

FREE GROWING DAMAGE CRITERIA FOR MULTI-LAYERED STANDS IN BRITISH COLUMBIA

February 9, 2007

1.1. Introduction and Purpose

DISCLAIMER
<p>The following criteria are provided for information purposes only. The responsibility for defining the specific damage criteria to be used to assess the acceptability of the residual coniferous trees is up to the FSP preparer and what is accepted in the approved FSP. The following criteria may be considered the “default” criteria in the absence of alternate criteria contained in the FSP.</p>

Damage criteria are presented that will be used to assess the acceptability of residual coniferous trees retained in multi-layered conifer and mixedwood stands following harvesting. For definitions and background information about survey procedures and stocking standards, please refer to the *Stocking and Free Growing Survey Procedures Manual* available from Forest Practices Branch, May 2002.

These free-growing damage criteria are intended to help users consistently define “healthy” as part of “healthy, well-spaced trees” as used in the *Forest and Range Practices Act* and associated regulations. These criteria are designed for use during the free-growing assessment to determine the acceptability of **individual residual crop trees** (conifers only) across the province. Acceptability of a stand will depend on several factors including predetermined thresholds of damage and applicable stocking standards.

Listed in **Table A** are various types of damage, causal agents and species of trees. Agents and damage are referred to by their codes listed on the *Silviculture Damage Agent and Condition Codes* (FS 747) field form. Tree species codes are from the various *Establishment to Free Growing Guidebooks* (May 2000 revised) and the *Silviculture Survey Reference* form (FS 660).

There are several key points to keep in mind when using these criteria:

1. These criteria apply **only** at the time the free-growing survey is conducted and are specific to **conifer species only** in stands where two or more layers have been retained for regeneration purposes with the primary objective being the production of timber. The assumptions made on the impact of pest damage to residual crop trees are founded on these factors.
2. The free growing damage **criteria in the attached table are not legislated in regulation**. The district manager may allow or require deviations from these guidelines to adequately achieve land use and resource management objectives or to provide better results for forest resource stewardship.

3. Broadleaf species are noted in these criteria (usually as non-susceptible host species) but there are no damage criteria listed here for these species. This is because the characteristics of most broadleaf species (e.g., pests, growth habits, etc.) are sufficiently different from those of conifers that creating a single table would be difficult. Broadleaf species are covered under a separate set of standards.

These criteria are based on the best available data and professional opinion. They will be revised in the future, as new knowledge and information become available.

TABLE A. Free growing damage criteria for multi-layered stands. Criteria apply to all layers unless otherwise indicated.

LOCATION OF DAMAGE	TYPE OF DAMAGE	TREE BEING ASSESSED IS UNACCEPTABLE IF:	HOST SPECIES	LIKELY DAMAGE AGENTS & DAMAGE AGENT CODES	COMMENTS
STEM	WOUND (including sunscald and girdling)	<ul style="list-style-type: none"> Refer to table X for layers 1-4. 	All	squirrel AS, beaver AZ, vole AV, porcupine AP, hare AH, Warrens root collar weevil IWW, fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TT.	A wound is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (=scars) are acceptable.
STEM	DECAY	<ul style="list-style-type: none"> Any pathological indicator(s) are present. This may include conk, blind conk, frost crack, or rotten branches. 	All	various decay fungi DD.	
STEM	DEFORMATION (including crook, fork, and dead or broken top)	<p>These criteria apply to layer 1& 2 trees only. For layers 3 &4. use the even-aged damage criteria.</p> <ul style="list-style-type: none"> A crook displaces the portion of the stem above the defect by >50% from the line of growth formed by the stem below the point of defect in the bottom 2/3rds of the stem only. A fork occurs above stump height in the bottom 2/3rds of the stem only. A dead or broken top extends more than 20% of the stem length or the live crown is removed. 	All	defoliators ID, white pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, cattle AC, deer AD, elk AE, moose AM, frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TT, Dwarf mistletoes (see below).	
STEM	INFECTION (including cankers, and galls)	<ul style="list-style-type: none"> Any infection occurs on the stem. 	All	comandra blister rust DSC, stalactiform blister rust DSS, white pine blister rust DSB, western gall rust DSG, atropellis canker DSA, exploding canker DTNT, Dwarf mistletoes (see below).	Note: Wounds caused by rodent feeding around rust cankers should have stem rust recorded as the causal agent.
BRANCH	INFECTION (cankers)	<ul style="list-style-type: none"> These criteria apply to layer 2, 3 & 4 trees only. An infection occurs on a live branch less than 60 cm from the stem. 	Pw, Pi, Py	white pine blister rust DSB, comandra blister rust DSC, stalactiform blister rust DSS.	Branch infections on layer 1 trees can be ignored.
BRANCH	GALLS	<ul style="list-style-type: none"> These criteria apply to layer 2, 3 & 4 trees only. A gall rust infection occurs on a live branch less than 5 cm from the stem. 	PI, Py	western gall rust DSG.	Branch infections on layer 1 trees can be ignored.
FOLIAGE	DEFOLIATION	<p>For defoliating insects:</p> <ul style="list-style-type: none"> > 80% of foliage has been removed, lost or damaged due to foliage disease. <p>For foliar diseases:</p> <ul style="list-style-type: none"> > 50% of foliage has been removed, lost or damaged 	All	defoliators ID, foliage diseases DF.	
STEM or BRANCH	ADELGID GOUTING	<ul style="list-style-type: none"> Any adelgid gouting occurs on a stem or branch. 	Ba, Bg, Bl	balsam woolly adelgid IAB.	Gouting is defined as excessive swelling on a branch or shoot caused by balsam woolly adelgid, and is often accompanied by misshapen needles and buds. It is most common on branch tips and at nodes near the ends of branches. Consult a recent distribution map to identify the geographic extent of this pest.

LOCATION OF DAMAGE	TYPE OF DAMAGE	TREE BEING ASSESSED IS UNACCEPTABLE IF:	HOST SPECIES	LIKELY DAMAGE AGENTS & DAMAGE AGENT CODES	COMMENTS
STEM OR BRANCH	DWARF MISTLETOE INFECTION	<p>These criteria apply to layer 2, 3 & 4 trees:</p> <ul style="list-style-type: none"> Any infection occurs on the stem or a live branch, or A susceptible tree is located within 10 m of a higher layer tree that is infected with dwarf mistletoe. <p>These criteria apply to layer 1 trees:</p> <ul style="list-style-type: none"> Hawksworth rating >3, or severe stem infections (major swelling or deformity) present. 	Hw, Pl, Lw, Fd	hemlock dwarf mistletoe DMH, lodgepole pine dwarf mistletoe DMP, larch dwarf mistletoe DML, Douglas-fir dwarf mistletoe DMF.	<p>Note: To confirm infection, the surveyor must observe mistletoe aerial shoots or basal cups on regeneration or on live or dead fallen brooms.</p> <p>The Hawksworth rating system is described in the FPC <i>Dwarf Mistletoe Management Guidebook</i>.</p>
ROOTS	ROOT DISEASE	<ul style="list-style-type: none"> Sign(s) or definitive combinations of symptoms of root disease are observed. 	All	armillaria root disease DRA, laminated root rot DRL, tomentosus root rot DRT, annosus root disease DRN, blackstain root disease DRB.	<p>Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar thinning or chlorosis, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. Symptoms alone are not usually sufficient to identify root disease. Both signs and symptoms may be detected from old stumps, root balls, or other post-harvest remains.</p>
		<ul style="list-style-type: none"> Infected conifer found in plot. See Table Y for well-spaced tree net down calculation by layer. 	All	armillaria root disease DRA.	<p>Note: All conifer species are considered susceptible. Broadleaf species are considered not susceptible for survey purposes only.</p> <p>Example: How to apply net down for root disease.</p> <p>If root disease-infected trees are found in the plot:</p> <ol style="list-style-type: none"> Determine the number of healthy, well-spaced trees in each layer using the prescribed minimum inter-tree distance (MITD) (e. g., 3 layer 1, 3 layer 3 and 4 layer 4 = 10 healthy, well-spaced) ignoring the M-value; Count the number of infected trees (e. g., 1 layer 1 tree and 1 layer 3 tree); Working from the uppermost layer down, apply the multiplier in Table Y to each lower layer. Subtract the resultant from each layer in turn, for susceptible species only (e. g., if all trees are susceptible, 1 infected layer 1 tree removes 1 healthy, well-spaced layer 1 tree plus 3 layer 3 trees plus 4 layer 4 trees). Note the effects are cumulative, not exclusive and lower layers do not effect higher layers; Calculate the remaining healthy, well-spaced trees once all removals due to infected trees are completed (e. g. 10 – 8 = 2). The result is the maximum number of free growing trees tallied for the plot.
		<ul style="list-style-type: none"> Infected conifer found in plot. See Table Y for well-spaced tree net down calculation. 	Fd, Sx, Se Lw, Ba, Bg	laminated root rot DRL.	<p>Note: Bl, Cw, Pl, Pw, Py, and broadleaf species are considered not susceptible for survey purposes only.</p>
		<ul style="list-style-type: none"> Infected conifer or stump found in plot. See Table Y for well-spaced tree net down calculation. 	Se, Sx, Pl	tomentosus root rot DRT.	<p>Note: Ba, Bl, Cw, Fd, Pw, Py and broadleaf species are considered not susceptible for survey purposes only.</p>
		<ul style="list-style-type: none"> Infected conifer found in plot. See Table Y for well-spaced tree net down calculation. 	Ba, Hw, Ss	annosus root rot DRN.	<p>Note: Bg, Bl, Cw, Cy, Fd, Hm, Pl, Pw, Py, Sx and broadleaf species are considered not susceptible for survey purposes only.</p>

TABLE X. Tree wounding criteria for layers 1-4. Trees are unacceptable if any ONE criterion is met.

TREE SPECIES	STAND MANAGEMENT OBJECTIVE ¹			
	SHORT TERM RETENTION ² (Layers 1 & 2)	LONG-TERM RETENTION ³ (Layers 1 & 2)	UNEVEN-AGED MANAGEMENT ⁴ (Layers 1 & 2)	LAYERS 3 & 4
B, H, Lw, Ss and Cw <60 years	<ul style="list-style-type: none"> wound girdles >33% stem circumference, or wound on major root within 1 m of stem, or tree has gouge in stem. 	<ul style="list-style-type: none"> wound girdles >33% stem circumference, or one wound >400 cm² on stem, or wound on major root within 1 m of stem, or tree has gouge in stem. 	<ul style="list-style-type: none"> dead or broken top for 3+ years or >1 m, or wound girdles >33% stem circumference, or one wound >400 cm² on stem, or wound on major root within 1 m of stem, or tree has gouge in stem. 	<ul style="list-style-type: none"> See Table A10-1 in the Establishment to Free-Growing Guidebook.
Cy, Sx and Cw >60 years	<ul style="list-style-type: none"> wound girdles >33% stem circumference, or wound on major root within 1 m of stem, or tree has gouge in stem. 	<ul style="list-style-type: none"> wound girdles >33% stem circumference, or one wound >400 cm² on stem, or wound on major root within 1 m of stem, or tree has gouge in stem. 	<ul style="list-style-type: none"> wound girdles >33% stem circumference, or one wound >400 cm² on stem, or wound on major root within 1 m of stem, or tree has gouge in stem. 	<ul style="list-style-type: none">
Fd, Pw	<ul style="list-style-type: none"> wound girdles >50% stem circumference. 	<ul style="list-style-type: none"> wound girdles >33% stem circumference, or wound on major root within 1 m of stem, or tree has gouge in stem. 	<ul style="list-style-type: none"> wound girdles >33% stem circumference, or one wound >400 cm² on stem, or wound on major root within 1 m of stem, or tree has gouge in stem. 	<ul style="list-style-type: none">
Pl, Py	<ul style="list-style-type: none"> wound girdles >50% stem circumference. 	<ul style="list-style-type: none"> wound girdles >50% stem circumference. 	<ul style="list-style-type: none"> wound girdles >33% stem circumference, or wound on major root within 1 m of stem, or tree has gouge in stem. 	<ul style="list-style-type: none">

¹ The stand management objective should be specified in the site plan. Where it is not, the criteria for uneven-aged management should be applied.

² Where tree will be removed within 20 years.

³ Where tree will be removed in more than 20 years.

⁴ Where stand is managed in a true uneven state.

⁵ A gouge involves a wound where penetration is into the sapwood or deeper.

TABLE Y. Deductions from numbers of acceptable well-spaced uninfected stems for trees infected by root disease in uneven-aged stand layers.

Tree layer with infected tree(s) or stumps	Multiplier used to determine number of acceptable trees to be deducted from:			
	Layer 1	Layer 2	Layer 3	Layer 4
Layer 1	1	2	3	4
Layer 2		2	2	3
Layer 3			2	2
Layer 4				2

1.2. Layer 1 and 2: Mature and pole trees

Criteria for mature and pole (layer 1 & 2) trees currently exist in Table 10-2 in Appendix 10 of the various regional *Establishment to Free Growing Guidebooks* (May 2000 revised). Where residual crop tree acceptability is influenced by pests, it is expected that the criteria in Table A will replace those in Table 10-2. This table is provided for information only.

Table 10-2. Acceptability guidelines for mature and pole layer crop trees in uneven-aged stands

Wounds and Damage	<p><i>Tree Wounding and Decay Guidebook (multi-layered stands):</i> Trees with one or more of the following criteria¹ are unacceptable:</p> <ul style="list-style-type: none"> • Wound greater than one-third of the stem circumference • Wound greater than 400 cm² in area (except for Pl and Py which have no size limit) • Wound on a supporting root within 1 m of the stem • Gouge in the stem • For B, H, Lw, Ss, and Cw <60 years, dead or broken top representing three or more year's growth or longer than 1 m. For broadleaved species, dead or broken top.
Continuous Live Crown	An acceptable tree should generally have greater than 30% continuous live crown. However, for trees greater than 17.5 cm dbh (>12.5 cm dbh for Pli), greater than 20% live crown will be acceptable.
Vigour	Evidence of release.

¹ Definitions: A *wound* is an injury that removes a portion of the bark and cambium from the tree but does not penetrate into the sapwood. A *gouge* involves penetration into the sapwood or deeper. A *supporting root* is one that originates from the base of the tree and maintains a diameter greater than 2 cm.

1.3. Advanced Regeneration, Layer 3 and 4.

Criteria for advance regeneration (layer 3 & 4) currently exist in Table 10-1 in Appendix 10 of the various regional *Establishment to Free Growing Guidebooks* (May 2000 revised). Where residual crop tree acceptability is influenced by pests, it is expected that the criteria in Table A will replace those in Table 10-1. This table is provided for information only.

Table 10-1. Acceptability guidelines for layer 3 and 4 advance regeneration

Species ¹	Ba, Bl,	Cw ² , Hm, Yc	Hw		Sx, Se, Sw	Fdi, Lw	Pa, Pli, Py
BEC Zones	All ³	CWH, CDF, MH, ICH	CWH, CDF, MH, ICH (Pr.Rup.)	ICH (other regions)	All (except BWBS)	All	All
Height at time of release	No height limit		<0.5m		No height limit		
Wounds and damage	All species: No open (unhealed) injuries; no closed (healed) injuries with a horizontal width at the widest point(s), which is greater than 25% of the circumference of the tree at that point; no closed injuries that exceed 10% of the total length of the stem; no stem infection caused by a stem rust or dwarf mistletoe; no other externally visible pathological indicators including broken top, frost crack, conk, extreme basal sweep or unacceptable forks and crooks. See free growing damage criteria in Appendix 5, Establishment To Free Growing Guidebook, May 2000 version, for description of unacceptable forks and crooks.						
Continuous live crown	All species: An acceptable tree has greater than 30% continuous live crown. Continuous live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height. Continuous live crown refers to foliage on adjacent live green branches that forms the main part of the crown of a tree and extends over at least half of the circumference of the tree.						
Vigour	All species: Evidence of release (i.e., generally good post-harvest height increment) — Increased leader growth is not a requirement for trees in layer 3 and 4 in partial cut situations with low basal area removal where the trees remain heavily shaded by layer 1 and 2 trees.						
Other	Destructive sampling of a few stems is encouraged to ensure that most of						

¹ For those species not listed here, the normal free growing acceptability criteria apply

² Beware of sun scald. If advance regeneration western redcedar is to be used, check for incidence of heart rot.

³ All refers to zones where these species are acceptable

Considerations	the retained stems are sound. This is critical when heart rot susceptible species are retained as pole/mature residual crop trees and are listed as <i>preferred</i> in the SP.
-----------------------	---

1.4. Layer 3 and 4: Regeneration.

Please refer to Free Growing Damage Criteria for Age Class 1 (1 – 20 years) stands found in Appendix 5 of the various regional *Establishment to Free Growing Guidebooks* (May 2000 revised).