Forest Inventory Technical Bulletin

Ministry of Forests and Range, Forest Analysis and Inventory Branch[1]

Issue Number 1: July 2007

Vegetation Resources Inventory (VRI)
Ground Sampling (timber attributes) Update

Introduction:

This technical bulletin has been initiated to enhance communication within the forest inventory community. It will be distributed as required, to address various inventory topics. The concise format is intended to provide information that can serve as the basis for more detailed discussions.

Issue Number 1 is focused on VRI ground sampling; specifically for timber attributes. It has been written with technical input from Ministry of Forests and Range staff and inventory consultants. In order for the provincial forest inventory to be "provincial", it is necessary to have principles and procedures applied consistently for all VRI projects. Ground samplers and auditors have noted that clarification around the following principles and procedures would be helpful. These topics include:

1. **High side principles**
2. **DBH determination with forking at or near DBH**
3. **Boring facing plot centre**
4. **Remaining bark (%)**
5. **Twist determination**
6. **Plot location, tie points and access notes**
7. **Sample packages**
8. ***Fomitopsis pinicola***
9. ***Phaeolus schweinitzi***
10. **Net factoring with more than one deduction per log**
11. **Net factoring using the Butt Rot Table**
12. **Net Factoring using conical deductions for butt rot or missing wood**
13. **Recoverability considerations in call grading**
14. **Recoverability for checked dead trees (re: mountain pine beetle)**

[1] Forest Analysis and Inventory Branch wishes to acknowledge the contribution of Norm Shaw with assistance from regional and headquarters VRI staff in the creation and production of this technical bulletin.

1. High side principles

VRI ground sampling procedures are designed to be principle based, not rule based. If the interpretation of the procedure produces an unreasonable result, the ground sampler should revert to principle of the measurement being taken. There has been no change in the interpretation of high side since the VRI manual was produced, which is to measure the DBH from the high side of the tree, where applicable, while considering where the 30 cm stump height would be located. If the choice of high side results in a stump height that is below ground level, than the sampler must reconsider their interpretation of the procedure. Illustrations have been provided in the procedures manual to guide the sampler.

Ultimately, the exact location of DBH is less important than ensuring that the location marked as DBH is the same location that is used to determine if the tree is in/out of the plot. It is an error to select a tree based on a diameter that is different from the one that is marked and recorded.

2. DBH determination with forking at or near 1.3 metres.

Related to the high side issue, VRI procedures indicate that the "one or two tree" decision is based on where the stems separate relative to 1.3 m (breast height). For two trees, each stem is determined to be in/out with the prism. The selection points, recorded as DBH, will be somewhere above the common stem for each tree.

For one tree, select which stem represents the tree and then sight on the selection point for that stem. The selection point will likely be somewhere above the common stem below the fork. The common stem is usually not appropriate to describe the true taper of the one tree.

In each case, the selection point, recorded as DBH, should be reasonable in describing the trees. Resolving the forked tree issue involves two separate steps. First, decide whether it is one tree or two. Then decide on reasonable selection point(s) for the measurement of DBH. If the high side definition does not provide a reasonable location, revert to principles.

3. Boring facing plot centre

Increment boring is used as a sample for both age and radial increment. Trees are always bored facing plot centre to eliminate bias, but this is not always easy on steep terrain. The potential for bias in radial increment comes from compression wood that is formed by conifers (reaction wood in deciduous) growing with pronounced leans or on steep slopes. The uphill side of the tree has narrow rings and the down slope side has wide rings. Consequently, the selection of the easier location of the uphill side will introduce bias; tree age may not change, but the increment almost certainly will.

When it is not possible to bore facing plot centre, the principle is to get an accurate, unbiased estimate of age and increment. This is accomplished by boring 2 times from opposite directions and averaging the results.

4. Remaining bark (%)

The DBH is recorded as the diameter of the outside bark. The first step in volume compilation is to reduce outside bark measurement to inside bark so that wood volume can be estimated.

Remaining bark percent provides the means for the compilation program to recognize that a full bark thickness reduction may not be necessary. For example, removing 10 cm of bark from a 150 cm tree reduces its basal area by 25%.

5. Twist determination

Percent twist does not refer to the deflection in percent. It refers to the deflection over 30 centimetres as a % of the log top diameter. This is the same process used for scaling and appraisal cruising, which evolved from inches per foot.

The deflection is measured at DBH and is then used to estimate the deflection at mid point or the point which best represents the bulk of the log volume.

6. Plot location, tie points and access notes

Plot location:
An unbiased plot location is the foundation of the VRI inventory. Matching the plot location to the estimates for the polygon in which the plot is actually located, is also critical.

Tie points:
The reference point must be referenced to a photo tie. If there is an identifiable point or opening within a reasonable distance of the IPC, then GPS can be used to access that point and then use it as a tie point. If the current photos are out of date, of poor quality, or if field conditions limit the establishment of a reasonable tie point, (e.g. area has been logged) then establish the reference point using the GPS, but also tie it to a feature which will show up as an appropriate photo tie on a new photo.

Access notes:
While GPS coordinates can be used to re-locate the sample, comprehensive access notes are also needed to document the correct plot and polygon location.

Access notes must provide detailed and stable information on direction, time, road conditions, and equipment requirements to ensure that the point can be accessed in the future. The starting point must be a major stable feature. Avoid temporary features, anything that is likely to disappear, and the use of local names (e.g. branch 124).

Ideal stable starting points include a permanent feature in a town or a major highway intersection. Access notes must be legible. Be cautious when developing access notes in reverse; recheck and edit them carefully. Helicopter access points must be identified on the photo. Access information should be written on both the photo and map.

7. Sample packages

The quality, and therefore the utility, of sample packages have begun to decline in recent years. The packages are critical for appropriate bid estimates, crew safety, efficiency and quality control.

Packages should include:

- The latest and most complete road access and history updates possible. Poor map and photo data can lead to lost field time, potentially incorrect locations, or missing tie point information.
- A document or ortho photo so that polygon boundary information can be matched to the selected sample. A document or ortho photo has the polygon line-work that has actually been used for the polygon and sample point selection.
- A stereo pair suitable for identifying photo features for tie point location, access safety assessment, verification of IPC and auxiliary point locations, plot type selection and border plot information.
- True north and grid north clearly identified on all photos and maps, along with documentation of resolution and accuracy (meta data).
- Clearly identified projection, datum and coordinate systems (UTM, zone, NAD, etc.).

  Examples:
    - Map projection: UTM or Albers
    - Map grid coordinates: UTM or Albers
    - Horizontal datum: NAD 27 or NAD 83

8. *Fomitopsis pinicola*

Pinicola is most commonly treated as a saprophyte rather than a heart rot. It is usually located on dead wood (scars, sapsucker wounds, etc. or dead trees). It is not considered a conk even when it is associated with local or generalized sap rot. Only on rare occasions when the fruiting body appears on live cambium, can it be considered a heart rot decay.

9. *Phaeolus schweinitzii*

The inventory convention assumes a cone of rot has a ¾ butt ratio and extends 3 metres from the ground. On occasion *schweinitzii* fruiting bodies may be located well above the ground or root area. In this case, assume the conical rot starts at the ground with a ¾ butt ratio and extends 3 metres beyond the fruiting body.
The net factor for the affected length is 81% or it can be expressed as a length (.19 x length of decay).

10. Net factoring with more than one deduction per log

Deductions in the VRI process are cumulative, but do not attempt to account for overlapping deductions. In logs with more than one deduction, simply apply the procedure(s) and combine the deductions.

Example 1:
A 10 m log with heart rot conk, and a 4 m frost crack will have a 5 metre deduction for the conk, and a 0.5 metre deduction for the frost crack. The total deduction on the 10 metre log will be 5.5 metres or a net factor of 4.5 / 10 x 100 = 45%.

In this case, the decay itself in not visible, so the appropriate procedure should be followed without subsequent personal interpretation.

Example 2:
If butt rot with a ½ butt ratio is also identified on the same tree and it is determined that the butt rot and conk are connected, calculate the net factor for the conk and butt rot combined. For example, the combined deduction is 49% or 5.1 metres of length. With the addition of the non visible portion of the frost crack (0.5m) the total deduction of 5.6 metres results in a net factor of 44%.

11. Net factoring using the Butt Rot Table

The butt rot table is the most convenient process for net factoring butt rot. It is used for conical butt rot of unknown length. The table does not apply to heart rots, which are cylindrical, or to missing wood that is conical in shape.

To use the table, first measure the diameter of the rot *at the butt* of the log and compare that to the DBH (not the butt diameter). This ratio is then used to access the closest fraction within the table.

Example: A butt rot diameter of 23 cm and a DBH of 90 cm (23/90) are closest to the ¼ ratio.

The butt rot table provides 3 scaling factors for a ratio of ¼:

The **length of the decay cone** ranges between **1.8 to 2.4 metres**.
The **soundwood length deduction** to be used **is 0.2 metres.**
The **grade consideration** to be used is **0.6 metres** in length.

Example: For a 7 metre log, the butt rot would require a **length deduction of 0.2 metres**, leaving 6.8 metres of soundwood. Calculated as a net factor, this would be: (6.8m / 7m) x 100 or **97% net factor**.

The **grade consideration** indicates the bottom 0.6 metres are not available for lumber production. This leaves you 6.4 metres from which to cut. If there are no other factors affecting recoverability in the remaining 6.4 metres (breaks, etc), then the computed recoverability is 91% (6.4 metres / 7 metres x 100).

Therefore, the example tree has a 97 % net factor and 91% recoverability.

12. Net Factoring using conical deductions for butt rot or missing wood

The key principle in decay estimation is to always measure what can be observed and only apply a procedure in cases where decay cannot be seen. That is, deductions should always be calculated wherever the extent of the decay is visible or otherwise known.

Situations where the length of butt rot is visible or known are unusual but not entirely unheard of. A more common situation is conical missing wood or exposed conical rot and missing wood in cedar. In this situation, the butt rot table is inappropriate since it assumes a length. In this case, use the actual length in conjunction with the ratio of decay.

Example: A tree with 40 cm rot (total diameter) and 90 cm DBH has a ratio of decay of 40cm/90cm. Therefore, its proportional decay area is $(40cm/90cm)^2$. For a measured decay length of 2.1 metres, the length deduction would be:

$(40cm/90cm)^2$ x 1/3 (conical shape adjustment) x 2.1m = 0.1 metre deduction.

13. Recoverability considerations in call grading

Each grade has a recoverability requirement. This is the first number under the minimum scale column in the field guide. For lumber grades it is the “L”umber before the “CL”ear requirement. For peeler it is 80% recoverability and for sawlogs it is the “L”umber before the “M”erchantable requirement.

The common recoverability requirements are 75%, 50% and 33% and refer to the amount of the log which is physically available to cut lumber.

When using the butt rot table the "grade consideration" length defines how much length at the butt is **not** available.

Consideration must be given to parts of the log that would be unavailable due to shatter, large forks, excessive twist, very poor form etc. When defects isolate parts of a log less than 2.5 metres in length, the isolated section becomes part of the non-recoverable portion.

Example:
An 8 metre log contains a deep and twisting frost crack from 2 metres to 5 metres. If after examining its depth and shape, the cruiser determines it does not contain a 2.5 metre section that will yield a 2.5 metre board, then the 3 metre frost crack portion of the log is not recoverable. The 8 metre log would then have a net factor of 0.3 metres of length and a net factor of 96%.

Taking this example a step further, if the two metres below the frost crack area are isolated by other defects, the entire 5 metre section is not recoverable. Therefore, the log has just has 3 metres of available wood above the frost crack over its 8 meter length, or 38%. The highest grade for the 8 metre log would then be "X" grade which requires 33% recoverability.

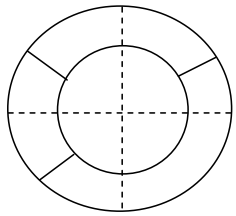
14. Recoverability for dead trees with checks (re: mountain pine beetle)

When call grading and net factoring dead trees the primary issues are often grade and recoverability loss due to checking. Checks are similar to frost cracks but have no decay associated with them and vary in depth. Since checks affect the outer portion of the tree where the bulk of the volume and grade lie, the presence of them can reduce recoverability significantly. Recoverability uses the ratio between the unchecked inner diameter (**d**) and the total diameter (**D**): **d** is calculated as [**D** minus **check depth]**.

Examples:

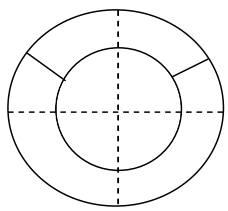
A tree is usually considered in cross section first. If the entire log has checks in **all four quadrants** and the depth of the checks is ≤1/3 of the diameter (D) measurement, then 50% of the log is non-recoverable. Recoverability can be determined for checking to any depth based on $(d/D)^2$ where d is the unchecked inner diameter and D is the tree diameter.

If the entire log has checks in **3 out of 4 quadrants** with a check depth equal to 1/3 of the diameter, the loss will be 50% for ¾ of the log. Maximum recoverability is 62%. The cruiser would then have to assess the remaining ¼ of the log to determine if it is actually able to be processed. If the remaining portion is too small to yield lumber, recoverability is reduced further.



Checks 3 quadrants

If the entire log has checks in **2 adjacent quadrants** with a check depth equal to 1/3 of the diameter, loss would be 50% for ½ of the log. Maximum recoverability for the entire log would be 75%; trim considerations would reduce it further.



Checks 2 adjacent quadrants

With respect to checks, the sampler is assessing the location and depth of checking to determine what proportion of the volume remains recoverable. This assessment includes consideration for the minimum recoverable log length of 2.5 metres and determining whether the remaining portions are large enough to yield lumber (e.g., 2x4s) with trim allowance. The latter is of particular significance for small diameters.

QUESTIONS? COMMENTS? SUGGESTIONS FOR FUTURE BULLETIN TOPICS? YOUR FEEDBACK IS WELCOMED.

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