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# **Vegetation Resource Inventory: Growth and Yield Standards and Procedures**

## Remeasurement of Permanent Sample Plots in Natural Stands

Prepared by  
Ministry of Forests, Lands and Natural Resource Operations  
Forest Analysis and Inventory Branch

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## Preface

The standards and procedures are based upon the *Minimum Standards for the Establishment and Remeasurement of Permanent Sample Plots in British Columbia*.

This 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

With the inactivity of the FPC, the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) continues to upgrade the standards in response to client needs. The chapter following reflects that updated methodology and supersedes the FPC Minimum Standards document. The Ministry of Forests, Lands and Natural Resource Operations recommends that this methodology be followed for all establishments and measurements of permanent sample plots.



## Acknowledgments

The Resources Information Standards Committee supports the effective, timely and integrated use of land and resource information for planning and decision making by making by developing and delivering focused, cost-effective, common provincial standards and procedures for information collection, management and analysis. Representatives to the Committee and its Task Forces are drawn from the ministries and agencies of the Canadian and the British Columbia governments, including academic, industry and First Nations involvement.

The Resources Information Standards Committee evolved from the Resources Inventory Committee, and addressed concerns of the 1991 Forest Resources Commission.

For further information about the Resources Information Standards Committee, please access the RISC website.

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# Table of Contents

Preface.....	i
Acknowledgments.....	iii
Introduction.....	1
Preparing for Field Work.....	<b>Error! Bookmark not defined.</b>
Field Training.....	<b>Error! Bookmark not defined.</b>
Relocating the Plot.....	5
Checking Location and Access.....	5
New Tie Point Needed.....	5
Checking the Tie Line.....	6
Checking the Centre Tree.....	6
Checking the Plot Centre Tree Markers.....	7
Missing or Illegible Plot Markers.....	7
When the Plot Centre Is Also a Tie Point.....	<b>Error! Bookmark not defined.</b>
Checking the Plot Centre Stake.....	7
In Case the Stake is Missing.....	7
Remeasuring the Plot and Sub-plot.....	9
Converting Breast Height in Industrial Permanent Samples.....	<b>Error! Bookmark not defined.</b>
Sectors in the Plot.....	9
Tagging Trees.....	9
Missing Tags.....	10
Measuring DBH.....	10
Classifying Trees.....	11
Tree Classes.....	11
Pathological Indicators.....	13

## Remeasurement of PSPs in Natural Stands

Assessing Damage Agents and Severity .....	14
Assigning a Crown Class Code.....	14
Estimating Live-crown Length .....	15
Tagging Ingrowth Trees.....	15
Dealing with Forked Trees.....	<b>Error! Bookmark not defined.</b>
Tagging Procedure for Ingrowth Trees .....	15
Recording Data About the Sample: .....	16
Sub-plot and Tree Count.....	16
Measuring Sub-plot Trees .....	17
Gathering & Recording Information About Sub-plot Trees .....	17
Determining the Stand Structure.....	18
Height Sample Trees.....	18
Top Height .....	19
Remeasuring Heights Consistently .....	19
Selecting Sample Trees.....	<b>Error! Bookmark not defined.</b>
Measuring Suppressed Trees with Flattened Tops.....	<b>Error! Bookmark not defined.</b>
Age Sample Trees .....	20
Estimating Other Plot Attributes.....	21
Estimating Crown Closure .....	21
Determining Elevation .....	21
Determining Aspect and Slope .....	21
Determining Slope Position .....	22
Stem Mapping.....	23
Collecting Ecological Data .....	<b>Error! Bookmark not defined.</b>
Quality Assurance.....	27
Checking Sampling Crews.....	27



Checking the Samples in the Office ..... 27

Inspecting the Sample ..... 27

    Pre-field Inspection ..... 27

    Field Inspection ..... 28

    Post-field Inspection..... 29

Damage to the Sample and Returning the Samples..... 31

    Damage to the Sample..... 31

    Returning the Samples..... 31



## Introduction

The target for measuring samples in natural stands is ten years and should be maintained whenever possible. The standards of measurement for permanent samples are listed in Appendix 1.

Permanent samples and their data contribute to growth modelling , protecting them is of the utmost importance. To ensure their protection, the protection buffers illustrated in Appendix 18 are recommended.



## Digital Data

Forest Analysis and Inventory Branch shall provide the following for the measurement of samples:

Sample data for the plots' previous measurement;

Access notes for navigation and updating

Digital map files or .KMZ files for planning

**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”.



# Relocating the Plot

## Checking Location and Access

Use old access notes to relocate the sample. If access has changed, update the access notes. GPS coordinate are available for most samples. Check to make sure they are correct and update if necessary. For samples that do not have GPS coordinates, collect and record the coordinates for both the Tie Point and the Plot centre.

The notes on the location of the plot and access to the plot usually begin with a description of an easily identifiable point. Include GPS coordinates for starting point (recreational GPS is suitable).

1. Follow the access notes to the tie point.
2. Correct the notes where necessary and include GPS reference where ever notes could be confusing or possible future development may affect access refer to Appendix 17 for example of access notes.

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 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. Refresh paint and ribbon on tie point tree and replace plaques if damaged or missing.

The aluminum marker contains pertinent sample information such as:

- region number;
- compartment number;
- sample type (G);
- sample number and plot number (usually 1, but 3-plot samples exist);
- 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 to replace damaged or missing tie tree::

1. Select a new suitable live prominent tie point tree.
2. If necessary, measure and record the new bearing and distance to the plot centre. Collect new coordinates if more than 5 meters away from previous tie point.
3. Paint both sides of the tie tree in the direction of the tie line.
4. Nail an aluminum sample marker above the paint on both sides of the tree.

## Remeasurement of PSPs in Natural Stands

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 flagging tape ensuring the markings are inter-visible. .

## Assessing the Plot Condition:

Following table represents acceptable status codes in the GYHAND software.

Status Code	Description
<b>A</b>	Active
<b>B</b>	Badly disturbed (e.g. loss of buffer, partial blow down, ice damage, unauthorized tree removal, vandalism)
<b>D</b>	Inactive, abandoned
<b>L</b>	Lost in field
<b>P</b>	Pest damaged (threshold is 5% loss/mortality by basal area)
<b>X</b>	Destroyed (e.g. partial or complete harvest or blow down)

## Checking the Centre Tree

Each established plot has a centre tree marked with aluminum markers and strands of flagging tape. The markers and tape are usually secured about two metres above ground to avoid interfering with DBH measurements. Refresh paint and ribbon on centre tree and replace plaques if damaged or missing. If the centre tree is missing or fallen:

1. Select another centre tree near the plot centre.



2. Mark it with the two aluminum markers and flagging tape.

## Checking the Plot Centre Tree Markers

### Missing or Illegible Plot Markers

Discovering missing or illegible plot centre tree markers is not unusual. Here's how to proceed:

1. Replace the old markers. Centre tree markers are the same as those used for tie point trees. See Appendix 5.
2. Complete the top and bottom sections of the markers. Include the following information:
  - sample type (G);
  - sample number;
  - plot number;
  - region number;
  - compartment number;
  - date the plot was established.
3. If the centre tree is a tie point for the next plot on the tie line ensure that the middle section of tree plaque is also filled out.

## Checking the Plot Centre Stake

The plot centre is marked by an aluminum stake either driven into the ground or supported by a cairn on rocky ground. If the plot centre stake location has never been stem mapped, select three trees around the plot centre and record the bearing, slope, and distance from the plot centre stake to the centre of each tree. Place a nail at the centre of each tree for consistency in measuring distance to the centre stake.

Replace the plot centre stake if the stake is:

- missing;
- pulled out but lying on the ground;
- bent but still in the original location.

To replace a stake use the stem map data from previous measurements.

### In Case the Stake is Missing

Unless the centre stake location was stem mapped, relocating a missing plot centre stake is a difficult, time-consuming, but necessary task.

If the centre stake location was not stem mapped:

1. Tally the original trees on the plot before relocating the centre stake. Some tags may be down or missing, so replace them before relocating the centre stake.
2. Determine the approximate centre by observing the layout of the sectors.
3. Find trees close to the plot perimeter and measure the plot radius from those trees until you determine the approximate plot centre. Using the 'approximate plot centre' and the

## Remeasurement of PSPs in Natural Stands

plot radius as a starting point, check that all tagged trees are in the plot. If not, adjust the plot centre until they are.

4. If not already done, build a cairn around the newly relocated plot centre stake.
5. Measure the bearing, slope percent, and slope distance from the plot centre to 3 trees nearby. Place a nail at the centre of each tree for consistency in measuring distance to the centre stake.
6. In sample remarks, record that the centre stake was missing.

## Remeasuring the Plot and Sub-plot

Accurate work is required when you compare new measurements with previous ones. Always position the DBH tape just above the nail and perpendicular to the bole of the tree. 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.”

### DBH Sectors in the Plot

Plots were generally divided into eight tagging sectors with number one starting clockwise from the direction of the original tie line or, in later years, from the north. 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 clockwise from the direction of the original tie line or from north. See Appendix 24. The original Tie Line bearing is available from the access notes or from the sample set up screen in the GYHAND software.

### Defining Tree Species

Commercial versus non-commercial tree species see Appendix \*\*. Non-commercial tree species are not tagged below 4 cm DBH in the sub-plot.

If previously numbered trees no longer meet the definition of tree and are now considered shrubs they must be deleted by coding them as (D)ropped in the Missed/Dropped/Fallen column.

### Tagging Trees

Determine the breast height of trees with missing tags, as well as of ingrowth trees. In 1991, breast height determination changed from using the point of germination to using the base of the tree on the uphill side. Therefore:

- for samples established **before 1991**, continue using the point of germination
- for samples established **after 1990**, use the base of the tree on the uphill side

When either replacing or tagging ingrowth trees nail the tag to the tree:

- use 6 cm aluminum nails;
- drive the nail slightly upward so the tag hangs away from the tree;
- drive the nail into the trunk just enough to hold the tag securely and yet allow for radial growth.
- do not bend the nail

## Missing Tags

For all previously measured living trees with missing tags:

1. Determine breast height at 1.3 m above germination, or 1.3 m above the base of the tree on the uphill side for samples established after 1990.
2. Replace missing tag with a new tag of the same number

## Finding Missing Tags

During the establishment, tagging began near the centre in sector 1 and continued in a zigzagging pattern toward the circumference with the tags facing the plot centre. Once all taggable trees in sector 1 were tagged, the procedure was repeated in sector 2, only this time tagging began at the circumference with the tags facing away from the plot centre. The procedures for tagging sectors 1 and 2 were repeated alternately for all remaining sectors of the plot. The DBH and near tree information is useful in determining tree numbers for trees with missing tags.

## Measuring DBH

For all **numbered living trees**, measure above the nail, to the nearest millimeter, 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 m.
2. Assign tree class of either 3 or 4 .

For all previously numbered living trees not found.

1. Assign it the same the diameter as the previous measurement
2. Assign an assumed tree class 4 and record it as (F)allen in the Missed/Drop/Fallen column

For all **previously dead numbered trees that were  $\geq 10.0$  cm DBH and are  $\geq 1.3$  m in height**:

1. If standing , collect the appropriate ‘*Dead tree Attributes*’. See Appendix 22.

2. If you cannot find the tree, record it as (F)allen.

For all **dead, standing, unnumbered trees that are  $\geq 10.0$  cm DBH and  $\geq 1.3$  m in height:**

1. Tag the tree with a unique number (by convention, where possible, use 600 series tags for natural snags and use 900 series tags for cut stumps).
2. Collect the ‘*Dead tree Attributes*’. See Appendix 22. .

## Classifying Trees

Classify each tagged tree according to its pathological indicators. Review the previous pathological indicators and ensure they are still valid. Record any new indicators. Delete any previous indicators that are no longer applicable. Record “path check” comment for indicators that are deleted or changed.

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.

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

Record each pathological indicator as occurring on the lower, middle or upper third of the total height of the tree. Do this by entering the following Pathological (Decay) Indicator Position Codes:

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.

## Remeasurement of PSPs in Natural Stands

### **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.
- Complete the dead tree attributes on screen #129 GYHAND (see Appendix 22). NOTE: Heights to break are to be measured to the nearest decimeter.

### **Down Status**

- Trees that are **not self supporting and hung up** in other trees are considered to be “DOWN: SUPPORTED”.
- Trees that are **down and lying prone** (e.g. parallel to the ground) are considered “DOWN; GROUND” and do not need further evaluation as to whether the bole itself is touching the ground.

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 down;
- the tree does not meet the Tree Class 3 criteria.
- Complete the dead tree attributes on screen #129 GYHAND (see Appendix 22). NOTE: Heights to break are to be measured to the nearest decimeter.

### **Down Status**

- Trees that are **not self supporting and hung up** in other trees are considered to be “DOWN: SUPPORTED”.
- Trees that are **down and lying prone** (e.g. parallel to the ground) are considered “DOWN; GROUND” and do not need further evaluation as to whether the bole itself is touching the ground.

- 

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;
- 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.

### **Tree Class 6: Dead, Cut Down**

Record Tree Class 6 if a previously live numbered tree has been 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 decimeter) is a broken leader.

**Conk** the fruiting body of decay fungi.

**Mistletoe** is 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.

## Remeasurement of PSPs in Natural Stands

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

The following abnormalities are not pathological indicators.

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

## Assessing Damage Agents and Severity

Insect, disease and injury data are collected 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: Co-dominant;
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 or 2. For tree class 5, assign crown class 5 (see “Classifying Trees” in this chapter).

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**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.

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## 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.

- When determining the base of the lowest contiguous live crown, do not consider forks or epicormic branches;
- 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 now meet that limit.

When all previously numbered trees have been remeasured, tag all living trees now 4 cm and greater at DBH by consecutive number for the plot.

### Tagging Procedure for Ingrowth Trees

1. If a large number of ingrowth trees are present, use consecutive, pre-numbered blue plastic tags. If 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—or above the base of the tree on the uphill side, for samples established after 1990 see Appendix 9 for determining DBH location.
3. Do not use previously used numbers within the plot.
4. Where it is clear that the particular ingrowth tree should have been previously measured, the tree should be coded “M” for “Missed” in the “M/D/F” column and an age core taken and submitted to the ministry for estimating previous diameters.

For plots in dense stands, string the plot circumference beforehand.

### 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;

## Remeasurement of PSPs in Natural Stands

- 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.

## Recording Tree Data

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;
- the live-crown length;
- damage agent 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”.

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

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## Sub-plot and Tree Count

To have some representation from trees below the plot tagging limit, a sub-plot was established for each sample. The objective was to obtain a total of 20 living trees that were less than the plot tagging limit but at least 0.3 m in height.

Within the sub-plot, all living commercial trees **2 cm DBH and greater but less than the plot tagging limit** were tagged using method 1 or method 2, previously mentioned in “Tagging Trees” in this chapter.

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

### Measuring Sub-plot Trees

Each sub-plot trees will be recorded using one of two methods. For trees 2 cm DBH and greater use the same method as in the main plot. For trees greater than 0.3 m in height and less than 2 cm DBH a dot tally will be conducted. See “Tagging Trees” in this chapter.

#### Trees greater than 2.0 cm and less than 4.0 cm

Follow measuring, tagging and classifying procedures as per main plot.

This is for commercial species only.

Trees greater than 0.1 m and less than 2.0 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
-1	0.1 m to 0.29m high
0	0.3 m to 1.3 m high
1	0.1 cm to 1.9 cm DBH

Trees with a DBH class of -1 must be dealt with in the comment section in GYHAND. The precise text comment should be in the following form: BS+Plot size(in meters)^species-species tally X n  
e.g. BS3.99m P13 Sx2, or BS5.64m Fd21 B15.

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 & 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 all attributes as described in the above section.

### **Forked Trees Less than 2 cm DBH:**

Give special attention to the method of counting forked trees less than 2 cm DBH.

**Example:** To avoid counting numerous leaders 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.

## **Stand Structure**

Stand structure is the physical arrangement or pattern of organization 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)
2. Single layer, complex stands (uneven age and height)
3. Multi layer stands
  - layer 1 is the top layer
  - layer 2 is the bottom layer

For single layer stands, tree class 5 identifies the veteran trees.

For further details on stand structure, see Appendix 13.

## **Height 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 species composition of the plot, which is based on basal area.

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 the 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 requirements. 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.

A suitable tree must be a dominant or co-dominant, healthy, not have a broken or damaged top, not have its height growth affected by a competitor nor be a residual left from previous stand.

For all height trees, height to live crown must be measured to the nearest meter.

### **Top Height**

Select the top height tree from a 0.01 ha (5.64 m radius) circular plot at the 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. . There is no substitution for an unsuitable tree.

### **SIBEC Trees**

SIBEC Trees are the largest diameter tree, dominant or codominant, for each species, in a 0.01 ha plot (5.64m radius), providing the tree is suitable. There is no substitution for an unsuitable tree. Record “C” (centre sector) for the tree.

### **Site Trees**

Site Trees are selected for the first two major species (20% or more). They are defined as follows: the largest diameter living tree within each 0.01 ha site sector and must be a dominant or co-dominant. There is no substitution for an unsuitable tree. (Refer to Appendix 24 for site sector definition) **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.

### **Other Height Trees**

Suitable height trees have the following characteristics:

- free of major defects that either affect diameter or height growth (e.g. a major scar at breast height or forks);
2. For each species select 15 height trees distributed evenly across the remaining DBH range, down to 2 cm DBH. All trees must have been identified as “suitable for height”

### **Veteran Trees**

Take heights for all veteran trees.

### **Remeasuring Heights Consistently**

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).

## Remeasurement of PSPs in Natural Stands

For trees not previously measured paint a blue dot at DBH to indicate the direction from which the height measurement was taken. Heights for leaning trees should be perpendicular to the lean.

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

Trees identified as Site Trees, SIBEC Trees and Top Height Tree will have an age core taken.

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**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.

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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 **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. Re-bore 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. Ring counts must be completed in the office using a dissecting microscope and the ring count recorded.
6. Broken cores must be glued back together using cyanoacrylate glue (super glue) ensuring the segments are in the correct orientation.
7. Cores must be marked with indelible ink at 5-year, 10-year, and 20-year increment marks without obliterating the annual ring. Cores must not be mutilated or sequence of broken parts altered and carefully re-slotted back into labeled straws and delivered to the

Ministry in bundles sorted by sample plot. Core straws must not be heat sealed or taped so as to avoid molding and decay (suggested closure by crimping or stapling).

8. Record the evidence of suppression, if any by coding “Y” in the GYHAND “Age Screen” under “suppressed core (currently the software will only allow “Y” if there is data in the suppression screen – crews are to enter “99” in all of five fields in GYHAND screen 120).
9. Place the cores in plastic straws with the following information:
  - the region number, R#
  - the compartment number, Co#
  - the sample number, G#
  - tree number
  - species

### **Counting Rings on Rotten 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 this total as breast-height age with an (**R**)otten in the pith code.

### **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 percent.

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 as per the following table if not already done:

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



## Stem Mapping

The contract will identify which samples require stem mapping and the diameter limits that are to be used. If the sample was previously stem mapped, you only have to stem map the tagged ingrowth trees in both the plot and the sub-plot.

To create a stem map, you begin from the plot centre stake and measure the bearing and distance to each tagged tree. See Appendix 4 for a list of equipment needed for stem mapping.

To stem map the plot, follow this procedure:

1. If no large tree nearby interferes with sight lines, set up the compass directly over the aluminum plot centre stake, then:
  - level the instrument;
  - record that the compass was not offset.
2. If a large tree interferes with sight lines, set up the compass in an opening close to the plot centre, then:
  - level the instrument;
  - measure and record the bearing and distance from the compass to the plot centre;
  - record that the compass was offset.
3. Adjust the compass for magnetic declination and raise the sighting vanes. In western Canada, magnetic declination is east of true north. Obtain the correct magnetic declination from an isogonic chart. See Appendix 7.
4. Sight on to the first tree on the plot. Some tips for sighting are listed below:
  - to avoid sighting the wrong tree, wrap the DBH stick with flagging tape to make it more visible, then place the stick in front and center of the tree;
  - to avoid false compass readings as you sight the tree, keep sources of magnetic interference away from the compass, including steel tapes, axes, knives, steel datum holders, eye glasses with steel frames, and most metal objects;
  - to simplify recording and possibly minimize errors, use a staff compass with Azimuth bearings when possible;
5. Measure the slope distance between the compass and the centre of the tree;
6. Measure the slope with a Vertex or a Suunto clinometer (using the percent scale);
7. Read the compass bearing on the scale at the north end of the compass needle;
8. Record the measurements for each live tagged tree in the plot and each dead standing tree greater than 10.0 cm.
9. Appendix 26 discusses stem mapping of dead fallen trees >10.0 cm that were live at previous measurement.







## 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 verified for completeness prior to sending to the contract coordinator. 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 plot from the ones checked in the office.
2. Enter the following information in the section at the top of the plot inspection report:
  - sample identification – region, compartment, sample, sample type, plot;
  - the plot and sub-plot sizes;
  - the plot and sub-plot radii
  - the inspection date;
  - the original tally crew;

## Remeasurement of PSPs in Natural Stands

- the measurement date.
3. Randomly select 7 live trees and 2 dead from the tree detail section.
  4. Transcribe the measurements of the 7 live trees and 2 dead to the top section of the plot inspection report. See Appendix 15.
  5. Randomly select five 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.

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

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### 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 Location and Access” 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 and sub-plot radius at a minimum of three different locations. Look for trees that should have been included or excluded from the plot or sub-plot.
6. Check that the chosen diameter class was properly dot tallied.
7. Carefully measure all the trees you selected in 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 for plots established before 1991, or at 1.3 m above the base of the tree on the uphill side for plots established after 1990. 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 selected ingrowth trees for bearing, distance and percent slope.

8. Assess the crown closure for the plot.
9. Compare your measurements with the crew's measurements. Give the crew the benefit of the doubt.
10. Check that the results conform to the standards of measurements. See Appendix 1.
11. Complete the inspection items section of the inspection report.
12. Rate the quality of the work on the plot using the weighted system in Appendix 2.
13. 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 greater than the allowance.





# Damage to the Sample and Returning the Samples

## Damage to the Sample

Damage to samples can result from natural or artificial causes.

1. If the sample was damaged it should be remeasured and notes taken as to the damage, e.g. logging, snow, wind throw. The only time a sample is not to be measured is if more than 10% of the trees have been harvested.

If a sample is to be decommissioned refer to Appendix 28:

## 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 and the electronic download from the GyHost Forest Analysis and Inventory Branch, Victoria
2. Keep a copy of all the above for security and reference.