Minimum Standards and Stem Analysis Procedures for Site Index Research

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Preface

The Minimum Standards and Stem Analysis Procedures for Site Index Research were developed in 1995. The Technical Advisory Committee to the Forest Productivity Council (FPC) at that time reviewed and endorsed these procedures and were subsequently adopted by the FPC in 1996. These "revised November 1998" standards now reflect procedural changes that have occurred since that time.

The objective of stem analysis for site index research is to identify sample trees that reflect the productivity of the site and hence are not affected by non-site factors such as suppression or damage from wind, insects, or disease. These trees are sampled to obtain sufficient data to recreate their height growth. Models that predict the height of site trees and/or site index are developed from these data. Only trees that are expressing the potential of the site are suitable for sampling.

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1 Scope

These standards provide the minimum criteria and sampling procedures for collecting stem analysis data for constructing site index, height-age, and growth intercept models. They are intended for use by forestry personnel and agencies that co-operate with the Forest Productivity Council to establish and maintain a database of forest productivity measures for the productive forest lands of British Columbia.

All field measurements must conform to the metric system of measurement. Ages are breast height age and all distance measurements are horizontal.

2 Plot Selection and Measures

2.1 Scope

Section 2 provides the minimum criteria and essential measurements required to describe the stem analysis sample plot.

2.2 Plot establishment criteria

- minimum of 100 plots are required for site index, height-age, and growth intercept models;
- no more than one plot can be established in a stand; unless
- a second plot can be established in the same stand but in a different site series from the first plot;
- plots must be established in areas that do not have tree felling restrictions;
- unless objectives of the project dictate otherwise, sampling should:
  - be uniform across the range of site index (most important); and then
  - be uniform across the biogeoclimatic range.

2.3 Plot selection

Plot selection is done by walking through a stand and selecting a location that is:

- even-aged (ages of the trees in the main canopy are in a 20 year range);
- single-layered;
- moderately dense;
- not the result of partial cutting;
- at least 80 years old but preferably over 100 years old (for site index and height-age model construction); or
- at least 50 years old (for growth intercept model construction);
- ecologically uniform (i.e., is wholly contained in one site series);
- preferably composed of at least 60% (by basal area) of the target species;
- not within 50m of a major disturbance (road, harvested area, etc.);
- not affected by non-site factors that may affect the site index (fertilization, repression, heavy pruning); and
- contains a site (sample) tree.

Note: Stand selection. *Plots can be established in any stand provided the plot selection criteria are met.* T*he following is a guide to finding suitable stands. Stands that are potentially suitable for sampling may be identified from inventory information (PSPs, forest cover maps, etc.), ecological knowledge, local knowledge, other research projects, and any other information that is available. Other potential sites may be identified during plot reconnaissance. Stands that are prime candidates for the establishment of site index plots are:*

- *composed of at least 60% (by basal area) of the target species;*
- *even-aged;*
- *single-layered;*
- *moderately dense;*
- *not the result of partial cutting;*
- *not affected by non-site factors that may affect the site index (e.g., fertilization, repression, heavy pruning); and*
- *at least 80 years old but preferably over 100 years old (for site index and height-age model construction); or at least 50 years old (for growth intercept model construction).*

2.4 Access notes

Routes and distances from an easy-to-find and unlikely-to-change starting point should be described in detail en route to the tie point. Features such as road junctions, creek or river crossings and bridges should be noted.

2 Plot Selection and Measures

2.5 Tie point

A well-marked tie point tree containing the plot identification, bearing and horizontal distance must be established for each plot.

2.6 Tie line flagged

A flagged line must be established and maintained between the tie point and the plot.

2.7 Location

Each established plot must be located and identified on a forest cover map having a scale of 1:<20 000.

The plot location(s) must be recorded in degrees, minutes and seconds of latitude and longitude, or in UTM units to the nearest metre.

A plot location sketch showing the tie point, the plot(s) and other significant topographic features must also be produced.

The type of administrative unit (TFL, TSA, Woodlot, Private, Park, Indian Reserve, etc.) must be recorded for each plot.

2.8 Plot centre and corners

The plot centre of each circular plot, or the four corners of each square or rectangular plot, must be marked. The centre stake of the circular plot must be stem mapped to one tree. Two of the diagonal corners of each square or rectangular plot must be stem mapped to one tree.

2.9 Plot number

Stem analysis plots must receive a plot number that is unique to the project.

2.10 Ecological information

The plot must be classified and recorded to the Biogeoclimatic Ecosystem Classification (BEC) site series level including soil moisture and nutrient regimes. Classification must be conducted by qualified personnel according to Research Branch specifications.

Note: Use of form FS882 is recommended for identification to the site series (see Luttmerding *et al*., 1990).

2.11 Plot size and shape

Plot size

Plots must be 100 square metres in size and chosen to conform with the site tree sampling procedure.

Shape

The plot must be square, circular, or rectangular and must be coded and recorded as per Appendix 1. Rectangular plots must not exceed a length:width ratio of 2:1.

Dimensions

The plot dimensions (e.g., radius, diagonals and length of sides) must be measured and recorded as horizontal distance.

2.12 Plot identification

Each established plot must be identified with a marker containing the plot number.

2.13 Plot site attributes

Slope

The average plot slope must be recorded to the nearest percent.

Slope position

The slope position must be coded and recorded as per Appendix 1.

2 Plot Selection and Measures

Aspect

The plot aspect must be recorded in an azimuth bearing to the nearest 5 degrees. Zero is used to indicate that the plot is flat and 360 degrees indicates a north aspect.

Elevation

The elevation must be recorded to the nearest 50m.

2.14 Measurement date

The date of plot measurement must be recorded.

2.15 Measurement signature

Each field crew chief must sign and date the plot field sheet and, if applicable, the contractor must be noted.

2.16 Stand origin

The primary origin of the stand must be estimated and recorded as per Appendix 1.

3 Tree Measures within the Plot

3.1 Scope

Section 3 describes the measurements and characteristics required to describe and identify trees within the plot.

3.2 Tallying plot trees

All living trees equal to or larger than 2 cm at DBH must be measured.

3.3 Breast height

At plot establishment, breast height must be measured at 1.3 m above the base of the tree on the uphill side. The breast height point of measurement must be adjusted and recorded if it occurs at a branch whorl, swelling or other abnormality.

3.4 Diameter at breast height

Breast height diameters must be measured and recorded to the nearest 0.1 cm.

3.5 Species

Trees must be identified as to species; however, birch and willow may be identified at the genus level.

3.6 Crown class

Each live tree must be assigned a crown class and coded as per Appendix 1.

4 Stem Analysis

4.1 Scope

Section 4.1 describes the measurements and characteristics required to identify and section selected trees within the plot.

4.2. Tree selection for sectioning

One tree within the sample plot is selected according to the following criteria:

- is the largest diameter;
- is dominant or co-dominant;
- is not a wolf, open-grown, or veteran tree;
- has a straight stem that is free of disease, damage, or breakage;
- is free of suppression (above breast height); and
- is vigorous with a full crown.

Increment cores will assist in detecting suppression before the tree is cut down. The cores may also show past abnormal growth, which may be indicative of insect or other damage. Other indicators of a healthy, unsuppressed tree are large branches or branch stubs close to the ground and uniform internode growth.

Samples not meeting the above criteria are abandoned.

4.3 Sample Tree Identification

The sample tree must be clearly marked and a metal identification tag must be affixed to the tree below stump height.

4.4 Exception

If a site tree is felled and damage, suppression, or some other problem is found, it is inefficient to abandon the plot. Therefore, the next largest diameter tree of the target species can be sampled, provided it meets all other criteria for sample trees. If this tree is unsuitable, then the plot must be abandoned. Only one substitute tree is allowed before the plot is abandoned.

4.5 Tree height

The sample tree heights must be recorded before and after felling in case the tip is lost during felling. It is necessary to reconstruct a tree if it breaks.

4.6 Stem sectioning

The tree bole is sectioned as follows:

- stump height (1.0 m below breast height)
- breast height (1.3 m above the base of the tree on the uphill side)
- 19 equally spaced locations between breast height and the tip of the tree.

The sections must be cut thick enough so that they remain intact during handling.

4.7 Stem section records

The sections are clearly labelled with plot number, tree number, and section number, and their heights are recorded.

The ring counting is done:

- under magnification;
- each section is counted twice or until two identical ring counts are obtained; and
- optionally, ring widths can be measured along an average radii.

4.8 Alternatives to sectioning

Two alternatives to stem sectioning that provide better height growth data but are not possible for all species are available. These are:

- split the stem and measure the distance from stump or breast height to the pith nodes revealed by the splitting procedure; or

- identify the annual height growth from branch stubs, using stem analysis and/or splitting to confirm that annual whorls have not been missed.

4.9 Data storage

Data that are acquired through the expenditure of public funds is entered into the Ministry of Forest's stem analysis database administered by the Research Branch. Data contributed by cooperating organizations may be stored in the database but are subject to the data sharing policies as endorsed by the Forest Productivity Council of B.C.

5 References

Luttmerding, H. A., D. A. Demarchi, E., C. Lea, D. V. Meidinger, and T. Vold. (editors). 1990. *Describing Ecosystems in the Field*. 2nd edition. B.C. Min. Environ., Lands and Parks, Victoria, B.C. MOE Manual 1 1.

Appendix I

Standard Symbols and Computer Codes for Site Index Research

Acceptable code		Description
Plot shape (2.11)		
	C	Circular
	R	Rectangular
	S	Square
Slope position (2.13)		
	c	Crest
	u	Upper slope
	m	Middle slope
	l	Lower slope
	t	Toe
	d	Depression
	f	Flat
Stand origin (2.16)		
	C	Coppice
	F	Fill-planted
	G	Genetically improved
	N	Natural
	P	Planted
	R	Residual stand
	S	Seeded
Crown class (3.6)		
	1	Dominant
	2	Codominant
	3	Intermediate
	4	Suppressed
	5	Veteran
	6	Understory