

# Standard Operating Procedure #6:

## *Field Methods and Data Collection*

Version 2.1 (1/26/2024)

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## **Revision History Log**

| Date                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Previous version | New version | Authors                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------|----------------------------------------|
| 2012                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1.0              | 2.0         | Suzanne Sanders and Jessica Grochowski |
| We no longer monitor shrubs and seedlings in circles at transect endpoints; many browse methods have been modified.                                                                                                                                                                                                                                                                                                                                           |                  |             |                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |             |                                        |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2.0              | 2.1         | Suzanne Sanders and Jessica Kirschbaum |
| Revised to: <ul style="list-style-type: none"><li>• reflect the fact that we now use tablets, rather than paper datasheets, and stand-alone cameras;</li><li>• remove all references to canopy cover estimates, since these are no longer done;</li><li>• detail that we now have 30 circles for assessing direct browse, rather than 68;</li><li>• not note that we collect samples for the herbarium;</li><li>• improve wording and flow of text.</li></ul> |                  |             |                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |             |                                        |

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## 6.0 Introduction

This standard operating procedure defines the criteria for data collection in the field. It is intended to ensure consistency between observers and sampling events. In addition, this SOP clarifies potentially ambiguous scenarios, eliminating uncertainty with measurements and data collection. It is intended to be a reference source, taken into the field and consulted as needed.

## 6.1 Whole Plot Data

**Plot identification** — Record the predetermined plot identifier and date.

**Kotar/NVCS forest type** — Record the forest type using the Kotar Classification system and/or the choices within the National Vegetation Classification System. This is typically done after all groundlayer and overstory data have been collected.

- **Photopoints** — Three photos are taken at each of the six transect endpoints, facing directly into the plot. Therefore, at endpoints 1, 3, and 5, the photos are taken facing due east (90°), while at endpoints 2, 4, and 6, the photos are taken facing due west (270°). Photos are always taken at these bearings, even at active plots where the transect line may not be exactly 90°. These photos are taken with the camera in the tablets.

## 6.2 Tree Data

Trees  $\geq 2.5$  cm (1 in) in diameter are sampled within the belt transects. ‘Tally trees’ are defined as all live and standing dead trees in the transects the first time a plot is established, and all trees that grow into the transects thereafter. Details of measuring standing dead trees are presented below. Trees are considered ‘live’ if they have any living green parts (leaves, buds, cambium) **at or above the point of diameter measurement**. Trees that have been temporarily defoliated are still live. Once tallied, dead trees at least 2.5 cm in diameter are tracked until they no longer qualify as standing dead.

**Working around dead trees is a safety hazard. Crews should exercise extreme caution! Trees that are deemed unsafe to measure should be estimated.**

### 6.2.1 Standing Dead

To qualify as a standing dead tally tree, dead trees must be at least 2.5 cm in diameter at breast height, have a bole with an unbroken height of at least 1.37 m (4.5 ft), and lean less than 45 degrees from vertical as measured from the base of the tree to 1.37 m. See Figures 1–3 for examples. (Note that dead trees equal to or greater than 45 degrees from vertical are counted as coarse woody material. See section 6.3 for details.)

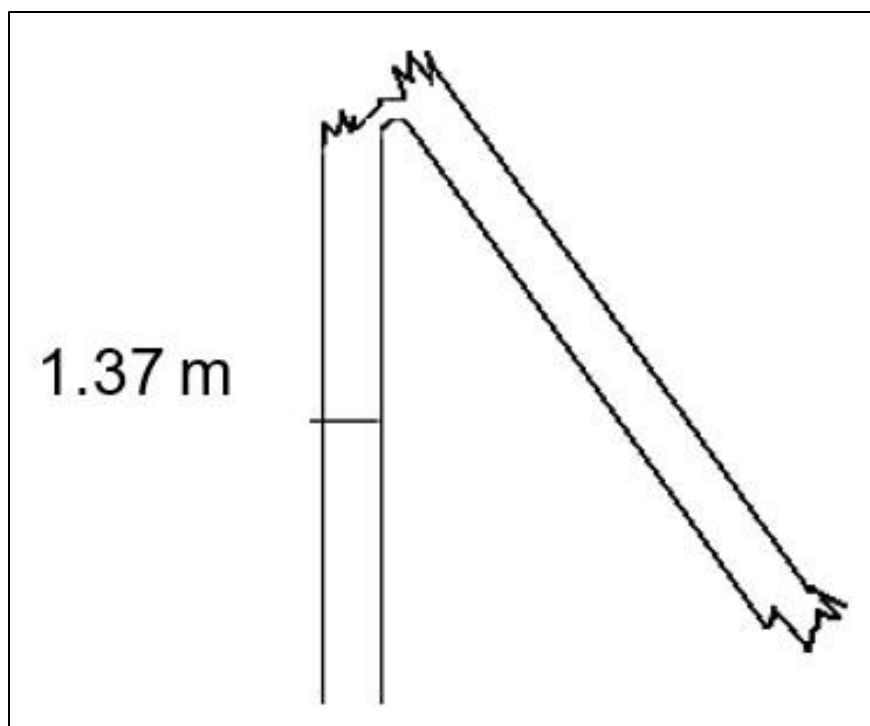


**Figure 1.** This tree would be tallied because it is at least 1.37 m in unbroken actual height and is at least 2.5 cm in diameter at the 1.37 m height.

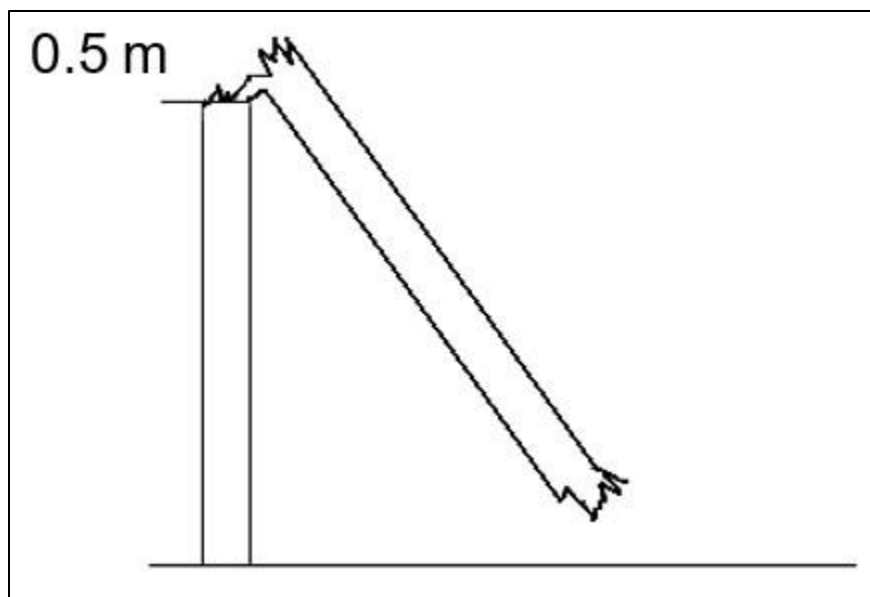


**Figure 2.** This tree would not be tallied because it does not have an unbroken height of 1.37 m.

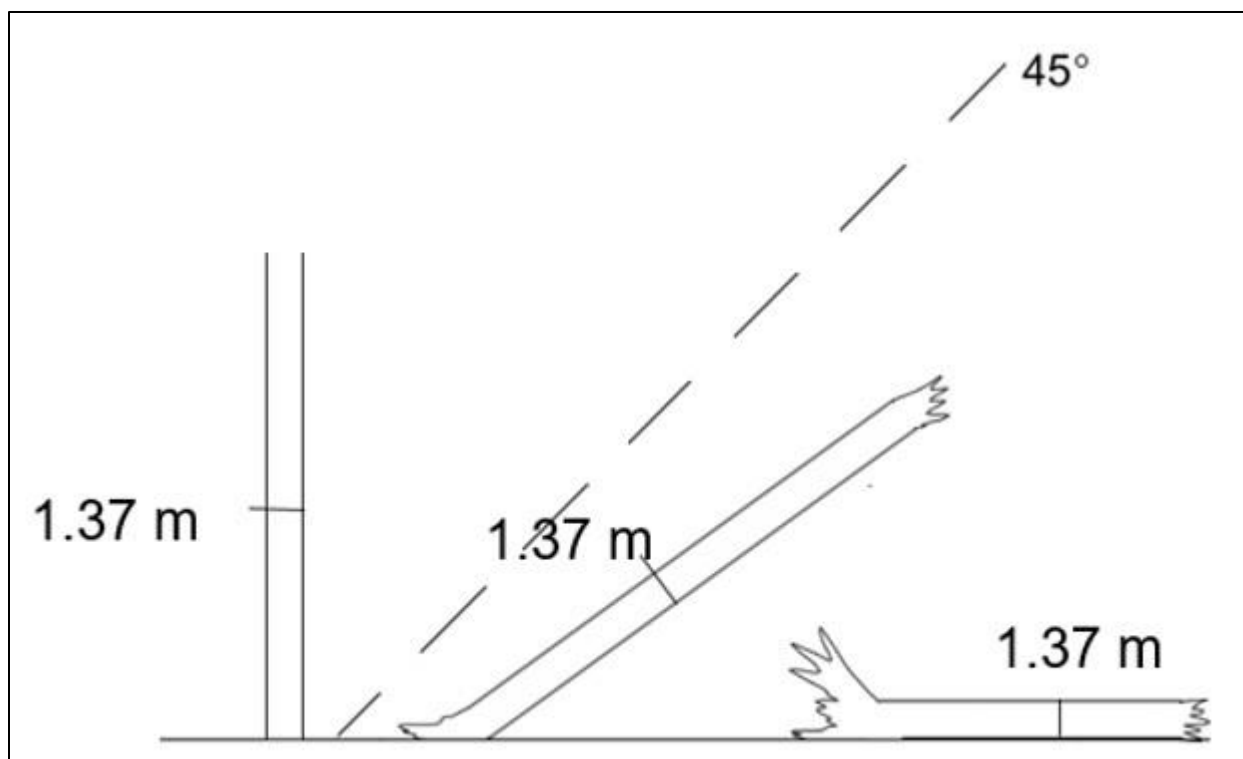


**Figure 3.** Other examples of dead trees. The tree on the left would be tallied since it is at least 2.5 cm in diameter at the 1.37 m height, and it has at least 1.37 m in unbroken actual height. The tree in the middle would not be tallied as standing dead tree since it is leaning at an angle  $\geq 45^\circ$  from vertical. The tree on the right would not be tallied because it is down and dead.

- **Species** — Record the species name of each tree  $\geq 2.5$  cm diameter at breast height (DBH, 1.37 m) in each of the three 6-meter-wide belt transects.
- **Diameter** — Unless one of the following special situations is encountered, measure the diameter at 1.37 m above the ground line on the uphill side of the tree. Make sure that the diameter tape is horizontal to the ground, not slanting downward on the far side of the tree, and that it is pulled tight. Round each measurement down to the nearest tenth of a centimeter. For example, a reading of 12.78 cm is recorded as 12.7 cm. For trees with a DBH smaller than 5 cm, it is more efficient to use the calipers for measurement. When using the calipers, continue to record to the nearest tenth of a centimeter, rounding down when necessary. In many situations, irregularities in the bole (e.g., forking trees, bulges) will impede the circumference measurement. Refer to the special instructions below for taking measurements in these instances.
- **Live/dead** — Record whether the tree is living or dead.
- **Damage** — If any damage is evident, use the diagnostic key for tree pest detection to pinpoint the area and type of damage. Examine the bark as well as any branches, leaves/needles, and buds that are accessible and/or observable from the ground. Table 1 lists

the primary and secondary pest and pathogen signs. Consider the following information about locations affected by damage when collecting damage data:

- Roots — Above ground up to 30 cm on bole.
- Bole — Main stem(s) starting at 30 cm (12 in), including forks up to a 10 cm top. (A fork is at least one-third the diameter of the main stem and occurs at an angle  $<45^\circ$  in relation to the main stem.)
- Branch — All other woody material. Primary branch(es) extend at an angle  $>45^\circ$  in relation to bole.
- Foliage — All leaves, buds, and shoots.

**Table 1.** Primary and secondary pest and pathogen signs to look for using the diagnostic key. Shortcut notation is not needed in tablet data collectors but should be used in the event that we need to collect data on paper datasheets.

| Primary Pest/Pathogen Sign | Secondary Pest/Pathogen Sign         | Shortcut                     |
|----------------------------|--------------------------------------|------------------------------|
| Dieback                    | $>10\%$ , but not pervasive          | Die – $>10\%$                |
| Dieback                    | pervasive, throughout the crown      | Die – pervasive              |
| Epicormic sprouts          | on bole ( <b>not root collar</b> )   | Epi sprouts                  |
| Wilted foliage             | partial crown                        | W – partial crown            |
| Wilted foliage             | whole crown                          | W – whole crown              |
| Environmental              | frost cracks                         | Env – frost cracks           |
| Environmental              | lightning strike                     | Env – lightning              |
| Environmental              | hail injury                          | Env – hail                   |
| Environmental              | Sunscald                             | Env – sunscald               |
| Environmental              | broken branches                      | Env – broken branches        |
| Environmental              | Flooding                             | Env – flooding               |
| Environmental              | drought/poor soil                    | Env – drought                |
| Environmental              | cedar bark splitting                 | Env – cedar splitting        |
| Environmental              | Fire                                 | Env – fire                   |
| Environmental              | Other                                | Env – other                  |
| Human-caused Stress        | topping/poor pruning                 | Stress – topping             |
| Human-caused Stress        | poor or restricted planting/mulching | Stress – restricted planting |
| Human-caused Stress        | wounding of woody tissues            | Stress – wounding            |

| <b>Primary Pest/Pathogen Sign</b> | <b>Secondary Pest/Pathogen Sign</b>             | <b>Shortcut</b>              |
|-----------------------------------|-------------------------------------------------|------------------------------|
| Human-caused Stress               | salt/chemicals                                  | Stress – salt                |
| Human-caused Stress               | Other                                           | Stress – other               |
| Defoliation                       | defoliation >10% foliage, but not pervasive     | Def – >10%                   |
| Defoliation                       | defoliation pervasive throughout crown          | Def – pervasive              |
| Defoliation                       | leaf mining, >10% of foliage, but not pervasive | Def – leaf mining >10%       |
| Defoliation                       | leaf mining, pervasive throughout crown         | Def – leaf mining, pervasive |
| Defoliation                       | chewing of the mid-rib only (any level)         | Def – midrib only            |
| Discolored Foliage                | mottling, spots, or blotches                    | DF – mottling/spots          |
| Discolored Foliage                | marginal scorching of leaves                    | DF – marginal scorching      |
| Discolored Foliage                | interveinal scorching of leaves                 | DF – interveinal scorching   |
| Discolored Foliage                | white coating                                   | DF – white coating           |
| Discolored Foliage                | black coating (often sticky)                    | DF – black coating           |
| Discolored Foliage                | complete browning/bronzing of needles           | DF – browning/bronzing       |
| Discolored Foliage                | complete yellowing of leaves or needles         | DF – yellowing               |
| Discolored Foliage                | stippling                                       | DF – stippling               |
| Discolored Foliage                | yellow/orange/white pustules                    | DF – pustules                |
| Abnormal Foliage                  | foliage/twigs distorted or galls                | AF – distorted/galls         |
| Abnormal Foliage                  | witches' brooms                                 | AF – witches' brooms         |
| Insect Signs (foliage & twigs)    | caterpillars/sawflies feeding throughout crown  | ISFT – caterpillars feeding  |
| Insect Signs (foliage & twigs)    | beetles feeding throughout the crown            | ISFT – beetles feeding       |
| Insect Signs (foliage & twigs)    | aphids/white cotton pervasive throughout crown  | ISFT – aphids/white cotton   |
| Insect Signs (foliage & twigs)    | bags pervasive throughout the crown             | ISFT – bags                  |
| Insect Signs (foliage & twigs)    | scales pervasive throughout the crown           | ISFT – scales                |
| Insect Signs (foliage & twigs)    | tents/webbing on more than one branch           | ISFT – tents/webbing         |
| Foliage Affected                  | >10% but less than 30%                          | Fol – >10%                   |
| Foliage Affected                  | >30% but not the whole crown                    | Fol – >30%                   |
| Foliage Affected                  | whole crown                                     | Fol – whole crown            |
| Insect Signs (branches & bole)    | frass only                                      | ISBB – frass                 |

| <b>Primary Pest/Pathogen Sign</b> | <b>Secondary Pest/Pathogen Sign</b>            | <b>Shortcut</b>         |
|-----------------------------------|------------------------------------------------|-------------------------|
| Insect Signs (branches & bole)    | sawdust                                        | ISBB – sawdust          |
| Insect Signs (branches & bole)    | pitch/resin exudation                          | ISBB – pitch/resin      |
| Insect Signs (branches & bole)    | D-shaped exit holes                            | ISBB – D-shaped exit    |
| Insect Signs (branches & bole)    | pencil round or oval exit holes ( $\geq 2$ mm) | ISBB – round/oval exit  |
| Insect Signs (branches & bole)    | shot holes ( $< 2$ mm)                         | ISBB – shot holes       |
| Insect Signs (branches & bole)    | other holes                                    | ISBB – other holes      |
| Insect Presence                   | caterpillars                                   | IP – caterpillars       |
| Insect Presence                   | beetles                                        | IP – beetles            |
| Insect Presence                   | aphids                                         | IP – aphids             |
| Insect Presence                   | scale                                          | IP – scale              |
| Insect Presence                   | carpenter ants                                 | IP – carpenter ants     |
| Disease Signs                     | decay                                          | DS – decay              |
| Disease Signs                     | conks                                          | DS – conks              |
| Disease Signs                     | fleshy mushrooms                               | DS – fleshy mushrooms   |
| Disease Signs                     | cankers                                        | DS – cankers            |
| Disease Signs                     | bleeding/slime flux                            | DS – bleeding           |
| Disease Signs                     | resinosis/gummosis                             | DS – resinosis          |
| Disease Signs                     | woody galls or burls                           | DS – woody galls        |
| Problem Location                  | branches                                       | PL – branches           |
| Problem Location                  | bole and/or root collar                        | PL – bole               |
| Problem Location                  | both branches and bole                         | PL – branches & bole    |
| Loose Bark                        | loose bark only                                | LB – loose bark only    |
| Loose Bark                        | rhizomorphs present                            | LB – rhizomorphs        |
| Loose Bark                        | mycelial fans or pads present                  | LB – mycelial fans/pads |
| Loose Bark                        | insect boring or galleries causing loose bark  | LB – insect boring      |

## 6.2.2. Special DBH Situations

### ***Forked tree***

In order to qualify as a fork, the stem in question must be at least one-third the diameter of the main stem and must branch out from the main stem at an angle of 45 degrees or less. Forks originate at the point on the bole where the piths intersect. Forked trees are handled differently depending on whether the fork originates below 30 cm, between 30 cm and 1.37 m (inclusively), or above 1.37 m.

**Note: Fork does not have to be live to be considered a fork.**

#### Trees forked below 30 cm.

Trees forked in this region are treated as distinctly separate trees (Figure 4). Distances are measured individually to the center of each stem where it splits from the stump (Figure 4). DBH is measured for each stem at 1.37 m above the ground. When stems originate from pith intersections below 30 cm, it is possible for some stems to be within the limiting distance of the belt transect, and others to be beyond the limiting distance. If stems originating from forks that occur below 30 cm fork again between 30 cm and 1.37 m (Figure 7-E), the rules in the next paragraph apply.

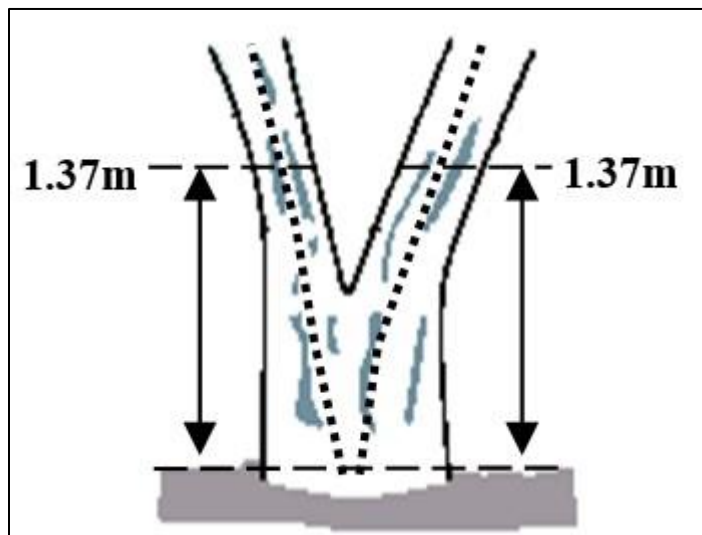


**Figure 4.** Forked below 30 cm.

#### Trees forked between 30 cm and 1.37 m.

Trees forked in this region are also counted as separate trees (Figures 5, 7 D-F). The DBH of each fork is measured at a point 1.07 m (3.5 feet) above the pith intersection. When forks originate from pith intersections between 30 cm and 1.37 m, the limiting distance is the same for all forks—they are either all in or all out—and it is determined by the central stump.

Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure DBH on all stems at 1.07 m above the common pith intersection (Figure 7-F).

Once a stem is tallied as a fork that originated from a pith intersection between 30 cm and 1.37 m, do not recognize any additional forks that may occur on that stem. Measure the diameter of such stems

just below the base of stem separation as shown in Figure 7-E (i.e., do not move the point of diameter the entire 1.07 m above the first fork).

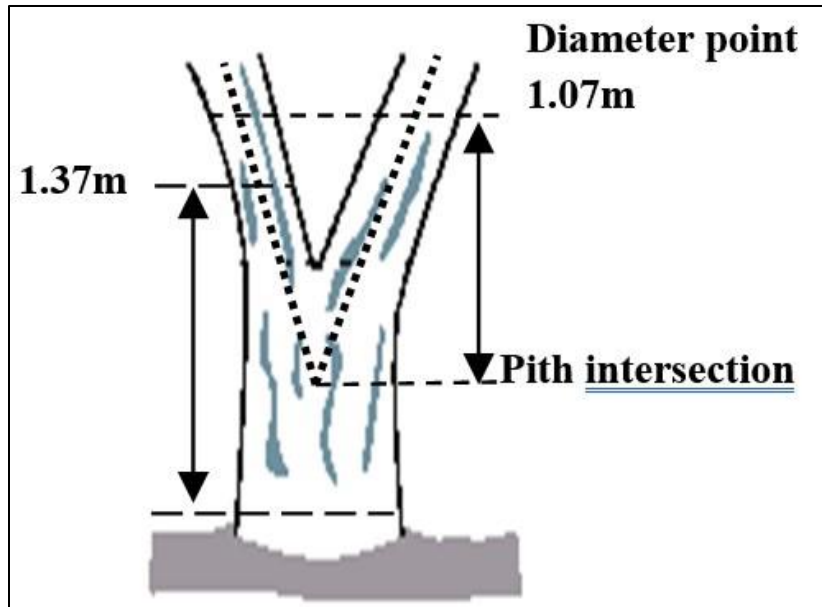


**Figure 5.** Forked between 30 cm and 1.37 m.

Trees forked at or above 1.37 m.

Trees forked in this region are considered to be a single tree (Figure 6). If a fork occurs at or immediately above 1.37 m, measure diameter below the fork just beneath any swelling that would inflate DBH.

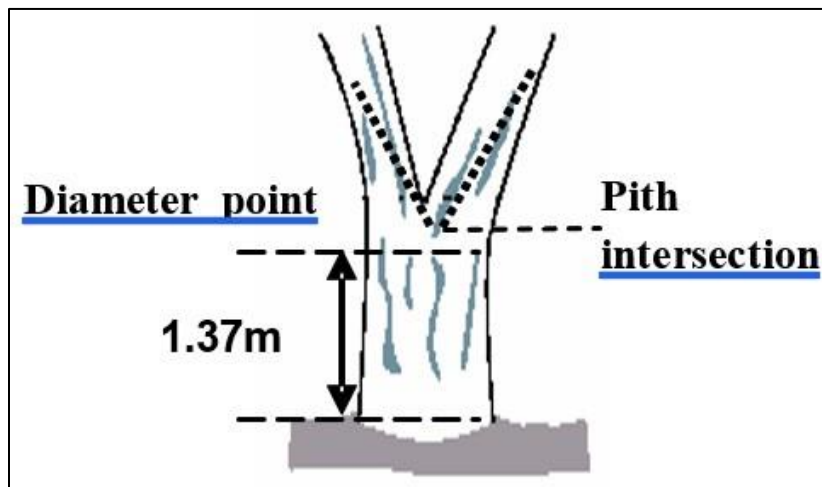


**Figure 6.** One tree.

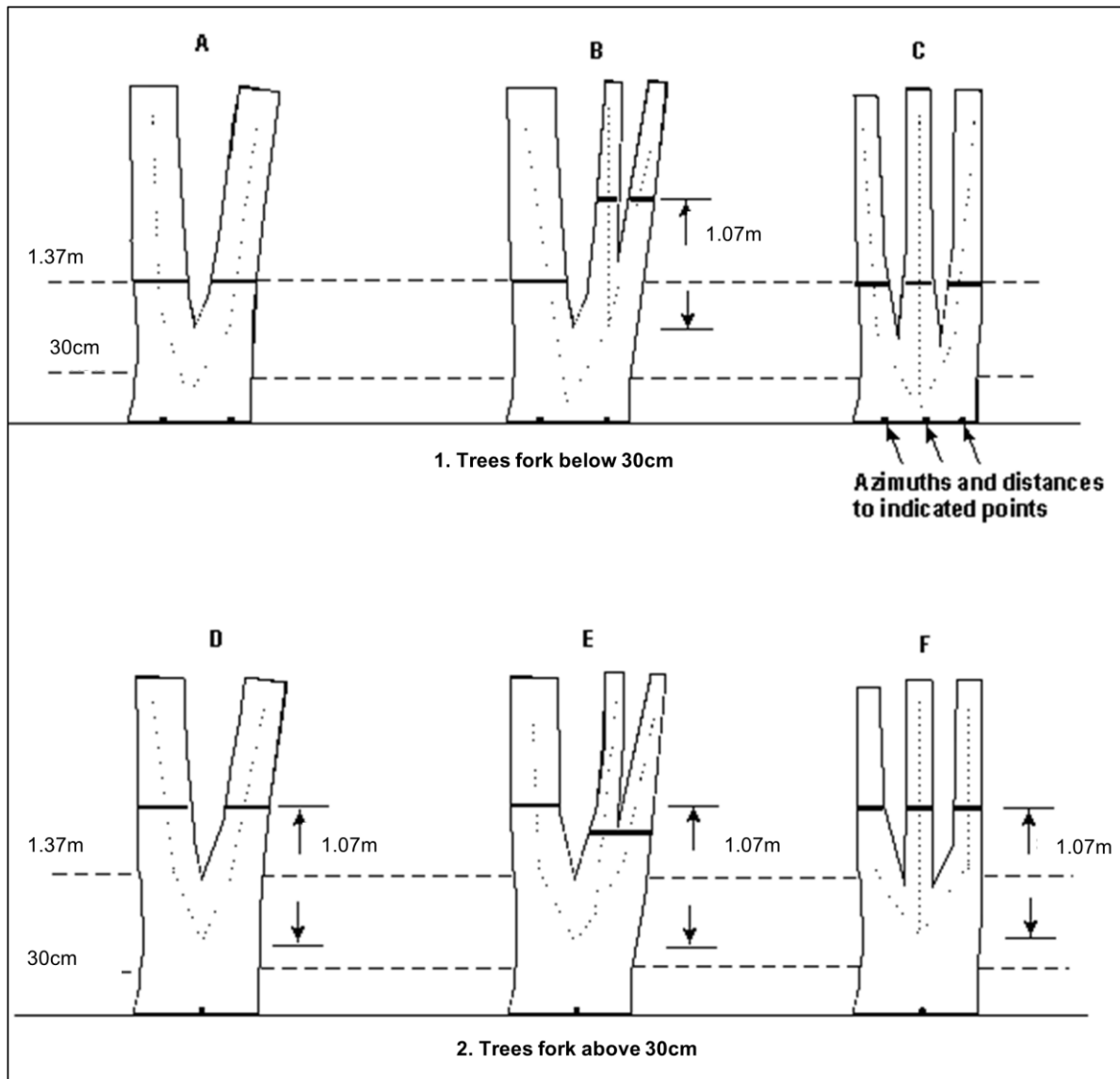


**Figure 7.** Summary of where to measure DBH, distance, and azimuth on forked trees.

### ***Stump sprouts***

Stump sprouts originate between ground level and 1.37 m on the boles of trees that have died or been cut. Stump sprouts are handled the same as forked trees, with the exception that stump sprouts are not required to be one-third the diameter of the dead bole. Stump sprouts originating below 30 cm are measured at 1.37 m from ground line. Stump sprouts originating between 30 cm and 1.37 m are measured at 1.07 m above their point of occurrence. As with forks, rules for measuring distance depend on whether the sprouts originate above or below 30 cm. For multi-stemmed woodland species, treat all new sprouts as part of the same new tree.

### ***Tree with butt-swell or bottleneck***

Measure these trees 46 cm above the end of the swell or bottleneck if the swell or bottleneck extends 91 cm or more above the ground (Figure 8).

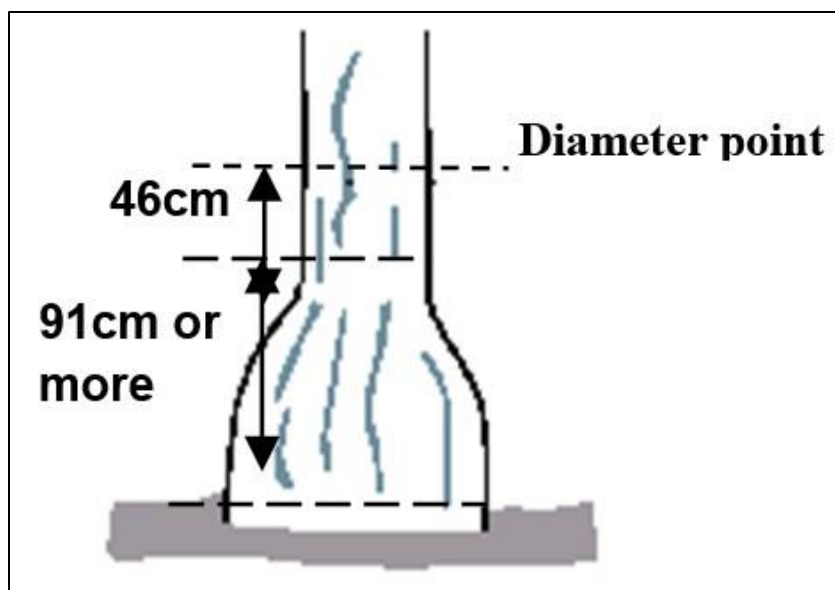


**Figure 8.** Bottleneck tree.

***Tree with irregularities at DBH***

On trees with swellings (Figure 9), bumps, depressions, or branches (Figure 10) at DBH, measure the diameter immediately above the irregularity at the place it ceases to affect normal stem form.

**Note:** If a normal diameter cannot be obtained at or above 1.37 m, it is valid to measure the diameter below 1.37 m.

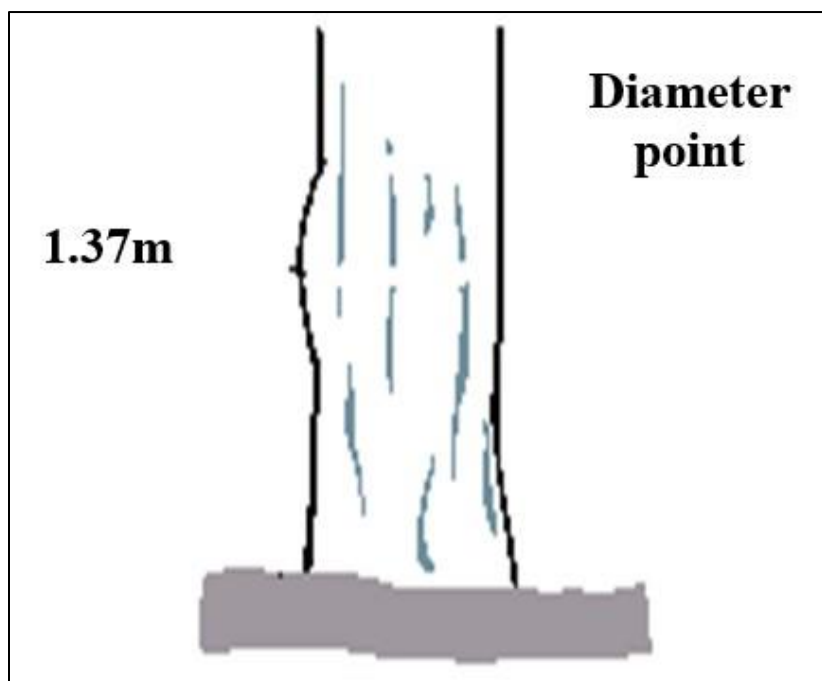


**Figure 9.** Tree with swelling.

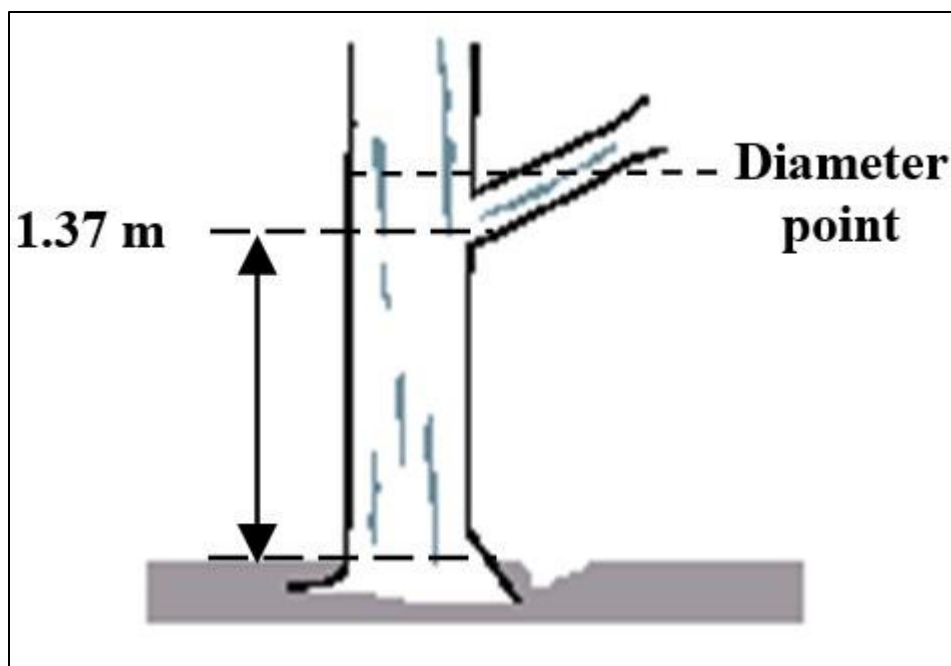


**Figure 10.** Tree with branch.

***Tree on slope***

Measure diameter at 1.37 m from the ground along the bole on the uphill side of the tree (Figure 11).

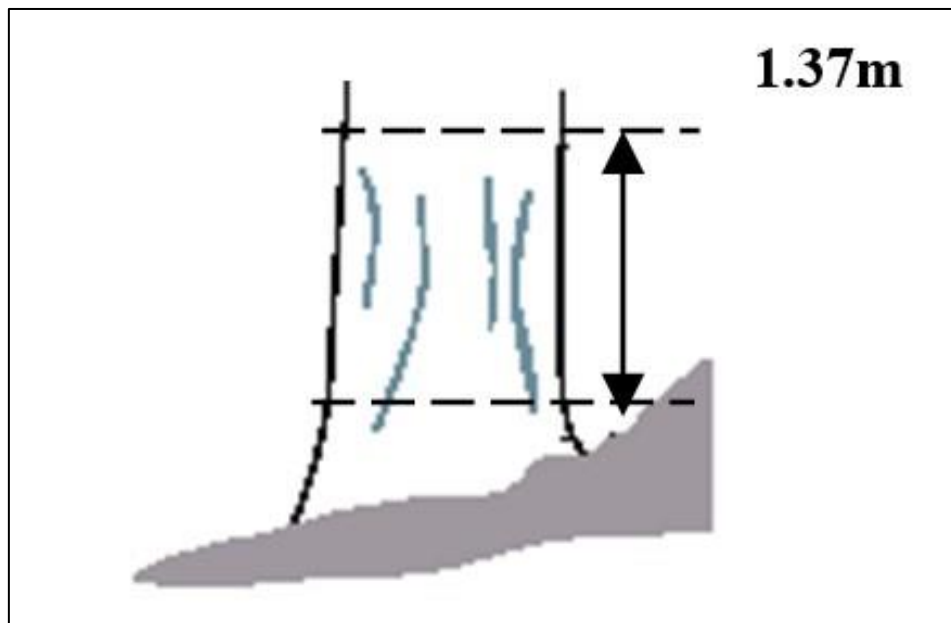


**Figure 11.** Tree on a slope.

***Leaning tree***

Measure diameter at 1.37 m from the ground along the bole. The 1.37-m distance is measured along the underside face of the bole (Figure 12).

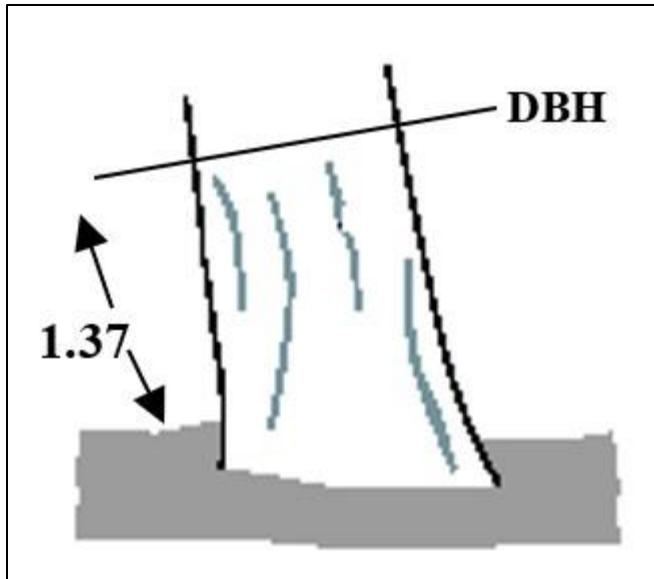


**Figure 12.** Leaning tree.

***Independent trees that grow together***

If two or more independent stems have grown together at or above the point of DBH, continue to treat them as separate trees. Estimate the diameter of each.

***Missing wood or bark***

Do not reconstruct the DBH of a tree that is missing wood or bark at the point of measurement. Record the diameter (to the nearest 0.1 cm) of the wood and bark that is still attached to the tree (Figure 13). If a tree has a localized abnormality (gouge, depression, etc.) at the point of DBH, apply the procedure described for trees with irregularities at DBH (see Figures 9 and 10).

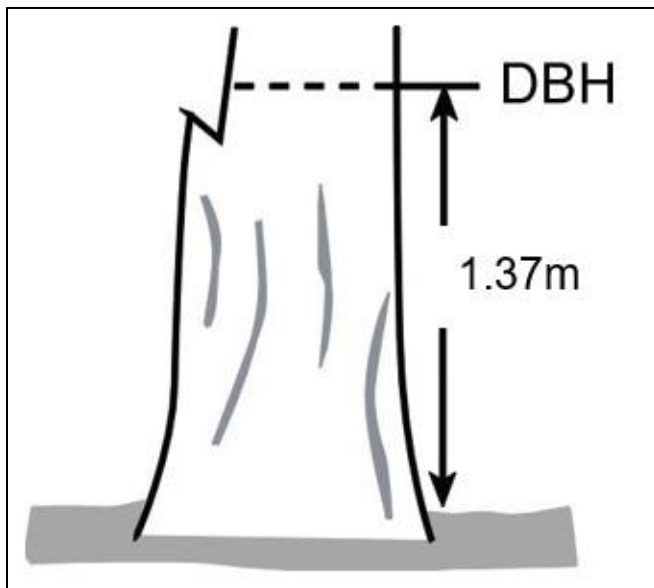


**Figure 13.** Tree with part of stem missing.

### ***Live windthrown tree***

Measure from the top of the root collar along the length to 1.37 m (Figure 14). Note that this only applies to **live, rooted trees**. The angle of the tree from the vertical does not matter as long as the tree is **live**.

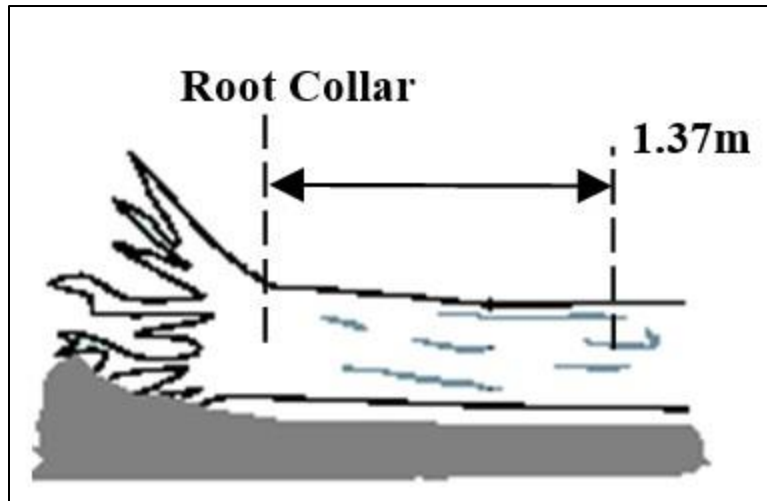


**Figure 14.** Tree on the ground.

### ***Down live tree with tree-form branches growing vertical from main bole***

When a down live tree that is touching the ground has vertical (less than 45 degrees from vertical) tree-like branches coming off the main bole, first determine whether or not the pith of the main (downed) bole is above or below the duff layer.

- If the pith of the main bole is above the duff layer, use the same forking rules specified for a forked tree, and take all measurements accordingly (Figure 15).
- If the pith intersection of the main down bole and vertical tree-like branch occurs below 1.37 m from the stump along the main bole, treat that branch as a separate tree, and measure DBH 1.07 cm above the pith intersection for both the main bole and the tree-like branch (Figure 15).

If the intersection between the main down bole and the tree-like branch occurs beyond the 1.37 m point from the stump along the main bole, treat that branch as part of the main down bole (i.e., do not tally it) (Figure 15).

- If the pith of main tree bole is below the duff layer, ignore the main bole, and treat each tree-like branch as a separate tree; take DBH from the ground, not necessarily from the top of the down bole (Figure 16). However, if the top of the main tree bole curves out of the ground towards a vertical angle, treat that portion of that top as an individual tree originating where the pith leaves the duff layer.

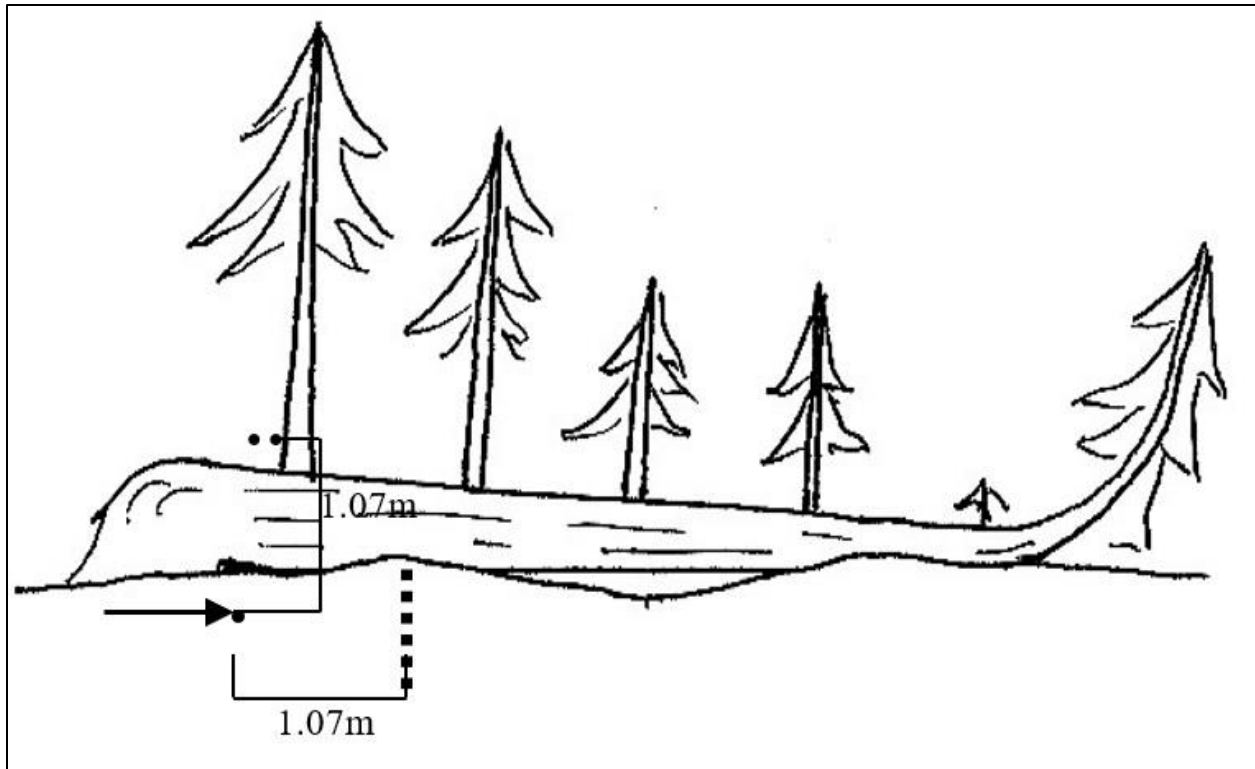


**Figure 15.** Down tree above duff.

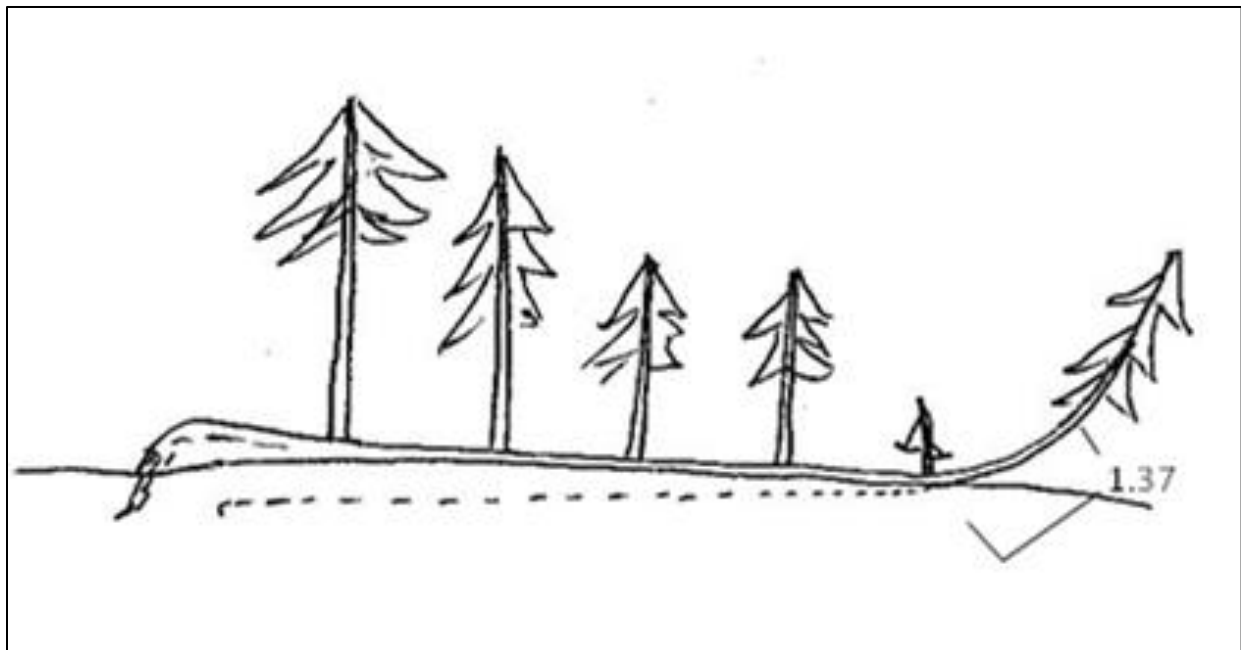


**Figure 16.** Down tree below duff.

***Tree with curved bole (pistol butt tree)***

Measure along the bole on the uphill side (upper surface) of the tree (Figure 17).

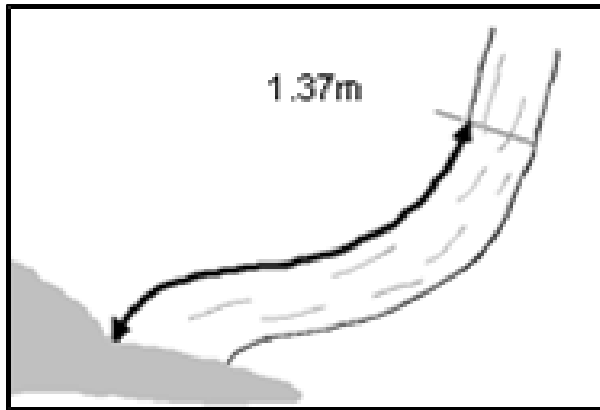


**Figure 17.** Tree with curved bole (pistol butt tree).

Any transect that has no trees is designated as **sampled, no data**. If a transect is not sampled due to time constraints or safety, this is designated as **not sampled**.

## 6.3 Coarse Woody Materials

Data on coarse woody material is collected along each of the three, parallel, 50-m, horizontal distances using the planer intercept method. Tally rules follow below. For all pieces of coarse woody material tallied, the parameters recorded are species, diameter at plane intercept, small end diameter, large end diameter, length, and decay class.

### 6.3.1 Species

Record the six-digit code of each piece of coarse woody material ( $\geq 0.90$  m [3 ft] long and  $\geq 7.5$  cm [3 in] diameter) that crosses the plane of the transect. Because this is a planar transect, the tree is counted whether it is on the ground, or at any height above it.

### 6.3.2 Diameter at Plane Intercept

Record the diameter (in centimeters) at the point of intercept. This diameter is measured perpendicular to the length of the log, regardless of the orientation of the piece to the transect plane. Record the measurement to the tenth of a centimeter, rounding down, rather than to the nearest tenth. For example, a reading of 12.78 cm is recorded as 12.7 cm.

### 6.3.3 Small End Diameter

Record the diameter (in centimeters) at the piece's small end. This diameter will occur either (1) at the actual end of the piece, if the end has a small end diameter of  $\geq 7.5$  cm, or (2) at the point where the piece tapers down to 7.5 cm in diameter. If the end is splintered or decomposing (sloughing off), measure the diameter at the point where it best represents the overall log volume. Record the measurement to the tenth of a centimeter, rounding down, rather than to the nearest tenth.

### 6.3.4 Large End Diameter

Record the diameter (in centimeters) at the piece's large end. The large end will occur either at a broken end, a fracture, or at the root collar. If the end is splintered or decomposing (sloughing off),

measure the diameter at the point where it best represents the overall log volume. Record the measurement to the tenth of a centimeter, rounding down, rather than to the nearest tenth.

### 6.3.5 Length

Record the length of the piece from the piece's recorded diameter at small end to the recorded diameter at large end. For curved logs, measure along the curve. Record the measurement to the tenth of a centimeter, rounding down, rather than to the nearest tenth. For example, a log that is 3.57 meters would be recorded as 3.5 m.

### 6.3.6 Decay Class

Record the decay class of the piece using the rules outlined in Table 2. Because decay conditions may vary along a piece, record the decay class that predominates.

**Table 2.** Distinguishing characteristics of the five decay classes (From Woodall and Williams, 2005).

| Decay class | Structural integrity                                                                                                                                       | Texture of rotten portions                                                               | Color of wood                   | Invading roots | Branches and twigs                                                                           |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|---------------------------------|----------------|----------------------------------------------------------------------------------------------|
| 1           | sound, freshly fallen, intact logs; all bark intact; hard when kicked                                                                                      | intact, no rot; conks of stem decay absent                                               | original color                  | absent         | if branches are present, fine twigs are still attached and have tight bark                   |
| 2           | sound; some bark missing; hard when kicked                                                                                                                 | mostly intact; sapwood partly soft (starting to decay) but can't be pulled apart by hand | original color                  | absent         | if branches are present, many fine twigs are gone and remaining fine twigs have peeling bark |
| 3           | heartwood sound; most of the bark is missing; piece supports its own weight; still hard when kicked                                                        | hard, large pieces; sapwood can be pulled apart by hand or sapwood absent                | reddish brown or original color | sapwood only   | branch stubs will not pull out, and most of the branches <1 inch missing                     |
| 4           | heartwood rotten; piece does not support its own weight, but maintains its shape; sounds hollow when kicked and you can remove wood from outside with boot | soft, small blocky pieces; a metal pin can be pushed into heartwood                      | reddish or light brown          | throughout     | branch stubs pull out                                                                        |
| 5           | none, piece no longer maintains its shape, it spreads out on the ground; easy to kick apart                                                                | soft; powdery when dry                                                                   | red-brown to dark brown         | throughout     | branch stubs and pitch pockets have usually rotted down                                      |

### 6.3.7 Tally Rules for Coarse Woody Material Sampling

1. Tally dead and down trees whose central longitudinal axes intersect the transect plane (Figure 18). This includes all *unrooted* dead trees and their branches regardless of the angle at which they are leaning away from vertical. Some parameters may have to be estimated, depending whether part or all of the piece is elevated.

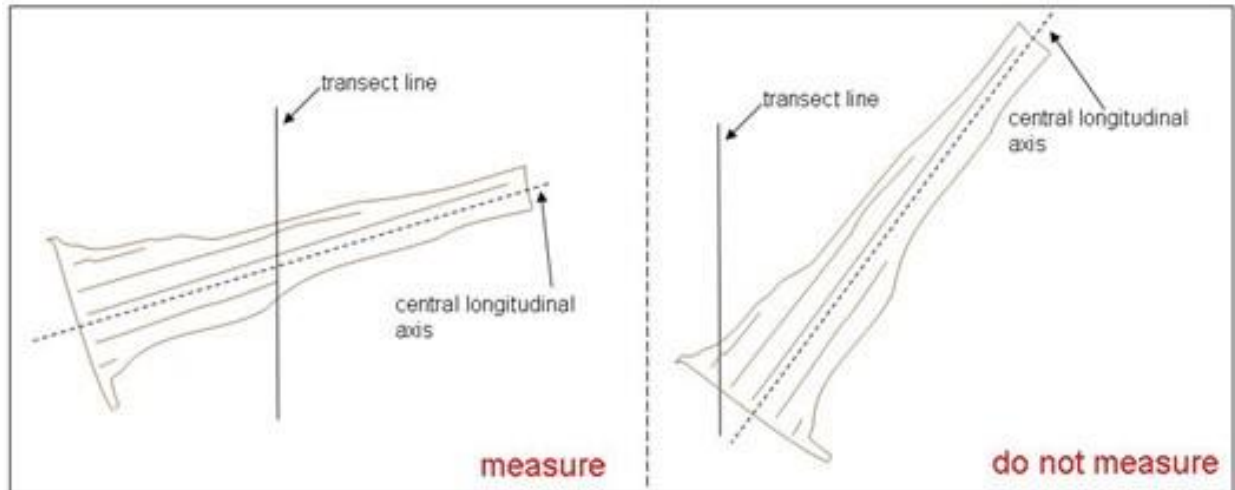


**Figure 18.** Do not tally any CWM piece whose central longitudinal axis does not cross the transect plane.

2. Tally dead trees and stumps that are leaning  $\geq 45^\circ$  from vertical. (Do not tally live trees or standing dead trees and stumps that are still upright and leaning  $< 45^\circ$  from vertical. See section “Tree Data” above.)
3. The minimum length of any tally piece is 0.90 m (3 ft) for decay classes 1 through 4.
4. The decay class of the piece determines whether or not the piece is tallied.
  - a. For decay classes 1 to 4: tally a piece if it is  $\geq 7.5$  cm in diameter at the point of intersection with the transect plane. The piece must also be  $\geq 0.90$  m (3 ft) in length and  $\geq 7.5$  cm (3 in) in diameter along that length.
  - b. For decay class 5: tally a piece if it is  $\geq 12.7$  cm in diameter at the point of intersection with the transect. The piece must also be  $\geq 1.5$  m (5 ft) in length and  $\geq 12.7$  cm in diameter along that length. Only pieces that still have some shape and log form are tallied – humps of decomposed wood that are becoming part of the duff layer are not tallied.
5. Tally pieces created by natural causes or by human activities such as cutting only if not systematically machine-piled.
6. Tally a piece only if the point of intersection occurs above the ground. If one end of a piece is buried in the litter, duff, or mineral soil, the piece ends at the point where it is no longer visible. Measure the diameter and length at this point.
7. If the central longitudinal axis of a piece is intersected more than once on a transect plane, tally the piece each time it is intersected. This is an uncommon situation. (Figure 19).

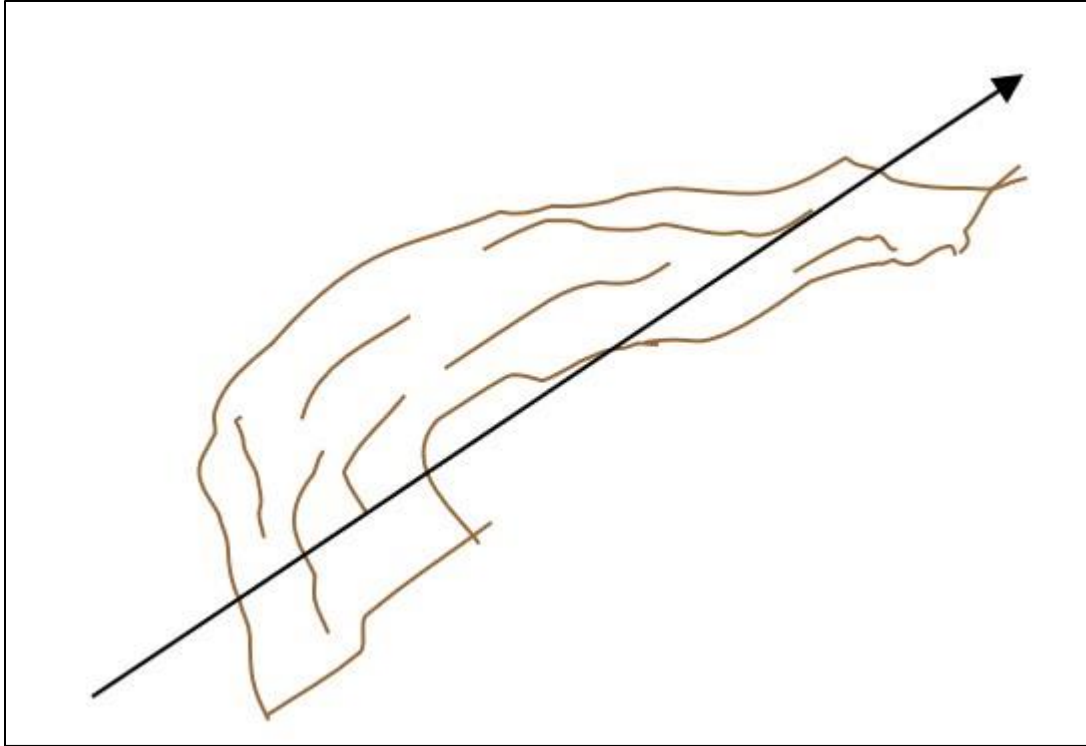


**Figure 19.** If the central longitudinal axis crosses a transect twice, then tally the piece twice.

8. If a piece is fractured across its diameter or length, and would pull apart at the fracture if pulled from either end or sides, treat it as two separate pieces. Tally only the piece intersected by the transect plane. If judged that it would not pull apart, tally as one piece.
9. Do not tally a piece if it intersects the transect plane on the root side of the root collar (see right side of Figure 18). Do not tally roots.
10. When the transect crosses a down tree bole that is forked, or a large branch connected to a down tree, tally each qualifying piece separately (Figure 20). To be tallied, each individual piece must meet the minimum diameter and length requirements.
11. In the case of forked trees, consider the 'main bole' to be the piece with the largest diameter at the fork. Variables for this fork, such as 'decay class' and 'total length' should pertain to the entire main bole. For smaller forks or branches connected to the main bole (even if the main bole is not a tally piece), variables pertain only to that portion of the piece up to the point where it attaches to the main bole (Figure 20).

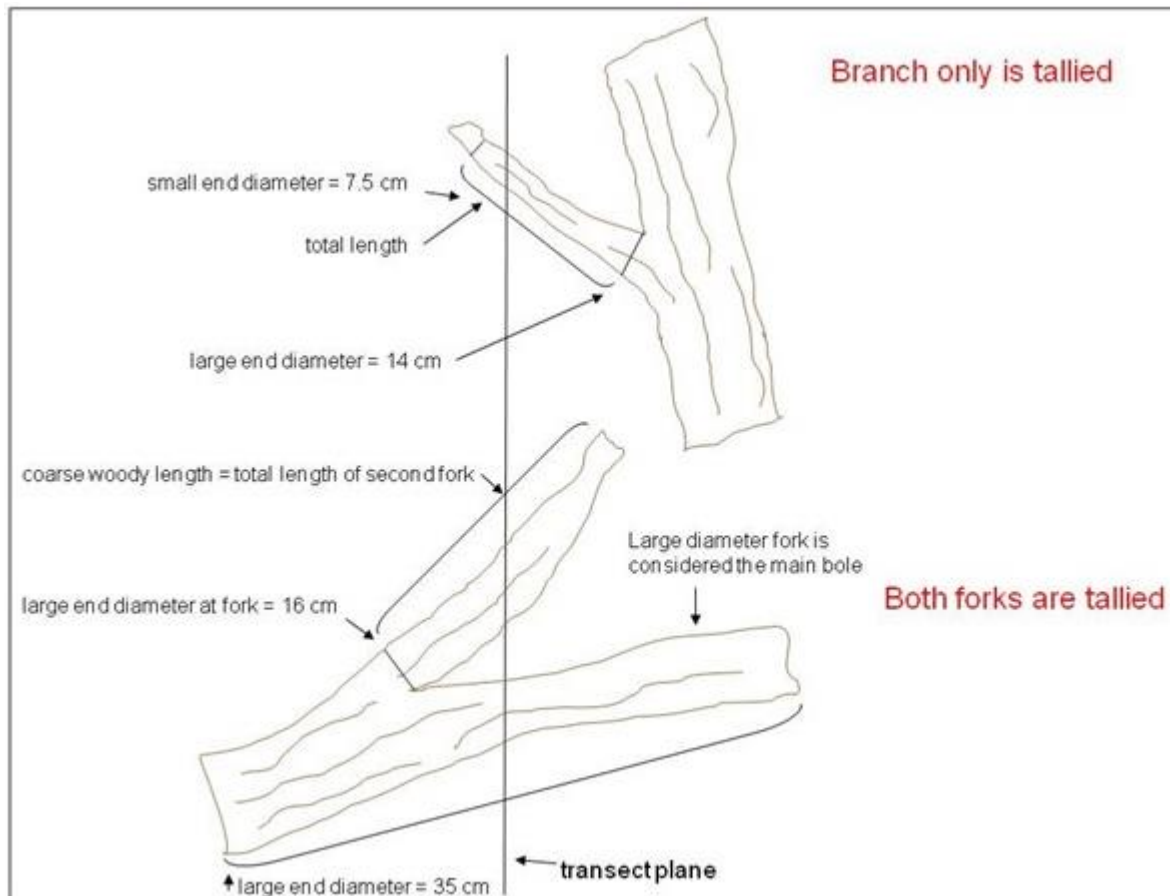


**Figure 20.** CWM tally rules for forked trees.

Any transect that has no CWM is designated with **sampled, no data**. If a transect was not sampled due to time constraints or safety, this is recorded as **not sampled**.

## 6.4 Groundlayer

Herbs, tree seedlings, shrubs, and indirect browse are all assessed in the thirty  $1\text{ m} \times 1\text{ m}$  groundlayer quadrats. For herbaceous plants and shrubs, record each species that is rooted in each groundlayer quadrat. Do not count these or estimate coverage.

Record the species of qualifying tree seedlings in each  $1\text{ m} \times 1\text{ m}$  groundlayer quadrat. Qualifying tree seedlings must be at least 15 cm tall and exhibit signs of second-year growth, such as bud scars. Seedlings must also be <2.5 cm diameter at breast height. In addition, record the count of each species present. For stem sprouts, if you can clearly see that the sprouts are growing from the trunk of a tree, do not count them. If there are numerous seedlings at the base of a tree, but they are growing from the ground, they are counted. In the case of *Thuja occidentalis*, which roots and produces ramets from downed trees, count the number of ramets rooted within the groundlayer quad only if the pith of the downed tree bole from which they are growing lies below the duff layer. Make sure that only those shoots that meet the qualifying tree seedling criteria (above) are tallied.

If there are no plants in a quadrat, the quadrat is considered sampled, but with no data. A quadrat landing on a dirt trail with no living plants is considered sampled with no data because there is potential for vegetation to grow there. A quadrat comprised of mud, a pile of coarse woody debris, or a large tree trunk with no visible vegetation growing should also be recorded as sampled, no data.

If a quadrat is not sampled, for example if the transect is cut short due to a cliff or if one quadrat is skipped due to a ground hive, record this as being not sampled. A quadrat landing completely on a mowed or paved area (including gravel or hard-packed dirt) should be recorded as not sampled, as the vegetation is continually altered or is unable to grow, respectively. Any quadrat with water deep enough that you cannot tell if vegetation is growing or not should be recorded as not sampled.

## **6.5 All Species Search**

Prior to completing the plot, perform a 30-minute time-delimited search of the entire plot (50 meters × 100 meters) to determine the complete list of species that are present. Any species that have already been accounted for in the groundlayer or tree sampling are not recorded again. Record each species only once.

## **6.6 Browse**

### **6.6.1 Indirect Browse**

Indirect browse measures are made in each of the 30 groundlayer quadrats. For each park, three pre-identified herbaceous species are examined in each quadrat. For each of the three target species, record the maximum height to the nearest half centimeter, and note whether or not any individuals of the given species are reproductive or show evidence of browse. It is not uncommon for a plant to be browsed early in the season so that only a few centimeters of the stem remain, but then produce another fully developed stem. Where this occurs, if the connection is at or above ground level and is clearly discernible, the individual is considered to be browsed. When measuring the maximum height, do not lift or extend any part of the plant. Instead, measure the maximum height of the natural stature of the plant (Figure 21a). If the plant is growing on unlevel ground, measure the distance to the ground immediately below the highest part of the plant (Figure 21b). If the plant is growing on a structure that is off the ground, like a tip-up mound, measure the height from the highest part of the plant to where it is rooted.

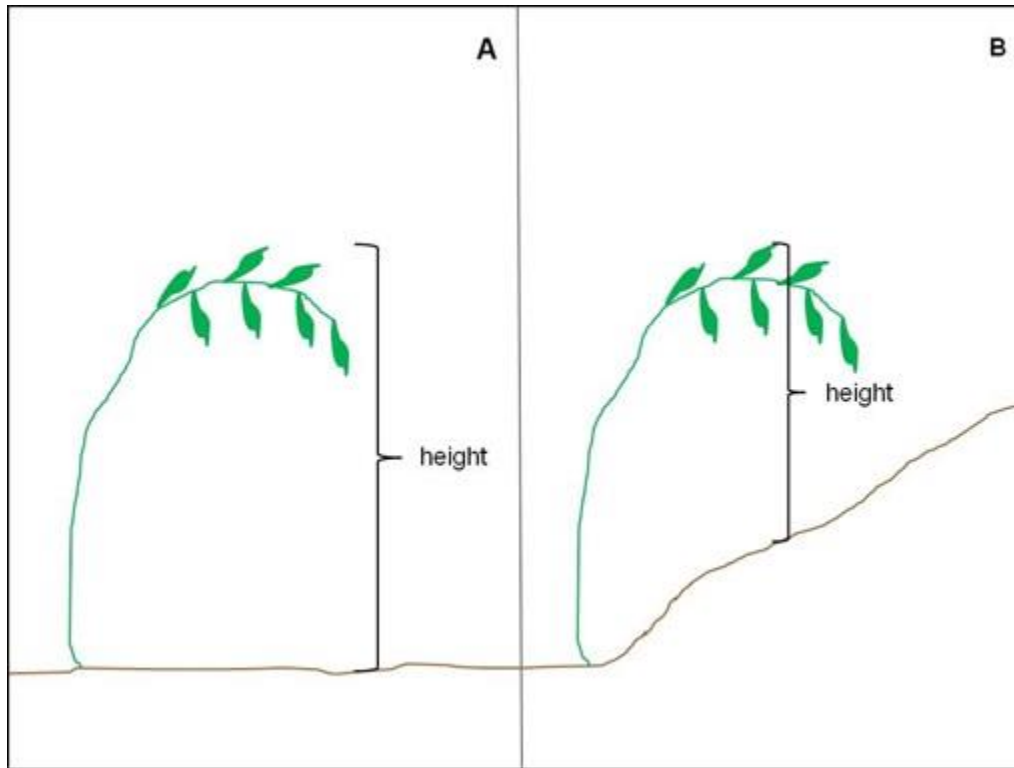


**Figure 21.** Locations for measuring height of indirect browse herbs.

The predetermined species are chosen based on a number of criteria including abundance of each potential species at a given park, known browse species preferences at the park, and height of potential species (white-tailed deer in the region generally exhibit a lower preference for smaller species, such as *Maianthemum canadense* (Kirschbaum and Sanders, personal observation)). Potential species include, but are not limited to, *Streptopus* spp., *Actaea* spp., and *Aralia nudicaulis*. Note that all of these species are above-ground throughout the growing season. At Isle Royale, where moose are present, but not deer, indirect browse taxa are *Aralia nudicaulis*, *Streptopus* spp., and *Trillium grandiflorum*.

### 6.6.2 Direct Browse

Direct browse is measured every five meters along each of the three 50-meter transects. Direct browse measurements are done in a 3.14-m<sup>2</sup> circular sampling area (with a radius of 1.0 m) (Figure 22). At ISRO, the direct browse measurements are done in a 2-m<sup>2</sup> sampling area (with a radius of 0.8 m).

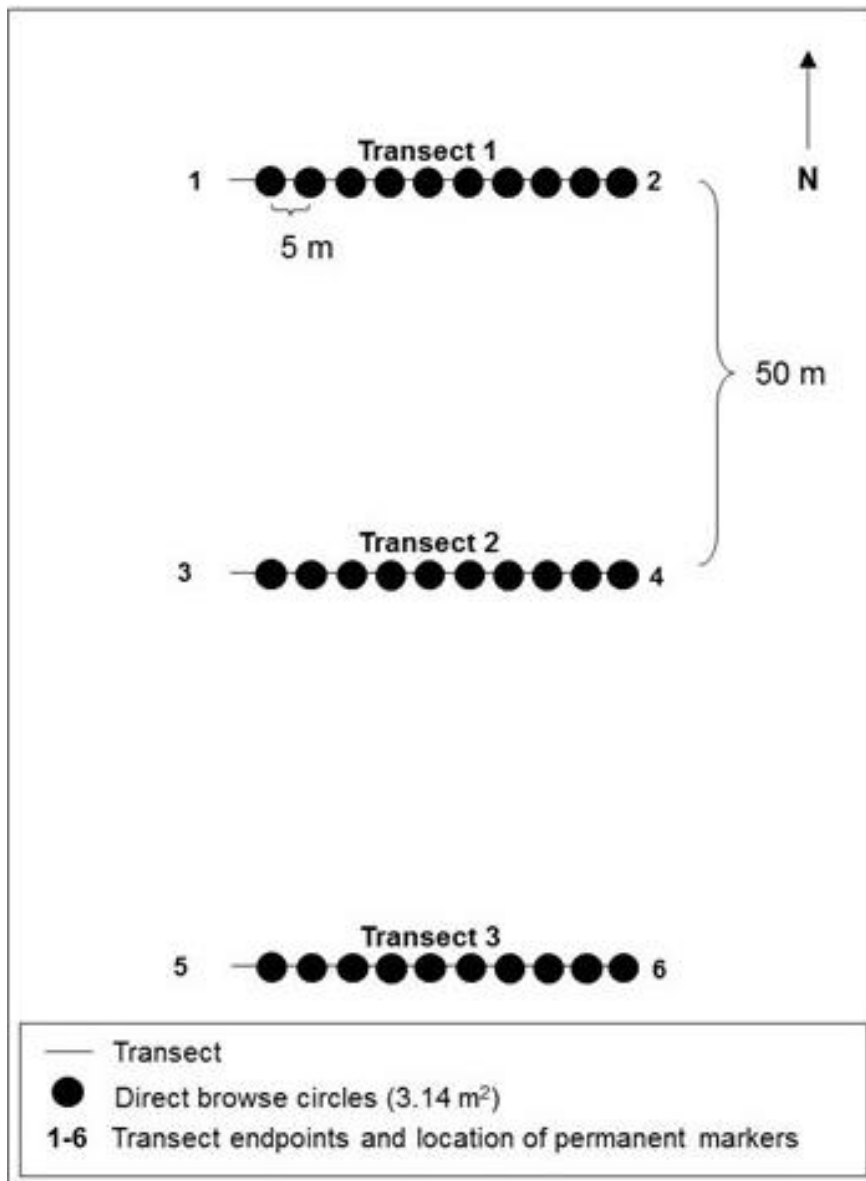


**Figure 22.** Direct browse sampling circles in plot.

These browse sampling circles are centered every 5 meters along each transect, starting at the 5-meter mark, for a total of 10 circles along each transect. For each direct browse sampling circle, all woody species present from ground level (shrub species only) up to the top of the browse zone (defined as 1.8 m in height [3.0 m at ISRO]) are recorded. For tree species in the browse circles, seedlings need to be at least 15 cm high and show signs of second-year growth to be counted as present in the circle. The upper limit of the browse zone remains the same. In addition to species presence, evidence of any ungulate browse on that species in the sampling circle is recorded. Only evidence of the current year's browse is recorded. Note that for both presence and browse, it does not matter whether a tree or shrub is rooted within the cylinder; presence and browse are recorded if any part of a tree or shrub is within the cylinder and if any part within the cylinder is browsed. For example, browse is noted on a tree rooted outside of the cylinder that has branches extending into the

cylinder, where it is browsed. In contrast, a tree that is rooted within the cylinder but that is browsed outside of the cylinder is not marked as being browsed.

It is possible there will be no shrubs or saplings within the sampling circle; in these instances, no direct browse is assessed for those sampling circles. These browse circles are considered sampled, but with no data, and should be recorded as such.

If a browse circle is not sampled, for example if the transect is cut short due to a cliff or if one quadrat is skipped due to a ground hive or deep standing water, indicate this in the tablet as not sampled.

## **6.7 Acknowledgments**

We are indebted to the U.S. Forest Service, North Central Region both for providing text files of the FIA field guide and allowing us to incorporate it into the GLKN field guide.

## **6.8 Literature Cited**

- DNR (Minnesota DNR). 2007. A Handbook for Collecting Vegetation Plot Data in Minnesota: The Relevé Method. Minnesota Department of Natural Resources, St. Paul, Minnesota.
- Woodall, C., and M. Williams. 2005. Sampling protocol, estimation, and analysis procedures for the down woody materials indicator of the FIA program. General Technical Report NC-256. U.S. Department of Agriculture, Forest Service, North Central Research Station, St. Paul, Minnesota.