of the closest, previously numbered living tree (if ingrowth).

The data must be captured digitally in the field with an Electronic Field Recorder (EFR) using Gyhost/Gyhand software (see "Gyhost/Gyhand: A Data Collecting, Editing and Reporting System" on the Ministry's Web page. In case of emergency (i.e. EFR breaks down) the data may be collected on field sheets and then later entered into the Gyhost/Gyhand system. For information on how to fill out the field sheets, see "Completing the Field Sheets" in Appendix 16. See Appendix 19 for a copy of the "Growth Sample Record Sheet".

Note: Previously classified trees that are now considered to be shrubs must be dropped (code "D" for drop) from the sample and tags removed.

Sub-plot and Tree Count

To have some representation from trees below the plot tagging limit, a circular sub-plot was established with its centre at the intersection of diagonals from the corner posts. The objective was to obtain a minimum of 20 living commercial trees that were less than the plot tagging limit but at lease 0.3 m in height. The sub-plot size was selected from Appendix 6. However, the sub-plot radius was less or equal to one-half the length of the shortest side of the rectangle even if less than 20 stems were obtained.

The centre was marked with an aluminum tubular stake. A plot centre tree close to the aluminum stake was selected and marked with aluminum markers.

If the plot centre tree is missing, whether from natural causes or not:

1. Select another centre tree near the plot centre.

2. Mark it properly. Nail two aluminum plot markers approximately 2 metres above the ground.
3. Inscribe the following information on the markers:
   - sample type (R);
   - sample number;
   - plot number (1 assumed);
   - region number;
   - compartment number;
   - the original date the plot was established.
4. Mark the centre tree with two strands of plastic flagging tape, one above and one below the aluminum markers.

If the centre tree is present but its markers are missing or illegible, replace them.

If the stake was pulled out, the bearing and distance from the centre stake to 3 trees nearby were recorded. Use this information to relocate the centre stake.

Within the sub-plot, all living commercial trees **2 cm dbh and greater but less than the plot tagging limit** were tagged using one of two methods. See "Tagging Trees" in this chapter.

Trees of commercial species **less than 2 cm dbh but 0.3 m in height** had their tags wired either to a branch or to the main stem. These tags and wires should be removed, if possible, to prevent girdling the stems.

Measuring Sub-plot Trees

For trees 2 cm dbh and greater previously tagged within the sub-plot, use the same method as in the main plot. See "Tagging Trees" in this chapter.

Attach a number tag to the tree with a nail at breast height (1.3 m) if the tree:

- was less than 2 cm dbh during the last measurement;
- now has a dbh of 2 cm or greater, and;
- is a commercial species.

Include the tree in the dot count if the tree:

- is less than 2 cm dbh, and;
- is a commercial species.

Special rules govern the tagging of forked trees at least 2 cm dbh but less than 4 cm dbh within the sub-plots:

- If the fork occurs above 1.3 m, tag the stem as a single tree;
- If the fork occurs below 1.3 m, tag each fork as a tree provided each is 2 cm dbh and greater.

Gathering and Recording Information about Sub-plot Trees

Trees 2 cm dbh and greater:

For each tree 2 cm dbh and greater in the sub-plot, record the following:

- the tree number;
- the species;
- the tagging sector number;
- the site sector number;
- the dbh;
- the tree class;
- any pathological indicators;
- the crown class;
- the live-crown length;
- damage agent codes, if applicable;
- suitability for height measurement (Y)es, (N)o, (C)ould be, (F)lagged, (V)ery difficult to measure, (E)asy to measure;
- the number of the closest previously tagged plot living tree.

Trees less than 2 cm dbh:

Count trees less than 2 cm dbh in a dot tally and record them:

- as dbh class 0 or 1 (see Table 1 below)
- by species. See Appendix 3.

Table 1 Metric dbh Classes and Limits

dbh class	Limits
0	0.3 m to 1.3 m high
1	0.1 cm to 1.9 cm dbh

Forked trees less than 2 cm dbh:

Give special attention to the method of counting forked trees less than 2 cm dbh. For example: To avoid counting numerous leaders of trees that have been severely browsed, count only the tallest leader. See Appendix 10 for a further explanation.

Unusual trees:

Now and then, you will find unusual live trees within the sub-plot. Special rules apply when measuring the height of abnormal trees less than 2.0 cm dbh. See Appendix 10.

Determining the Stand Structure

Stand structure is the physical arrangement or pattern of organisation of the stand. Stand structure is described and classified according to recognizable age and height differences.

The recognized stand structures are:

1. Single layer, simple stands (even age and height)
    - with veterans
    - without veterans

2. Single layer, complex stands (uneven age and height)
    - with veterans
    - without veterans
3. Multi layer stands
    - layer 1 is the top layer
    - layer 2 is the bottom layer

For single layer stands, layer 1 is assumed for trees in the main stand and tree class 5 identifies the veteran layer.

For multi layer stands, record 1 for the top layer trees and 2 for the bottom layer. The sample primary layer, according to regional priorities, must be identified.

For further details on stand structure, see Appendix 13.

Height Sample Trees

Local height-diameter curves are constructed from sample data before compiling samples.

To construct reliable curves, a substantial number of heights is needed for each species. The number depends on the stand composition, which ultimately is based on basal area. In the field, use the calculated basal area for stand composition.

Top Height

Select the top height tree from a 0.01 ha circular plot at plot centre. Record "C" (centre sector) for the tree. Top height (1998) is the height of the largest diameter tree, regardless of species, in a 0.01 ha plot, providing the tree is suitable. A suitable tree must be healthy, not have a broken or damaged top, not have its height growth affected by a competitor nor be a residual left from previous logging. There is no substitution for an unsuitable tree.

If the PSP is one selected for SIBEC, select the largest diameter tree of each additional species in the 0.01 ha circular plot at plot centre, and record "C" (centre sector) for the tree.

For a single-layered stand, or for each layer in a multi-layered stand, select height sample trees as follows:

First Two Major Species

For each of the first two major species (20 percent or more by composition), select trees for the sample as follows:

1. Select the required number of site trees on the basis of the largest diameter living tree per 0.01 ha plot or sector, to a maximum of ten. In the case of a sample larger than 0.1 ha, randomly select ten site sectors and take the site trees from them - do not substitute. In future remeasurements, the same sector numbers will be used to choose site trees.

    Suitable site trees have the following characteristics:
    - free of major defects;

- crown class of 1 or 2. The exception is in the case of the second layer in a two-layer stand where crown class 3 and 4 are acceptable;
- cannot be substituted.

Example: On a 0.1 hectare sample, the ten largest dbh trees from each of the two leading major species are selected for site tree measurements. Similarly, four trees would be selected in a 0.04 hectare sample.

2. Select an additional 15 trees distributed evenly across the remaining dbh range, down to 2 cm dbh.

For Third and Fourth Majors, Minor and Scattered Species

For the third and fourth major species (20 per cent or greater by composition), each minor species (10 to 19 percent by composition) and for scattered species (less than 10 percent by composition), select 15 trees, if present and suitable. Distribute them across the dbh range, down to 2 cm dbh. Place emphasis on larger diameter classes.

For Veterans

For the veteran layer:

1. Select one sample tree from each species present.
2. Estimate the height of all others.
3. Record the estimated height of all the veterans in the small tree or Vet height section.

Remeasuring Heights Consistently

To ensure future height measurements are taken consistently from the same direction, paint a blue dot, if not already done, at dbh to indicate the direction from which the height measurement was taken.

Ensure that height sample trees previously taken are remeasured for height and from the same direction as indicated by the blue painted dot (unless no longer suitable) even if the resultant distribution over the dbh classes is not optimum. If possible, strive for the full range of diameters down to 2.0 cm dbh.

Selecting Sample Trees

When possible, select residual trees (Tree Class 1). See "Classifying Trees" in this chapter. Otherwise, select trees that do not have major suspect characteristics, such as a major fork, which affects the true height or a major scar at breast height which affects its true diameter.

Do not select trees with:

- diameters that were estimated;
- sweeps or leans greater than 5 degrees.

In some areas, it may be impossible to meet sample height requirements if only suitable trees as described above are taken. In this situation, take the best of the "poor" trees to meet the

requirement. However, do not select a tree if its height is less than 95% of what it would be without its defect – lean, fork, broken top, etc.

Measuring Suppressed Trees with Flattened Tops

To ensure accurate measurements of suppressed trees:

1. Sight on the highest point of the top.
2. For hemlock trees, sight on the highest point of the droop.
3. For cedar trees, make sure you take the top reading on the tiny leader and not on a lateral branch, which may be higher.

Age Sample Trees

Note: If the present top height and site trees had their ages taken at 1.3 m during the last measurement, no further ages are required. If the top height tree or any tree of first and second leading major species do not have an age at 1.3 m, it must be taken now and recorded in the "New Age" field.

In **single layer, simple stands,** pure and mixed, the age of the stand is determined by averaging the ages of the site trees of the leading major species in the sample. However, ages of the site trees of the second major species must also be taken.

The sample mean age is derived from the site trees of the leading species only, even if some of their cores are rotten. The rotten portion must be estimated to derive a total age for the tree. See "Counting Rings on Rotted Cores" in this chapter.

Bore trees that appear to be veterans to confirm they are in fact veterans. Bore the smallest diameter veteran per species only; the others can be assumed to be veterans too. Use these ages for the veteran layer.

In **single layer, complex stands**, the average age of the stand is determined from the ages of the site trees of the leading major species. However, to show the variation of the stand's age, take two additional ages of the leading major species from the younger portion of the stand. Treat the second major species the same as the leading.

In **multi layer stands**, select sample trees, as outlined above, for each layer.

Taking the Age of a Tree

1. Bore the selected trees at 1.3 m.
2. Remove the core. Make sure two cores per species include the pith.
3. If the core includes the pith, record "Y" in the pith field.
4. Rebore the tree if you missed the pith by more than an estimated:
   - 2 years on a tree younger than 100 years, or;
   - 2 percent on a tree older than 100 years.
5. While in the field, count the rings on the core and record the count.
6. Measure and record the radial increment for the last 5, 10 and 20 years.

7. Measure and record the evidence of suppression, if any. See Appendix 23.
8. Place the cores in plastic straws with the following information:
9. Place the cores in plastic straws with the following information:
   - the region number, R#;
   - the compartment number, Co#;
   - the sample number, R#;
   - tree number;
   - species;
   - counted age.

Counting Rings on Rotted Cores

If the sample tree has rotten portions:

1. Count the rings on the sound portion of the core.
2. Estimate the number of years in the rotten portion.
3. Add the number of years in the sound portion to the estimated number of years in the rotten portion.
4. Record the total breast-height age, with an (**R**)otted for pith.

Estimating Other Plot Attributes

Estimating Crown Closure

Crown closure is the percentage of ground area covered by the vertically projected crowns of trees.

For each plot, estimate and record the crown closure by layer to the nearest 10%.

For the veteran component of the plot, record crown closure to the nearest percent. If the crown closure of the veteran component for the sample is six percent or more, it must be classified as a separate layer.

Determining Elevation

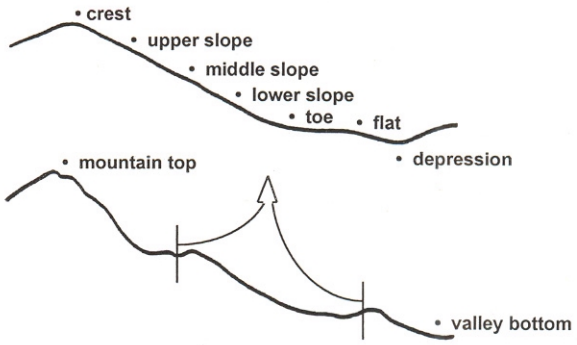
Determine and record the elevation of each plot if not already done.

Determining Aspect and Slope

Determine the aspect and slope for each plot if not already done.

Determining Slope Position

Slope position is the relative position of the plot within a water catchment area. Determine the slope position and record the appropriate code:

Code	Category	Slope Position
C	Crest	
U	Upper	
M	Mid	
L	Lower	
T	Toe	
F	Flat (level)	
D	Depression	

Collecting Ecological Data

All samples established in natural stands are ecologically assessed. If not already done, collect and record ecological data to the Biogeoclimatic Ecosystem Classification (BEC) site series level. See Appendix 25. If it is not possible to collect the ground data at the time of measurement, at minimum, obtain the BEC Zone, Sub-Zone, and Variant.

Quality Assurance

Sampling crews should emphasize accuracy over production. For the standards of measurement, see Appendix 1.

Checking Sampling Crews

To ensure crews follow and understand recommended procedures, carry out regular inspections.

1. Inspect at least 10 percent of all samples remeasured. If the sample has been poorly done, the original crew may be required to redo it.
2. Make spot checks as work progresses to be sure tie points and tie lines are properly marked.
3. To observe sampling crew performance, occasionally visit each crew on the sample.

Checking the Samples in the Office

All samples must be inspected in the office before sending them to the Vegetation Resources Inventory Section of the Terrestrial Information Branch. Ensure that:

1. The sample identification is correct and valid.
2. The sample header is as complete as possible.
3. The number and distribution of tree heights – both top height and others – were met.
4. The required number of ages and piths were met.
5. The access notes are complete and include the tie point sketch.

Inspecting the Sample

Once the samples have been checked in the office, randomly select one of the samples and conduct the following:

- a pre-field inspection;
- a field inspection;
- a post-field inspection.

Pre-field Inspection

1. Randomly select one sample from the ones checked in the office.
2. Enter the following information in the section at the top of the plot inspection report:
   - the sample identification – region, compartment, sample, sample type and plot;
   - the plot and sub-plot sizes;
   - the length of plot sides and sub-plot radii;
   - the inspection date;
   - the original tally crew;
   - the measurement date.

3. Randomly select 7 live and 2 dead trees from the tree detail section.
4. Transcribe the measurements of the 7 live and 2 dead trees to the top section of the plot inspection report. See Appendix 15.
5. Randomly select 5 trees for height from the sample tree section.
6. Transcribe the height measurements of the 5 trees to the sample tree section of the plot inspection report.
7. Select two age cores and check the age count as well as the suppression readings.
8. Transcribe the crown closure, aspect, slope and slope position of the plot to the appropriate section of the plot inspection report.
9. From the tree count summary section, randomly select one diameter class for a species. Later, you will use this diameter class in the field to check that the dot tally is correct for that class.

Note: Steps 2 to 9 are automatically done on the Gyhost/Gyhand Data Capture and Reporting System. Select the quality assurance report for printing.

Field Inspection

1. Use the access notes to get to the sample and verify their accuracy and completeness.
2. If a new tie tree was selected on remeasurement, check that it was marked as specified in "Checking the Tie Point" in this chapter.
3. If a new tie line was run, verify that the bearing and distance were run within the allowable standards.
4. Check that the plot centre markers were inscribed correctly and the plot centre stake was properly protected with a cairn.
5. Check the plot sides and the sub-plot radius at a minimum of three different locations. Look for ingrowth trees that should have been included or excluded from the plot or sub-plot. Flag with a circled asterisk any tree missed or mistakenly tallied.
6. Check that all sub-plot trees less than 4 cm dbh but at least 0.3 m in height were either tagged or counted in the dot tally.
7. Carefully measure all the trees you selected during the pre-field inspection:
   - **Tree Identification** – Check that the genus or species of each tree inspected is correct. If not, place a circled asterisk beside the tree;
   - **Tree tag height** – Check the tag height of the selected ingrowth trees to verify that breast heights, if applicable, were located at 1.3 m above the germination point. At the same time, make sure the nails were securely driven into the trees and the nail with the tag was driven in at a slight angle so that the tag hangs away from the tree;
   - **Diameter and pathological remarks** (decay indicators) – Measure the 7 live and 2 dead selected trees and classify them;
   - **Sample tree heights** – Measure the 5 selected trees for height;
   - **Stem mapping** – If the sample was stem mapped, check the 7 selected trees for bearing, distance and percent slope.
8. Assess the crown closure for the plot.

9. Compare your measurements with the previous ones giving the crew the benefit of the doubt.
10. Check that the results conform to the standards of measurement. See Appendix 1.
11. If the difference between two measurements is greater than the allowable error, place an asterisk in the margin.
12. If the error is greater than two times the allowable error, circle the asterisk.
13. Complete the inspection items section of the inspection report.
14. Rate the quality of the work on the plot using the weighted system in Appendix 2.
15. Record your rating of the plot and any other comments in the remarks section of the plot inspection report.

Post-Field Inspection

1. Discuss the results of your inspection with the original field crew.
2. Make recommendations to the original field crew, if necessary, on how to improve their work.
3. Correct the original data changing all the data that was flagged with an asterisk or a circled asterisk in your inspection report.

Damage to the Sample and Returning the Samples

Damage to the Experimental Plot

Damage to samples can result from natural or artificial causes.

1. If the sample was damaged by natural causes such as slides, snow, fungi, insects, disease and fire, it should be remeasured if at least 25% of the plot trees are still living.

2. If the sample was damaged (disturbed) by artificial means, refer to "Guidelines for Deciding if Damaged Permanent Plots Should be Remeasured" in Appendix 20.

If a sample is to be destroyed:

1. Remeasure it one last time if at least three years have elapsed since the last measurement.
2. Classify it ecologically.
3. Make sure the plot centre can be relocated after logging so that the long-term productivity effects can be determined.

Returning the Samples

Once the samples are checked in the office and corrected:

1. Send a list of all the samples, any original field sheets, the electronic download from the GyHost as well as a hard copy of reports 1,2,3,5,6 and 7 to the Vegetation Resources Inventory Section of the Terrestrial Information Branch.
2. Keep a copy of all the above for security and reference.