Ministry of Forests, Lands and Natural Resource Operations

Stand Development Monitoring Protocol

Field and Office Procedures for Stand Development Monitoring Surveys

SDM Technical Committee September 11, 2018

Stand Development Monitoring (SDM) 2.0

Background:

Stand Development Monitoring (SDM) 2.0 is a result of a collaborative effort between Forest Analysis and Inventory Branch (FAIB) and the Forest and Range Evaluation Program (FREP). Like FAIB's Young Stand Monitoring (YSM) program, SDM samples mid-rotation stands collecting mensuration and forest health data. The difference is that YSM is designed to monitor change at a given point on the landscape while SDM is designed to capture within stand variability at a given point in time. YSM is designed to provide stratum level averages while SDM is designed to score the performance of individual blocks within a defined post free growing population. The philosophy behind the development of the SDM 2.0 protocol is that performance of a stand is more readily assessed at projected harvest rather than mid-rotation. The protocol was therefore designed so the data collected could be projected by a growth and yield model.

Specifically, the objectives of SDM 2.0 are:

1. to capture the variability in tree size and forest health condition across a mid-rotation stand;
2. for the performance of an individual stand to be assessed at projected harvest;
3. for the population sampled to be scalable from stands of a given leading species, BGC zone, Landscape Unit or watershed up to an entire management unit or Resource District;
4. to collect a statistically robust sample; and
5. once compiled the data collected is compatible with compilations of data from the Young Stand Monitoring program.

It is envisaged the audience for the data and subsequent reports would be:

- Forest Health (FH) specialists wanting to know the types and severity of damage present in post free-growing (FG) stands;

- While it is not a silviculture survey, the data would have utility to Silviculturalists and District staff wanting to know the stand conditions that have resulted from past reforestation practices (as portrayed in FLNRO's Reporting Silviculture Updates and Land Status Tracking System (RESULTS)); and

- FAIB wanting to augment their own data in those management units and strata where YSM sample sizes are small or non-existent.

Defining the population:

The default target population for SDM 2.0 is:

- all harvested stands within a Timber Supply Area (TSA);
- aged 15 to 50 years of age as portrayed in the provincial Vegetation Resources Inventory—the VRI.

Flexibility exists within the protocol for the target population to depart from the default.

Example of a target population for a defined population:

- Pine leading stands,
- 15 to 30 years old,
- with an "Opening_ID",
- outside of parks and ecological reserves,
- on TSA crown land,
- within the ICH BEC zone,
- within the boundary of the XXX TSA.

This approach would address a concern staff may have about the performance of this specific stand type. A sample would be drawn from this population with probability of polygon selection being proportion to polygon area. Plots locations within the selected polygons would be located randomly.

Using the above example, once collected the sample will provide an unbiased estimate of that specific population. It will not give an unbiased estimate of all harvested stands within the TSA, nor all harvested pine stands because they were not the populations identified for sampling.

5-Year Random Sample List:

Districts will be given a list of randomly selected polygons for sampling that will be good for five years. The default 15 to 50 age range will reflect the age of the polygons when the sample list was created. If a stand becomes greater than 50 years of age at time of survey it is still eligible for sampling (e.g.: a polygon was 49 years old when the 5-Year random list was generated but is 52 when surveyed).

The probability that a polygon is sampled is proportional to its size (area).

The number of (nested) plots established per polygon increases with polygon area (see Table 1).

Table 1: Number of sample plot locations by polygon area.

Polygon area(ha)	number of plot locations
< 5	2
5.0-9.9999	3
10.0-19.9999	4
20.0-29.9999	5
30.0+	6

Samples drawn to date have averaged approximately 5 plots per polygon.

UTM coordinates will be provided for the plots specified in a district's 5-year random list.

Figure 1: Random location of 6 – 5.64 m plots within an inventory polygon

Plot configuration:

At each plot location two nested plots are established as per Table 2.

Table 2: Nested Plot overview

Plot Type	Radius(m)	DBH limit(cm)	Measurement/Tally	Forest Health(Yes/No)
Main	5.64	>= 4	Measurement	Yes
Sub	2.5	< 4	Tally	No

The sub-plot is laid out in quadrants—NE,SE,SW,NW—using the cardinal directions to delineate the quadrants. Quadrants have been introduced as a coarse filter to objectively capture within plot variation in tree density. In the main plot within plot variation in tree density is captured explicitly by measuring a bearing and distance to each tree from plot centre.

Office procedures:

The only office procedures required in this protocol are those required to allow the field crews to navigate to the plot locations. To aid field crews in navigating to the plots, the entire population is provided as a shapefile for context along with a point shapefile showing the plot locations. Alternatively this information is provided in a file geodatabase. The plot locations are also provided as an EXCEL file detailing the "sample number" inventory attributes associated with the plot and the easting, northing and UTM zone for the plot.

During the planning phase it is important to assess whether a plot centre is located within 5.64 m of the mapped polygon boundary. If so, record the distance for later use in the field as per Appendix 3.

Field Procedures:

Field Gear Checklist:

Field Gear Checklist

Use the following checklist to ensure all field gear is available.

Item	Got it?
SDM survey field cards (FS1357) or iPad app	
Orthophoto or map with coordinates for 5 random plots (on GPS or iPad)	
Plot cord(s) suitable for 2.5 m and 5.64 m plots, or loggers tape	
DBH measuring tape	
Clinometer (analog or digital, e.g., Vertex) – Vertex preferred (alternate – Nikon Forestry Pro Nikon Forestry Pro at Amazon.ca)	
Small hatchet or field knife	
Small swede saw, or folding saw	
Hand lens (5x or better)	
Pest field identification guide(s)	
SDM 2.0 protocol with appendices	
Pest Management (or other coloured) flagging ribbon	
Flagging ribbon for marking “in trees”	
Increment borer (plus spare)	
Calculator	
Camera	
Personal field and safety gear	

Navigation to the Plot:

The surveyor may use handheld GPS (Garmin or IPAD) to establish SDM plot locations in the field adhering to the following: when arriving at the pre-determined plot location, the surveyor shall stop and wait to get the lowest GPS error distance before finally marking the plot centre.

Null plots and moving plots from roads:

The population being sampled is identified using the inventory. If the plot by chance is located on a non-mapped water feature, rock outcrop or other area devoid of trees the plot is not moved—it is recorded as a null plot. The exception to "not moving plots" is a plot whose centre falls on a road. In this case, while the road is not known to the inventory it is (most likely) recorded in the Provinces spatial road layers. In a TSR context, the roads are either spatially or non-spatially removed from the inventory. The unmapped water features etc. are not. Marking a plot that falls on a road as a "null plot" would result in a double counting of roads in the timber supply analysis. To avoid this double counting the plot is moved in the following manner:

Stand on the road facing the direction that leads back towards town (descending kilometers). Use Form B, Side 1 of Appendix 2 to randomly pick the forest edge on either the right or left side of the road. To do so, close your eyes and stab the page with your finger. If "Left" is written in the cell beneath your finger—proceed left. Next pick a random number between zero and 20 using the listing in Form B, Side 2 of Appendix 2. This distance is the distance in metres that the plot will be relocated from the forest edge. The distance relocated is perpendicular to the forest edge. A random direction and number generator will be included on the electronic field form.

Plots that fall outside the population according to the ground characteristics:

Again the population being sampled is identified using the provincial inventory—that includes all the errors present in the inventory. If a plot is located in a stand that is outside the population of interest—according to its ground characteristics (e.g.: mature timber, a different species, etc.) but is within the population according to the inventory—measure the plot.

Safety:

Assess safety considerations to determine if the plot is safe to establish.

Plot Measurement Procedures

Depending on the sequence of measurements, perform the functions described below.

Record all data on the June 2018 version of the FS 1357 field card (see Appendix 1). Alternatively use the FREP "SDM field form 2" iPad App.

The purpose of this survey is to record the current condition of the treed vegetation—it is not a silviculture survey. Both live and dead (standing/elevated) conifers and deciduous trees will be measured.

Establishing the Plots:

5.64 m plot measurements:

Establish a 5.64 m fixed-radius plot for trees 4.0 cm DBH and larger.
Make sure plot centre is flagged. Mark the flagging ribbon as "SDM" with the date and surveyor's initials.

If your office preparation revealed the plot to be a border plot, measure the distance from plot centre to the "mapped" polygon border and delineate the border with flagging tape.

Proceeding clockwise from cardinal north number all trees 4.0 cm DBH and larger. It is suggested that flagging tape is used for this purpose.

For each numbered tree record the:

- tree number;
- bearing (degrees);
- distance(m);
- species;
- live or dead;
- Count;
- diameter at breast height;
- total height;
- percent live crown; and
- forest health damage agents.

Each attribute is described in the following sections.

<u>Tree number:</u>

Each tree assessed in the 5.64 m radius plot is assigned a unique number. If a tree forks below breast height, each fork is recorded as a separate tree.

Bearing:

A bearing (in degrees) from plot centre to each tree is recorded. The bearing on the tree is measured at breast height.

Distance:

The distance (in metres) from the plot centre to each tree (at breast height) is recorded. If a tree is forked, the distance to each fork is measured.

Species:

Both conifers and deciduous trees are measured provided the species has potential to persist in the upper canopy throughout most of the rotation. Species codes are provided in Appendix 4.

Live or dead:

Both live and dead trees are recorded (coded L or D respectively). Dead trees are recorded only if they remain elevated above the forest floor.

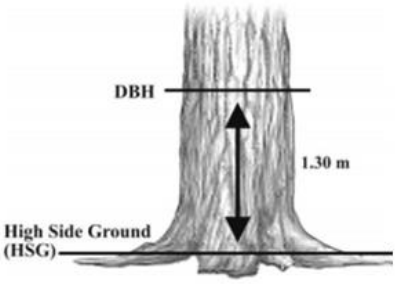
Count:

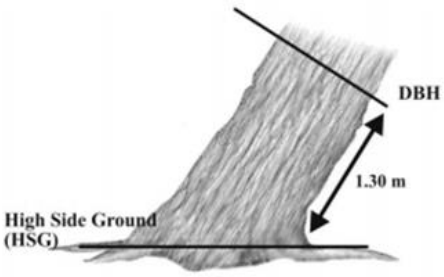
A tree usually has a count of "1" unless it resides within a "walk through" plot. "Walk through" plots are those plots with are located partially under the drip line of a stand of mature timber. The procedure for assessing "walk through" plots is presented in Appendix 3.

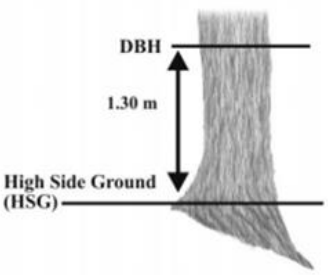
Diameter at breast height:

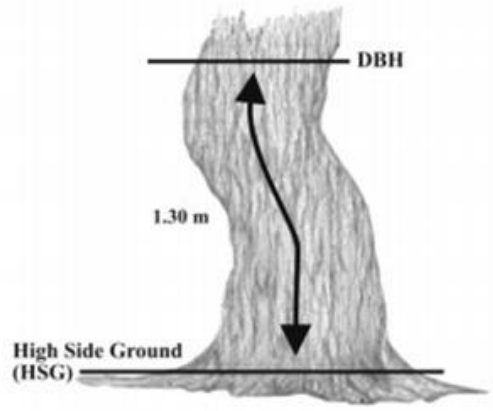
Diameter of the tree is measured at 1.3 m (termed breast height). Diameters are measured for those trees 7.5 cm DBH and greater. Diameters are estimated to the nearest centimeter for those trees between 4 and 7.49 cm.

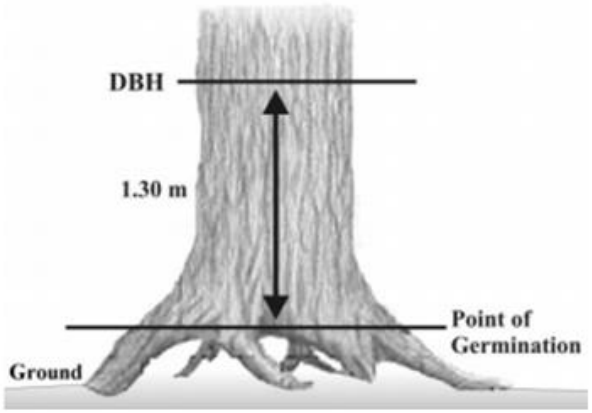
The following diagrams illustrate different situations possibly encountered.

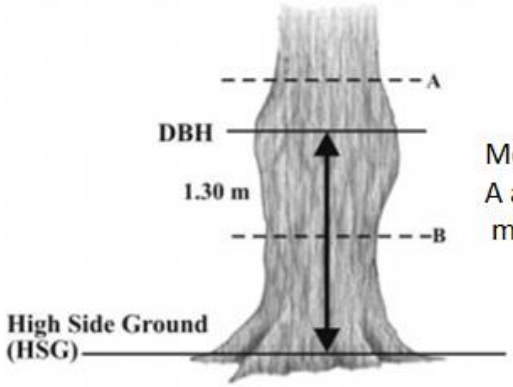




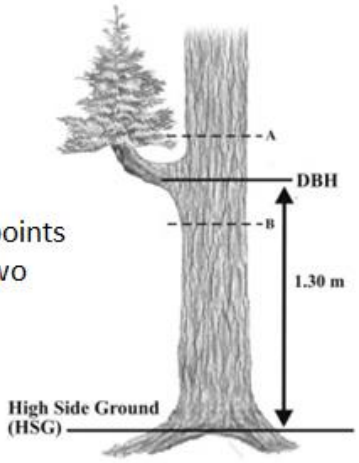


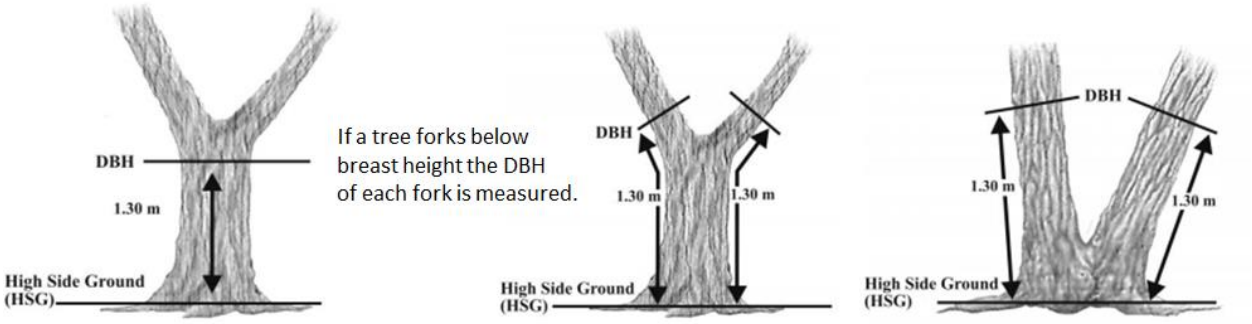






Measure the diameter at points A and B and average the two measurements

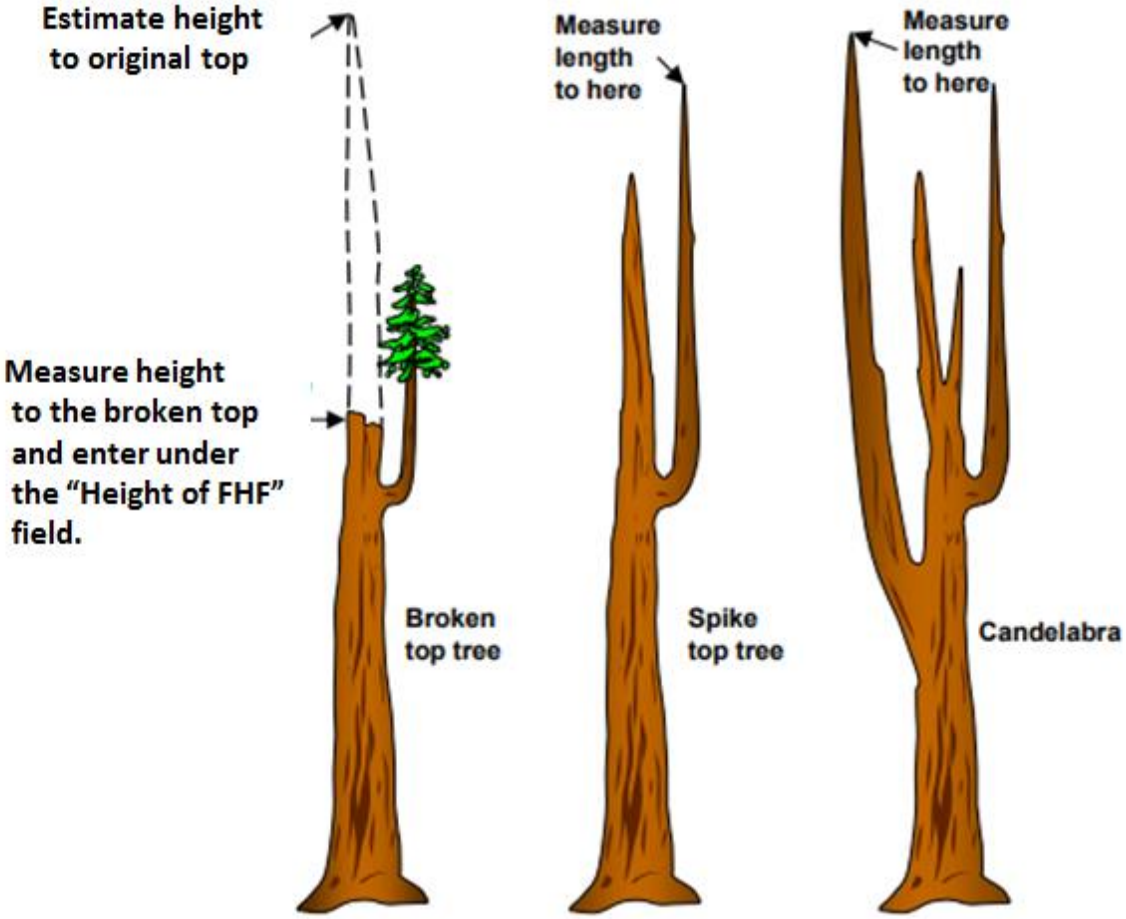




Total height:

Measure one height per species per quadrant (NE, SE, SW and NW). To ensure unbiased tree selection, measure the height of the first tree (by species) encountered within the quadrant as you move clockwise throughout the plot. The heights of the remaining trees will be estimated using a height diameter equation when the data is compiled.

The following illustration shows how to measure heights for some odd shaped trees.



Percent live crown:

Percent live crown is estimated to the nearest 10 percent. Assuming the top of the tree is live, percent live crown is estimated from the first whorl from the bottom of the tree where at least 75% of the whorl is living. If the top of the crown is dead, percent live crown is estimated from the first whorl from the bottom of the tree where at least 75% of the whorl is living to the last whorl from the bottom of the tree where at least 75% of the whorl is living.

Forest health damage agents:

Forest health damage agents are assessed as per the comprehensive guide in Appendix 5.

Note: The height of the forest health damage agent (FHF) is only recorded if the FHF is a "gall", fork, crook or a dead or broken top.

If multiple forest health agents are present on the tree, record up to three agents. To record multiple agents repeat the tree number on the field card for each subsequent agent. If more than three are present, first record mortality agents, second record agents that have a growth impact and third record those agents that cause a form defect. In addition to recording forest health agents on live trees, if possible, record them on dead trees.

Site Index:

Within the 5.64 m plot select the largest diameter tree of up to two leading species that are healthy and have no broken tops as the site index trees. In addition to total tree height, breast height age will be measured using an increment borer (increment taken at 1.3 m above point of germination).

The site index will be calculated when the field data is submitted to Victoria.

Boundary plots:

If the plot centre is within 5.64 m of the "mapped" boundary follow the walk through method detailed in Appendix 3.

2.5 m nested plot measurements:

Once the trees in the 5.64 m plot have been recorded, commence a tally of trees (less than 4.0 cm DBH but greater than 30 cm in height) within the 2.5 m nested plot. Both plots have the same plot centre.

From cardinal north proceed clockwise counting the number of small trees (<4.0 cm) recording the:

- species (both conifers and deciduous),
- whether live or dead,
- quadrant (NE,SE,SW and NW),
- whether above or below breast height, and
- the stem count.

Forest health assessments are NOT required for the trees on the 2.5 m plot. Appendix 1 provides an example of how the card should be filled out for the 2.5 m plot.

Boundary plots:

If the plot centre is within 2.5 m of the "mapped" boundary follow the walk through method detailed in Appendix 3.

APPENDIX 1: SDM 2.0 field card (FS1357)

BRITISH COLUMBIA Forest and Range Evaluation Program

STAND DEVELOPMENT MONITORING (V2)
VOLUME TREE CARD, FORM A, SIDE 1

PLOT IDENTIFICATION

Opening ID _____ Feature ID _____ Plot # _____

Management Unit _____ Page _____ of _____

Evaluator(s) _____ Date of Evaluation Y Y Y Y / M M / D D

GPS Coordinates: Easting _____ Northing _____ Zone _____

VOLUME TREES (trees 4cm DBH and greater in the 5.64m main plot)

Tree No	Bearing (°)	Distance (m)	Species	Live/Dead (L/D)	Count	DBH (cm)	Height (m)	Percent Live Crown	Forest Health Code	Severity	Height of FHF (m)	Breast Height Age (yrs)

FS1357 HFP 2018/06

BRITISH COLUMBIA Forest and Range Evaluation Program

STAND DEVELOPMENT MONITORING (V2)
TALLY TREE CARD; FORM A, SIDE 2

PLOT IDENTIFICATION

Opening ID 4684 Feature ID 9623178 Plot # 102

Management Unit BIG SKY TSA Page 2 of 2

Evaluator(s) FRED SMITH/Tom Jones Date of Evaluation 2017/08/12

TALLY TREES (less than 4cm DBH in the 2.5m radius subplot)

Species	Live/Dead (L/D)	Quadrant (NE,SE, SW,NW)	Count	Above/Below breast height (A/B)
PLI	L	NE	1	B
SX	L	NE	2	A
SX	L	NE	2	B
SX	D	SE	1	A
PLI	L	SW	2	A
SX	L	NW	4	B
SX	L	NW	2	A

FS1357 HFP 2017/05

Appendix 2: Random Directions and Numbers

BRITISH COLUMBIA Forest and Range Evaluation Program

STAND DEVELOPMENT MONITORING
REFERENCE, FORM B, SIDE 1

Random directions to relocate a plot center that is located on a road.								
Left	Right	Right	Left	Left	Left	Right	Right	Left
Right	Right	Left	Left	Left	Right	Right	Left	Left
Left	Left	Right	Right	Right	Right	Left	Right	Right
Left	Left	Right	Right	Right	Left	Right	Right	Left
Left	Left	Left	Left	Right	Left	Right	Right	Left
Right	Left	Left	Right	Right	Right	Left	Left	Right
Right	Left	Right	Right	Left	Right	Left	Right	Left
Right	Right	Left	Left	Left	Left	Left	Right	Left
Left	Left	Left	Left	Left	Left	Right	Right	Left
Left	Right	Left	Left	Left	Right	Left	Left	Left
Left	Right	Left	Right	Left	Right	Right	Right	Right
Right	Right	Right	Left	Left	Right	Left	Left	Right
Right	Right	Left	Left	Left	Left	Right	Right	Left
Left	Left	Right	Right	Right	Right	Right	Left	Right
Right	Left	Left	Left	Left	Left	Right	Right	Right
Right	Right	Right	Left	Left	Right	Left	Right	Right
Right	Left	Right	Left	Right	Left	Right	Right	Left
Left	Left	Left	Right	Right	Left	Right	Right	Right
Left	Right	Left	Left	Right	Left	Right	Right	Left
Left	Right	Left	Left	Left	Left	Left	Right	Left
Left	Left	Right	Left	Left	Right	Right	Left	Left
Left	Right	Left	Right	Left	Left	Left	Right	Right

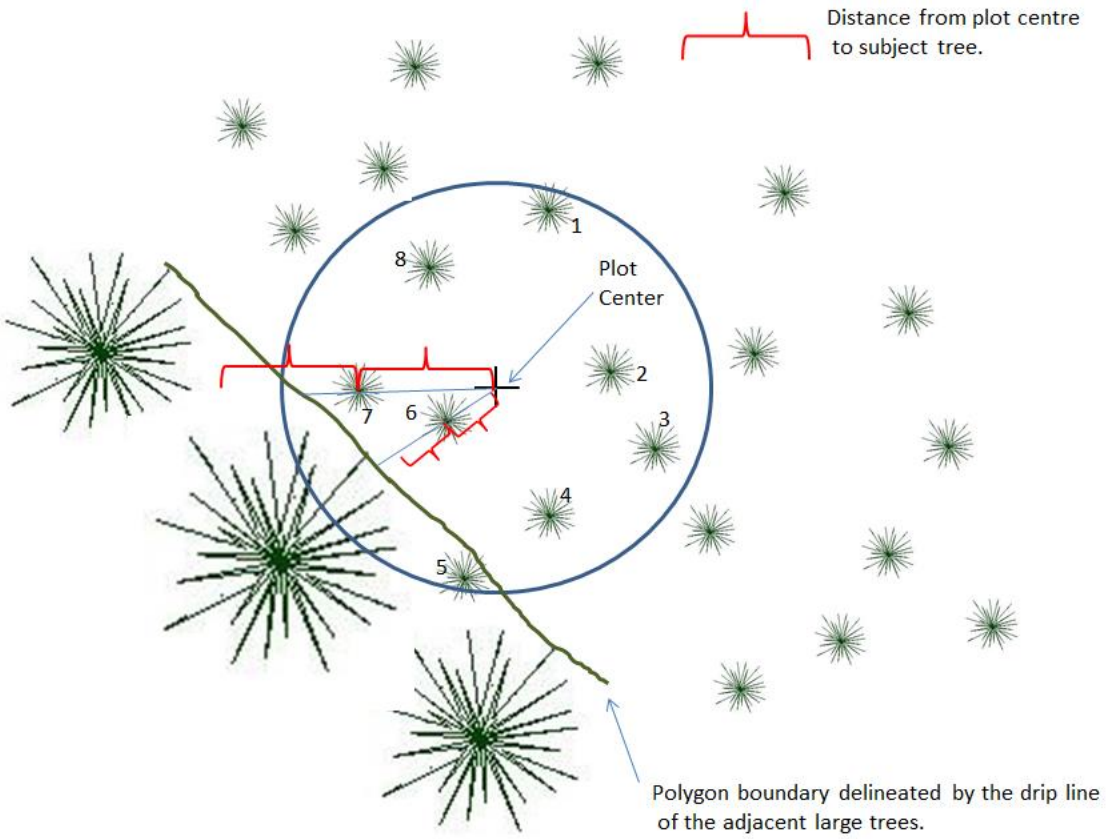
FS1357 HFP 2017/05

Random numbers for the distance to relocate a plot center that is located on a road.								
15.74	16.22	3.9	16.45	4.22	1.19	13.96	12.60	15.14
14.86	2.73	2.84	11.79	3.63	3.39	9.49	11.63	7.92
5.03	15.44	9.43	0.93	15.22	3.40	0.21	14.36	19.04
10.95	18.79	1.35	6.98	13.99	17.15	3.81	7.18	6.65
11.01	18.84	9.42	2.09	10.45	16.09	18.39	4.07	7.14
16.62	8.38	16.31	15.98	9.48	10.81	15.45	7.09	19.59
13.63	9.38	8.76	3.56	1.27	1.24	17.26	13.15	16.17
18.63	3.52	19.50	11.63	11.92	13.57	10.15	8.74	17.73
2.67	13.90	12.86	10.33	13.86	16.11	7.15	1.80	18.82
14.52	3.46	11.52	9.53	7.97	14.82	5.45	7.64	1.90
3.43	15.52	1.38	3.67	9.18	18.49	9.99	10.51	10.53
17.02	4.33	10.30	6.90	17.23	15.89	8.02	1.81	3.56
4.81	13.47	4.85	3.10	6.59	17.66	1.26	0.29	15.30
11.00	7.68	13.89	6.22	15.91	4.02	7.91	19.43	16.89
10.01	1.47	2.10	15.33	19.63	0.54	16.48	4.03	16.33
2.63	15.73	1.85	0.21	10.66	5.68	17.79	3.26	17.73
18.40	2.72	1.31	0.02	11.38	12.71	6.28	17.63	17.92
6.31	3.94	19.28	1.03	19.38	10.02	3.51	3.03	5.36
11.01	5.45	9.10	7.31	8.22	18.05	11.99	11.77	18.52
7.35	9.86	15.11	6.23	13.16	7.33	4.34	9.37	9.33
9.54	15.58	4.26	19.70	19.77	8.58	14.65	12.16	6.92
13.20	5.55	10.85	18.79	4.06	1.80	0.32	12.75	18.48

Appendix 3: Walk through Methodology – YSM methodology for SDM Samples

This is a pictorial representation of the walk through method to be utilized if a plot is partially outside the polygon of interest. The purpose of the walk through method is to ensure the tree density, basal area and volume per hectare measures associated with the plot reflect the fact they come from a partial plot.

Consider the following diagram:



Eight trees fall within the gross boundaries of the plot.

Tree numbers 1,2,3,4 and 8 would each be recorded as one stem/plot. Tree number 5 would be recorded as zero stems/plot as it falls outside the polygon. Tree numbers 6,7 require closer examination using the walkthrough method—if twice the distance from the plot centre to the tree exceeds the distance from the plot centre to the polygon boundary (on the same bearing), the tree is tallied twice. Tree number 6 would be recorded as 1 stem/plot and tree number 7 would be recorded as 2 stems/plot.

Appendix 4: VRI tree species codes

Native Conifers

Common name	Scientific Name	Code
Cedar	***Thuja***	**C**
western redcedar	*Thuja plicata*	Cw
Cypress	***Chamaecyparis***	**Y**
yellow-cedar	*C. nootkatensis*	Yc
Douglas-fir	***Pseudotsuga***	**F**
Douglas-fir	*P. menziesii*	Fd
coastal Douglas-fir	*P. menziesii* var. *menziesii*	Fdc
interior Douglas-fir	*P. menziesii* var. *glauca*	Fdi
Fir (Balsam)	***Abies***	**B**
amabilis fir	*A. amabilis*	Ba
grand fir	*A. grandis*	Bg
subalpine fir	*A. lasiocarpa*	Bl
Hemlock	***Tsuga***	**H**
mountain hemlock	*T. mertensiana*	Hm
western hemlock	*T. heterophylla*	Hw
mountain x western hemlock hybrid	*T. mertensiana* x *heterophylla*	Hxm
Juniper	***Juniperus***	**J**
Rocky Mtn. juniper	*J. scopulorum*	Jr
Larch	***Larix***	**L**
alpine larch	*L. lyallii*	La
tamarack	*L. laricina*	Lt
western larch	*L. occidentalis*	Lw
Pine	***Pinus***	**P**
jack pine	*P. banksiana*	Pj
limber pine	*P. flexilis*	Pf
lodgepole pine	*P. contorta*	Pl
lodgepole pine	*P. contorta* var. *latifolia*	Pli
lodgepole x jack pine hybrid	*P.* x *murraybanksiana*	Pxj
ponderosa pine	*P. ponderosa*	Py
shore pine	*P. contorta* var. *contorta*	Plc
western white pine	*P. monticola*	Pw
whitebark pine	*P. albicaulis*	Pa

Native Conifers

Common name	Scientific Name	Code
Spruce	***Picea***	**S**
black spruce	*P. mariana*	Sb
Engelmann spruce	*P. engelmannii*	Se
Sitka spruce	*P. sitchensis*	Ss
white spruce	*P. glauca*	Sw
spruce hybrid	*Picea* cross	Sx
Engelmann x white	*P. engelmannii* x *glauca*	Sxw
Sitka x white	*P.* x *lutzii*	Sxl
Sitka x unknown hybrid	*P. sitchensis* x *?*	Sxs
Yew	***Taxus***	**T**
western yew	*Taxus brevifolia*	Tw

Native Hardwoods

Common name	Scientific Name	Code
Alder	***Alnus***	**D**
red alder	*A. rubra*	Dr
Apple	***Malus***	**U**
Pacific crab apple	*Malus fusca*	Up
Aspen, Cottonwood or Poplar	***Populus***	**A**
poplar	*P. balsamifera*	Ac
balsam poplar	*P. b.* ssp. *balsamifera*	Acb
black cottonwood	*P. b.* ssp. *trichocarpa*	Act
hybrid poplars	*P.* spp.	Ax
trembling aspen	*P. tremuloides*	At
Arbutus	***Arbutus***	**R**
Arbutus	*Arbutus menziesii*	Ra
Birch	***Betula***	**E**
Alaska paper birch	*B. neoalaskana*	Ea
Alaska x paper birch hybrid	*B.* x *winteri*	Exp
paper birch	*B. papyrifera*	Ep
water birch	*B. occidentalis*	Ew
Cascara	***Rhamnus***	**K**
cascara	*R. purshiana*	Kc

Common name	Scientific Name	Code
Cherry	***Prunus***	**V**
bitter cherry	*P. emarginata*	Vb
choke cherry	*P. virginiana*	Vv
pin cherry	*P. pensylvanica*	Vp
Dogwood	***Cornus***	**G**
Pacific dogwood	*Cornus nuttallii*	Gp
Maple	***Acer***	**M**
bigleaf maple	*A. macrophyllum*	Mb
vine maple	*A. circinatum*	Mv
Oak	***Quercus***	**Q**
Garry oak	*Q. garryana*	Qg
Willow	***Salix*** spp.	**W**
Bebb's willow	*S. bebbiana*	Wb
Pacific willow	*S. lucida*	Wp
peachleaf willow	*S. amygdaloides*	Wa
pussy willow	*S. discolor*	Wd
Scouler's willow	*S. scouleriana*	Ws
Sitka willow	*S. sitchensis*	Wt

Unknowns

Common name	Scientific Name	Code
Unknown		**X**
Unknown conifer		Xc
Unknown hardwood		Xh

Others

Common name	Scientific Name	Code
Other tree, not on list		**Z**
Other conifer		Zc
Other hardwood		Zh

Exotics

Common name	Scientific Name	Code
Apple	**Malus**	**U**
apple	*Malus pumila*	Ua
Aspen, Cottonwood or Poplar	***Populus***	**A**
*southern cottonwood	*P. deltoides*	Ad
Birch	***Betula***	**E**
European birch	*B. pendula*	Ee
silver birch	*B. pubescens*	Es
*yellow birch	*B. alleghaniensis*	Ey
Cherry	***Prunus***	**V**
sweet cherry	*P. avium*	Vs
Cypress	***Chamaecyparis***	**Y**
*Port Orford-cedar	*C. lawsoniana*	Yp
Fir (Balsam)	***Abies***	**B**
*balsam fir	A. balsamea	Bb
noble fir	A. procera	Bp
*Shasta red fir	**A. magnifica var. shastensis**	Bm
*white fir	**A. concolor**	Bc
Larch	***Larix***	**L**
*Dahurian larch	*L. gmelinii*	Ld
Maple	***Acer***	**M**
box elder	*A. negundo*	Me
*Norway maple	*A. platanoides*	Mn
*Sycamore maple	*A. pseudoplatanus*	Ms
Oak	***Quercus***	**Q**
*English oak	*Q. robur*	Qe
*white oak	*Q. alba*	Qw

Other exotics

*incense-cedar	Calocedrus decurrens	Oa
*giant sequoia	*Sequoiadendron giganteum*	Ob
*coast redwood	*Sequoia sempervirens*	Oc
European mountain-ash	*Sorbus aucuparia*	Od
Siberian elm	*Ulmus pumila*	Oe
common pear	*Pyrus communis*	Of

Common name	**Scientific Name**	**Code**
Oregon ash	*Fraxinus latifolia*	Og
*white ash	*Fraxinus Americana*	Oh
*shagbark hickory	*Carya ovata*	Oi
Pine	***Pinus***	**P**
*Monterey pine	*P. radiate*	Pm
*red pine	*P. resinosa*	Pr
*sugar pine	*P. lambertiana*	Ps
Spruce	***Picea***	**S**
*Norway spruce	*P. abies*	Sn

Appendix 5: Assessing Forest Health Damage Agents

Inventory and forest health specialists will use the forest health data collected in SDM 2.0 to study the impacts of forest health agents. SDM 2.0 protocol is set up to augment the stand attribute information collected in Young Stand Monitoring (YSM). The codes and procedures described here are the same as those used in Young Stand Monitoring/Change Monitoring Inventory (CMI) data collections. The following section - Codifying the Damage Agent – provides additional guidance and interpretation for assessing damage agents as listed Table 1: CMI/YSM Severity Codes for Forest Damage in BC.

Codifying the Damage Agent

Forest Health damage codes will be recorded on the SDM 2.0 field card. Damage codes are based on a two or three letter code where the first letter indicates a broad category of damage and subsequent letters indicate more specific damage causes. Surveyors should contact their regional forest health specialist to gain the knowledge needed to identify the specific cause of damage. The broad categories of forest health damage are animal (A), abiotic (N), disease (D), insect (I), mites (M), Treatment injuries (T), and problem vegetation (VT). Where the exact cause of damage cannot be identified, unknown (U) is recorded.
The Field Guide to Forest Damage in B.C. (available as a downloadable pdf – link for document in Table 2) illustrates and describes the damage agents in British Columbia with their applicable pest codes.

- Surveyors are strongly encouraged to use the complete two or three letter code whenever possible since broad categories of damage have limited value from a forest health perspective. For a complete list of damage codes refer to Appendix 5A, found at the end of this text.

Multiple pests can be recorded for a single tree, and damage agents should be listed in order of importance. This is a subjective call based on the individual surveyor's knowledge of damaging agents. As a general guide:

- Mortality agents would be recorded first,
- Forest Health damage agents that affect growth would be recorded next, and
- Forest Health damage agents that affect wood quality would be recorded last.

Local forest health specialists can provide information on the priority of specific combinations of damage agents.

The coding and additional guidance for each broad category are provided in the following sections.

A - Animal Damage

Table 1A: Field codes for Animal Damage

	Description	
Field Code	Common Name	Scientific Name
AB	Bear	
AC	Cattle	
AD	Deer	
AE	Elk	
AH	Rabbit or Hare	
AM	Moose	
AO	Pika	
AP	Porcupine	
AS	Squirel	
AV	Vole	
AX	Birds	
AZ	Beaver	

Table 1B: Severity codes for Animal Damage

Damage Agent	Severity Code	Severity Code Explanation
ANIMAL DAMAGE (A_)	% girdling	Stem girdling is estimated at widest point to nearest 5%. For damage close to the ground the % circumference damage can be checked by measuring.

N - Abiotic Injuries

Table 2A: Field codes for Abiotic Damage

	Description	
Field Code	Common Name	Scientific Name
NAV	Avalanche or snow slide	
NB	Fire	
NBP	Post burn mortality	
NCA	Aspen (At) decline	
NCB	Birch (E) decline	
NCY	Yellow cedar (Yc) decline	
ND	Drought	
NF	Flooding	
NG	Frost	
NGC	Frost crack	
NGH	Frost Heaved	
NGK	Shoot/bud frost kill	
NH	Hail	
NK	Fumekill	
NL	Lightning	
NN	Road salt	
NR	Redbelt	
NS	Slide	
NW	Windthrow	
NWS	Windthrow-soil failure	

NWT	Windthrow—treatment or harvest related	
NX	Wind scaring or rubbing	
NY	Snow or ice (includes snow press)	
NZ	Sunscald	

Table 2B: Severity codes for Abiotic Damage

Damage Agent	Severity Code	Severity Code Explanation
NH	% defoliation	Estimate defoliation to the nearest 10%.
NB, NL, NX, NZ	S,L	S—Severe > 33% of bole circumference has dead cambium. A wind scar or sunscald damage greater than 1m in length would also be recorded as severe regardless of the % girdling. L—Low <33% of bole circumference has dead cambium. For fire damage, the % girdling can often be estimated from the amount of scorching, but some sampling outside the plot is generally required to calibrate scorching with cambium damage.
ND, NF, NGK, NN, NR	S,L	S—Severe > 33% of tree shows symptoms L—Low < 33% of tree shows symptoms
NGF	Length of frost crack estimated to nearest 0.5 m	
NY, NW	S,L	S—Severe: tree would not likely make it to rotation L—Low: tree would likely make it to rotation

Diseases:

Table 3A: Field codes for Diseases

	Description	
Field Code	Common Name	Scientific Name
DB	Broom rusts	
DBF	Fir broom rust	*Melampsorella caryophyllacearum*
DBS	Spruce broom rust	*Chrysomyxa arctosphyli*
DD	Stem decay	
DDA	White mottled rot	*Ganoderma applanatum*
DDB	Birch trunk rot	*Fomes fomentarius*
DDC	Brown cubical rot of birch	*Piptoporus betulinus*
DDD	Sulfur fungus	*Laetiporus sulphureus*
DDF	Brown crumbly rot	*Fomitopsis pinicola*
DDG	Sterile conk rot of birch	*Inonotus obliquus*
DDH	Hardwood trunk rot	*Phellinus igniarius*
DDO	Cedar brown pocket rot	*Postia sericeomollis*
DDP	Red ring rot	*Phellinus pini*
DDQ	Quinine conk rot	*Fomitopsis officinalis*
DDT	Aspen trunk rot	*Phellinus tremulae*

Table 3A(cont.): Field codes for Diseases

	Description	
Field Code	Common Name	Scientific Name
DF	Foliage Diseases	
DFA	Western pine aster rust	*Coleosporium asterum*
DFB	Delpinella tip blight	*Delphinella* spp.
DFC	Large spore spruce labradortea rust	*Chrysomyxa ledicola*
DFD	Spruce needle cast	***Lirula*** macrospora
DFE	Elytroderma needle cast	*Elytroderma deformans*
DFF	Marssonina leaf blights	*Marssonina spp.*
DFG	Cottonwood leaf rust	*Melampsora occidentalis*
DFH	Larch needle blight	*Hypodermella laricis*
DFI	Linospora leaf blotch	*Linospora tetraspora*
DFJ	Phaeoseptoria needle cast	*Phaeoseptoria contortae*
DFK	Septoria leaf spot	*Septoria populicola*
DFL	Pine needle cast	*Lophodermella concolor*
DFM	Larch needle cast	*Meria laricis*
DFN	Leptamelanconium needle blight	*Leptomelanconium pinicola*
DFO	Lophoderium needle cast	*Lophodermium seditiosum*
DFP	Fir fireweed rust	*Pucciniastrum epilobii*
DFQ	Alpine fir needle cast	*Isthmiella quadrispora*
DFR	Douglas fir needle cast	*Rhabdocline pseudotsugae*
DFS	Dothistroma needle blight	*Dothistroma septosporum*

Table 3A(cont.): Field codes for Diseases

	Description	
Field Code	Common Name	Scientific Name
DFT	Sirrococcus tip blight	*Sirrococcus conigenus*
DFU	Cedar leaf blight	*Didymascella thujina*
DFW	Swiss needle cast	*Phaeocryptopus gaeumannii*
DFX	Brown felt blight	*Herpotrichia spp.*
DFY	Hendersonia needle cast	*Hendersonia* pinicola
DFZ	Rhizospaera needle cast	*Rhizosphaera kalkhoffii*
DL	Diease caused dieback	
DLD	Dermea canker	*Dermea pseudotsugae*
DLF	Red flag disease	*Potebniamyces balsamicola*
DLK	Conifer cytospora canker	*Leucostoma kunzei*
DLP	Phomopsis canker	*Phomopsis lokoyae*
DLS	Sydowia (Sclerophoma) tip dieback	*Sclerophoma* pithyophila
DLV	Aspen-poplar twig blight	*Venturia spp.*
DM	Dwarf Mistletoe	
DMF	Douglas-fir dwarf mistletoe	*Arceuthobium douglasii*
DMH	Hemlock mistletoe	*Arceuthobium tsugense*
DML	Larch mistletoe	*Arceuthobium laricis*
DMP	Lodgepole pine dwarf mistletoe	*Arceuthobium americanum*

Table 3A(cont.): Field codes for Diseases

	Description	
Field Code	Common Name	Scientific Name
DR	Root Disease	
DRA	Armillaria root disease	*Armillaria ostoyae*
DRB	Black stain root disease	*Leptographium wageneri*
DRC	Laminated root rot (cedar strain)	*Phellinus weirii*
DRL	Laminated root rot (Fd form)	*Inonotus sulphurascens*
DRN	Annosus root disease	*Heterobasidion annosum*
DRR	Rhizina root disease	*Rhizina undulata*
DRS	Schweinitzii butt rot	*Phaeolus schweinitzii*
DRT	Tomentosus root rot	*Inonotus tomentosus*
DS	Stem Diseases (Cankers and rusts)	
DSA	Atropellis canker (lodgepole pine)	*Atropellis piniphila*
DSB	White pine blister rust	*Cronartium ribicola*
DSC	Comandra blister rust	*Cronartium comandrae*
DSE	Sooty bark canker	*Encoelia pruinosa*
DSG	Western gall rust	*Endocronartium harknessii*
DSH	Hypoxylon canker	*Hypoxylon mammatum*
DSP	Cryptosphaeria canker	*Cryptosphaeria populina*
DSR	Ceratocystis canker	*Ceratocystis fimbriata*
DSS	Stalactiform blister rust	*Cronartium coleosporioides*
DST	Target canker	*Nectria galligena*
DSY	Cytospora canker	*Cytospora chrysosperma*

Table 3B: Severity codes for Diseases

DISEASE	Severity Code	Severity Code Explanation
BROOM RUST Fir broom rust (DBF) spruce broom rust DBS)	1,2,3,4,5,6	Use the Hawksworth 6 point Dwarf Mistletoe Rating System with rust brooms in place of dwarf mistletoe brooms. See Figure 1, page 34.
STEM DECAYS (DD_)	N/A	Severity is not recorded. See page 34 for further explanation.
FOLIAGE DISEASES		
Elytroderma needle cast (DFE)	1,2,3,4,5,6	Use the Hawksworth 6 point Dwarf Mistletoe Rating System with stunted branches in place of dwarf mistletoe brooms. For DFE stem cankers the damage code is recorded as DFE/SC and severity is recorded as for stem disease. See page 34.
All other foliage diseases (DF_)	% defoliation	Estimate % defoliation to nearest 10% or use the defoliation method outlined in Fig. 2, page 37.
LEADER OR BRANCH DIEBACKS (DL_)	% girdling	Estimate % girdling to nearest 5%. Only applies to damage agents that have cankers on main stem.
DWARF MISTLETOE Douglas-fir (DMF) Hemlock (DMH) Larch (DML) Lodgepole pine (DMP)	1,2,3,4,5,6 S	Use the Hawksworth 6 point dwarf mistletoe rating. S (stem swelling) is recorded in addition to Hawksworth rating when present. See Figure 1, page 34.

Table 3B(cont.): Severity codes for Diseases

ROOT DISEASES Armillaria (DRA) Black Stain (DRB) Laminated (DRL) Tomentosus (DRT)	S, BR, CS	S – Crown symptoms. Identified based only on crown symptoms and presence in stand. BR – Basal Resinosis. Identified based only on basal resinosis, crown symptoms, and presence in stand. CS – Confirmatory Signs. Identified based on stain, decay, mycelia, rhizomorphs, or fruiting bodies. See page 38 for further explanation.
STEM DISEASE Atropellis (DSA) Comandra (DSC) Gall (DSG) Stalactiform (DSS)	Stem Canker height to nearest 0.1m and % circumference	Record height to widest point of canker (nearest 0.1m) and % circumference expressed as a fraction. For stem cankers above 2m the height should be estimated to the nearest 0.5m and the % circumference estimated to the nearest 5%. Record up to 5 of the largest cankers per tree. DSA is only recorded as a damage agent if the diameter of the canker is >33% of the stem circumference. DFE stem cankers are recorded using the damage code DFE/SC.

Further Guidance

DB - Broom Rust

Enter a value from 1 to 6 using the Hawksworth 6 point dwarf mistletoe rating, assessing rust brooms instead of mistletoe brooms (Fig. 1).

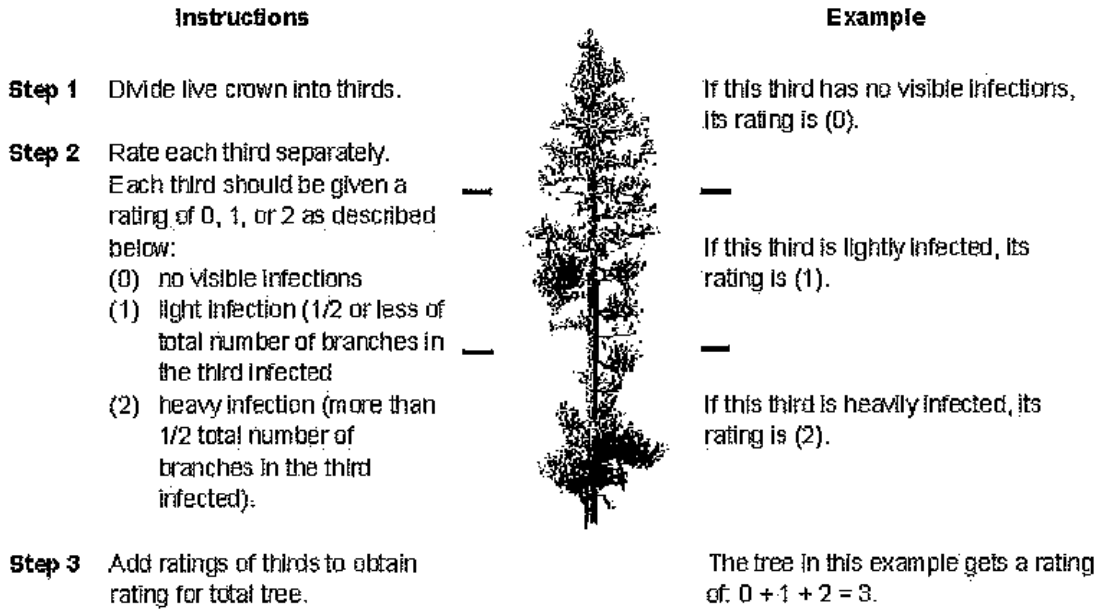


Fig. 1. Hawksworth 6 Point Dwarf Mistletoe Rating Procedure – also applicable to broom rust.

DD - Stem Decays

Severity is not recorded. These damage agents are not common in young stands. The true heart rots: DDE (Rust red stringy rot), DDP (Red ring rot), & DDT (Aspen trunk rot) are the rots most often associated with decay in live trees. These rots often have characteristic 'conks' (the fruiting body of a wood decay fungus) at branch stubs. Most other stem decays are wound pathogens and are less commonly associated with live trees. Stem decays on dead standing trees comes in after the tree is dead. Some of the more common stem decays are described in the Field Guide to Forest Damage in B.C.

DF - Foliage diseases

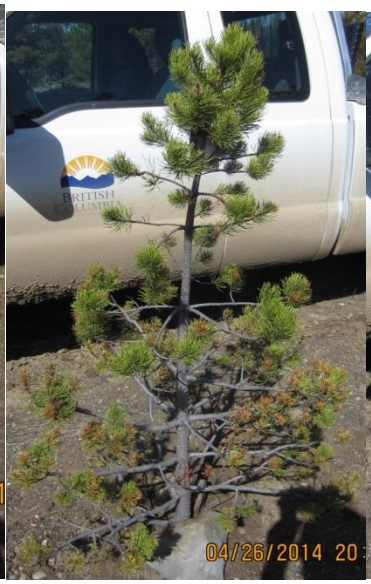
When assessing the foliage disease, ***Elytroderma needle cast*** (DFE); especially where there are stunted branches on the tree, a specially developed assessment protocol (below) is used.

Divide the live crown into thirds. Give a rating for each third using the following scale:

- 0 if no stunting visible,
- 1 if less than 50% of branches have stunting somewhere on the branch,
- 2 if more than 50% of branches have stunting somewhere on the branch.

Add the rating together for each third to come up with a final rating between zero and six. Below are some illustrations of trees rated using the Hawksworth Rating System. Although this rating system can be used at any time of the year, the pictures were taken in the spring when the needles were still attached and red, making it easier to identify the stunted foliage in the picture. Almost all of the red needles in these pictures are associated with stunting. Assume that the front of the tree is representative of the entire tree (front & back).

1) Bottom ___2__
Middle____2__
Top_____2__
Total _____6__



2) Bottom ___2____
Middle____2____
Top _____
Total _____4____

3) Bottom ___2_____
Middle ____1_____
Top _____
Total _____3_____

4) Bottom ___2_____
Middle____2_____
Top _____
Total _____4_____

5) Bottom ___1____
Middle _____
Top _____
Total _____1____

6) Bottom __1__
Middle __1__
Top _____
Total ____2__

7) Bottom ___2___
Middle____0___
Top_____0___
Total _____2___

8) Bottom ___2____
Middle___2_____
Top_____1_____
Total ____5_____

All other foliage diseases:

Estimate defoliation as a percentage, or use the method outlined in Fig. 2.

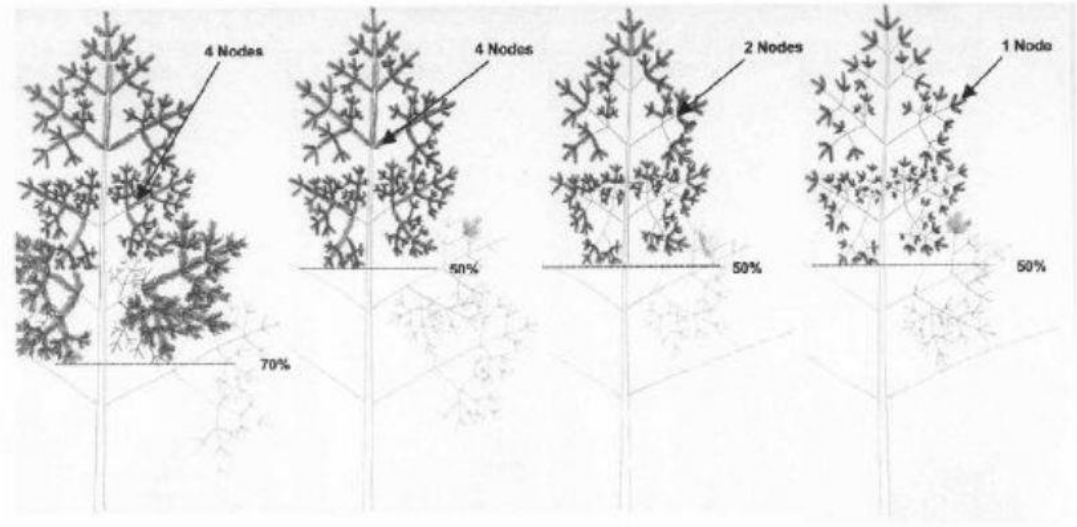


Fig. 2 Method for estimating defoliation

Note: *As percent live crown is collected for all trees (in the 5.64 m plot) that estimate should reflect the defoliation*

DR - Root Diseases

Because destructive sampling is not permitted on standing plot trees, diagnosis of plot trees will usually be based on crown symptoms and the presence of root disease in the surrounding stand.

- One of the easier ways of confirming root disease in a stand is to look at exposed roots on windthrow during the walk in.
    - Live or recently dead *Armillaria* (DRA) infected trees may have basal resinosis present at the base of the tree. Fruiting bodies may also occur, especially in the fall.
    - In the case of laminated root disease (DRL/DRC) it is sometimes possible to carefully expose mycelium on the outside of major roots at the root collar with minimal soil disturbance.
    - Tomentosus (DRT) and Armillaria (DRA) can sometimes be identified from fruiting bodies present in the fall.
- Within plots –
    - Crown symptoms of root disease include reduced height growth, yellowing and thinning of foliage, and distress cones (Figs. 137 &145 in the Field Guide to Forest Damage in BC).
    - The presence of root disease can be determined from examining the roots of dead and down trees within the plot.
- Outside of the plot –
    - Root disease in surrounding stands is generally indicated by the presence of root disease centers – e.g., *old rotten stumps or broken old snags in the center; trees uprooted or snapped at the base; recent mortality near the margin; live trees at margin that look sick.*
    - The roots of symptomatic live and dead standing trees outside of the plot may be examined (destructive sampling) for evidence of root disease (particularly black stain). It is recommended that surveyors carry a pulaski when surveying in high root rot hazard ecosystems (e.g. Douglas-fir leading stands in the ICH or CDF BEC zones).
    - Also, root disease can be determined from examining the roots of dead and down trees outside of the plot.

DS - Stem Diseases

The severity of stem diseases is recorded as the height to the widest point of the canker and the % circumference of the main stem occupied by the canker at its widest point.

- For cankers below 2m, the height should be recorded to the nearest 0.1m and for cankers above 2 m, the height should be estimated to the nearest 0.5m.
- The % encirclement of cankers is estimated to the nearest 5%.
- Up to three cankers should be recorded per tree.
- Multiple cankers that have merged together are recorded as a single canker.

- For hard pine stem rusts the order of priority for listing on the field card is: 1)Comandra (DSC), 2)Stalactiform (DSS), and 3)Western Gall (DSG).
- Atropellis cankers (DSA) are only recorded if they are >33% of the trees circumference.
- Branch cankers are not recorded.
- Stem cankers caused by Elytroderma are not recorded in SDM 2.0

Table 4A: Field codes for Insects

I	INSECTS			
	IA		Aphids	
		IAB	Balsam Woolly Adelgid	*(Adelges piceae)*
		IAC	Giant Conifer Aphid	*(Cinara spp.)*
		IAG	Cooley Spruce Gall Adelgid	*(Adelges cooleyi)*
		IAL	Larch (Lw) Cone Woolly Aphid	*(Adelges lariciatus)*
		IAS	Green Spruce Aphid	*(Elatobium abietinum)*
	IB		Bark Beetles	
		IBB	Western Balsam Bark Beetle	*(Dryocoetes confusus)*
		IBD	Douglas-fir Beetle	*(Dendroctonus pseudotsugae)*
		IBE	Silver Fir Beetle	*(Pseudohylesinus sericeus)*
		IBF	Fir Engraver Beetle	*(Scolytus ventralis)*
		IBH	Hylurgops Beetle	*(Hylurgops rugipennis)*
		IBI	Engraver Beetles	*(Ips spp.)*
		IBL	Lodgepole Pine Beetle	*(Dendroctonus murryanae)*
		IBM	Mountain Pine Beetle	*(Dendroctonus ponderosae)*
		IBP	Twig Beetles	*(Pityogenes, Pityophthorus spp.)*
		IBR	Fir Root Bark Beetle	*(Pseudohylesinus granulatus)*
		IBS	Spruce Beetle	*(Dendroctonus rufipennis)*
		IBT	Red Turpentine Beetle	*(Dendroctonus valens)*
		IBW	Western Pine Beetle	*(Dendroctonus brevicomis)*
	ID		Defoliators	
		ID1	Leaf Beetles	*(Chrysomela spp.)*
		ID2	Bruce Spanworm	*(Operophtera bruceata)*
		ID3	Winter Moth	*(Operophtera brumata)*
		ID4	Cottonwood Sawfly	*(Nematus curvans)*
		ID5	Fall Webworm	*(Hyphantria cunea)*
		ID6	Aspen Leaf Miner	*(Phyllocnistis populiella)*
		ID7	Woolly Alder Sawfly	*(Eriocampa ovata)*
		ID8	Aspen Leaf Roller	*(Pseudexentera oregonana)*
		ID9	Birch Leaf Skeletonizer	*(Bucculatrix spp.)*
		IDA	Black Army Cutworm	*(Actebia fennica)*
		IDB	Two-year Budworm	*(Choristoneura biennis)*
		IDC	Larch Casebearer	*(Coleophora laricella)*

Table 4A(cont.): Field codes for Insects

I	INSECTS			
		IDD	Western Winter Moth	*(Erranis tiliaria vancouverensis)*
		IDE	Eastern Spruce Budworm	*(Choristoneura fumiferana)*
		IDF	Forest Tent Caterpillar	*(Malacosoma disstria)*
		IDG	Greenstriped Forest Looper	*(Melanolophia imitata)*
		IDH	Western Blackheaded Budworm	*(Acleris gloverana)*
		IDI	Pine Needle Sheath Miner	*(Zellaria haimbachi)*
		IDJ	Gray Forest Looper	*(Caripeta divisata)*
		IDK	Northern Tent Caterpillar	*(Malacosoma californicum)*
		IDL	Western Hemlock Looper	*(Lambdina fiscellaria lugubrosa)*
		IDM	Gypsy Moth	*(Lymantria dispar)*
		IDN	Birch Leaf Miner	*(Fenusa pusilla)*
		IDO	Filament Bearer	*(Nematocampa filamentaria)*
		IDP	Larch Sawfly	*(Pristophora erichsonii)*
		IDQ	Hemlock Needle Miner	*(Epinotia tsugana)*
		IDR	Alder Sawfly	*(Eriocampa ovata)*
		IDS	Balsam Fir Sawfly	*(Neodiprion abietis)*
		IDT	Douglas-fir Tussock Moth	*(Orgyia pseudotsugata)*
		IDU	Satin Moth	*(Leucoma salicis)*
		IDV	Variegated Cutworm	*(Peridroma saucia)*
		IDW	Western Spruce Budworm	*(Choristoneura occidentalis)*
		IDX	Large Aspen Tortrix	*(Choristoneura conflictana)*
		IDY	Birch-Aspen Leafroller	*(Epinotia solandriana (Linnaeus))*
		IDZ	Western False Hemlock Looper	*(Nepytia freemani)*
		IEA	Unidentified Aspen Defoliation	
		IEB	Hemlock Sawfly	*(Neodiprion tsugae)*
		IEC	Larch Budmoth	*(Zeiraphera improbana)*
		IED	Larch Looper	*(Semiothis sexmaculata)*
		IEF	Cottonwood Leaf Skeletonizer	*(Phyllonorycytes apparella)*
		IEG	Lodgepole pine Sawfly	*(Neodiprion burkei)*
		IEH	Phantom Hemlock Looper	*(Nepytia phantasmaria)*
		IEI	Saddleback Looper	*(Ectropis crepuscularia)*
		IEJ	Willow Leafminer	*(Micrurapteryx salicifoliella)*
		IEK	Rusty Tussock Moth	*(Orgyia antiqua)*
	IS		Shoot Insects	
		ISA	Bronze Birch Borer	*(Agrilus anxius)*
		ISB	Western Cedar Borer	*(Trachykele blondeli)*
		ISC	Poplar Borer	*(Saperda calcarata)*
		ISE	European Pine Shoot Moth	*(Rhyacionia buoliana)*
		ISG	Gouty Pitch Midge	*(Cecidomyia piniinopsis)*
		ISP	Pitch Nodule Moths	*(Petrova spp.)*
		ISQ	Sequoia Pitch Moth	*(Vespamima sequoiae)*
		ISS	Western Pine Shoot Borer	*(Eucosma sonomana)*
		ISW	Poplar and Willow Borer	*(Cryptorhynchus lapathi)*

Table 4A(cont.): Field codes for Insects

I	INSECTS			
	IW		Weevils	
		IWC	Conifer Seedling Weevil	*(Steremnius carinatus)*
		IWM	Magdalis Species	*(Magdalis spp.)*
		IWP	Lodgepole pine Terminal Weevil	*(Pissodes terminalis)*
		IWS	White pine Weevil (on Spruce)	*(Pissodes strobi)*
		IWW	Warren's Root Collar Weevil	*(Hylobius warreni)*
		IWY	Cylindrocopturus Weevil	*(Cylindrocopturus spp.)*
		IWZ	Yosemite Bark Weevil	*(Pissodes schwarzi)*
M	MITE DAMAGE			*(Thisetacus spp.)*

Table 4B: Severity codes for Insects

DISEASE	Severity Code	Severity Code Explanation
APHIDS OR ADELGIDS Giant conifer aphid (IAC) Green Spruce Aphid (IAS) Balsam woolly adelgid (IAB) Cooley spruce gall adelgid (IAG)	N/A	Severity is not recorded. See page 42 for further explanation.
BARK BEETLES Spruce (IBS) Mountain pine (IBM) Douglas-fir (IBD) Balsam (IBB)	FA, GR, RA, GY	FA - Failed attack or pitchout GR - Current (green attack) RA - Red attack. For 1 year cycle bark beetles this would be trees that were green attack the previous year GY - Trees that have not had live beetle for more than 1 year. See page 43 for further explanation.

Table 4B(cont.): Severity codes for Insects

DEFOLIATING INSECTS 2-year cycle budworm (IDB) Eastern spruce budworm (IDE) western spruce budworm (IDW)	% defoliation	% defoliation to the nearest 10%. See page 43 for further explanation.
SHOOT AND STEM INSECTS Lodgepole pine terminal weevil (IWP) white pine terminal weevils (IWS)	O, M, N, F, S, C	O - Old attack M - Major crook. Lateral is offset from main stem by at least ½ the stem diameter. N - miNor crook. Lateral is offset from main stem < ½ the stem diameter. F – Forking S - Staghead (three or more laterals) C- Current attack See page 43 for further explanation.
WEEVILS		
Warrens Rot Collar Weevil (IWW)	% girdling	% girdling to the nearest 10%. Only recorded for trees with above ground symptoms. See page 43 for further explanation.
MITE DAMAGE	N/A	Severity is not recorded

IA - Aphids and Adelgids

Severity is not recorded.

- Cooley Spruce Gall Adelgid (IAG) should only be recorded for smaller trees that are severely infected.
- Any woody adelgid on subalpine fir should be recorded.

IB - Bark Beetles

Bark beetle severity is recorded as FA (failed attack), GR (green attack), RA (red attack), or GY (grey attack).

- Failed attack trees have pitch coming out of the parent gallery and usually don't contain larval galleries.
- Green attack trees contain live beetles. The foliage colour of green attack trees can be red, green, (or grey for spruce beetle).
- Red attack trees are trees which were green attack in the previous year.
    - The exception is 2 year cycle beetles like spruce beetle which have green attack trees for 2 years.
- Grey attack trees are trees which have not had live beetle for more than 1 year. Grey trees can still have red foliage present on the branches but generally have fewer needles than trees that had live beetles in the previous year.

ID - Defoliating Insects

Defoliation does not have to have occurred during the year of measurement.

- Severity is estimated as % defoliation of the live crown to the nearest 10%.
- Severe damage is often associated with dead tops.

IS - Shoot and Stem Insects and Terminal Weevils

Severity is recorded as a two letter code,

- Where the first letter is either C (current) or O (old weevil with emergence holes present).
- The second letter indicates the damage caused,
    - M (major crook > ½ diameter displacement between top and bottom of crook),
    - N (minor crook < ½ diameter displacement),
    - F (forking),
    - S (staghead, 3 or more competing leaders).
- In order to attribute crooks or forks to weevil, the damage needs to be close to the ground so that the dead leader can be examined for signs of weevil or there needs to be confirmed weevil damage present in the stand.

IW - Root Weevils

Root collar weevil is only called on trees with above ground symptoms: random mortality or, single or small groups, damaged trees exhibit straw-coloured to deep red foliage, starting with the older needles.

- Severity for Warrens root collar weevil (IWW) and other root weevils is expressed as the % girdling estimated to the nearest 5%. The girdling can be determined by minimal disturbance of soil around the base of the tree. On young trees this is also a good way of distinguishing Warren's root collar weevil from Armillaria root disease.

Table 5A: Field codes for Treatment Injuries

T	TREATMENT INJURIES			
	TC		Chemical Injury	
	TL		Logging Wounds	
	TM		Other Mechanical Damage (non-logging)	
	TP		Planting (incorrectly planted)	
		TPM	Planting (poor microsite)	
	TR		Pruning Wound	
	TT		Thinning or Spacing Wound	

Table 5B: Severity codes for Treatment Injuries

TREATMENT INJURIES	Severity Code	Severity Code Explanation
	N/A	Severity is not recorded

Table 5A: Field codes for Problem Vegetation

V	PROBLEM VEGETATION			
	VH		Herbaceous Competition	
	VP		Vegetation Press	
	VS		Shrub Competition	
	VT		Tree Competition	

Table 5B: Severity codes for Problem Vegetation

PROBLEM VEGETATION	Severity Code	Severity Code Explanation
	N/A	Severity is not recorded

Table 5A: Field codes for Unknown

U	UNKNOWN (Damage evident but causal agent unknown)			
		UBT	Unknown Broken Top	
		UCR	Unknown Crook	
	UF		Unknown Fork Damage	
		USW	Unknown Sweep	

Table 5B: Severity codes for Unknown

UNKNOWN	Severity Code	Severity Code Explanation
	N/A	While no severity code is recorded for crooks, forks and broken tops the height at which they occur are recorded.

Other Sources of forest health information

Old forest health damage, particularly defoliation damage, can be difficult to diagnose without local knowledge of the history of forest health outbreaks. There is often very little direct evidence of the causal agent left over from previous years or even earlier in the same season for some defoliating insects. To make accurate forest health calls under these situations it is important to do some preparation before going out in the field by consulting recent Summary of Forest Health Conditions in B.C. reports. Hazard rating tables, maps showing the distribution of damaging agents reported in RESULTS, and Stand Development Monitoring (SDM)summaries are also a good source of information on which pests you can expect to encounter for a given area and should be consulted prior to heading out in the field.

Table 6: Sources of Information for Forest Health Damage in B.C.

Type of Information	**Source**	**Internet/e-mail**
Field Guides	Field Guide to Forest Damage in British Columbia	https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/Field%20Guide%20Draft%2006_16_2014.pdf
	Common Tree Diseases of B.C. by Eric Allen, Duncan Morrison, and Gordon Wallis	http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/4633.pdf
	Diseases of Populus in British Columbia by Brenda Callan	http://www.cfs.nrcan.gc.ca/pubwarehouse/pdfs/5119.pdf
	Cruising Manual	http://www.for.gov.bc.ca/ftp/hva/external/!publish/web/manuals/cruising/2014/Cruising2014FebMaster.pdf
Annual Pest Summaries	Overview of Forest Health Conditions in B.C.	http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/

Table 6(cont.): Sources of Information for Forest Health Damage in B.C.

	Overview of Forest Health Conditions in Southern B.C.	http://www.for.gov.bc.ca/ftp/RSI/external/!publish/Aerial_overview_surveys/ http://www.for.gov.bc.ca/rsi/ForestHealth/Overview.htm
Hazard Rating	District and Regional Forest Health Strategies	http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/TSA_FH_Strategies/
	Stand Establishment Decision Aids (Forrex)	http://www.forrex.org/stand-establishment-decision-aids-sedas
	RESULTS forest health distribution maps	http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/RESULTS%20incidence%20maps/
Regional Forest Health Specialists	Cariboo	David.Rusch@gov.bc.ca,
	Coast	Stefan.Zeglen@gov.bc.ca
	Kootenay Boundary	Michael.Murray@gov.bc.ca, Art.Stock@gov.bc.ca
	Omineca and Northeast	Jeanne.Robert@gov.bc.ca, Jewel.Yurkewich@gov.bc.ca
	Skeena	Ken.J.White@gov.bc.ca,
	Thompson Okanagan	Lorraine Maclauchlan@gov.bc.ca, David.Rusch@gov.bc.ca