British Columbia's Dangerous Tree Assessment Process[1]

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Abstract

New dangerous tree assessment guidelines have recently been developed by the Wildlife Tree Committee of British Columbia. They are intended to provide information and technical procedures for assessing and safely retaining trees in various situations, ranging from parks and urban/municipal settings to industrial forestry activities and wildland fire fighting. The decision to retain a wildlife tree must include worker and/or public safety, the type of activity occurring around the tree, site factors and tree condition, and wildlife habitat values. These guidelines will be of interest to persons involved in any activity where the management of trees for wildlife habitat or other purposes is desirable.

Introduction

In British Columbia, the historical definition of a standing dead tree or "snag" has been: "*Any standing dead or dying tree over 3 meters in height.*" New Workers' Compensation Board Occupational Health and Safety Regulations (WCB 1998) were adopted into law effective April 15, 1998. With these new regulations, the term snag was replaced with *"dangerous tree."* According to section 26.1 of these regulations, a dangerous tree is now defined as: *"Any tree that is hazardous to workers because of location or lean, physical damage, overhead hazards, deterioration of the limbs, stem or root system, or a combination of these."*

Recently, new dangerous tree assessment guidelines and technical criteria were developed by the Wildlife Tree Committee of British Columbia in conjunction with the changes to the Workers' Compensation Board regulations. The guidelines were first pilot tested throughout British Columbia with a range of individuals experienced

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[1] An abbreviated version of this paper was presented at the Symposium on the Ecology and Management of Dead Wood in Western Forests, November 2-4, 1999, Reno, Nevada.

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in occupational health and safety, logging, forest pathology, and forest and wildlife ecology. This information was subsequently incorporated into the provincially sponsored "Wildlife/Danger Tree Assessor's Course" (see WTC 2001), which provides technical information and practical field skills to persons who wish to assess trees for hazards and wildlife habitat value.

Determining Tree Danger

The determination of a tree's failure potential (i.e., the likelihood that all or a portion of a tree will break), and ultimately whether or not it is dangerous, involves a four step process:

Step 1—Determine the level of ground or tree disturbance around the tree

Step 2—Conduct a site assessment overview

Step 3—Conduct a visual tree inspection

Step 4—Make the appropriate safety decision.

Step 1—Level of Disturbance

Various activities are associated with differing levels of ground or tree disturbance. Activities rated as low disturbance, such as surveys, tree pruning, or use of back country hiking trails, involve negligible ground or tree disturbance, and as a result expose people to very little danger. However, as the level of disturbance or exposure increases, such as with timber harvesting, heavy machinery use, or in high-use park facilities, the potential danger and risk of injury also increases. Consequently, potentially dangerous trees considered for retention in these situations must be carefully assessed for any hazards in order to determine tree failure potential and reach an appropriate safety decision.

Step 2—Site Assessment Overview

The determination of a tree's failure potential begins with a site assessment overview, which involves assessing forest health factors (e.g., root rots, insect damage), stand condition (e.g., age, tree species, presence of heart rots), soil profile and condition, and other site variables (e.g., windthrow hazard, slope, fire damage). The site overview provides a context for subsequent assessment of individual trees (i.e., it identifies overall site problems, such as damaged stands or root rot, which can influence tree failure).

Step 3—Visual Tree Inspection

The third step in the dangerous tree assessment process is a visual tree inspection, which results in a failure potential rating (low, medium, or high) for a given tree defect. Failure potential is rated according to tree species groupings, and considers the following factors: hazardous tops, large dead limbs, witches' broom, split trunk, stem damage (scarring, butt rot), thick sloughing bark, fungal fruiting bodies (conks, mushrooms), butt and stem cankers, tree lean, and root condition.

Four native tree species groupings have been identified: Douglas-fir-larch-pines-spruces; western redcedar and yellow cedar; hemlocks and true firs; and deciduous trees ("soft" hardwoods such as aspen, cottonwood, paper birch, maple, alder).

Failure potential ratings for a particular defect, such as stem damage, can be different based on the tree species grouping (e.g., cedars have a larger permissible stem scarring threshold than the other tree species groupings).

With adequate experience and training, the visual tree inspection can be an efficient process that usually requires only a few minutes per tree. If the visual inspection is inconclusive as to the condition of the tree (e.g., root rot is suspected based on the site assessment), a detailed tree assessment can be conducted in order to gather more information on the condition of the bole (stemwood shell thickness) and roots. This involves exploratory tests in the lower bole (e.g., increment boring, drilling, or sounding) and excavating and probing around the root collar.

Step 4—Making a Safety Decision

Once a failure potential rating has been determined from the visual tree inspection, a tree can be rated as either safe (S) or dangerous (D), depending on the level of disturbance or type of activity around the tree. This procedure is illustrated in *table 1.* A classification for coniferous trees is shown in *figure 1.*

Table 1—*Overall Tree Danger Rating.*

Level of disturbance	**Detection failure potential**		
	Low	**Medium**	**High**
1 (Low)	S[1]	S[1]	S[1]
2 (Medium)	S	S	D
3 (High)	S	S (for veteran and dominant conifers)[2] D (for all other trees)	D
4 (Very High)	S (for class 1 trees) S (for class 2 cedars with low failure potential) S (class 2 and 3 trees with no defects)[3] D (all other trees)	D	D

[1] For Low level (1) disturbance activities, any trees that have one or more of the following significant tree hazards will become D (dangerous):

- Insecurely lodged trees, or hung-up limbs or tops
- Highly decadent or unstable trees (e.g., >50 percent cross-section area stem damage, or >50 percent lateral roots damaged/unsound)
- Trees with recent high lean (>15 percent toward work area or target) and damaged root system/anchoring soil layer.

[2] Employ safe falling and yarding practices around trees assessed as SAFE with Medium failure potential; do not hit or disturb the trees, and fall and yard or skid away.

[3] Trees with no defects will not have any defect indicators other than small dead limbs or minor stem scrapes that are not associated with decay or loss of structural strength. Class 2 trees with no defects will usually be wind- or snow-snapped green trees. Class 3 trees with no defects will usually be insect kill, climate kill, or a recent light intensity fire where no structural tree damage occurred.

	LIVE		DEAD						DEAD FALLEN
			Hard			Spongy	Soft		
Tree class	1	2	3	4	5	6	7	8	9
						approx. 2/3 original height	approx. 1/2 original height	approx. 1/3 original height	
Description	**Live/healthy;** no decay or structural damage.	**Live/unhealthy;** internal decay or growth deformities or other structural damage (including stem damage, dead or broken tops); dying tree.	**Dead;** recently **dead,** needles or fine twigs present.	**Dead;** no needles/twigs; 50% of branches lost; only larger limbs remain; often loose bark.	**Dead;** most branches/bark absent; some internal decay.	**Dead;** very little branches or bark; sapwood/heart-wood may be sloughing from upper bole; decay more advanced; lateral roots of larger trees usually softening.	**Dead;** extensive internal decay; outer shell may be hard; lateral roots usually completely decomposed; hollow or nearly hollow shells.		**Debris;** downed trees or stumps.

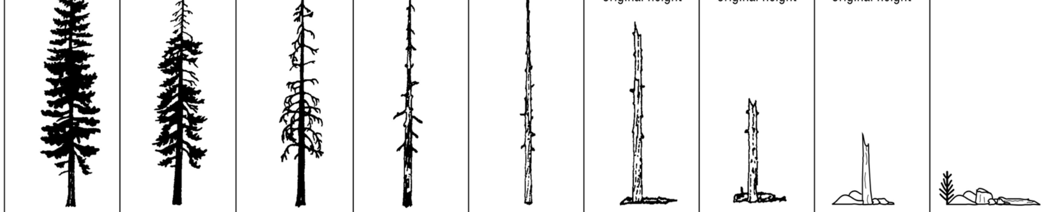

Figure 1—British Columbia's Tree Classification System (adapted from Maser and others 1979).

If a tree is determined to be dangerous for a particular type of work activity, then appropriate safety procedures must be implemented. These include removing the tree or any hazardous parts (e.g., top, limbs) or establishing an appropriately sized safe buffer area (called a *no-work* or *hazard zone*) around the tree to eliminate exposure to the hazard. However, if a tree is assessed as safe for a given type of activity, work can proceed up to the tree regardless of whether it is dead or live.

Inherent to the implementation of any safety decision is an understanding of the concept of *"risk." RISK = HAZARD x EXPOSURE*. For example, if there is exposure of workers to a dangerous tree or a *"target"* exists (e.g., buildings or equipment within striking distance of a dangerous tree), then an inherent risk of injury or property damage also exists. On the other hand, if there is no hazard (i.e., the tree is not dangerous) or there is no target exposure, then there is no or very minimal risk.

Applications

Wildlife tree patches and other stand-level reserves (e.g., riparian management areas) are generally the safest and most operationally efficient means of retaining wildlife trees and other biodiversity attributes at the stand level in forestry operations.

However, the new dangerous tree assessment process now facilitates retention of SAFE standing dead and SAFE live defective trees in forest harvesting operations outside of patches and reserves. This is particularly relevant to partial-cutting silvicultural systems, where the retention of individual standing dead and live defective trees is desirable in order to provide additional stand structure, wildlife habitat, and biodiversity values over time.

The dangerous tree assessment process can be applied to a variety of situations, including:

- Forest harvesting
- Silviculture operations such as tree planting and stand tending
- All silvicultural systems, but especially useful for partial-cutting systems such as variable retention, group selection, shelterwood, and single tree selection
- Wildland fire fighting
- Road sides
- Utility corridors
- Parks and recreation sites (e.g., trails, campgrounds and other developed facilities)
- Recreational wooded areas such as golf courses and ski hills.

With these "dangerous tree assessment tools" now available to forest managers, there can be more flexibility in the type, condition, density and location of retained trees in harvest blocks and other applications where the retention of trees is a management objective.

Dangerous Tree Assessment Research and Training

The description and quantification of tree conditions and defects, and the correlation to the likelihood of tree failure, has received relatively little research. There have been a few pioneering studies in this area, however, such as Wagener's assessment of tree hazards in California recreation sites (Wagener 1963). The findings of Wagener's research continue to be broadly applied in North American hazard tree and arboriculture management. Some researchers in the southeastern United States (Smiley and Fraedrich 1992) and in southern California (Matheny and Clark 1991) are relatively active in this field, as are Mattheck and Breloer (1997) in Germany.

In Canada, there is a general lack of research in the field of hazard tree pathology and applied management. However, in British Columbia, a research project has recently been completed (Manning 2001). This project collected quantitative data on visible external tree defects and corresponding internal tree conditions. Correlations were tested between the occurrence of external tree defects and the incidence of internal decay and the resultant loss of stem shell thickness. Highly significant differences ($p<0.001$) were found between the actual/expected stem shell thickness ratios for the three tree defect failure potential ratings (low, medium, high). This suggests a strong positive relationship between the actual shell thickness measured at the corresponding defect positions and the assigned failure potential rating for that defect. For example, where a high failure potential rating was recorded for a defect, such as a stem scar, the corresponding shell thickness at that position was less than the theoretical required shell thickness at the same position. Based on these correlations and related interpretations, the tree failure potential ratings and associated safety procedures used in the "Wildlife/Danger Tree Assessor's Course" (WDTAC) appear to be justifiable and reliable.

The results of this research will ultimately be used to improve dangerous tree assessment procedures and related safety training methods in the WDTAC. Three course modules currently exist for the WDTAC: forest harvesting and silviculture; wildland fire fighting; and parks and recreation sites.

The WDTAC is jointly sponsored by the British Columbia Ministry of Forests, the Workers' Compensation Board of B.C., and the B.C. Ministry of Water, Land and Air Protection. Specific details (e.g., level of disturbance/work activity ratings) and technical procedures associated with the four-step dangerous tree assessment process, as well as additional information about WDTAC modules, can be found on the Wildlife Tree Committee of British Columbia web site: www.for.gov.bc.ca/hfp/wlt/.

Acknowledgments

The authors would like to thank the members of the Wildlife Tree Committee of British Columbia and the WDTAC course instructors for their support in the development of the new dangerous tree assessment process. We would also like to thank Dr. Eric Allen (Canadian Forest Service), Dr. Duncan Morrison (Canadian Forest Service), and Alan Lundgren (TimberWest Forest Ltd.) for their help with tree pathology and development of defect indicators.

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