4 MENSURATION

Contents

Appendices *Page*

Tables

Figures

MENSURATION

MENSURATION FORM

SURVEYOR(S): (1)

TREE#	SPP.	DBH	HEIGHT CALCULATIONS						HT. TO DBH	TOTAL HT.	BH AGE	SI	SUP.	CONK	BL. CONK	SCAR.	F. OR C.	F. CRACK	MISTLE.	R. BRAN.	D. OR B. TOP	DAMAGE		SITE SERIES
			TOP	BOT.	SD	SL.	HD	HT.														TYPE	SEV.	
(2)	(3)	(4)				(5)					(6)	(7)	(8)				(9)					(10)		(11)

NOTES

TREE DIAMETER TALLY

TREE #	SPP.	DBH	TREE #	SPP.	DBH

Field Procedure

Getting Started

1. Establish plot boundaries.
2. Traverse the plot systematically to identify candidate sample trees according to project objectives. If largest diameter trees are being sampled, use Tree Diameter Tally to assist in selection.
3. When numbering trees, start with the tree closest to due north of plot centre and proceed in a clockwise direction.

Measure and Record

1. Enter the name(s) of persons collecting mensuration data.
2. Record tree numbers and species of sample trees.
3. Examine each tree for evidence of suppression, pathological indicators, and pests or injury. If present, and if determining the site index is a primary objective of the project, select a different sample that is free of defects (if possible). If site index is not a primary objective, or no alternate defect-free trees exist, retain the sample and enter coding as appropriate.
4. Determine and record diameters and age at breast height. If age is to be determined later, place the collected core in a labelled straw.
5. Determine and record measurements for height calculations.
6. Calculate height, total height, and site index (or leave blank and calculate using *SiteTools* software and the data entry program VENUS).
7. If the site is variable, identify the site series code for the area around each tree, in consultation with other surveyors.
8. Check that all the required information has been collected and noted on the form. Strike through any fields that were not assessed.

Selecting Stands and Sample Trees for Mensuration

Stand selection criteria will depend entirely on project objectives. If the data is being collected to determine site index, stands should have the following characteristics:

- even-aged (preferably 20–150 years of age)
- dominated by one tree species (or target species > 60% of basal area)
- moderately dense
- ecologically uniform site of at least 400 m^2

When determining site index is not a primary objective, select the two or three largest diameter trees of each species for mensuration. If the data is being collected to determine site index, collect mensuration data on "top-height" trees that meet the following criteria:

- 100 largest diameter trees per hectare (largest 4 per 400 m^2 plot)
- dominant or co-dominant
- not wolf, open grown, or veteran
- straight-stemmed, free of disease, damage, and breakage
- free of suppression (above breast height)
- vigorous, with full crowns

Completing the Form

Numbered items below refer to circled numbers on the Mensuration form shown at the beginning of this section. A recommended sequence for completing the form is described under "Field Procedure."

1. Surveyor

Enter the first initial and last name of the person(s) collecting mensuration data.

2. Tree Number

Assign numbers sequentially to each tree sampled. Start with the tree closest to due north of plot centre and proceed clockwise. Numbers may be painted or tagged on trees.

3. Species

Identify tree species using the codes given in Appendix 4.1.

4. Diameter at Breast Height

Record DBH (diameter at breast height) to the nearest 0.1 cm. Measure at 1.3 m above the point of germination. On slopes, measure from the high side of the root collar.

5. Height Calculations

Record the following measurements: heights and distances in metres and slopes in percent. Tree height can be calculated in the field using equations and tables provided, or automatically using the data entry program "VENUS."

Slope to top of tree (TOP):
Enter the percent slope reading to the top of the tree, showing the sign (usually "+"). If a reading greater than 100% is obtained, move further from the tree, or upslope.

Slope to DBH or base of tree (BOT):
Enter the percent slope reading to DBH, or to the base of the tree, or to lowest visible point, including the sign ("+" or "–"). The maximum allowable is 100%.

Slope distance (SD):
Enter the distance (in metres, to one decimal) from the observer to the centre of the tree trunk, usually at breast height.

Slope (SL):
Enter the slope gradient between the observer and the tree at breast height (the slope of the measuring tape used to determine slope distance). This value is used in height calculations done by "VENUS."

Horizontal distance (HD):
Calculate this by multiplying slope distance (SD) by a slope distance factor from Table 4.1. The slope percent column in this table refers to the slope gradient measurement Slope (SL).

Height (HT):
Enter the height (m) of the measured part of the tree to one decimal, calculated as follows:
$HT = [(TOP - BOT) \times HD] \div 100$

Height to DBH (HT TO DBH):
If the BOT reading was not taken at the base of the tree, record the height at which it was taken. This is usually DBH, but can be another value. Enter "0" if taken at the base of tree.

TABLE 4.1. Slope distance factors

% slope	Factor	% slope	Factor	% slope	Factor
10	.995	36	.941	62	.849
11	.994	37	.938	63	.846
12	.993	38	.935	64	.842
13	.992	39	.932	65	.838
14	.990	40	.928	66	.834
15	.989	41	.925	67	.830
16	.987	42	.922	68	.827
17	.986	43	.919	69	.823
18	.984	44	.915	70[a]	.819
19	.982	45	.912	75	.800
20	.980	46	.908	80	.781
21	.979	47	.905	85	.762
22	.977	48	.902	90	.743
23	.974	49	.898	95	.725
24	.972	50	.894	100	.707
25	.970	51	.890	105	.690
26	.968	52	.887	110	.673
27	.965	53	.883	115	.656
28	.963	54	.880	120	.640
29	.960	55	.876	125	.625
30	.958	56	.872	130	.610
31	.955	57	.868	135	.595
32	.952	58	.865	140	.581
33	.950	59	.861	150	.555
34	.941	60	.857		
35	.944	61	.853		

[a] Interpolate for slopes between 70 and 150%.

Total height (TOTAL HT) :
The total height of the tree = HT + HT TO DBH

Note the following example calculation:

TOP = +62, BOT = –24, TOP – BOT = 62–(–24) = 86
SD = 20.5 m, SL = 23%, slope distance factor (from table) = 0.974
HD = SD × slope distance factor = 20.5 × 0.974 = 20.0
HT = [(TOP – BOT) × HD] ÷ 100 = (86 × 20.0) ÷ 100 = 17.2 m
HT TO DBH = 1.3 m
Total height = HT + HT TO DBH = 17.2 + 1.3 = 18.5 m

6. Age at Breast Height

Measure age at breast height, 1.3 m above the ground on the high side. The core must show the pith for the age to be accurate. Depending on the requirements of the project, counts may be done in the field using a hand lens. If greater accuracy is required, place the core in a plastic straw labelled with the plot and tree number and determine age later in the office. In some cases a microscope may be required to achieve an accurate count.

7. Site Index

Calculate site index (reference age 50) using the *Site Tools (version 3)* software available from MOF Research Branch.

8. Suppression

Ideally, trees selected for measurement should be free of suppression. If this is not the case, indicate by entering an "**S"** here, otherwise leave blank.

9. Pathological Indicators

Defects and pathological indicators are frequently signs of decay or rot in the wood. Identify the type of defect and determine if it is "suspect" (i.e., a probable indicator of decay). If suspect, enter a code under the type of defect observed, and indicate its location on the tree using the codes in Table 4.2.

TABLE 4.2. Defect location codes

Code	Defect occurrence on tree
1	Lower third only
2	Middle third only
3	Upper third only
4	Lower and middle thirds
5	Middle and upper thirds
6	Lower and upper thirds
7	Entire tree

Conks:
Fruiting bodies of stem decay fungi are reliable indicators of decay. They are typically thick, hard, and woody-like perennial structures that may appear anywhere on the main stem or branches, but that usually appear around knots and on the underside of dead branch stubs and live branches.

Blind conks:
"Swollen knots" (see Figure 4.1) are reliable indicators of decay. They appear as pronounced swellings or depressions around knots and are thought to represent an attempt to heal over decay emerging though a knot or branch stub. Bright yellow or buff-coloured material is found by chopping into basal branch stubs. Blind conks most often occur in the Interior.

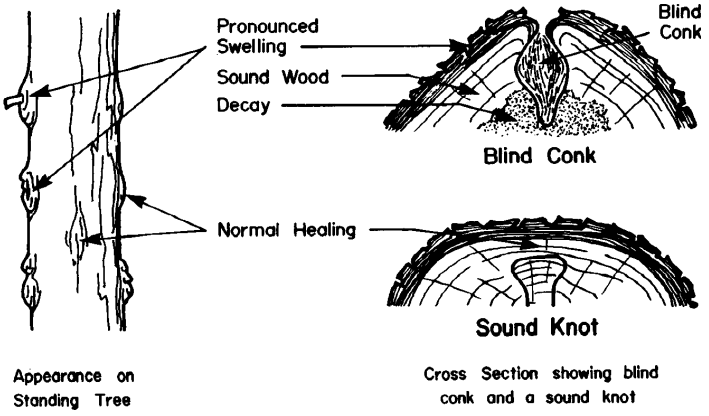


FIGURE 4.1. Blind conk and sound knot, on a standing tree and in cross-section.

Scars:

Scars result from past injuries caused by external forces that have damaged the cambium or heartwood, exposing the tree to wood decay fungi. These scars are considered suspect if located on the main stem or root collar, unless they are of recent origin (Figures 4.2 and 4.3).

Scars may be open or closed. *Open scars* are areas of exposed wood of varying size and shape from severe damage caused by fire, lightning, logging, machinery, etc. *Closed scars* may appear healed over, with slight to pronounced indentations of the bark, or there may be pronounced scar tissue or callous growth, often with abundant resin flow.

Several common types of scars are described below.

Fire scars – may appear as indentations, open catfaces, or hollowing of the trunk; usually confined to base of trunk.

Lightning scars – extensive damage to the trunks and tops of trees; strips of torn wood typically observed, often extending the entire length of the tree in a spiral.

Falling-tree scars – the fallen tree generally found against or near the scarred tree.

Logging or other machinery scars – selective cutting operations may cause extensive damage; usually on the base of the trunk, or the upper portion of the trunk if caused by rigging.

Old blazing – frequent entry points for wood-rotting fungi; do not record recent blazing.

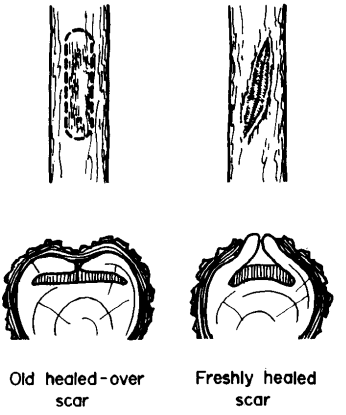


FIGURE 4.2. Appearance of scars that are old or freshly healed.

Scars caused by breakage – scars on trunks from the breakage of live branches or secondary leaders; breakage caused by high winds, heavy snow, or branches falling from adjacent trees.

Animal or bird scars – for example, woodpeckers can make large, deep holes in the trunk; bears, deer, moose, and elk may remove areas of bark and cambium; scars can be caused by bear claws and gnawing by beavers or other rodents.

Cankers caused by fungi – results in the death of localized areas of bark and cambium (Figure 4.4); dead bark is sloughed off, exposing underlying wood; usually evidence of repeated callous growth; may be mistaken for "mechanical" scars; usually flattened, elongated, and of irregular shape; exposed wood often stained and impregnated with resin; fruiting bodies of the fungus may be visible.

Scars caused by rock slides or falling rock – usually confined to base of trunk, however falling rock sometimes causes scars much higher on stem because of high snow levels or rocks bouncing; usually occur on the upslope side (Figure 4.5).

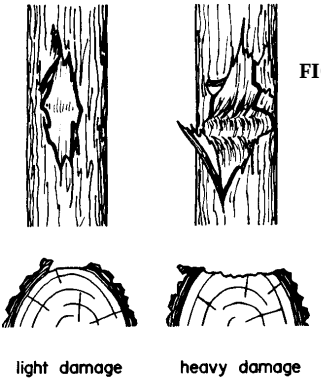


FIGURE 4.3. Appearance of scars with light or heavy damage.

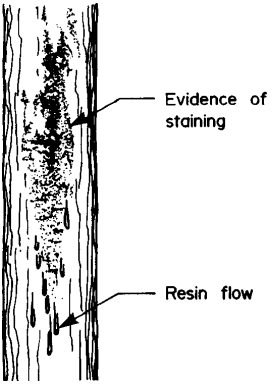


FIGURE 4.4. Appearance of cankers caused by fungi.

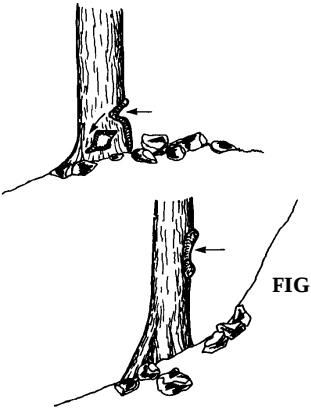


FIGURE 4.5. Appearance of scars caused by rock slides or falling rock.

Fork or crook (F or C):
Forks or crooks that develop after an early injury to the top of the tree are reliable indicators of decay (Figure 4.6). The following are not considered forks: candelabra branches; natural branching in deciduous trees; small, sharply angled branches or spikes, unless associated with a noticeable offset or diameter change at the location; flattening of tree tops caused by wind or physiological conditions where no terminal leaders are evident.

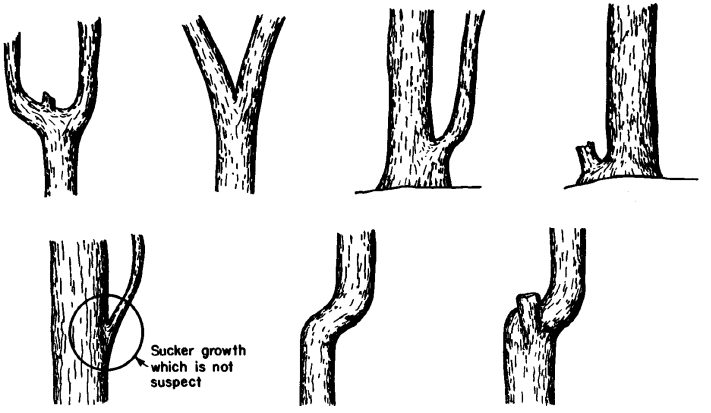


FIGURE 4.6. Appearance of different forms of forks and crooks.

Frost cracks (F. Crack):
Frost cracks are caused by uneven expansion of moisture in the tree following a sudden and pronounced drop in temperature. They result in deep radial splitting of the trunk and are considered suspect. Usually originating at the base of the trunk, frost cracks may extend many metres up the tree. These cracks are often re-opened by wind stresses or low temperatures; repeated healing of the wood produces considerable callous tissue, giving the wound a pronounced ribbed appearance (Figure 4.7).

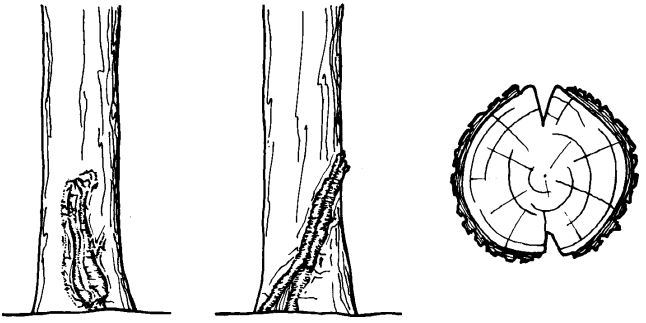


FIGURE 4.7. Appearance of frost crack on standing tree and in cross-section.

Mistletoe (Mistle):
Mistletoe infection may be indicated by either abnormal swelling or malformation of the trunk (see Figure 4.8A), or by clusters of dead and broken branches on the trunk, or on swollen branches adjacent to the trunk (see Figure 4.8B). Infection on branches should be noted only where swelling has extended to within 30 cm of the trunk (Figure 4.9).

(A) **(B)**

FIGURE 4.8. Examples of mistletoe infection.

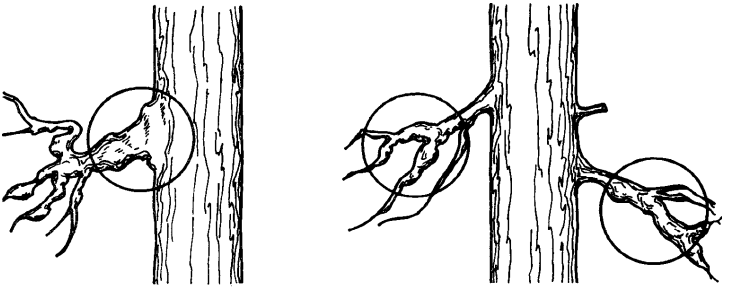


FIGURE 4.9. How to determine if mistletoe infection causes tree to be suspect.

Rotten Branch (R. Bran.):
Large, rotten branches, typically on old-growth trees often indicate decay. Note only those branches that are greater than or equal to 10 cm in diameter at the base and that are clearly rotten (usually on overmature trees) (see Figure 4.10A). Do not include small, dead branches typically just below the live crown or on the lower trunk of open-grown trees (see Figure 4.10B).

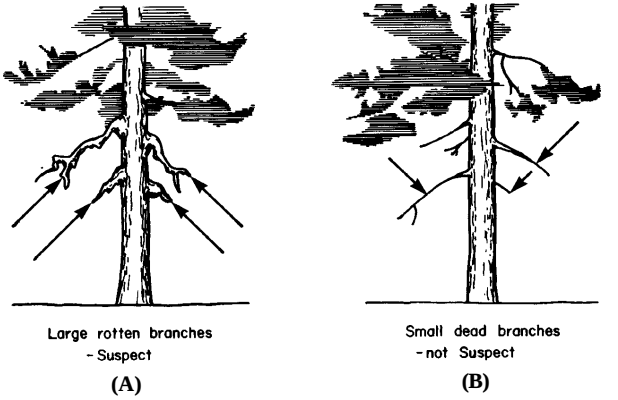


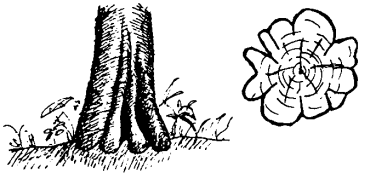
FIGURE 4.10. How to determine if rotten branches are a probable indicator of decay.

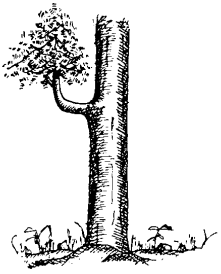
Dead or broken top (D. or B. Top):
These may be caused by wind, snow, mechanical damage from other falling trees, etc. Only note those not recent in origin (i.e., must be obviously weathered).

Non-suspect abnormalities:
The following features should *not* be recorded as "suspect" pathological indicators.

External evidence of butt rot not associated with suspect abnormalities
Butt rot may be evident in exposed roots or within root crotches. However, unless one or more abnormality which is considered suspect also appears on the tree, do not consider butt rot as an indicator of decay.

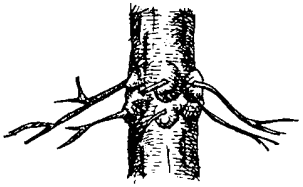
Flutes Pronounced flutes in the trunk (illustrated right) are characteristic of many species and do not signify decay.



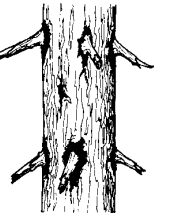


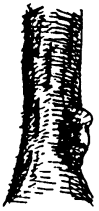
Candelabra branches Candelabra branches (illustrated left) develop as a result of abnormal branch growth and do not signify decay. They may be confused with suspect forking; unlike forks, however, they do not originate in the trunk of a tree.

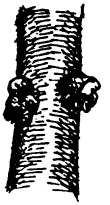
Branch fans A branch fan (illustrated right) develops through abnormal branching, appearing most commonly as a 'fan' of branches which originates from a burl-like swelling on the trunk. These are not considered suspect.



Black knots Black knots (illustrated right) frequently develop around unhealed knots and wounds. A superficial saprophytic fungus feeding on exuded sap causes the blackness. These do not signify decay.



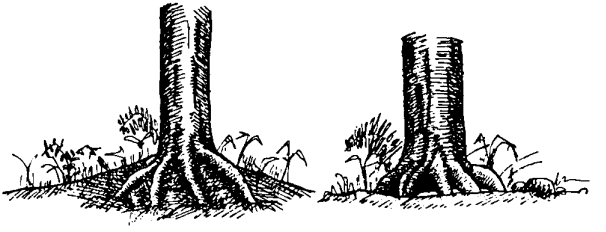




Burls and galls Burls and galls (illustrated left) develop from abnormal cell growth in trees. Although formidable in appearance, they do not signify decay.

Sweep Sweep refers to a slight curvature or distortion of the trunk (illustrated right). This does not indicate decay.

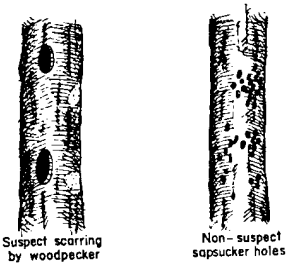
Exposed roots Exposed roots and buttress roots (shown below) do not signify decay unless scarring is present above the point of germination.



Spiral grain Spiral grain is a growth characteristic of some trees and does not signify decay.

Dry side Dry side results from the death of the cambium through bruising by other trees or other physiological causes. It appears as a narrow to wide strip or small localized area on the side of a tree, with the bark often remaining intact over the dead areas. Does not signify the presence of decay.

Sapsucker holes Sapsucker holes are superficial and do not signify decay. Do not confuse with the deeper scarring of woodpeckers.



Insect borings Borings by bark beetles or by other insects do not signify decay and are non-suspect.

10. Damage

Specify the type of damage agent and severity of effect on the tree. Damage agents may include insects, diseases, wildlife, competing vegetation, or abiotic agents. If more than one type occurs on the same tree, record the most damaging one.

Type of Damage (Type):
Specify the type of damage agent using codes listed in Appendix 4.2.

Severity of Damage (Sev.):
Rate the severity of the effect on the tree. Either assess subjectively using the following codes or leave blank (severity is difficult to assess without training).

L = Low
M = Moderate
S = Severe
P = Past attacks

11. Site Series

If the site is variable, enter the site series code for the area in a 4 m radius around the tree.

APPENDIX 4.1 Tree Species Codes

Conifers

Common name	Species	Code
Cedar	*Thuja*	
western redcedar	*T. plicata*	Cw
Cypress	*Chamaecyparis*	
yellow-cedar	*C. nootkatensis*	Yc
Douglas-fir	*Pseudotsuga*	
Douglas-fir	*P. menziesii*	Fd
interior Douglas-fir	*P. menziesii* var. *glauca*	Fdi
coast Douglas-fir	*P. menziesii* var. *menziesii*	Fdc
Fir (Balsam)	*Abies*	
amabilis fir	*A. amabilis*	Ba
grand fir	*A. grandis*	Bg
subalpine fir	*A. lasiocarpa*	Bl
Hemlock	*Tsuga*	
mountain hemlock	*T. mertensiana*	Hm
western hemlock	*T. heterophylla*	Hw
mountain x western hemlock hybrid	*T. mertensiana* x *heterophylla*	Hxm
Juniper	*Juniperus*	
Rocky Mountain juniper	*J. scopulorum*	Jr
Larch	*Larix*	
alpine larch	*L. lyallii*	La
tamarack	*L. laricina*	Lt
western larch	*L. occidentalis*	Lw
Pine	*Pinus*	
whitebark pine	*P. albicaulis*	Pa
limber pine	*P. flexilis*	Pf
jack pine	*P. banksiana*	Pj
lodgepole pine	*P. contorta*	Pl
lodgepole x jack pine hybrid	*P.* x *murraybanksiana*	Pxj
shore pine	*P. contorta* var. *contorta*	Plc
lodgepole pine	*P. contorta* var. *latifolia*	Pli
western white pine	*P. monticola*	Pw
ponderosa pine	*P. ponderosa*	Py
Spruce	*Picea*	
black spruce	*P. mariana*	Sb
Engelmann spruce	*P. engelmannii*	Se
white spruce	*P. glauca*	Sw
Sitka spruce	*P. sitchensis*	Ss
spruce hybrid	*Picea* cross	Sx

Conifers

Common name	Species	Code
Engelmann x white	*P. engelmannii* x *glauca*	Sxw
Sitka x white	*P.* x *lutzii*	Sxl
Sitka x unknown	*P. sitchensis* x *?*	Sxs
Yew	*Taxus*	
western yew	*T. brevifolia*	Tw

Hardwoods

Common name	Species	Code
Alder	*Alnus*	
red alder	*A. rubra*	Dr
Apple	*Malus*	
Pacific crab apple	*Malus fusca*	Up
Aspen, Cottonwood, Poplar	*Populus*	
poplar	*P. balsamifera*	Ac
balsam poplar	*P. b.* ssp. *balsamifera*	Acb
cottonwood	*P. b.* ssp. *trichocarpa*	Act
hybrid poplar	*P.* spp.	Ax
trembling aspen	*P. tremuloides*	At
Arbutus	*Arbutus*	
arbutus	*A. menziesii*	Ra
Birch	*Betula*	
Alaska paper birch	*B. neoalaskana*	Ea
Alaska x paper birch hybid	*B.* x *winteri*	Exp
paper birch	*B. papyrifera*	Ep
water birch	*B. occidentalis*	Ew
Cascara	*Rhamnus*	
cascara	*R. purshiana*	Kc
Cherry	*Prunus*	
bitter cherry	*P. emarginata*	Vb
pin cherry	*P. pensylvanica*	Vp
choke cherry	*P. virginiana*	Vv
Dogwood	*Cornus*	
western flowering dogwood	*C. nuttallii*	Gp
Maple	*Acer*	
bigleaf maple	*A. macrophyllum*	Mb
vine maple	*A. circinatum*	Mv
Oak	*Quercus*	
Garry oak	*Q. garryana*	Qg

Hardwoods

Common name	Species	Code
Willow	*Salix*	
peach-leaf willow	*S. amygdaloides*	Wa
Bebb's willow	*S. bebbiana*	Wb
pussy willow	*S. discolor*	Wd
Pacific willow	*S. lucida*	Wp
Scouler's willow	*S. scouleriana*	Ws
Sitka willow	*S. sitchensis*	Wt

Others

Common name	Species	Code
Unknown		
Unknown conifer		Xc
Unknown hardwood		Xh
Other tree, not on list		
Other conifer		Zc
Other hardwood		Zh

Exotics[1]

Common name	Species	Code
Apple	*Malus*	
apple	*Malus pumila*	Ua
Aspen, Cottonwood or Poplar	*Populus*	
*southern cottonwood	*P. deltoides*	Ad
Birch	*Betula*	
European birch	*B. pendula*	Ee
silver birch	*B. pubescens*	Es
Cherry	*Prunus*	
sweet cherry	*P. avium*	Vs
Cypress	*Chamaecyparis*	
*Port Orford-cedar	*C. lawsoniana*	Yp
Fir (Balsam)	*Abies*	
*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*	
*Siberian larch	*L. siberica*	Ls
Maple	*Acer*	
box elder	*A. negundo*	Me

Exotics[1]

Common name	Species	Code
*Norway maple	*A. platanoides*	Mn
*Sycamore maple	*A. pseudoplatanus*	Ms
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
Oregon ash	*Fraxinus latifolia*	Og
Pine	*Pinus*	
*Monterey pine	*P. radiata*	Pm
*red pine	*P. resinosa*	Pr
*sugar pine	*P. lambertiana*	Ps
Oak	*Quercus*	
*English oak	*Q. robur*	Qe
Spruce	*Picea*	
*Norway spruce	*P. abies*	Sn

[1] (*) Introduced species not known to occur on Crown Land, but requiring a code for database purposes, are indicated with an asterisk.

APPENDIX 4.2 Damage Agent Codes

Damage agent code			Description
A			**Animal Damage**
	AB		Bear
	AC		Cattle
	AD		Deer
	AE		Elk
	AH		Hare or rabbit
	AM		Moose
	AP		Porcupine
	AS		Squirrel
	AV		Vole
	AX		Birds
	AZ		Beaver
D			**Diseases**
	DB		**Broom rusts**
		DBF	Fir broom rust *Melampsorella caryophyllacearum*
		DBS	Spruce broom rust *Chrysomyxa arctostaphyli*
	DD		**Stem rot**
		DDA	Artists conk *Ganoderma applanatum*
		DDB	Birch trunk rot *Fomes fomentarius*
		DDC	Cedar brown pocket rot *Poria sericeomollis*
		DDD	Sulfur fungus *Laetiporus sulphureus*
		DDE	Rust-red stringy rot *Echinodontium tinctorium*
		DDF	Brown crumbly rot *Fomitopsis pinicola*
		DDH	Hardwood trunk rot *Phellinus igniarius*
		DDP	Red ring rot *Phellinus pini*
		DDQ	Quinine conk rot *Fomitopsis officinalis*
		DDS	Schweinitzii butt rot *Phaeolus schweinitzii*
		DDT	Aspen trunk rot *Phellinus tremulae*
	DF		**Foliage Disease**
		DFA	Western pine aster rust *Coleosporium asterum*
		DFC	Large-spored spruce-Labrador tea rust *Chrysomyxa ledicola*
		DFD	Spruce needle cast *Lirula macrospora*
		DFE	Elytroderma needle rust *Elytroderma deformans*
		DFH	Larch needle cast *Hypodermella laricis*

Damage agent codes		Description
	DFL	Pine needle cast *Lophodermella concolor*
	DFM	Larch needle blight *Meria laricis*
	DFP	Fir-fireweed rust *Pucciniastrum epilobii*
	DFR	Douglas-fir needle cast *Rhabdocline pseudotsugae*
	DFS	Redband needle blight *Mycosphaerella scirrhia pini*
	DFT	Sirococcus tip blight *Sirococcus strobilinus*
	DFU	Cedar leaf blight *Didymascella thujina*
DL		**Disease-caused Dieback of Leader**
	DLD	Dermea canker *Dermea pseudotsugae*
	DLF	Red flag disease *Potebniamyces balsamicola*
	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 dwarf mistletoe *Arceuthobium tsugense*
	DML	Larch dwarf mistletoe *Arceuthobium laricis*
	DMP	Lodgepole pine dwarf mistletoe *Arceuthobium americanum*
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 *Phellinus weirii*
	DRN	Annosus root disease *Heterobasidion annosum*
	DRR	Rhizina root disease *Rhizina undulata*
	DRT	Tomentosus root rot *Inonotus tomentosus*
DS		**Stem Disease (Bark 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	Cryptospaeria populina *Cryptospaeria populina*
	DSR	Ceratocystis canker *Ceratocystis fimbriata*

Damage agent codes			Description
		DSS	Stalactiform blister rust *Cronartium coleosporioides*
		DST	Nectria canker *Nectria galligena*
		DSY	Cytospora canker *Cytospora chrysosperma*
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 cone wooly aphid *Adelges lariciatus*
		IAS	Spruce aphid *Elatobium abietinum*
		IAX	Gall aphids or woolly aphids *Adelges spp.*
	IB		**Bark Beetles**
		IBB	Western balsam bark beetle *Dryocetes confusus*
		IBD	Douglas-fir beetle *Dendroctonus pseudotsugae*
		IBI	Engraver beetles *Ips* spp.
		IBM	Mountain pine beetle *Dendroctonus ponderosae*
		IBP	Twig beetles *Pityogenes, Pityophthorus* spp.
		IBS	Spruce beetle *Dentroctonus rufipennis*
		IBT	Red turpentine beetle *Dendroctonus valens*
		IBW	Western pine beetle *Dendroctonus brevicomis*
	ID		**Defoliators**
		IDA	Black army cutworm *Actebia fennica*
		IDB	2-year cycle budworm *Choristoneura biennis*
		IDC	Larch casebearer *Coleophora laricella*
		IDD	Western winter moth *Erannis 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*
		IDL	Western hemlock looper *Lambdina fiscellaria lugubrosa*
		IDM	Gypsy moth *Lymantria dispar*
		IDN	Birch leaf miner *Fenusa pusilla*
		IDP	Larch sawfly *Pristiphora erichsoni*
		IDR	Red alder sawfly *Eriocampa ovata*
		IDS	Conifer sawflies *Neodiprion* spp.
		IDT	Douglas-fir tussock moth *Orgyia pseudotsugata*
		IDU	Satin moth *Leucoma salicis*
		IDV	Variegated cutworm *Peridroma saucia*

Damage agent codes			Description
		IDW	Western spruce budworm *Choristoneura occidentalis*
		IDX	Large aspen tortrix *Choristoneura conflictana*
		IDZ	Western false hemlock looper *Nepytia freemani*
	IS		**Shoot Insects**
		ISB	Western cedar borer *Trachykele blondeli*
		ISE	European pine shoot moth *Rhyaconia buoliana*
		ISG	Gouty pitch midge *Cecidomyia piniiopis*
		ISP	Pitch nodule moths *Petrova* spp.
		ISQ	Sequoia pitch moth *Vespamina sequoiae*
		ISS	Western pine shoot borer *Eucosma sonomana*
	IW		**Root and Terminal Weevils**
		IWC	Conifer seedling weevil *Steremnius carinatus*
		IWM	*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 weevils *Cylindrocopturus* spp.
		IWZ	Yosemite bark weevil *Pissodes schwartzi*
	M		**Mites** *Trisetacus* spp.
N			**Non-biological Injuries**
	NB		Fire
	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

Damage agent codes			Description
	NW		Windthrow
		NWS	Windthrow soil failure
		NWT	Windthrow treatment or harvesting related
	NY		Snow or ice (includes snow press)
	NZ		Sunscald
O			**No Detectable Abiotic or Biotic Damage**
T			**Treatment Injuries**
	TC		Chemical
	TH		Harvested
	TL		Logging
	TP		Planting
		TPM	Poor microsite planting
	TM		Other mechanical damage (non-logging)
	TR		Pruning
	TT		Thinning or spacing
V			**Vegetation Problems**
	VH		Herbaceous competition
	VP		Vegetation press
	VS		Shrub competition
	VT		Tree competition