United States
Department of
Agriculture

Forest
Service

Alaska
Region

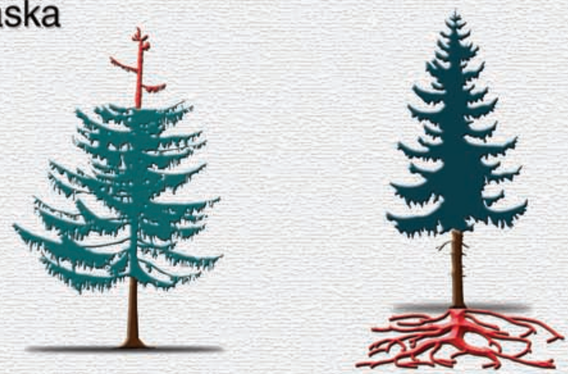
State and
Private Forestry

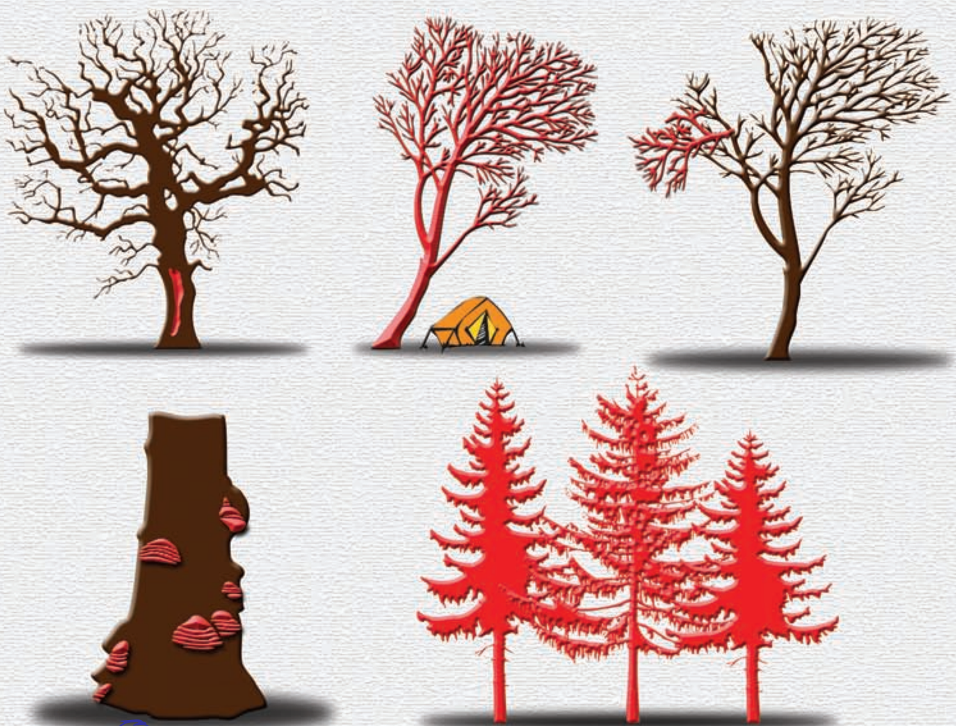
Forest Health
Protection

2009

Hazard Trees in Alaska

A Guide to the Identification and Management of Hazard Trees in Alaska





Hazard Trees in Alaska

A Guide to the Identification and Management of Hazard Trees in Alaska

Lori Trummer, U.S. Forest Service Pathologist
Paul Hennon, U.S. Forest Service Pathologist

Publication No. R10–TP–142
February 2009

Table of Contents

Chapter One
Introduction....................5

Chapter Two
Components of Tree Hazard Analysis.......11

Chapter Three
Tree Defects that Influence Hazard...19

Chapter Four
Hazard Tree Rating....................29

Chapter Five
Prevention and Maintenance................37

Chapter Six
Hazard Profiles of Alaskan Tree Species....................41

Chapter Seven
Backcountry Travel and Hazard Trees....................57

Acknowledgments....................61

References....................61

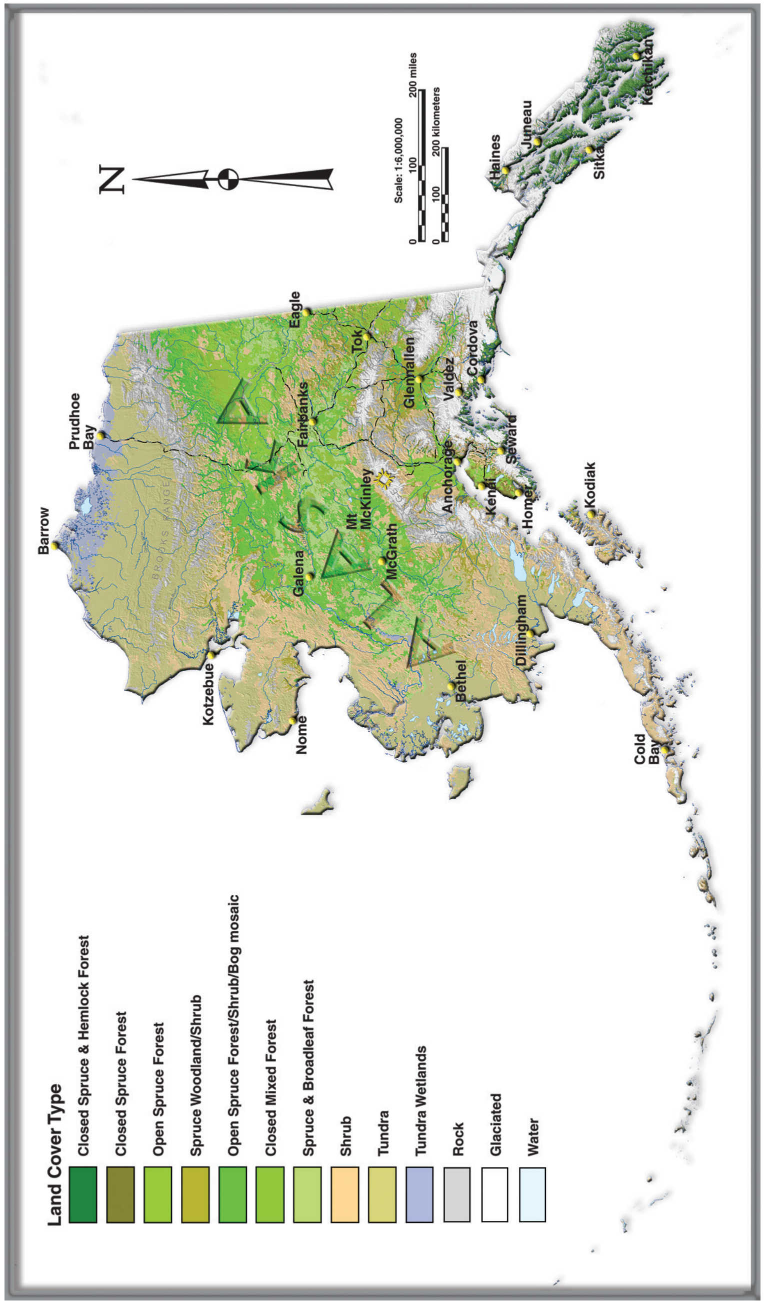
Introduction

Chapter 1

Insects, diseases, decays, and other forms of tree defect and mortality are important parts of a healthy, functioning forest ecosystem. They play many ecological roles in forests such as altering plant succession and providing wildlife habitat. In forest settings, trees die and fall to the ground where they become recycled. Although dying and falling trees are important in the development of forests, they are not welcome in high-use recreation areas where they risk human life and property.

People enjoy recreating in Alaska's forests, particularly forests with large old trees. Unfortunately, these are the very trees that often provide the greatest risk in terms of hazard. Large trees are more likely to contain significant amounts of internal wood decay and other defects. Also, because of their size, they can cause more damage when they fall. As long as people want to be around standing trees, there will be some level of tree failure risk. Thus, recreation managers are often faced with an apparent paradox—how to maintain safety for visitors while providing an aesthetic environment with large trees.

The goal of vegetation management in developed sites is to sustain the forest in an aesthetically pleasing condition while reducing unacceptable risk to visitors. A hazard tree program is an important part of vegetation management. However, simply identifying and treating hazard trees is only a short-term approach. Careful vegetation management is the key to sustainable healthy forest conditions that will provide desired benefits and produce a minimum of hazard trees in the future.



The forests of Alaska encompass 51.4 million hectares and stretch from the coastal forests of Southeast Alaska through the boreal forests of Interior Alaska.

This book was designed to provide managers with basic information about hazard trees. We present the information with a logical flow from hazard tree concepts to recognition, evaluation, and lastly prevention. Hazard profiles of Alaskan trees are included that describe the common defects and a general failure potential for the various tree species. A chapter is included on safe backcountry travel principles around hazard trees. References are included for further information on this topic.

What is hazard?

Hazard is the exposure to the possibility of loss or harm. With regard to trees, it is the potential that a tree or part of a tree will fail and cause injury or damage property. All standing trees of sufficient size, alive or dead, present some hazard. All trees will eventually come down. But high potential for tree failure by itself does not automatically mean a tree is hazardous. Hazard exists when a tree is within striking distance of an object of any value.

Hazard is the potential that a tree or tree part will fail and cause injury or damage property.

Thus, a tree is considered potentially hazardous if:

- it has defects which predispose all or part of the tree to failure, and
- it is located so that the failure poses a threat to people or property.

Hazardous trees may occur in both the urban or wild land setting.

Why be concerned about hazardous trees?

Moral obligations

Few visitors to recreations areas are experts on trees. Managers cannot assume that visitors will be able to evaluate hazardous trees and avoid them. Visitors will be either oblivious to the possibility of hazard trees or they will assume that managers have eliminated such trees. Thus, managers have some moral obligation to provide a relatively safe environment for visitors.

Legal obligations

Visitors assume some level of risk when they recreate on public lands, but managers who create and maintain designated recreation areas are responsible for ensuring visitor safety for reasonably foreseeable hazards. The Federal Tort Claims Act generally holds the federal government liable in the same way as a private party for negligent acts committed by federal employees in the course of their employment. Failure to inspect and treat known hazard trees in developed recreation areas may be considered negligent. Informing visitors of potential hazards (e.g. by signs) does not always eliminate the danger to visitors or the risk of liability. It is the responsibility of managers to inspect and correct the most serious threats or foreseeable dangerous conditions in order to minimize the potential for injury to visitors or damage to property.

Managers of designated recreation areas are responsible to inspect and treat known hazard trees.

Generally, liability in cases that involve injuries or damage resulting from hazard trees is based on what a reasonable professional in the situation would have done. If a manager knew, or should have known, of a hazard but failed to take reasonable actions to alleviate the hazard, the federal government may be liable for negligence. The individual manager may also be personally liable if such inaction is considered beyond the scope of his/her employment. A hazard tree program is an important tool to ensure the safety of visitors and help avoid liability. At a minimum, a hazard tree program consists of trained individuals inspecting trees on a regular basis, taking mitigating measures on trees that are judged to be the highest risk hazards, and documenting actions taken to mitigate hazards. The level of training provided to tree inspectors and the forms used to demonstrate inspection are critical components of establishing that the agency took proper actions to alleviate hazards. Thus, training and documentation are essential components of a hazard tree program.

Training of hazard tree inspectors is an essential component of a hazard tree program.

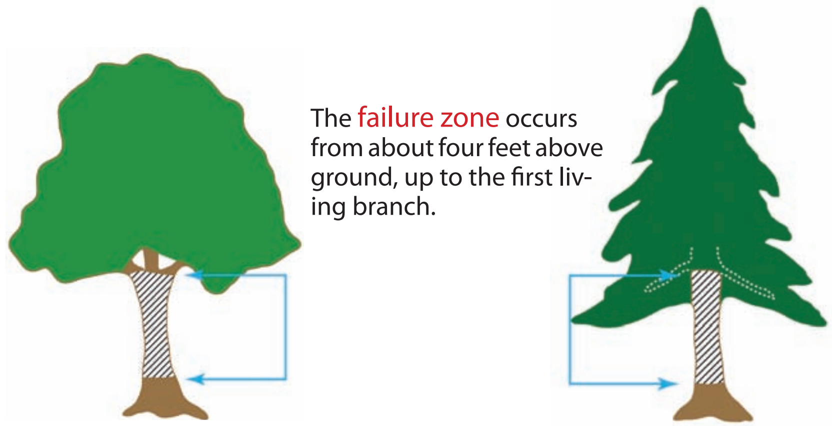
Hazard increases with four factors:

A. Potential for tree failure
B. Potential for striking a target
C. Potential for serious damage of the target
D. Value of target.

These factors are treated below and later used in an example of a quantified hazard rating system.

A. Potential for Tree Failure.
Estimating the potential for tree failure is challenging because of many interacting variables. Failure potential is estimated by examining a tree, determining defects that contribute to weakening or failure, and estimating the potential for failure before the next inspection period.

The location of a defect can be critical factor when determining the hazard level of an individual tree. Tree stems have a zone called the failure zone which receives greater strain than wood above or below it. The failure zone occurs from about four feet above the groundline up to the lowest living branch. If defects occur within this zone, failure potential is increased.



B. Potential for Striking a Target

A hazardous situation requires

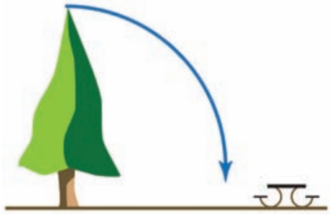
- a defective tree and
- a potential target.

Trees or tree parts that could fall on a potential target need to be inspected regularly.

Needs inspection

Tree could fall on potential target.

Does not need inspection



Tree would not reach the potential target.

Courtesy of MN DNR

The potential for a tree or tree part to strike a target is determined by evaluating where failed trees will likely land and whether the strike zone is occupied by a target at the time of failure. Moving targets are less likely to be struck than stationary targets.

Variables to consider include:

- Is the tree in striking distance of parking areas, tent pads, picnic areas, fire rings, restrooms, or children's play areas?
- Timing of probable failure and use of the area. Are some targets absent (people) when failure is likely (winter)?
- Is the tree leaning towards the target? Strong winds and other factors, however, may alter the direction of fall.

Trees in striking distance of picnic tables require regular inspection.

C. Potential for Serious Damage

The potential for serious damage depends upon size of failed portion of tree (e.g., limbs, or size of entire tree in complete tree failure). Consider that some structures far from a hazard tree may not be seriously damaged if the top of a tree strikes, but a structure close to a hazard tree may be demolished if the bole strikes.

D. Value of Target

The value of a target depends upon the maximum extent of loss if the target is struck by a failed tree. Values are typically expressed in relative terms such as low, medium, and high. Obviously, target value is at a maximum when human life is at risk. Examples of low value targets may be garbage cans, and information boards when people are not present.

Other Factors Affecting Hazard Level

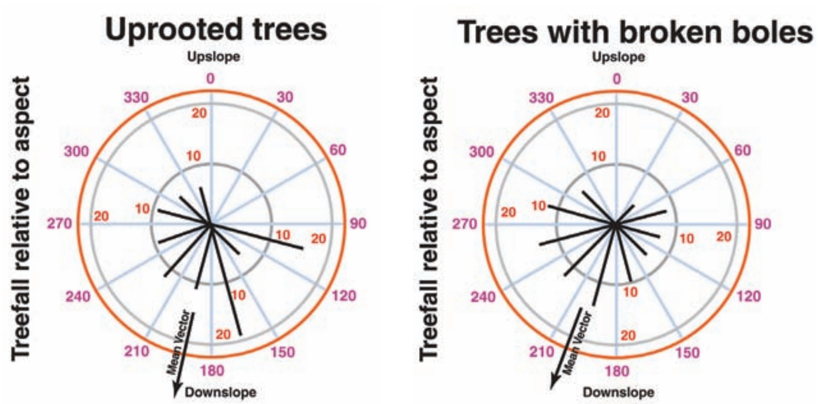
Additional factors to consider when assessing hazard level include

- site factors
- tree age and size
- tree species

Site Factors

Site factors to consider include exposure to wind, especially prevailing wind during storm seasons, slope, soil conditions, and history of tree failure. Trees that have lived most of their lives in an exposed condition are usually well-adapted to wind. A higher potential for failure exists when stands are opened through thinning, other forms of management, or natural causes (wind events, fire, etc.). Trees with a high height to diameter ratio (e.g. tall trees with skinny boles) are more susceptible to wind damage.

Recent research in old-growth stands in southeast Alaska, indicates slope has a strong influence on tree failure direction. In most cases, trees fall downslope. While this seems obvious, it is an important factor in evaluating whether a tree has the potential for striking a target in the event of failure. Targets located upslope of hazardous trees have a lower potential for being struck than those located on the downslope side.



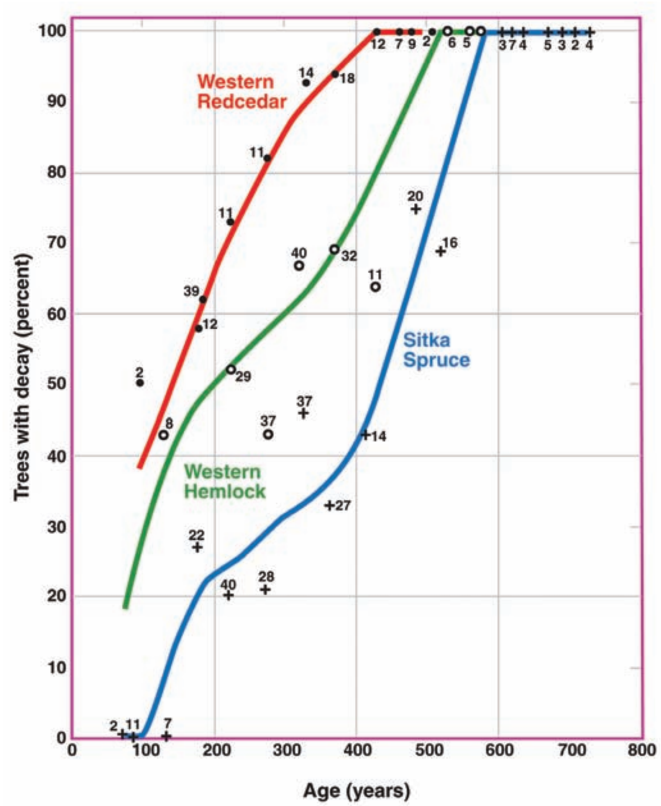
Polar diagram of tree failures for trees with broken boles and uprooted trees. Note that the direction of tree failure was predominantly downslope, indicating that targets upslope have a lower potential of being struck. Of course, trees can fall in any direction and targets upslope from a tree are not necessarily safe.

Tree Age and Size

Large trees present a greater hazard because they can strike targets at considerable distance and cause more damage when they fail. Defect, especially heart rot, is highly associated with tree age.

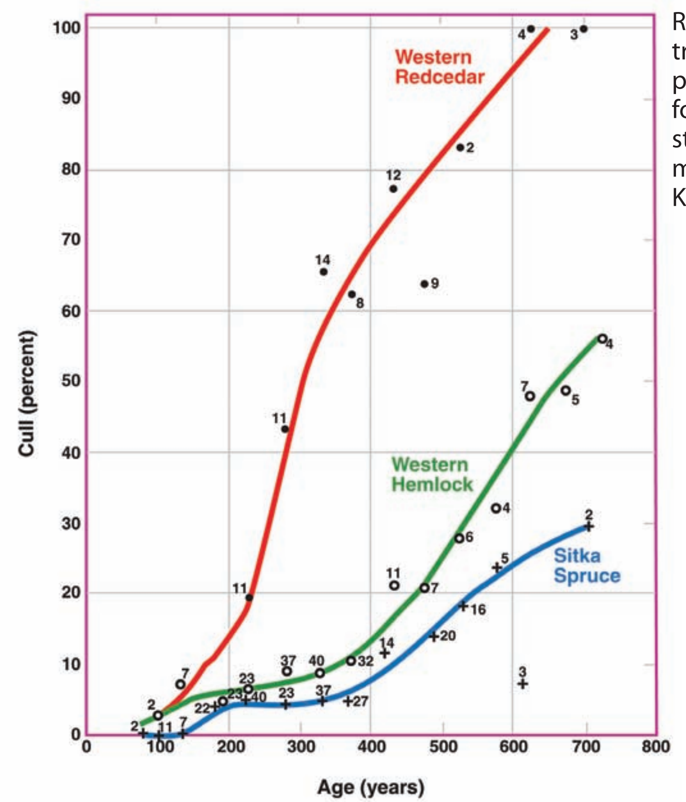
Tree species have a characteristic lifespan and the risk of tree failure increases as they reach maturity. For example, paper birch and aspen trees less than 60 years old are generally free of stem and root decay and thus have a low failure

potential. However, birch and aspen over 90 years old routinely have extensive heart and root rot. Thus, older birch and aspen trees constitute a higher failure potential than younger trees. Similar relationships of higher failure potential have also been noted for older conifer trees in Southeast Alaska.



Relationship of tree age to the percent of trees with decay. (Graph modified from Kimmey 1956.)

The amount of decay in trees is highly correlated with tree age. Note in the preceeding figure how the percentage of conifer trees with any decay increases sharply after trees are about 100 years old. Very few trees over 500 years old are completely free of decay. Note also the differences by tree species.



Relationship of tree age to the percent of cubic foot cull in the stem. (Graph modified from Kimmey 1956.)

Also, the graphs depict that the amount of decay increases sharply in trees over 400 years old. Western hemlock has more decay than Sitka spruce across all tree ages. Western redcedar is even more defective than either hemlock or spruce.

Tree longevity is an important factor to consider both when evaluating tree hazards in developed recreation sites and when selecting locations for new sites. Short-lived species, such as aspen and paper birch, should be avoided unless plans are made to regenerate or replace these species as they reach maturity.

Large trees are a greater hazard because they can strike distant targets and cause more damage when they fail.

Tree Species

Each tree species has its respective defects that affect the failure potential of the tree or sections of the tree. From this general information, preliminary hazard profiles of Alaska tree species have been developed (see Chapter 6). For each tree, profiles include their general potential for failure and the specific types of defect or injury that indicate failure potential. As more information becomes available through research or monitoring of failures at recreation sites, the profiles will be refined.

Birch trees have higher defect at younger ages than late successional species such as spruce.

Tree Defects that Influence Hazard

Common indications of defect in Alaska trees include: cracks, lean, root damage, top damage, internal decay, scars and stem cankers, dead trees and branches, and insect boring dust at the base of the tree. The unique symptoms and associated probabilities for failure of the defect categories are presented below.

1. Cracks

Cracks are the number one hazardous defect because they indicate the tree is already failing. Cracks need to be evaluated very carefully. They may or may not indicate substantial amounts of internal wood decay. Sometimes, cracks form as a consequence of massive internal decay as the tree buckles in the wind. Cracks near major branch unions can also indicate that trees have begun to fail, sometimes without associated heart rot. In other cases, bark cracks are caused by frost or some weather extreme and may or may not indicate decay or immediate failure. Careful evaluation using an increment borer or drill will help indicate extent of any associated decay.


Hemlock stem crack.


Birch frost crack.

High Failure Potential

- A crack goes completely through the stem or branch.
- Stem has two cracks on the same segment with a cavity or extensive decay on the inside.
- Stem has a crack in contact with another defect (canker, decay, weak branch union, leaning).
- Tree has a single crack with in-rolled bark and cavity or decay are inside.

2. Lean

Leaning trees or large branches do not always indicate high failure potential. If the lean is a recent change, the potential for failure is much higher than if the tree is a "long-term leaner." A tree that has been leaning for a long time will try to compensate for the lean by straightening the growth at the top of the tree. This corrected lean is a sign of a strong root system, indicating the tree may be fairly stable. A tree without corrected lean suggests the lean occurred recently—a potentially more hazardous situation. The direction of lean can give a strong indication of where the tree will probably fall. This knowledge can help evaluate the likelihood of a tree striking a target.

Trees with greater than a 10 degree lean may be unstable and should be monitored for potential failure.

High Failure Potential

- Freshly leaning tree with recent root-lifting, soil movement or mounding near base.
- Inadequate root support, greater than half of the roots severed inside drip line.
- Lean associated with unstable soils or cracks in the tree.
- Leaning over a target with greater than 45° angle to the lean.
- Tree with other defects leaning over target.

Uprooting due to tomentosus root disease caused by Inonotus tomentosus.

3. Root damage, including root disease

Because of cold soils and sometimes excessive moisture, many trees in Alaska have shallow root systems. Their root systems are easily damaged or killed. Trees with damaged or dead roots are more likely to uproot causing the whole tree to fail during wind storms. Trees in forests that are opened up due to thinning, the removal of adjacent hazard trees, or natural causes (wind events, fire, etc.) are more susceptible to windthrow. Exposed roots can be wounded in the same manner as tree boles and lead to the same problems of invasion by wood decay fungi. Undercut root systems are often encountered along streams and areas of road building.

Adequate root support may be compromised on trees with extensive exposed root systems.

Two Major Types of Root Problems.

- Undermined or Undercut Roots. These conditions are caused by mechanical damage/root severing or soil erosion. Undercut root systems are often encountered along streams and areas of road building. Trees with undermined roots have a high potential for failure.
- Root and Butt Diseases. Root and butt rots are caused by a number of fungi and are responsible for one of the most serious defects affecting trees in recreational areas. Learn to recognize the leading root disease fungi, especially Phaeolus schweinitzii and Inonotus tomentosus.

For more information on rot and butt rot fungi refer to Insects and Diseases of Alaskan Forests.

High Failure Potential.

- Inadequate root support; tree has more than $^1/_2$ of the root system decayed or severed inside the drip-line.
- Freshly leaning trees with evidence of recent root-lifting, soil movement, mounding near base of tree, or broken/decayed roots.

4. Top damage

This defect is usually fairly simple to recognize. Dead tops can result from various forms of damage, including root disease, stem cankers, animal feeding and soil problems. Forked tops need to be evaluated carefully because they may or may not be hazardous. If the tree forked because its top was broken out or killed, it may have internal wood decay around the fork. Look for cracks, conks, or other signs that the fork is beginning to fail.

Forked and broken top.

Broken top.

Dead spike top.

High Failure Potential.

- Broken tops with adjacent branches unhealthy.
- Large forked tops.
- Dead large tops and branches, especially if broken and lodged in other branches.
- Heavy U-shaped branches formed when side branches turn up to become leaders.

5. Internal decay

Decay is a leading cause of tree failure, but is difficult to observe in some trees. Hemlocks, cottonwood, birch, and aspen are all very prone to high levels of heart rot, but heart rot is common in all tree species of Alaska. Decaying trees can be prone to failure, but the presence of decay, by itself, does not indicate that a tree is hazardous. Thus, when heart rot is discovered in a tree, it is important to determine its extent and the amount of sound wood. Regarding failure potential, experience suggests using the One Third Rule. In most cases, visible indicators can be used to identify trees with heart rot. The most reliable indicators of decay are conks and mushrooms. Other indicators include large exposed wounds, broken or dead tops, and cracks.

Internal decay can be difficult to observe but is a leading cause of tree failure.

High Failure Potential.

- Less than $^{1}/_{3}$ of the tree's radius (or diameter) is sound. This is the One Third Rule for evaluating failure potential.
- Rot in a tree's failure zone; the area from about four feet above the groundline up to the lowest branch.
- Cavity, decay or fruiting body associated with an open crack or a weak branch union.

One Third Rule

Trees have a high rate of failure when less than $^{1}/_{3}$ of its radius (or diameter) is sound.

Relatively safe.
More than $^{1}/_{3}$ radius or diameter is sound.

Marginal.
About $^{1}/_{3}$ radius or diameter is sound.

Likely to fail.
Less than $^{1}/_{3}$ radius or diameter is sound.

Thus, if a tree with an 18" diameter (9" radius) has a column of wood decay in its center, then, at a minimum 3" of sound wood should be present in the outer wood for the tree to pass the One Third Rule.

Tree Diameter	Minimum Sound Wood Needed
9"	1.5"
18"	3"
30"	5"
48"	8"

This Rule needs to be modified when an exposed scar is present; an additional 25% sound wood is needed to provide more support. For example, an 18" diameter tree with a scar would need a minimum of 4" of sound wood to pass the One Third Rule.

Decay Indicators:


Conks on base of tree.


Large exposed wound.


Broken top.


Crack.

6. Scars and Stem Cankers

Unless a tree is scarred all the way around the circumference of its bole, scarring alone does not usually kill trees. Invasion by decay fungi is often the most serious aspect to a scar. Trees with scars, especially old, large scars should be evaluated very carefully for the extent of internal wood decay. Trees with exposed scars need more sound wood than the One Third Rule to be considered anything but a high hazard potential. Use an increment borer to determine the extent of decay.


Scar from moose damage.

High Failure Potential.
- Scar present with associated fungi fruiting bodies
- Scar or canker present with associated internal decay
- Multiple scars or cankers affecting more than $^{1}/_{2}$ of the tree's circumference

Cankers caused by fungi can look similar to exposed scars. Cankers are localized dead areas in the bark of stems and branches. The presence of

a canker increases the chances of stem breakage near the canker. A tree with a canker that encompasses more than half of the tree's circumference may be hazardous even if exposed wood appears sound. Thin barked and easily wounded, trembling aspen and paper birch are highly susceptible to invasion by canker fungi.


Canker caused by Ceratocystis fimbriata on aspen.


Canker caused by Nectria galligena on paper birch.

7. Dead branches

Depending upon the location of targets, dead branches may or may not present a hazard. Hanging dead branches are likely to fail soon and should be treated immediately if a target is nearby.

High Failure Potential.
- Any dead branch.
- A broken branch that is hanging or lodged in the crown.

8. Dead trees

Dead trees are simple to recognize and among the most likely to fail. Dead trees should typically be removed immediately, because once a tree dies, decay organisms invade and structurally weaken the stem. Large limbs and the top often break out of the crown before the entire tree fails. All Alaska trees other than western redcedar and Alaska yellow-cedar decay rapidly after death. Spruce killed by bark beetles in particular are rapidly invaded by saprots which quickly compromise the structural stability of the tree.


Dead trees are extremely hazardous and have a high failure potential.

High Failure Potential.
The stability and structural soundness of dead trees is severely compromised. Dead trees or sections of dead trees could fail at any time.

9. Carpenter Ants

Live trees with heartrot may be invaded by carpenter ants, further compromising the structural integrity of a tree. The ants specifically select softened wood to tunnel into for shelter and brood raising, but they do not eat the wood. Presence of carpenter ants can be detected by piles of boring dust at the base of a tree. Suspect trees should be increment cored or drilled to determine sound wood thickness and whether the tree passes the One Third Rule.


Carpenter ant boring dust at tree base.

Which Trees Should Be Evaluated?

Trees are not considered hazardous and need not be evaluated if they are not within striking distance of a target. This can be determined by measuring the height of the tree and distance from the base of the tree to any potential target. Some experts suggest systematic evaluations be made at least annually.


Courtesy of MN DNR

Every tree will ultimately fail unless removed. The task in rating hazard is to estimate the probability of failure during a specific period.

In recreation sites, areas can be stratified into tree hazard risk zones (High, Medium, Low) prior to inspection. Inspection intensity should vary directly with risk level. All trees within falling distance of targets (structures, vehicles, or people) should be inspected. The height of hazardous trees projected to the ground determines the width of the hazard zone. All trees within areas of intensive public use should be evaluated. Special attention should be given to trees eight inches or greater in diameter at breast height, since two-thirds of reported failures occur in trees of this size.

Courtesy of U.S. Forest Service—Region 2

Recreation areas can be divided into hazard risk zones which determine the intensity of evaluation.

The High Risk Zone includes high use areas with many people, parked vehicles and permanent structures. This zone is the highest priority for regular inspections and treatment. The Medium Risk Zone are areas with intermittent use by people and moving vehicles. The priority for inspections in this zone is based on amount and type of use. The Low Risk Zone includes areas lacking vehicles or structures with low visitor use. Regular inspections and treatment in this zone have low priority.

The purpose of a hazard tree evaluation is NOT to remove every tree that has defects; rather, the goal is to preserve the greatest number of trees in recreation areas consistent with safety. Removal of too many trees in an area can destroy the aesthetic qualities for which the site was selected. Also, stand stability may be affected and the probability of wind-throw increased.

Camping sites are a high use area and a high priority for regular inspections.

Hazard Rating System

All hazard tree programs need to have some method of objectively evaluating hazard. A quantified hazard rating system is recommended. Below is a rating method that has been developed in Region 6 of the USFS. Other systems can be used as long as they combine values of the two necessary components: A) potential for tree failure and B) potential and seriousness of damage in the case of a tree failure.

Tree Hazard Rating Score =
Potential for Failure + Potential for Damage

A. Potential for Tree Failure. This component addresses the potential for tree failure in a specific time frame. Ratings are on a scale of 1 to 4 in order of increasing failure potential.

- 1 = Very low failure potential. Sound trees that lack indicators of failure that are not leaning or not exposed to wind or snow load.
- 2 = Low failure potential. Trees with only minor defects, including internal decay that does not approach or exceed the One Third Rule and are not leaning or not exposed to wind or snow load.
- 3 = Medium failure potential. Trees with moderate defects (e.g., at or near the threshold of acceptable sound wood thickness) or that are growing in shallow soil or exposed to a high water table, or highly defective trees in areas well-sheltered from weather and wind extremes; or highly defective trees in areas exposed to weather extremes (e.g., heavy snow loads) only in the off-season.

4 = High failure potential. Highly defective trees in unsheltered areas; trees with root anchorage limited by erosion; dead trees; trees with obvious root disease.

B. Potential for Damage. Damage potential incorporates the potential for striking a target, potential for damaging a target, and target value. Damage potential is rated on a scale of one to four in order of increasing potential.

1 = No damage. Target impact will only involve very small trees or parts of trees; or there is no chance tree will cause damage to target.

2 = Minor damage. Failure of only small trees or parts of trees; damage is likely to occur when target is not occupied; target value is low.

3 = Medium damage. Failure involves small trees or medium-sized parts of trees; impacts will likely occur in areas with targets; impacts will be direct; and damage will likely be moderate; target value is moderate.

4 = Extensive damage. Failure involves medium to large tree parts or entire trees; impacts will be direct in areas with targets; target value is high; damage to property will likely be severe; or serious personal injury or death is the likely result.

Calculating the Tree Hazard Rating Score

The hazard score for individual trees is determined by adding the values from the two parts on the rating system. Each tree would yield a score from 2 to 8.

The next step is to evaluate the tree rating scores for a recreation area, which can then be helpful to prioritize which trees need treatment and in which order when resources are not available for treating all higher risk trees.

Hazard Rating Score	Treatment Priority
2–5	Low
6	Moderate
7	High
8	Very High

Recording an Evaluation

Documentation is a key part of a hazard tree management program to provide evidence that a tree was examined. Two examples of hazard tree inspection forms are included in the following pages. The forms can be used as is or modified as needed.

Recording the results of hazard tree evaluations has many advantages.

- Provides an assessment of current hazards and a framework for future vegetation management activities.
- Provides a database for future monitoring and treatment efforts.
- Provides a record of performance in the event of litigation (tort claims).

HAZARD TREE INSPECTION FORM

Campground or Unit ____________________

Campsite or Subunit ____________________

Inspectors ____________________

Date ____________________

Remarks ____________________

Map required only for campsites, picnic areas and near buildings in drive-in campgrounds.

Tree Location or map number	Tree species	Defect(s)	Hazard potential H or M	Remarks	Recommended action	Action taken/date

Local Manager ____________________ Date ____________

From "How to Detect, Assess and Correct Hazard Trees in Recreational Areas," 1993, Minnesota Department of Natural Resources—Forestry.

USFS, Alaska Region
Revised 9/8/95

TREE RECORD FORM

Area ____________ District ______________ Rec Site name = ____________________
Tree # ____________ Tree sp. ________
Ref point = ____________ Dist (ft) = ________ Azimuth (29 declin) = ________ degrees

	DBH	HT						Rind		Risk Rating		Target	Treatmt	Next	
Date	(in)	(ft)	Crown	Root	Butt	Stem	Scar	(in)	Fall Prob	Impact Prob	Total (2–8)	Value	date	exam	initials

Comments:

Footnotes:
1. Crown: DEAD, THIN (dying, off color foliage), DB (dead branches), BROOM (mistletoe brooms), DTOP (dead top)
2. Root: SCAR (exposed wounds on roots), UND (undercut root system), COMP (substantial soil compaction)
3. Butt: (first 10' of bole): SCAR
4. Stem: LEAN (leaning tree), SEAM (bark seam or frost crack), FORK (forked, multiple top), SCAR (at x ft high), FUNGUS (decay fungus, name in comments)
5. Scar:
6. Rind: inches of sound wood from inner bark radially to decay (or pith) (measured on back side if tree scarred)
7. Probability of failure: 1–4
8. Probability of target impact: 1–4
9. Value of target: 1–4
10. Recommended treatment: FELL, TOP (top at ft height), PRUNE (prune branches), MOV TAR (move target), EXCL (exclude visitors from target area)

Tools Used in Hazard Tree Evaluation

Increment Borer or Drill with long bit	for boring into tree to test for amount of sound wood or decayed wood; increment borers extract a small core of wood approximately ½" in diameter.
Binoculars	to check the top of the tree for defects
Hatchet or Axe	to check for root rot or to tap tree to judge for hollowness
Diameter Tape	to measure diameter at breast height (DBH) of tree. DBH = 4.5 ft. above ground
Clinometer	to measure height of tree
Tape Measure & Compass	to determine location of tree for future inspection
Camera	to document tree defects, hazard tree situations
Data Forms	to record pertinent information regarding the hazard tree

Corrective Actions for Hazardous Trees

Numerous corrective actions are available for managers including moving the target, closure of recreation areas, pruning part of the tree, topping the tree, adding cabling or pole supports, and tree removal.

Move the target

Moving the target to a new location or to a safe distance is a good option when the value of the tree is high. A thorough examination of trees in the target's new location is then necessary.

Closing the recreation area

Temporary or permanent closure of a recreation area (or portion thereof) is another option, especially if the area is concentrated with severe hazard trees and another more suitable site can be found. Closing recreation areas during severe storms can be an effective means of reducing injuries to people and property.


Careful tree and area assessment will help determine the appropriate corrective action for hazardous trees.

Prune part of the tree

When branches or multiple tops are the main form of failure potential, then pruning can be an effective method of action. Pruning can reduce failure potential and maintain the tree. If done correctly, pruning can improve the health of the tree. Improper pruning can lead to an architecture that has a high probability of failure.

Top the tree

Removing the top of the tree is the best option under some circumstances. It may reduce the height of the tree to the point that the tree can no longer reach a target if the tree fails. Topping the tree can greatly reduce the weight high in the tree and lower the "sail area" of the crown impacted by wind. This may curtail the potential for failure. Topping a tree can produce a more natural appearing structure than a stump, particularly if the cut top has a jagged shape. Topped trees often have considerable wildlife use. Topped trees should be carefully evaluated into the future to monitor for increased failure potential because of the long-term effects of decay that enters in the cut surface. Trees topped below the live crown will die, but this may be acceptable if reducing the height mitigates the chance of hitting a target.

Cabling and pole supports
Using cable supports on leaning or defective trees or poles for supporting large lateral limbs is usually not applicable for large conifers and would be used only as a last resort.

Remove the tree
Tree removal may be necessary to adequately reduce hazard potential. Care should be taken during tree falling to avoid wounding neighboring trees. If the stumps are viewed as unsightly, they can be treated with a stump grinder which reduces their height to about ground level. Careful analysis of the hazard potential should be made before recommending tree removal; credibility is lost when a specialist suggests removal because of internal defect but the tree is found to be largely sound when it is felled. The use of an increment borer or drill in several locations of the tree's bole is often the best method of determining how much sound wood exists in a tree.

Placement of New Recreation Sites
A thorough hazard tree evaluation should be conducted before new recreation sites are established. Some forest stands are better suited for the development of new recreation sites than others. The stage of forest development should be considered—younger forests generally have less decay and fewer tree defects than older forests. Also, vegetation can be manipulated more flexibly in some forest ecosystems or at some forest development stages. In the development of new recreation sites, potential targets can be established away from large valuable trees or in areas of forest stands that have relatively few defect problems.

Minimizing Future Hazard

- Educate visitors about the importance of not wounding trees in recreation areas.
- Minimize bole wounding and damage to roots systems during management activities such as tree removal.
- Maintain trees in a vigorous condition.
- Develop a vegetation plan that directs efforts towards maintaining and enhancing tree health.

Tree Failure Reporting
Using a reporting process on tree failure is an essential way to learn about the effectiveness of hazard evaluations. This involves documenting some details on how a tree failed, what defect factors were present, and how the tree had been evaluated during the most recent inspection. If most trees that fail are in a high risk category then you know that the hazard evaluation is effective. If trees with low scores for failure potential are failing, then adjustments need to

be made in evaluating hazard. Thus, tree failure reporting can provide a useful check for a hazard tree program.

Reporting tree failure can also be an effective way to build information on the characteristics of each of our Alaska tree species that may make them hazardous. For example, we might determine that the failure rate is so high for large cottonwood trees that management plans should describe methods to discourage them and favor tree species with fewer problems. Or by another example, we might learn that scars on conifers are more stable and constitute a lower hazard than scars on hardwood trees.

Tree failure databases can be developed at the local level or managers can utilize the International Tree Failure Database (ITFD). This comprehensive database has an Internet based form for collecting important information about trees that have failed structurally. Reports can be generated from the database to reveal characteristics of trees that fail and improve predictions of future failures. Training is required to report tree failures in ITFD. The ITFD application can be accessed at http://svinetfc2.fs.fed.us/natfdb/.

Hazard Profiles of Alaskan Tree Species

Preliminary hazard profiles of Alaskan tree species have been developed. As more information becomes available through research or monitoring of failures at recreation sites, these profiles will be refined.

White Spruce (*Picea glauca*)

Distribution and Habitat

White spruce is widespread and the most common conifer across Southcentral and Interior Alaska. The tree generally occupies sites with well-drained, permafrost-free soils. Pure stands of white spruce are largely confined to stream bottoms, river floodplains and terraces, and warm south-facing upland sites.

Common Defects

White spruce generally has a modest level of defect caused by heart, butt, and root rot fungi that predispose the tree to failure. The heart rot fungus Phellinus pini, and several brown rot fungi cause most of the stem defect in white spruce. Bole breakage is the most common failure of trees with heart or butt rot.

White spruce.

Stem wounds and top breakage often lead to internal wood decay of white spruce, but many trees with decay lack such indicators. Conks and mushrooms, when present, indicate substantial decay. Spruce trees with stem wounds should be evaluated carefully with a drill or increment borer to ensure trees are not unnecessarily removed. The root rot fungus Inonotus tomentosus causes a slow decline and death of white spruce of all ages. This fungus structurally weakens the root system of infected trees, increasing the probability of failure from uprooting, bole breakage, or outright mortality.


Uprooted spruce due to root disease.

Dense perennial witches' brooms, caused by the rust fungus Chrysomyxa arctostaphyli, are common in white spruce. Rust brooms, unless very large or dead, are not generally hazardous.

Outbreaks of the spruce bark beetle, Dendroctonus rufipennis, have resulted in widespread mortality of white spruce across Southcentral Alaska. White spruce snags killed by bark beetles generally do not stand for long. The fungus Fomitopsis pinicola causes a great deal of the wood decomposition in dead trees. Dead spruce typically fail suddenly by snapping near the base.


The most common failure zone of a spruce bark beetle-killed tree is within the first four feet of the base.

General Failure Potential

Stem breakage and uprooting are the most common forms of failure in white spruce. Dead standing spruce snags deteriorate and will fail. Due to the unpredictability of timing or location of failure, dead trees are considered a high hazard in recreation areas when they occur near targets and should be promptly removed. White spruce trees with shallow root systems on poorly drained soils are not generally windfirm. Damage to the root system will increase the probability of root failure.

Cottonwood (*Populus trichocarpa*)

Cottonwood is a fast growing tree found throughout Interior, Southcentral and Southeast Alaska, generally occurring along streams, river floodplains, and sandbars.


Eagle Eye Photo © Glenn M. Oliver

Cottonwood.

Common Defects

Older cottonwood trees typically develop wide spreading crowns with large dead or rotten branches. Large, old cottonwoods are often defective. Open wounds and poorly healed branch stubs provide entrance courts for wood decay fungi. One fungus, Ganoderma applanatum, causes the most defect in cottonwood.


Ganoderma applanatum conk.

General Failure Potential

The major hazard with this species is in the upper portion of the tree with top breakage and branch shedding of defective and dead limbs. Large limbs with weak unions or defective limbs should be removed to reduce this hazard. Older cottonwood stands usually contain many defective trees. Careful inspection of trees for conks or mushrooms of wood decay fungi is important. Use of a drill or increment borer may be necessary to determine the extent of decay in the stem and lower bole.


Breakage of tops and large limbs are the most common defects in cottonwoods.

Quaking Aspen (*Populus tremuloides*)


Aspen stand.

Distribution and Habitat
Quaking aspen occurs extensively throughout the Interior of Alaska, is common in Southcentral Alaska, and only occurs in the extreme northern part of Southeast Alaska near Haines and Skagway. Aspen is a fast growing tree common on slopes with a southern exposure, in well-drained benches lacking permafrost, and creek bottoms.

Common Defects
Due to its thin bark, aspen is highly susceptible to trunk injuries, particularly in recreation areas. Wounds and poorly healed branch stubs often lead to infection by wood decay and canker-causing fungi on the stem. Perennial cankers gradually enlarge over time and may girdle the tree. The presence of conks on the trunk indicates extensive wood decay. Armillaria root disease predisposes aspen to root failure. Most older aspen, >100 years old, have significant levels of wood decay and root disease.


Phellinus tremulae is the most common decay agent of aspen.

General Failure Potential
Stem breakage and uprooting are the most common forms of failure for aspen trees. Cankers structurally weaken the tree if they are large or infected by decay fungi. Four canker fungi are common in Alaska; of these, the sooty bark canker

(caused by the fungus Encoela pruinosa) is considered the most lethal, capable of girdling and killing an aspen in 3–10 years. Stems that have been structurally weakened by wood decay fungi are prone to breakage. Aspen suspected to have wood decay may be bored to determine the decay extent.


Sooty bark canker is the most lethal canker of aspen.

Paper Birch (*Betula papyrifera*)

Distribution and Habitat
Paper birch is common throughout Interior and Southcentral Alaska on rolling benchlands and lower foothill slopes. Paper birch develops best on warm slopes with moist porous soils but is common on cold north slopes and poorly drained lowlands.


Paper birch.

Common Defects
The thin fragile bark of paper birch is highly susceptible to injury. Trunk wounds, cracks, basal injuries, and broken branches provide entrance courts for wood decay and canker fungi. Both the false tinder conk (Phellinus igniarius), a stem decay fungus, and the cinder conk (Inonotus obliquus), a canker rot fungus,

are common in older birch stands. Incidence of root and stem decay increases with tree age; older stands (>90 years) typically have high levels of defect. The presence of conks or mushrooms indicates extensive decay. Root rot fungi, such as Armillaria spp., are particularly common in older birch trees and trees that are under stress. Older birch stands that have been heavily thinned or recently opened up may suffer from a progressive dieback or decline of twigs and branches from the upper crown downwards.


Cinder conk, Inonotus obliquus, a common canker rot fungus of birch.

General Failure Potential

Stem and branch breakage are the most common types of failure of birch trees. Bole breakage is typically associated with large stem cankers and structural weakening of the stem and root system from wood decay fungi. Trees are also easily fractured at the site of canker rot infections. Decay extent can be determined by boring trees, however, boring should be done only when necessary, as these practices create wounds which may serve as infection courts for canker and decay fungi. Root diseases structurally weaken the root system of infected trees, increasing the probability of failure. Cracks at the root collar of birch indicate a potential for breakage. Death and breakage of branches and tops are common in older trees, often resulting in lodged or hanging branches with a high failure potential.

Hazard Profiles of Alaskan Tree Species

Sitka Spruce (*Picea sitchensis*)

Distribution and Habitat

Sitka spruce is a large tree that grows in coastal Alaska from the southern portion of southeast Alaska to Kodiak and the adjacent Alaska Peninsula. On favorable sites, Sitka spruce is fast growing and can reach impressive sizes. It is particularly common along beaches and rivers where many developed recreation sites are located.

Common Defects

Sitka spruce is less defective than western hemlock. Most of the internal wood decay of live spruce is brown rot. One such fungus, Phaeolus schweinitzii, causes root and butt rot that can predispose spruce to failure in recreation areas.

Sitka spruce.


Susan McDougall © USDA—NRCS PLANTS Database

Much of the internal wood decay in Sitka spruce is associated with bole wounds and top breakage. Bole wounds are common on campground trees as people seem preoccupied with injuring trees with hatchets and axes. Wood decay in bole wounds progresses slowly in Sitka spruce; it often does not penetrate deeply into the bole. Spruce trees with bole wounds should be evaluated carefully with a drill or increment borer to ensure trees are not removed unnecessarily.

Although not particularly defective as a live tree, the wood of Sitka spruce is not decay resistant. Snags do not stand for long. The fungus Fomitopsis pinicola causes a great deal of the wood decomposition in dead trees. Dead Sitka spruce trees may fall piece by piece as the top and branches deteriorate, or fail near the base. Dead branches can be large and are shed from live trees as a normal part of shade pruning. Dead hanging branches can be a hazard if targets are located underneath these trees.

General Failure Potential
Stem breakage, branch falling, and windthrow are the most common forms of failure in Sitka spruce. Dead standing trees deteriorate and will fail. Sitka spruce are susceptible to windthrow, particularly in wind-exposed locations (south-facing slopes), or when their roots are weakened.

Western Hemlock (*Tsuga heterophylla*)
Mountain Hemlock (*Tsuga mertensiana*)


Charles Webber © California Academy of Sciences

Western hemlock.


Eagle Eye Photo © Glenn M. Oliver

Mountain hemlock.

Distribution and Habitat
Western hemlock is a large tree that grows in coastal Alaska from the southern portion of Southeast Alaska to Prince William Sound. The smaller mountain hemlock tree occurs at higher elevations or on poor soils in coastal Alaska and on the Kenai Peninsula. Western hemlock is exceedingly common in Southeast Alaska where it is the predominant tree species.

Common Defects
Both western and mountain hemlock have high levels of heart rot especially in older trees. These decays are caused by a large number of fungi for western hemlock; whereas two fungi (Phellinus pini and Echinodontium tinctorium) cause most of the defect in mountain hemlock.


Phellinus pini conks.

Most internal wood decay in western hemlock is associated with bole wounds and top breakage. Wood decay in bole wounds progresses rapidly in hemlock compared to other tree species. Along with wounding, defect levels are highly correlated with tree age. Unwounded western hemlocks have little internal wood decay in trees up to a hundred years old. The percentage of trees with decay increases rapidly with tree age to 50% in 300-year-old trees, and essentially all trees over 500 years old are infected.

The wood of hemlock is not decay resistant and snags do not stand for long. Dead hemlock trees may fall piece by piece as the top and branches deteriorate, or fail suddenly by snapping near the base.

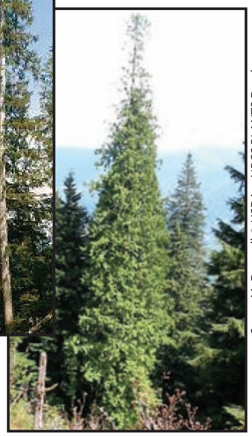
General Failure Potential
Stem breakage and windthrow are the most common forms of failure in both western and mountain hemlock. Large old trees can be assumed to have at least some internal wood decay. Exposed wounds, top abnormalities, and bole seams (cracks) can be reliable indicators of wood decay. Dwarf mistletoe brooms break out of canopies and fall to the forest floor. Dead standing trees deteriorate and fail, either in pieces or suddenly through bole breakage. Dead standing hemlock, especially those dead for more than a few years (e.g., fine twigs gone, bark slaughing off) have a greater risk of failure in the near future than other coastal forest trees.

Yellow-cedar (*Chamaecyparis nootkatensis*)

Western Redcedar (*Thuja plicata*)

Distribution and Habitat
Two species of cedar grow in coastal Alaska. Yellow-cedar occurs throughout Southeast Alaska and in small populations in the Prince William Sound. Western redcedar is restricted to Southeast Alaska south of Petersburg. Generally, neither tree is as common as Sitka spruce or western hemlock in developed recreation areas.

Yellow-cedar.



Western redcedar.

Susan McDougall © USDA—NRCS PLANTS Database

Hazard Profiles of Alaskan Tree Species

Common Defects
Both cedar species can have high levels of internal wood decay. Western redcedar generally has higher rates of heart rot, particularly in older trees. Most of the causal fungi do not produce large fruiting bodies, however. Therefore, much of the wood decay of live trees is hidden and not easily seen. The dead spike tops that are so common on western redcedar trees are not reliable indicators of decay.

Both cedars have thin bark and are easily wounded. Wounds may be infected by decay fungi, but these tree species are adept at compartmentalizing, or partitioning, wood decay.

The heartwood of both cedars is protected by natural fungicides and is decay resistant. This allows dead trees to persist standing for long periods of time, even up to a century. Enough wood decay finally develops near the ground line that old snags then break.

Alaska yellow-cedar snags.

General Failure Potential
Cedars can succumb to windthrow when they have shallow roots where they grow in wet soils or when their roots are compromised by physical damage. Stem breakage is common in trees that have extensive heart rot. The extreme decay resistance of the wood in both cedar species allows dead standing trees to persist without failure for much longer than other tree species.

This overview of diseases and decays of Alaskan trees is adapted from the book Insects and Diseases of Alaskan Forests. We recommend using this reference book for identification of, and learning more about, the disease agents that affect the hazard profiles of Alaskan trees.

Aspen, Quaking (Populus tremuloides)

Stem and Branch Diseases
- Cytospora canker (Cytospora chrysosperma)
- Sooty bark canker (Encoelia pruinosa)
- Ceratocystis canker (Ceratocystis fimbriata)
- Cryptosphaeria canker (Cryptosphaeria lignyota)

Root Diseases
- Armillaria root disease (Armillaria spp.)

Wood Decays
- Artist's conk (Ganoderma applanatum)
- Yellow cap mushroom (Pholiota spp.)
- Oyster mushroom (Pleurotus ostreatus)
- False tinder conk (Phellinus tremulae)

Birch, Paper (Betula papyrifera)

Stem and Branch Diseases
- Nectria canker (Nectria galligena)

Root Diseases
- Armillaria root disease (Armillaria spp.)

Wood Decays
- Red belt fungus (Fomitopsis pinicola)
- Artist's conk (Ganoderma applanatum)
- Yellow cap mushroom (Pholiota spp.)
- Oyster mushroom (Pleurotus ostreatus)
- Tinder conk (Fomes fomentarius)
- False tinder conk (Phellinus igniarius)
- Cinder conk (Inonotus obliquus)
- Birch conk (Piptoporus betulinus)
- Rainbow conk (Trametes versicolor)

Cedar, Yellow- (Chamaecyparis nootkatensis)

Root Diseases
- Armillaria root disease (Armillaria spp.)

Decline Syndrome
- Yellow-cedar decline

Cedar, Western Red (Thuja plicata)

Root Diseases
- Yellow ring rot (Phellinus weirii)

Wood Decays
- Red ring rot (Phellinus pini)
- Red belt fungus (Fomitopsis pinicola)
- Redcedar white ring rot (Ceriporiopsis rivulosa)

Cottonwood, Black (Populus trichocarpa)

Stem and Branch Diseases
- Cytospora canker (Cytospora chrysosperma)
- Cryptosphaeria canker (Cryptosphaeria lignyota)

Root Diseases
- Armillaria root disease (Armillaria spp.)

Wood Decays
- Artist's conk (Ganoderma applanatum)
- Yellow cap mushroom (Pholiota spp.)
- Oyster mushroom (Pleurotus ostreatus)
- False tinder conk (Phellinus igniarius)
- Cinder conk (Inonotus obliquus)
- Rainbow conk (Trametes versicolor)

Hemlock, Mountain (Tsuga mertensiana)

Root Diseases
- Armillaria root disease (Armillaria spp.)

Wood Decays
- Red ring rot (Phellinus pini)
- Red belt fungus (Fomitopsis pinicola)
- Chicken of the woods (Laetiporus sulphureus)
- Indian paint fungus (Echinodontium tinctorium)
- Hartig's conk (Phellinus hartigii)
- Borealis conk (Climacocystis borealis)
- Coniophora brown rot (Coniophora spp.)

Hemlock, Western (Tsuga heterophylla)

Stem and Branch Diseases
- Hemlock cankers (Xenomeris abietis, Discocania treleasii)

Root Diseases
- Annosus root and butt rot (Heterobasidion annosum)
- Armillaria root disease (Armillaria spp.)

Wood Decays
- Red ring rot (Phellinus pini)
- Red belt fungus (Fomitopsis pinicola)
- Chicken of the woods (Laetiporus sulphureus)
- Velvet top fungus (Phaeolus schweinitzii)
- Artist's conk (Ganoderma applanatum)
- Lacquer conk (Ganoderma tsugae)
- Quinine conk (Fomitopsis officinalis)
- Hartig's conk (Phellinus hartigii)
- Purple conk (Trichaptum abietinum)
- Yellow cap mushroom (Pholiota spp.)
- Coniophora brown rot (Coniophora spp.)
- Coral fungus (Hericium abietis)

Poplar, Balsam (Populus balsamifera)

Stem and Branch Diseases
- Cytospora canker (Cytospora chrysosperma)
- Sooty bark canker (Encoelia pruinosa)
- Cryptosphaeria canker (Cryptosphaeria lignyota)

Wood Decays
- Artist's conk (Ganoderma applanatum)

Root Diseases
- Armillaria root disease (Armillaria spp.)

Spruce, Sitka (Picea sitchensis)

Root Diseases
- Annosus root and butt rot (Heterobasidium annosum)
- Armillaria root disease (Armillaria sp.)
- Tomentosus root rot (Inonotus tomentosus)

Wood Decays
- Red ring rot (Phellinus pini)
- Red belt fungus (Fomitopsis pinicola)
- Chicken of the woods (Laetiporus sulphureus)
- Velvet top fungus (Phaeolus schweinitzii)
- Artist's conk (Ganoderma applanatum)
- Quinine conk (Fomitopsis officinalis)
- Borealis conk (Climacocystis borealis)
- Purple conk (Trichaptum abietinum)
- Coniophora brown rot (Coniophora spp.)
- Coral fungus (Hericium abietis)

Spruce, White (Picea glauca)

Root Diseases

- Armillaria root disease (Armillaria sp.)
- Tomentosus root rot (Inonotus tomentosus)

Wood Decays

- Pini conk (Phellinus pini)
- Pinicola conk (Fomitopsis pinicola)
- Velvet top fungus (Phaeolus schweinitzii)
- Artist's conk (Ganoderma applanatum)
- Quinine conk (Fomitopsis officinalis)
- Purple conk (Trichaptum abietinum)
- Coniophora brown rot (Coniophora spp.)

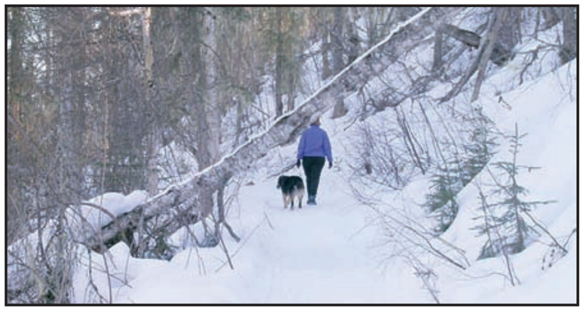
Backcountry Travel and Hazard Trees

Chapter 7

Alaska is known as one of the world's premier destinations for backcountry adventure. But with adventure comes the risk inherent in backcountry travel. Risks posed by hazard trees in remote areas are often overlooked or underestimated. Backcountry travelers assume responsibility for their safety and need to learn to identify tree hazards in settings where hazard tree evaluations and treatments are not possible. Managers can use the concepts in this chapter to advise visitors of risks associated with camping, backcountry travel, and hazard trees.

Trees are the dominant feature of forested ecosystems. Every tree will ultimately die, decay, and be recycled into the ecosystem to provide nutrients for future forests. While these processes are natural, they can pose a threat to backcountry travelers.

Land management agencies cannot remove all hazard trees in the vast public lands in Alaska. Typically they only attempt to inspect and treat hazard trees in developed areas with high public use. Forest visitors, therefore, need to recognize the dangers of hazard trees and take precautions, especially in backcountry settings.



Recreationists may encounter a wide variety of standing or elevated tree hazards.

Backcountry travelers engage in a variety of activities that may be influenced by hazard trees including hiking, picnicking and camping around trees. The exposure time to hazard trees varies based on the amount of time visitors are in one location. Hikers spend relatively little time in one location, thus their exposure to hazard trees is limited. Picnickers have a moderate exposure time to hazard trees, typically spending one to several hours in a location. Campers spend the longest time in a single location, thus they have the highest potential to encounter a hazard tree.

One of the most important decisions that backcountry travelers can make is where to camp for the night. Avoiding potentially dangerous situations around hazard trees takes knowledge, awareness and good judgment.

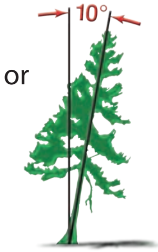
Suggested messages from managers to visitors:

What you can do to reduce risk

Be observant! Examine trees in your camping or rest area for evidence of hazard or failure potential. Take action by moving yourself and your belongings to a safe area if you suspect a hazard.

1. Avoid all standing dead trees, hazardous trees, and the danger zone in which they may fail. Never picnic or camp within at least one tree length of a dead tree. It could fall at any time without warning. Make a thorough assessment of the potential camping area to determine if it is a safe location to spend the night.

2. Never underestimate the danger posed by small trees and dead limbs. Both live and dead tree parts 6" in cross-section have fallen and hurt hikers and campers. A small tent offers little protection from falling trees and limbs.



3. Avoid trees with excessive lean (10° or greater) or evidence of defect.

4. Be especially cautious of hazard trees in strong winds. Trees or tree parts may dislodge in strong winds. Select a safe place to spend the night.

5. Avoid chopping or banging into dead trees. The entire tree, top, or branches may break out and fall on you.

Recognizing a Hazard Tree

First look up! Many hazards occur above our heads. Be sure to inspect trees carefully and systematically on all sides. Examine all parts of the tree, including roots, root or trunk flare, main stem, branches and branch unions. Some of the most common "watch out" hazard tree situations in the backcountry include:

1. Dead trees are unpredictable, very dangerous, and can break or fall at any time. Dead wood is often dry and brittle and cannot bend in the wind like a living tree.

Dead trees.

2. Hanging branches and tree tops that have already broken off are especially dangerous. These defects are called “hangers” or “widow-makers.” Inspect the tops of trees carefully for these defects.


Broken branches.

3. Signs of disease such as mushrooms or conks (fungal fruiting bodies) may occur on roots, stems and branches. These are evidence of advanced decay and weakened tree structure. Avoid trees with signs of disease.


Signs of disease.

4. Leaning trees at greater than 10° from vertical should be inspected carefully. A freshly leaning tree with recent root lifting, soil movement or mounding near the base indicates a high failure potential.

Trees leaning more than 10°.

The three basics for safety around hazard trees in the backcountry are knowledge, awareness and good judgment.

Acknowledgments

In compiling ideas, text, and pictures for this book, considerable use was made of multiple sources. The book Long Range Planning for Developed Recreation Sites in the Pacific Northwest was invaluable. We thank the authors, Bob Harvey and Paul Hessburg, for considerably advancing the thought process on this topic.

The book How to Detect, Assess and Correct Hazard Trees in Recreational Areas was also extensively used. We thank the State of Minnesota, Department of Natural Resources for allowing adaptation of failure potential guidelines and utilization of various line drawings and photographs.

We are especially indebted to David Allen, graphic designer with the Chugach Design Group, Chugach National Forest, for his creative and insightful design of this publication. We thank Jim Worrall and Marcus Jackson for their careful review of this book.

We thank the California Academy of Sciences for permission to use the western hemlock photograph on page 48. We thank Susan McDougall @ USDA—NRCS PLANTS Database for the Sitka spruce photograph on page 47 and the western redcedar photograph on page 50. We thank Eagle Eye Photo © Glenn M. Oliver for the mountain hemlock photo on page 48 and the cottonwood photo on page 43. All other photos were taken by Forest Health Protection Staff, Region 10, Alaska.

References

Albers, J.; Hayes, E. 1993. How to detect, assess and correct hazard trees in recreational areas. State of Minnesota, Department of Natural Resources- Forestry. 63p.

Farr, W.A.; LaBau, V.J.; Laurent, T.H. 1976. Estimation of decay in old-growth western hemlock and Sitka spruce in Southeast Alaska. USDA Forest Service Research Paper PNW-204. Pacific Northwest Forest and Range Experiment Station. 24p.

Harvey, R.D.; Hessburg, P.F. 1992. Long range planning for developed recreation sites in the Pacific Northwest. USDA Forest Service, Portland, OR. FPM-TP 039-92. 120p.

Holsten E.; Hennon, P.; Trummer, L.; Kruse, J.; Schultz, M.; Lundquist, J. 2008. Insects and Diseases of Alaskan Forests. USDA Forest Service, Alaska Region, Technical Report, R10–TP–140. 245 p.

Johnson, D.W. 1981. Tree hazards: recognition and reduction in recreation areas. USDA Forest Service, Rocky Mountain Region. Lakewood, CO. Technical Report R2-1. 17p.

Kimmey, J.W. 1956. Cull factors for Sitka spruce, western hemlock, and western red cedar in Southeast Alaska. Alaska Forest Research Center, Station Paper No. 6. USDA Forest Service. 31p.

Paine, L.A. 1971. Accident hazard evaluation and control decisions on forest recreation sites. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA. Research Paper PSW-68. 10p.

Wagener, W.W. 1963. Judging hazard from native trees in California recreation areas; a guide for professional foresters. USDA Forest Service Research paper PSW-P1. 29p.

For additional references regarding hazard trees, the website http://www.fs.fed.us/r10/spf/fhp/hazard/index.htm has an extensive alphabetical listing of hazard tree references compiled by Mike Schomaker and Bob Mathiasen.