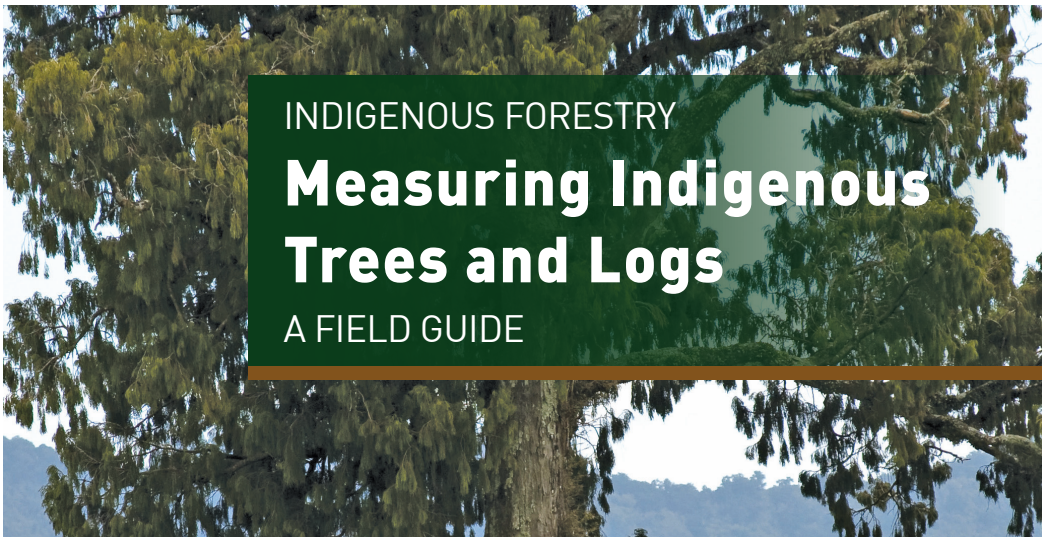
Te Uru Rākau New Zealand Forest Service



INDIGENOUS FORESTRY

Measuring Indigenous Trees and Logs

A FIELD GUIDE

New Zealand Government

July 2018

INTRODUCTION

This field guide has been prepared for those engaged in measuring indigenous trees and logs. It is the basis for the measurement of the timber contained in standing trees and logs for the purpose of implementing Part 3A, Forests Act 1949 and reflects the Te Uru Rākau – New Zealand Forest Service operating procedures and long standing industry practice. It is not an instruction manual for the operation of specialist forestry instruments.

EQUIPMENT

- electronic or other instrument for measuring height (e.g. Vertex or Suunto clinometer);
- Forestry Diameter Tape graduated in centimetres (cm), and tenths;
- distance tape, 20 or 30 metres (m) long graduated in m and cm;
- notebook and pencil.

TABLES, EQUATIONS & FORMULAE

- *Tree Volume Equations (and tables) for the Major Indigenous Species in New Zealand* (Ellis J C 1979). Referred to in this guide as the Ellis Tables;
- *Indigenous Timber Table of Metric Cylinder Volumes.* Ministry of Agriculture and Forestry, reprinted 2007;
- Huber's formula (refer Definitions & Section 2);
- Smalian's formula (refer Definitions & Section 2).

TREE/LOG IDENTIFICATION AND RECORDS

ALL measurements taken in accordance with this guide should be **RECORDED** in a field book or on record sheets.

DEFINITIONS

Bole The main stem or trunk of a tree extending from the ground to the point of branching such that timber beyond this branching point is not capable of being milled.

Branch Stub A point on the bole where through breakage or decay all that remains of a branch may be a short stub. Branch stubs can become a point of entry to the bole for insect or fungal attack, resulting in development of decay in the tree.

Buttswell An abnormal swelling of the base of the tree.

Catface A defect on the surface of a tree or log generally elliptical in shape, resulting from a wound where healing has not re-established the normal cross section. Seeping of resin from the point of damage may occur and an area of rot may develop.

Centre Girth The circumference at the point midway between the two ends of a log. Using a forestry diameter tape allows centre girth to be read off one side of the tape by passing the tape around the log's circumference and its diameter (centre girth diameter), to be read off the other side of the tape.

DBH Diameter at breast height (1.4 metres above ground on the uphill side of the tree).

Flange (or buttress). A ridge of timber generally parallel to the main axis of the bole, projecting outside the normal circumference of the bole. Usually confined to the base of the tree.

Fluting Depressions or grooves generally parallel to the main axis of the bole, projecting inside the normal circumference of the bole.

Huber's formula Used to calculate log volume from measurements of centre girth diameter and length (refer Section 2).

LED & SED Large end diameter and small end diameter respectively.

Multi leader Some trees fork into two or more leaders, that may be of similar size. This may occur close to the ground or higher up the tree.

Smalian's Used to calculate log volume from measurements of LED, SED formula and length (refer Section 2).

Toplog A large branch beyond the upper limit of the bole, of millable form and size. It can also include a portion of the stem above an irregularity such that the length occurring above this is millable yet is of a form that would not be consistent with its inclusion as a continuation of the bole and therefore requires separate assessment for accurate volume estimation (refer minimum inside bark log specifications in Section 2).

SECTION 1: standing tree measurement

Tree volumes are calculated using volume equations or tables derived from measurements of large samples of trees. Commonly diameter (dbh), and bole height are used to calculate standing tree volumes.

DIAMETER

Clear moss and loose bark around the circumference (girth) of the tree at breast height (1.4 metres (m) above ground on the uphill side of the tree).

Measure the diameter at breast height (dbh) at this point to the nearest 0.1 centimetre (cm). Most diameter tapes are graduated to read to 0.1 cm intervals.

If using tree volume tables (e.g. Ellis Tables), in preference to tree volume equations, round the diameter measurement to the nearest 2 cm.

Notes:

Take care to ensure the tape passes under any vines, is at right angles to the axis of the bole of the tree, is tight and not twisted.

Use a forestry tape that is graduated on one side to read off diameter when passed around the bole, and in cm on the other for measuring on a flat surface.

Make sure the correct side of the tape is facing out when passed around the bole so that diameter and NOT girth is measured/recorded.

Measure dbh outside bark. The Ellis Tables use outside bark measurement to give inside bark volumes.

Merchantable diameter for all species – 30 cm dbh and above. On occasion this may be reduced to 20 cm dbh (e.g. some beech forests).

DIAMETER DEDUCTIONS

The **ONLY** deductions made from the measured diameter are for fluting, flanging and buttswell.

1. In the case of **buttswell** extending beyond 1.4 m up the bole: **Measure** the "dbh" directly above the swelling.

2. In the case of **flanging** extending beyond 1.4 m up the bole: Measure the dbh over the flanging. **Measure** the average depth of the flanging.
If flanging occurs around the bole deduct 2 x the average depth of flanging from the measured dbh.
If it only occurs halfway round the bole deduct the average depth of flanging from the measured dbh.

3. In the case of **fluting**: **Measure** the diameter over the fluting; and 1. If the fluting occurs at various points around the bole and extends vertically to the top of the bole: **Deduct:** 2 x average depth of fluting, from the measured dbh.

2. If the fluting extends all the way round the bole and half way up the bole: **Deduct:** 1/2 x (2 x average depth of fluting), from the measured dbh.

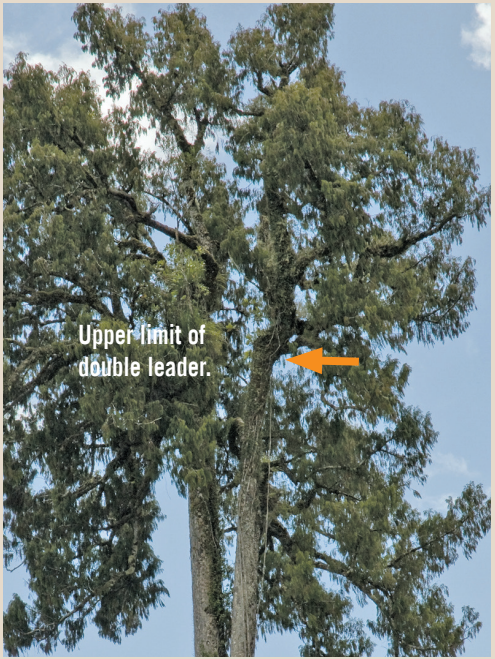
3. If the fluting extends half way round the bole and half way up the bole: **Deduct:** 1/2 x (average depth of fluting), from the measured dbh.

Notes:
Mark the depth of fluting and measure with a straight tape or ruler.
If a diameter tape is used, ensure the correct side of the tape is used.

MEASURING MULTI LEADERS

Where a tree forks below breast height, measure as separate trees. Where it forks above breast height measure as one tree if the leaders are of similar dimensions and form.

Where multi leaders that fork above 1.4 m show marked differences in length, diameter or form (e.g. taper) then measure and record as separate sections using the method for toplogs. Measure in 6 m lengths or less (refer the *Indigenous Timber Table of Metric Cylinder Volumes*, page 3).



HEIGHT MEASUREMENT

Instruments

Electronic devices (e.g. Vertex) are often used to measure height and distance. Properly calibrated at the beginning of each day, they will enable measurement to 0.1 m or less. Other instruments (e.g. clinometers), will enable measurement down to about 0.25 m. Operators should be trained in the use of these instruments where they are engaged in the collection of measurements for inventory purposes or compiling felling lists to accompany Annual Logging Plans. Follow the instructions for use of the specific instrument.

1. Measuring Bole Height Accurately using Instruments

Measure the distance from the base of the tree at the point of contact with the ground, to the point where the bole branches into the crown, or to the point where the bole tapers to 15 cm diameter, whichever comes FIRST (commonly referred to as “merchantable height”).

2. Estimating Bole Height

If a Vertex or clinometer is unavailable (e.g. when preparing a felling list), estimate the height of the bole by using a measured stick, say 2 or 3 m long held up against the tree as a gauge, then later measure the bole accurately once the tree is felled.

Measure and record the merchantable height with a tape once the tree is felled, from the base of the bole and add stump height, to the nearest 0.1 m.

Recalculate the tree volume using this measurement and the original dbh, using the appropriate table or equation for calculating tree volume (e.g. Ellis Tables), to ensure accurate records are maintained. If using the Ellis Tables in preference to tree volume equations, round the height measurement to the nearest 1 m.

NO allowance or substitution is permitted for any breakage occurring or defect identified on felling, respectively.

TOPLOGS

Toplogs are large branches above the upper limit of the bole (or may be leaders of different dimension and form arising from the bole), that are capable of being milled.

Estimate the length and centre girth diameter (diameter midway along the axis of each log). Divide long toplogs into two or more lengths so that each toplog is 6 m or less.

VOLUME DEDUCTIONS FROM STANDING TREES

1. Hollow Butt or Decayed Section of Bole

If a section of the tree is so decayed that it is not "capable of being milled":

Measure the dbh and total bole height inclusive of any decayed section to enable calculation of the total volume of the bole;

Measure and record the centre girth diameter of the decayed section and the length of the decayed section and record the measurements. Estimate centre girth diameter if this is beyond reach.

Make a deduction for bark thickness (the *Indigenous Timber Table of Metric Cylinder Volumes* includes guidelines for bark deductions according to species and diameter class).

Using these measurements, read the volume of the decayed section from the Metric Cylinder Volume Tables or calculate using Huber's formula.

Deduct this volume from the TOTAL Tree Volume obtained from the appropriate Tree Volume Table using dbh and total bole height.

2. Branch Stub, Catface or Other Visible Signs of Decay

If there is a part of the cross section of the standing tree that is defective (e.g. a catface, rot associated with a branch stub, or other visible signs of decay e.g. presence of bracket fungus):

Measure, or if out of reach estimate, the length, width and depth of the "box" that would enclose the defect.

Measure in 0.1 m graduations and deduct volume in cubic decimetres (dm^3), from the total tree volume (there are 1000 dm^3 in 1 m^3).

Example: A defective part of a bole measured as 0.7 m x 1.2 m x 0.1 m

= (7 x 12 x 1 decimetres) = 84 cubic decimetres (0.084 m^3).

Notes:

No deductions are to be made where the milling of the outer slabwood will also remove the defect.

1 m^3 = 1000 dm^3

1 dm^3 = 0.1 m x 0.1 m x 0.1 cm = 0.001 m^3

(Refer *Indigenous Timber Table of Metric Cylinder volumes*)

SECTION 2: measuring logs on the skid or at the mill

The preferred method for calculating log volume is using centre girth diameter and length, in conjunction with the *Indigenous Timber Table of Metric Cylinder Volumes* (based on Huber's formula, see below). Where centre girth diameter cannot be measured for practical and/or safety reasons, use LED and SED and length and calculate log volume using Smalian's formula.

CENTRE GIRTH DIAMETER AND LENGTH

Follow the instructions in the booklet – *Indigenous Timber Table of Metric Cylinder Volumes*.

Measure the centre girth diameter to the nearest 0.1 cm using a tree diameter tape. Where the *Indigenous Timber Table of Metric Cylinder Volumes* is to be used, round the diameter measurement to the nearest 2 cm.

Measure average bark thickness (preferably at two points opposite each other at the ends of the log) and deduct twice the average thickness from the outside bark diameter to give a volume "inside bark" when read off the table of diameter and length.

Alternatively bark deductions may be made using the average thicknesses given for a range of species and size classes on page 4 of the booklet *Indigenous Timber Table of Metric Cylinder Volumes*.

Measure log length to the nearest 0.1 m (10 cm).

Calculate log volume using Huber's formula ($V = 0.07854 \times D^2 \times L$) where V is the volume in cubic decimetres, D is the inside bark centre girth diameter in cm and L is the length in m), or by reading off the appropriate page in the *Indigenous Timber Table of Metric Cylinder Volumes* in dm^3.

Notes:

Centre Girth Diameter is the preferred method of diameter measurement.

To ensure accuracy, it is recommended that long logs are measured as two or more logs, each 6 m long or less.

LARGE END AND SMALL END DIAMETER AND LENGTH

It is preferable that LED and SED are measured by passing a tape around the circumference of the log at each end. There are occasions though where this may not be possible, either because logs are stacked or because the ends are not cylindrical and are better measured in cross section after establishing appropriate points of measurement and marking these on the log end.

1. Using a Diameter Tape Around The Log Circumference

If the tape cannot be passed under the log at mid length:

Measure the LED and SED by passing the tape around the circumference at each end.

Measure the average bark thickness at each end and deduct twice the average bark thickness from the SED and LED respectively.

Calculate the inside bark volume using Smalian's formula:

$V = 0.03927 \times (d^2 + D^2) \times L$ where d is the small end diameter inside bark and D is the large end diameter inside bark.

2. Measuring Cross Sectional Diameter
If the tape cannot be passed around the log at either end measure the cross sectional diameters. These can be measured inside bark.

Mark the points of measurement on the log ends inside bark taking two measurements at right angles and calculate the average diameter. If using a diameter tape as a straight "rule" for measurement check that the correct scale is read off the tape.

Calculate the inside bark volume using Smalian's formula.

DIAMETER DEDUCTIONS

1. Centre Girth Diameter Measurement

If a log has a swelling at the point of centre girth measurement, move the tape to a point just beyond the influence of the swelling.

2. Large and Small End Diameter Measurement

If the log has a major swelling or abnormal shape (e.g. a buttress) at the large or small end):

Mark with crayon the points on the end of the log that clearly indicate the reduced diameter measured i.e. fairly reflects the millable part of the log.

Measure the diameter using these points of measurement by taking the average of two cross-sectional diameters taken at right angles to each other.

There is no requirement for bark deduction where the measurements are taken inside the bark.

3. Fluting and Flanging

Where the log is fluted or flanged, and centre girth diameter is measured, record the gross diameter and then make the deduction for fluting/flanging as previously described for standing trees.

If LED and SED is measured, use a crayon to mark the outer limits of the solid core of wood (excluding the fluting/flanging) and measure the net cross sectional diameters at right angles at each end.

There is no requirement for bark deduction where the measurements are taken inside the bark.

Minimum Inside Bark Log Specifications (including toplogs):

- Length > 2.5 m;
- Minimum Centre Girth diameter – 20 cm;
- Minimum SED – 15 cm;
- Maximum branch number permitted is 2 major branches per 2.5 m length where a major branch has a diameter greater than or equal to 1/3 of the diameter of the log at the point of branching,
- Maximum spiral grain – 1:8 for logs greater than or equal to 30 cm centre girth diameter, 1:12 for logs less than 30 cm diameter;
- Maximum sweep from the centre of the log to the maximum point of sweep – 1/3 centre girth diameter for logs > 30 cm diameter and 1/8 centre girth diameter for logs < 30 cm centre girth diameter.

Guide for maximum volume deduction from any log is:

- Nil for centre girth diameter < 30 cm;
- Volume/3 for centre girth diameter < 60 cm > 30 cm;
- Volume/2 for centre girth diameter > 60 cm.

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