How To

Recognize Hazardous Defects in Trees

USDA United States Department of Agriculture

Forest Service

Northeastern Area State and Private Forestry

NA–FR–01–96

Revised August 2012

Authors

Minnesota Department of Natural Resources

Jana Albers
Plant Pathologist, Grand Rapids, MN

USDA Forest Service
Northeastern Area State and Private Forestry

Peter Bedker
Biological Scientist, St. Paul, MN

Martin MacKenzie
Plant Pathologist, Sonora, CA

Joseph O'Brien
Plant Pathologist, St. Paul, MN

Jill Pokorny
Plant Pathologist, St. Paul, MN

Acknowledgements

The authors wish to gratefully acknowledge the contributions of the authors of previous versions of this publication—Ed Hayes and Tom Eiber (Minnesota Department of Natural Resources) and Mary Torsello (USDA Forest Service Northeastern Area State and Private Forestry).

We are also grateful to Sandy Clark and Victoria Evans for their helpful suggestions, and for the editing, design, and layout of this publication.

How To

Recognize Hazardous Defects in Trees

United States
Department of
Agriculture

Forest Service

Northeastern Area
State and Private Forestry
Newtown Square, PA

NA–FR–01–96
Revised August 2012

www.na.fs.fed.us

Table of Contents

Introduction 1
Inspecting Trees 2
What to Look For 3
Dead Wood 3
Cracks 4
Weak Branch Unions. 5
Decay 6
Cankers 7
Root Problems 8
Poor Tree Architecture. 10
Multiple Defects 11
Corrective Actions. 12
Move the Target 12
Prune the Tree. 12
Remove the Tree 13
Cabling and Bracing 13
Topping and Tipping—Poor Pruning Practices 14
Conclusions 15
Suggested Reading 16
Minnesota Department of Natural Resources 17
USDA Forest Service Northeastern Area State and Private Forestry 17

Introduction

Trees add to our enjoyment of outdoor experiences whether they're growing in forests, parks, or urban landscapes. Too often, we are unaware of the risks associated with defective trees, which can injure people and damage property. There has been more interest in tree risk management in recent years because of safety and liability concerns that result from preventable accidents. Recognizing hazardous trees and taking proper corrective actions can protect property and save lives.

A tree is considered hazardous when it has "structural defects likely to cause failure of all or part of the tree, which could strike a 'target' and cause an unacceptable degree of injury or damage." A target can be a vehicle, building, or a place where people gather such as a park bench, picnic table, street, or backyard.

This brochure was created to help homeowners and land managers recognize hazardous defects in trees and to suggest possible corrective actions. We recommend that corrective actions be undertaken by professional arborists.

Because of the natural variability of trees, the severity of their defects, and the different sites on which they grow, evaluating trees for hazardous defects can be a complex process. This publication presents guidelines, not absolute rules, for recognizing and correcting hazardous defects. When in doubt, consult an arborist.

Inspecting Trees

Inspect trees that you are responsible for every year. You can inspect trees at any time of year regardless of whether or not leaves are present. To be thorough, inspect trees after severe storms.

Inspect trees carefully and systematically. Examine all parts of the tree, including the roots, root or trunk flare, main stem, branches, and branch unions. Be sure to examine all sides of the tree. Use a pair of binoculars to see branches high off the ground.

Consider the following factors when inspecting trees:

- **Tree Condition**

Trees in poor condition may have many dead twigs; dead branches; or small, off-color leaves. Trees in good condition will have full crowns; vigorous branches; and healthy, full-sized leaves. However, green foliage in the crown does not ensure that a tree is safe. Tree trunks and branches can be quite defective and still support a lush green crown.

- **Tree Species**

Certain tree species are prone to specific types of defects. For example, some species of maple and ash in the Northeast often form weak branch unions (page 5), and aspen is prone to breakage at a young age (50-70 years) due to a variety of factors, including the presence of decay and cankers.

- **Tree Age and Size**

Trees are living organisms subject to constant stress. Pay particular attention to older trees, which may have multiple defects and extensive decay.

What to Look For

Hazardous defects are visible signs that the tree is failing. We recognize seven main types of tree defects: dead wood, cracks, weak branch unions, decay, cankers, root problems, and poor tree architecture. A tree with defects may not represent a high-risk situation unless some part of it is within striking distance of a target.

Dead Wood

Dead wood is "not negotiable"—remove dead trees and large dead branches immediately. Dead trees and branches are unpredictable and can break and fall at any time (figure 1). Dead wood is often dry and brittle and cannot bend in the wind like a living tree or branch. Dead branches and tree tops that are already broken off ("hangers" or "widow makers") are especially dangerous because they are dead and have already started to fail.

Figure 1.—A hanging, broken branch (widow maker) is especially dangerous.

Take immediate action if...

- A broken branch or top is lodged in a tree.
- A tree is dead.
- A branch is dead and of sufficient size to cause injury (this will vary with the height and size of the branch).

Cracks

A crack is a deep split through the bark that extends into the wood of the tree. Cracks are extremely dangerous because they indicate that the tree is already failing (figure 2).

Take action if...

- A crack extends deeply into, or completely through, the stem.
- Two or more cracks occur in the same general area of the stem.
- A crack is in contact with another defect.
- A branch of sufficient size to cause injury is cracked.

Figure 2.—A serious crack like this one indicates that the tree is already failing!

Weak Branch Unions

Weak branch unions are places where branches are not strongly attached to the tree. Weak branch unions can form when two or more similarly-sized, usually upright branches grow so closely together that bark grows between the branches inside the union. This included bark does not have the structural strength of wood, so the union is much weaker than one that does not have included bark (figure 3). The included bark may also act as a wedge and force the branch union to split apart.

Figure 3.—This weak branch union has failed, creating a highly hazardous situation.

Tree species with a tendency to form upright branches, such as elm, ash, and maple, often produce weak branch unions. Weak branch unions can also form when epicormic branches develop.

Weak branch unions may form after a tree or branch is tipped or topped (page 14), which is the practice of cutting the main stem or a large branch at a right angle to the direction of growth, leaving a large branch stub. The stub

inevitably decays, providing very poor support for new (epicormic) branches that usually develop along the cut branch.

Take action if...

- A weak branch union occurs on the main stem.
- A weak branch union is cracked.
- A weak branch union is associated with a crack, cavity, or other defect.

Decay

Decaying trees can be prone to failure, but the presence of decay, by itself, does not indicate that the tree is hazardous. Signs of advanced decay—wood that is soft, punky, or crumbly, or a cavity where the wood is missing—signal that a tree is at high risk for failure (cover photo). Evidence of fungal activity, including mushrooms, conks, and brackets growing on root flares, stems, or branches, indicates advanced decay.

A tree usually decays from the inside out and eventually forms a cavity, but sound wood is also added to the outside of the tree as it grows. Trees with sound outer wood shells may be relatively safe, but this depends on the ratio of sound to decayed wood and other defects that might be present. It is usually best to have trained arborists evaluate the safety of a decaying tree (figure 4).

Take action if...

- Advanced decay is associated with cracks, weak branch unions, or other defects.
- A branch big enough to cause injury is decayed.
- The thickness of sound wood is less than 1 inch for every 6 inches of diameter at any point on the stem.

Figure 4.—This seriously decayed tree should have been evaluated and removed before it failed.

Cankers

A canker is a localized area on the stem or branch of a tree where the bark is sunken or missing. Cankers are caused by wounding or disease. The presence of a canker increases the chance of the stem or branch breaking near the canker (figure 5). A tree with a canker that encompasses more than half of the tree's stem or branch circumference may be hazardous even if the exposed wood in the canker appears sound.

Take action if...

- A canker (or multiple cankers) affects more than half of the tree's stem or branch circumference.
- A canker is physically connected to a crack, weak branch union, cavity, or other defect.

Figure 5.—The large canker on this tree has seriously weakened the stem.

Root Problems

Trees with root problems may blow over in windstorms. They may even fall without warning in summer when burdened with the weight of the tree's leaves. There are many kinds of root problems to consider: severing or paving over roots (figure 6), raising or lowering the soil grade near the tree, parking or driving vehicles over roots, or the presence of extensive root decay.

Tree symptoms often associated with root problems include soil mounding and recent tree lean (figure 7), twig dieback, dead wood in the crown, and off-color or smaller than normal leaves. Because most defective roots are underground and out of sight, aboveground symptoms may serve as the best warning.

Figure 6.—Severing roots decreases support and increases the chance of failure or death of the tree.

Figure 7.— The mound (arrow) at the base of this tree and the recently exposed and damaged roots indicate that this tree may soon fail.

Take action if...

- A tree is leaning with recent root exposure, soil movement, or soil mounding near its base.
- More than half of the roots under a tree's crown have been cut or crushed. These trees are dangerous because they do not have adequate structural support from the root system.
- Advanced decay is present in the root flares or "buttress" roots.

Poor Tree Architecture

Poor tree architecture is a growth pattern that indicates weakness or structural imbalance. Trees with strange shapes are interesting to look at, but may be structurally defective. Poor architecture often arises after many years of damage from storms, unusual growing conditions, improper pruning, topping, or other damage (figure 8).

Figure 8.— This tree is badly out of balance. Although trees can compensate for some level of asymmetry, this tree is in danger of failing because of the magnitude of the imbalance.

All trees lean to a certain extent. In some cases, tree lean is a new or recent condition and is due to root problems (see the **Root Problems** section on page 8). In other cases, the tree has leaned for a long time, has partially adjusted its growth, and is well anchored. A tree that has been leaning for a long time may pose an unacceptable level of risk if it leans excessively or has a serious defect(s) on the main stem. Because not all leaning trees are dangerous, however, have a professional arborist examine any leaning tree of concern.

Take action if...

- A tree leans excessively or has a serious defect(s) on the main stem such as decay, cracks, or cankers.
- A large branch is out of proportion with the rest of the crown.
- A large, horizontal branch has several vertical branches on it.
- A branch has a sharp bend or twist that compromises its structural integrity.

Multiple Defects

It is critical to recognize multiple defects in a tree when evaluating the tree's potential to fail. Carefully examine multiple defects that are touching or are close to one another. If more than one defect occurs on the tree's main stem, assume that the tree poses a high-risk situation.

Examples of multiple defects include:

- Multiple cracks
- Crack(s) with decay
- Weak branch unions with cracks or decay
- Cankers with decay

Corrective Actions

Corrective actions begin with a thorough evaluation. If a situation poses an unacceptable risk, there are three recommended options for correcting the problem: move the target, prune the tree, or remove the tree.

Move the Target

Moving the target is often an inexpensive and effective treatment for mitigating risk. Easily moved items like play sets and swings, RVs, and picnic tables can be placed out of the reach of the hazardous tree with little effort and expense.

If the target cannot be moved and a high-risk situation exists, consider blocking access to the target area until the hazard can be properly eliminated.

Prune the Tree

A defective branch or branches may cause unacceptable risk, even though the rest of the tree is sound. In this case, pruning the branch solves the problem.

Prune when...

- A branch is dead.
- A broken branch is lodged in the crown. Remove the branch and prune the stub.
- A branch of sufficient size to cause injury is cracked or decayed.
- A weak branch union exists and one of the branches can be removed.
- Branches form a sharp angle, twist, or bend.
- A branch is lopsided or unbalanced with respect to the rest of the tree.

Pruning a tree properly early in its life is a good way to effectively avoid many potential problems when the tree is older and larger. When done

correctly, routine tree pruning does not promote future defects. If done improperly, immediate problems may be removed, but cracks, decay, cankers, or poor architecture will be the ultimate result, which creates future hazardous defects.

We recommend using the "natural target" pruning method, which is fully described in *How to Prune Trees* (Bedker and others 1995).

Remove the Tree

Before cutting a tree down, carefully consider the alternatives. The effects of removing a tree are often pronounced in landscape situations and may result in environmental changes and reduced property values. Consider tree removal as the final option and only use it when the other two corrective actions will not work. Tree removal is inherently dangerous and is even more serious when homes and other targets are involved. Removing trees with hazardous defects is often a job for a professional arborist.

Cabling and Bracing

Cabling and bracing can sometimes partially offset the risk posed by certain hazardous tree defects. In particular, properly installing cables and brace rods in the tree can lessen the risk of failure of codominant branches with included bark. This technique requires annually examining the hardware involved to ensure that the devices are still effectively supporting the tree. For this reason, cabling and bracing techniques are appropriate only for very high-value or historically important trees where a commitment is made to perform the necessary inspections.

Cabling and bracing, if done incorrectly or installed and neglected, can result in increased risk of tree failure. For this reason, have only professional arborists trained in the proper use of cables, rods, and braces install this kind of hardware.

Topping and Tipping—Poor Pruning Practices

Topping is the practice of pruning large upright branches at right angles to the direction of growth, which is sometimes used to reduce the height of the crown. Tipping is the cutting of lateral branches at right angles to the direction of growth to reduce crown width. Both of these practices are harmful and should **never** be used. The inevitable result of such pruning wounds is decay in the remaining stub, which then serves as a very poor support to any branches that subsequently form. Trees pruned this way are also misshapen and esthetically unappealing (figure 9).

Figure 9.— This tree was topped and tipped, which will inevitably result in decay in the remaining stubs.

Conclusions

This publication was written to help you recognize defects in trees that can lead to tree failure. The risk posed by a defective tree may range from low to high depending on the situation. In situations where a defective tree is likely to fail and may strike a target such as people or structures, it is important to mitigate the hazard.

If you are unsure of the risk posed by a particular tree, consult a certified arborist. These are professionals who are trained and certified to understand how trees grow, acquire defects, and fail. You can find certified consulting arborists in the phone book or use the Internet to search for arborists who work in your location.

Remember that trees do not live forever. Design and follow a landscape plan that includes a cycle of maintenance and replacement. This is the best way to preserve the health of your trees and ensure a safe and enjoyable outdoor experience.

Suggested Reading

Albers, J.; Hayes, E. 1993. How to detect, assess and correct hazard trees in recreational areas. Revised edition. St. Paul, MN: Minnesota Department of Natural Resources. 63 p.

Bedker, P.J.; O'Brien, J.G.; Mielke, M.E. 1995. How to prune trees. NA–FR–01–95. Radnor [Newtown Square], PA: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 30 p. http://www.na.fs.fed.us/spfo/pubs/howtos/ht_prune/prun001.htm. (9 July 2012).

Fazio, J. 1989. How to hire an arborist. Tree City USA Bulletin No. 6. Nebraska City, NE: National Arbor Day Foundation. 8 p.

Fazio, J. 1989. How to recognize and prevent hazard trees. Tree City USA Bulletin No. 15. Nebraska City, NE: National Arbor Day Foundation. 8 p.

Pokorny, J.D. 2003. Urban tree risk management: a community guide to program design and implementation. NA–TP–03–03. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 194 p. http://www.na.fs.fed.us/spfo/pubs/uf/utrmm/. (9 July 2012).

Robbins, K. 1986. How to recognize and reduce tree hazards in recreation sites. NA–FR–31. Radnor [Newtown Square], PA: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 28 p.

Shigo, A.L. 1986. A new tree biology. Durham, NH: Shigo and Trees, Associates. 595 p.

Please cite this publication as follows:

Minnesota Department of Natural Resources and USDA Forest Service. 2012. How to recognize hazardous defects in trees. Revised. NA–FR–01–96. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 18 p.

Minnesota Department of Natural Resources

500 Lafayette Road
St. Paul, MN 55155-4044

USDA Forest Service Northeastern Area State and Private Forestry

Headquarters Office
Northeastern Area State and Private Forestry
USDA Forest Service
11 Campus Boulevard, Suite 200
Newtown Square, PA 19073

Durham Field Office
Northeastern Area State and Private Forestry
USDA Forest Service
271 Mast Road
Durham, NH 03824-9799

Morgantown Field Office
Northeastern Area State and Private Forestry
USDA Forest Service
180 Canfield Street
Morgantown, WV 26505-3101

St. Paul Field Office
Northeastern Area State and Private Forestry
USDA Forest Service
1992 Folwell Avenue
St. Paul, MN 55108-1099

Notes

How to Recognize Hazardous Defects in Trees was written to help people identify potential problems with trees. Trees with serious defects can pose an extreme hazard and should be treated with caution. The best way to correct a hazardous tree is to hire a professional arborist. Information in this publication can help users identify trees that require attention.

The United States Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal employment opportunity provider and employer.

How to Recognize Hazardous Defects in Trees