



# Help Stop Insect & Disease Invasions

**TREE CITY USA®  
BULLETIN**

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Although the threat of invasive pests is greater than ever, anyone with a love for trees can help professionals slow the spread or eradicate the insects and diseases that destroy our community trees. In some cases, help from citizens can even result in eradication.

*V*ast acreages of forests in our western mountains are turning brown as bark beetles spread across the once-green landscape. In earlier times, the American chestnut was almost completely destroyed in our eastern forests by a fungus from a foreign land. Although dealing with these kinds of epidemics is mostly the purview of professional foresters, insects and diseases that attack urban trees become everyone's responsibility. This bulletin is a call to action! We can all play a role in stopping the spread of invasive insects and diseases if we just know how to help.

America is under attack! The enemies in this case are insects and diseases that are destroying the shade trees in our urban forests. They are spreading at an alarming rate and killing across a broad spectrum of our most treasured species – trees like ashes, black walnuts, maples, and hemlocks.

The first serious invasion that occurred was in 1930. The now-infamous Dutch elm disease came to America on a load of logs from Europe. In this case, a deadly fungus did the damage, and it was transported from tree to tree by a tiny bark beetle. The result was that eventually our native elms were attacked throughout the country. In some communities where the streets were lined with this favored species, the cities were rendered nearly treeless. In fact, the shock of this invasion launched the creation of tree boards and urban forestry as we know it.

Many lessons were learned from the traumas of Dutch elm disease, including the need for diverse plantings instead of monocultures, proper disposal of infected wood, and the benefits of early detection. Today, the threats and need for action are greater than ever. This is because of our shrinking world. International trade is growing, transportation is faster, and incoming shipments are no longer restricted to seaports on the periphery of our borders. Hitchhiking pests arrive on clothing, logs, wooden packing materials, and even hidden in the wooden cores of artificial plants that decorate our homes and offices.

In the best of American tradition, we are rising to the challenge. Our government scientists and urban foresters are working overtime to control current invasions. But they need help. This bulletin is intended to expand the important function of citizen monitoring. Through this early alert system, it is possible to slow or even stop the spread of invasive pests.



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# America's Most (Un)Wanted

*The cast of infamous characters is constantly changing, but the U.S. Forest Service annually monitors about 20 serious forest pests. Some are native to our forests and ever-present, only becoming a problem when their populations periodically grow to epidemic proportions. Others are introduced, finding trees in America that did not evolve with the kinds of ecological defense mechanisms that kept the invader under control in its native land. On these pages are five of the most serious introduced pests that are destroying urban trees. Each of these has the potential of being controlled with the help of citizen monitors.*

## EMERALD ASH BORER

First reported in Detroit in 2002, this shiny green beetle is only about 1/3-inch long in the adult stage. It targets all ash trees, with a preference for green ash, white ash, and blue ash in that order. Tens of millions of ash trees in urban and forested settings have been killed, and the insect is spreading.



An adult emerald ash borer. It is well-named both because of its color and the damage it does to trees.

**BIOLOGY:** Adults emerge in summer and feed on ash leaves. Soon they lay eggs in the bark crevices, and after the eggs hatch, tiny larvae chew into the inner bark and feed in the phloem layer. Pupation occurs during winter, and the adults chew their way out, making D-shaped holes.

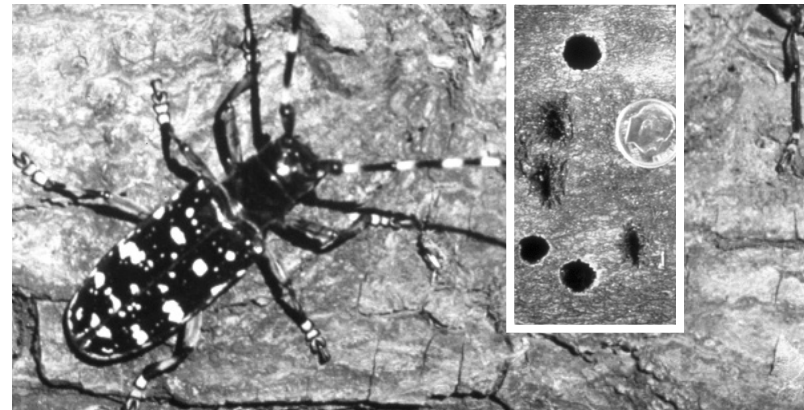
**RECOGNITION:** Sudden fading of an ash tree's crown in summer. D-shaped holes where the adults emerged. Direct observation of the adults feeding on leaves.

**CONTROL:** On the large scale, quarantines have been used, including removal of ash trees in a swath surrounding infected trees. For individual trees, there is some hope, although expensive. Insecticides applied under the bark (systemic treatment) and/or sprayed on the bark are proving effective. In some cases, trees that have less than 50 percent crown damage can still be saved. Use of the insecticides is the job of professionals, but brand names can be found at a link provided at [arborday.org/bulletins](http://arborday.org/bulletins).

## ASIAN LONGHORNED BEETLE

This infamous pest was first observed in the Brooklyn, New York area in 1996. However, it is believed it arrived there in the 1980s, probably in solid wood-packing material. It is a huge insect that bores into a wide variety of hardwood trees. These include its favorite – maples – as well as willows, horsechestnut, elms, birches, poplars, mimosa, hackberry, ashes, London plane, and mountain ash.

**BIOLOGY:** Adults emerge throughout the summer and early fall. They disperse only a short distance to new host trees where the females lay up to 160 eggs. In 10-15 days, the eggs hatch, and larvae then tunnel into the tree and pupate. When the adult condition is reached, the mature insect chews an exit hole.



The Asian longhorned beetle and the deadly holes they make when emerging from infected trees.

**RECOGNITION:** It is the large 3/8-inch exit hole that gives away this invader, often before the tree even shows signs of declining because of the tunneling activity. The adult is spotted black and white and is about 1-inch long with antennae that spread up to 3 inches. They usually feed on the midrib of leaves. Unfortunately, there are several harmless, native look-alikes.

**CONTROL:** Through early detection, quarantines, and tree removals, there is some hope this insect can actually be eradicated. Susceptible trees near infested areas have been successfully treated with a group of chemicals under the generic name, imidachloprid.

## OTHER MAJOR PESTS MONITORED BY THE U.S. FOREST SERVICE

Beech Bark Disease  
Butternut Canker  
Dogwood Anthracnose  
Dwarf Mistletoes

Fusiform Rust  
Gypsy Moth  
Laurel Wilt Disease  
Mountain Pine Beetle

Oak Wilt  
Sirex Woodwasp  
Southern Pine Beetle  
Spruce Beetle

Spruce Budworm  
Western Bark Beetles  
Western Spruce Budworm  
White Pine Blister Rust

## HEMLOCK WOOLLY ADELGID

Shady hemlock groves are dear to the hearts of many who enjoy our eastern forests. Hemlocks also add beauty to parks and home landscapes. Unfortunately, this species is attractive to a tiny, white insect introduced from Asia. Decline and mortality in hemlocks began to appear in Connecticut, New Jersey, and Virginia in the late 1980s and is being spread by wind, birds, and at least in one case, on nursery stock.

**BIOLOGY:** According to the Forest Service, this insect has a complex and unusual life cycle. For example, it has two generations per year, affects hemlock trees of all ages, goes through six life stages (eggs through maturity), is parthenogenetic (all-female population that does not require sexual reproduction), and feeds primarily in winter. In the crawler stage, the insect feeds on stored nutrients by penetrating xylem cells at the base of leaves. This stunts shoot growth, resulting in mortality over a 4- to 10-year period.

**RECOGNITION:** Large numbers of fluffy white specks that line twigs at the base of leaves on a hemlock is a sure giveaway that the tree is infected by mature hemlock woolly adelgids.



Hemlock woolly adelgids are easily recognized in the adult stage. During an earlier stage of the life cycle, they deprive the tree of stored starch in winter.

Immature stages are more difficult to detect because they are smaller than the diameter of a leaf and dark colored.

**CONTROL:** Nature's control is very cold weather. Cold periods can reduce a local population from 20-100 percent. Otherwise, in home and park landscapes, this pest is easily controlled on small trees or hedges with the use of any of several insecticides, including eco-friendly oils and soaps. On larger trees, injections have proved effective. In forest areas, control is more problematic and research on practical methods is underway.

## SUDDEN OAK DEATH

We have lived with oak wilt disease in eastern forests for years and have developed a number of preventive methods. Now there is a west coast disease that kills western oak species in the red oak group and can damage the foliage of many others, such as California bay laurel, Douglasfir, and coast redwood. The disease was discovered in the 1990s and spreads by infected nursery stock, wind-blown rain, and contaminated irrigation water.

**BIOLOGY:** This disease has been identified as *Phytophthora ramorum*, a water mold. When its spores land on the bark of a susceptible species, they germinate, penetrate the bark, form cankers, and reduce water flow in the tree.

**RECOGNITION:** This one requires laboratory analysis for positive identification. However, the diagnostic symptoms on susceptible species are red-brown to black cankers and seepage on the lower trunks.

**CONTROL:** Government efforts include intensified inspection of nursery stock and soils, and the clearing of infected and susceptible trees to develop host-free strips. A chemical, Agrifos<sup>®</sup>, is used to spray potential host trees in an effort to induce resistance to the disease.

Reddish-brown seepage in the lower part of a western oak tree.



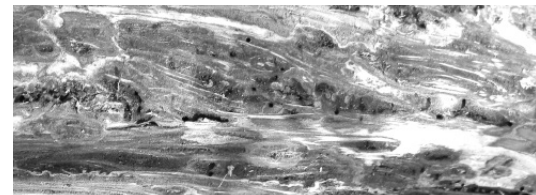
## THOUSAND CANKERS DISEASE

Eastern black walnut trees are the victim of this fungal disease. Mortality in black walnuts growing in the western states was at first attributed to drought, but a new fungus, *Geosmithia morbida*, has now been identified as the culprit. Unfortunately, the disease is spreading eastward into the native range of black walnuts.

**BIOLOGY:** The fungus is spread from tree to tree by a tiny insect, the walnut twig beetle. Once established, the pathogen forms multiple circular or oblong cankers in the phloem tissue under the bark. The cankers kill the tree's cambium layer and disrupt the flow of nutrients in the phloem. When thousands of the cankers coalesce, the tree declines and usually dies within three years.

**RECOGNITION:** Crown dieback and thinning in walnuts. Removal of bark will reveal the cankers, but laboratory cultures in agar and microscopic examination are necessary to positively identify the disease. The insect that carries the disease is smaller than a pencil point and difficult to detect. Sometimes there is seepage from the tiny hole it makes as it enters the tree.

**CONTROL:** At this time there is no safe and effective method of control. Trees with the disease should be isolated. Wood should be heated and pressure treated at 90 degrees C.



Coalescing cankers under the bark of a walnut tree.

# What You Can Do

*There is a role for everyone to help fight against the spread of insects and diseases that destroy trees. Whether you are an individual working alone or a member of an organized group, there is a need to heighten awareness about pests, be on the watch for invaders, and know who to contact for help or to report findings.*

## LEARN MORE

Whether working alone or as part of an organization, a first step is to become knowledgeable about the pests that threaten tree species in your area. An excellent guide to this information is an annual publication produced by the U.S. Forest Service titled “Major Forest Insect and Disease Conditions in the United States.” For more about this publication as well as links to specific websites about the major pests, visit [arborday.org/bulletins](http://arborday.org/bulletins). There are also workshops conducted in many communities. Your state forester, County Extension Office, or local branch of Master Gardeners would be a starting point to see what might be available.

## EXISTING GROUPS CAN INCLUDE MONITORING AND AWARENESS ACTIVITIES

The infrastructure already exists to develop citizen monitoring and awareness efforts. For example:

- Tree boards can expand their responsibilities by providing information about pests and pest control through local media, workshops, publications, and information booths at public events. Also, ordinances can be reviewed to assure content that allows for inspection and control of infected trees on private property as well as in rights-of-way and on public land. Suggested language for a section on tree protection can be found in Tree City USA Bulletin No. 6. Another activity potentially spearheaded by tree boards and/or the urban forester is to include pest monitoring as part of the tree inventory with a goal of using this information to guide future management decisions. i-Tree Pest Detection, part of the i-Tree suite of programs, is a free inventory tool to make this job easier. (See box on these pages.)
- Any tree-related organization can investigate ways to add monitoring to its activities. This would include Garden Clubs, neighborhood associations, and tree-planting organizations. Likewise, for Tree Stewards or similar groups that usually focus on pruning, monitoring is a natural extension of the volunteer work provided by these tree-minded citizens on weekends and evenings.

## START SOMETHING NEW

Every worthy cause has begun with a single individual or small group of like-minded visionaries. Perhaps you are the one to get your tree board or other organization introduced to pest monitoring. Another option is to start your own citizen monitoring program.



Tree boards and other tree-related groups can receive training to identify and report invasive pests such as the thousand cankers disease shown here.

## WHAT TO DO IF YOU FIND SOMETHING **SUSPICIOUS**

- 1** Carefully compare the symptoms or actual insect with photos in reference materials.
- 2** Collect samples. The insect is best when properly euthemized and contained in a tight container, such as a pill box. Chewed leaves, bark samples, etc., may also be helpful. In the case of diseases, the collected sample should be contained in a tightly sealed plastic bag or other container.
- 3** Take photos of the infected tree, both distant and close-up, and note exact location and date.
- 4** Describe the extent of damage, position on the tree(s), and other helpful observations.
- 5** Submit your findings to a specialist.

## HELP IS AVAILABLE

Invasive pests are so serious that numerous government agencies are throwing their weight behind countering the problem. You will have no trouble receiving assistance for your monitoring program.

**STATE FORESTER:** Most states have both an urban forestry coordinator and a forest pest specialist. For contact information, visit [arborday.org](http://arborday.org) and click on Tree City USA. This will take you to a national directory of coordinators.

**NATIONAL PLANT DIAGNOSTIC NETWORK:** This interagency network was provided to help detect and identify high-consequence insects and plant diseases and promptly provide information to appropriate responders and decision-makers. A state-by-state directory of diagnostic laboratories can be found at [www.npdn.org/home](http://www.npdn.org/home).

**COUNTY EXTENSION AGENT:** The help closest to home is probably your county extension agent. He or she represents an extension of your state's agricultural and forestry colleges. There are usually various specialists, and the office is often at the county building. A wealth of up-to-date information is available from this source as well as help with diagnosis and control methods.

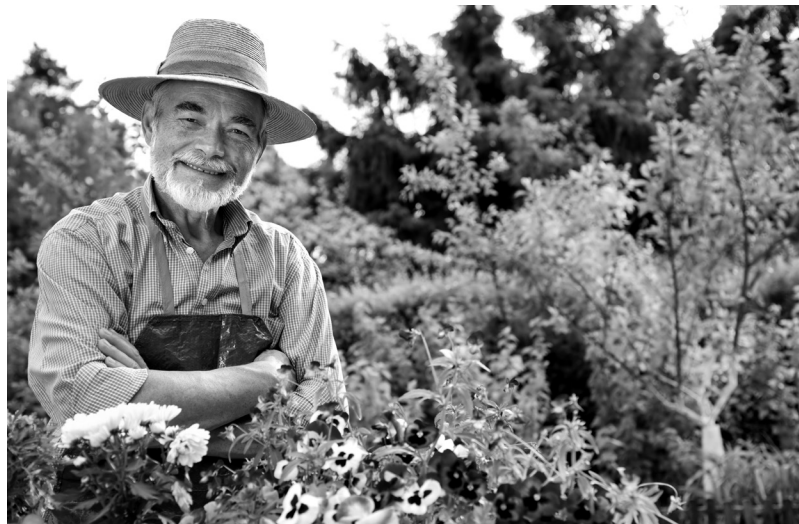


Methods to attract media attention and enlist help from the general public in the campaign against tree pests are limited only by the imagination!

## i-TREE PEST DETECTION

i-Tree Pest Detection is part of the i-Tree suite of computer programs developed by the Forest Service, Davey Resource Group, and other partners to assist in community tree inventories and provide other tools to analyze urban forests and guide management decisions. In the case of i-Tree Pest Detection, the program provides a standardized method for observing a tree for possible insect or disease problems, collecting and integrating data as part of street tree inventories, and reporting findings. This program is free, and one of its goals is to feed local information into a national database to provide improved trend data. A link to i-Tree can be found at [arborday.org/bulletins](http://arborday.org/bulletins).

**MASTER GARDENERS:** This is a program sponsored by the Extension office. It provides intensive training to interested citizen volunteers who then provide public service. These individuals assist county extension agents in such ways as fielding questions about diagnosis and providing public awareness about gardens and trees, including pest problems.



Master Gardeners are an excellent source of help for training, pest identification, and public awareness.

**U.S. APHIS:** APHIS, the Animal and Plant Health Inspection Service, is the regulatory agency charged with promoting and protecting agricultural health. Pest detection is one of its many responsibilities.

**U.S. FOREST SERVICE:** The Forest Service is a leader in the fight against invasive tree pests. Locally, its forest entomologists and pathologists can help with diagnosis and information. Nationally, its scientists conduct research on controls. The agency also takes the lead in monitoring and annually reporting the status of invaders.

# Groups That are Taking Action

*Fighting invasive tree pests is not a lost cause. Not only are municipalities and other government organizations investing millions of dollars in research and control, citizen organizations from Vermont to Alaska are helping through monitoring and reporting. Following are some examples, presented here to help others initiate similar efforts nationwide.*

## VERMONT

With grant funding from the National Urban and Community Forestry Advisory Council in 2009 and working in cooperation with the Forest Service's Urban Natural Resources Institute, University of Vermont Extension has completed a survey of citizen monitoring programs. A link to the results can be found at [arborday.org/bulletins](http://arborday.org/bulletins). That was a first step toward developing a statewide program similar to Minnesota's (below). An important outcome of initial research was the decision to develop two distinct monitoring programs – one for identifying and managing invasive plants, with The Nature Conservancy taking the lead, and one specifically for insect and disease monitoring managed by the Vermont Department of Forests, Parks and Recreation.

## MINNESOTA

Minnesota has a long history of citizen monitoring. The state's Certified Tree Inspector Program began in 1974 primarily to document the spread of Dutch elm disease and oak wilt. Today, this program is supplemented with Forest Pest First Detectors for the early discovery of infected trees. In this program, volunteers prepare to monitor a variety of tree pests by completing three online training modules and then an all-day workshop. Individuals learn how to identify targeted pests such as the emerald ash borer, properly collect samples, and report any findings to the Minnesota Department of Agriculture. They also are expected to help with public education campaigns. In addition, the Department of Agriculture maintains an "Arrest the Pest" hotline to help with quick response after the sighting of invasive pests in a new area.

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After the appearance of Dutch elm disease and oak wilt in the state, hundreds of volunteers and professionals received certification as Minnesota Tree Inspectors. A parallel program is now in place to broaden citizen monitoring to help control the spread of emerald ash borers and other insect invaders.



## TEXAS

Like Minnesota, Texas helped pioneer citizen monitoring. Its Citizen Scientists program was initiated in 2005 by a multi-agency partnership and is managed by the Lady Bird Johnson Wildflower Center. The focus has primarily been on plants but now includes a wide range of both plant and animal invaders. Volunteers, including high school students, are grouped regionally into "satellites" for more efficient reporting, communication, and action. There is an online newsletter, reporting form, and mapping feature. The program's goals are to:

- Train a large, geographically distributed cadre of citizen scientists to find and report outbreaks of selected invasive species.
- Validate and use reported data for maps of invasive species to improve understanding of distributions.
- Partner and provide information to regional resource managers and agencies to control and/or eradicate invasive species and, when possible, to provide opportunities for volunteers to help with control efforts.
- Provide continuing education to current citizen scientists who, in turn, can train the next generation.



A multiagency partnership under the leadership of the Lady Bird Johnson Wildflower Center has divided Texas volunteers into local "satellite" groups that monitor invasive plants and insect pests.

## KENTUCKY

Boone County is making an exemplary effort to thwart the attacks of emerald ash borers. Local officials there started with a management plan and a partnership that included the leadership in organizations such as the County Extension District, Boone County Arboretum, and the Urban Forest Commission. The campaign, funded by the U.S. Forest Service, includes:

- Awareness materials to help residents identify the emerald ash borer. Included are posters, displays, brochures, press releases, and ads.
- An insert distributed with the county newsletter that is sent to every household in county.
- A series on awareness presented to schools, garden clubs, service clubs, and others.
- Presentations in cooperation with the library district.
- An all-day seminar for nursery and landscaping personnel.
- The purchase of insect traps and training for individual citizen monitors in the use of the traps and other monitoring activities.
- Technical assistance to property owners via Internet and phone follow-up.
- An inventory and mapping of ash trees in public parks.

## CALIFORNIA

A partnership consisting of the U.S. Forest Service and the University of California at Riverside is taking citizen monitoring to new levels of high-tech input. This program allows citizen monitors to report findings using an existing phone-based GIS system. Called ARCGIS Mobile, the system was developed for the Huntington Museum to allow researchers, paraprofessionals, volunteers, and others with cellphones to input data into a spatial database to track oak mortality. The system also allows for a tiered method of information sharing and feedback to field observers so they can learn and improve skills and efficiency.

## CONNECT WITH INVASIVE PLANT CAMPAIGNS

The fight against noxious weeds and other invasive plants is older and more institutionalized than citizen monitoring for tree pests. Some communities have volunteer weed detection and control groups that are either independent or auxiliaries of interpretive centers or parks. Many counties also have paid weed control officers. Expanding the efforts of these organized campaigns to include tree insect pests and diseases has considerable potential.

## ALASKA

High-tech communication is especially essential in a huge state like Alaska. Here, a user-friendly Web portal is being developed to expand the Cooperative Extension Service's longstanding Integrated Pest Management Program. The website is a key component of this program that marshals the resources of citizen volunteers statewide. It allows the citizen monitors to interface with trained technicians about insect and tree diseases. The monitors can report findings, attach photos, and receive quick feedback. When completely operational, there will be links to identification aids and control information. Reports using the website are automatically integrated into the Western Plants Diagnostic Network and Cooperative Extension's reporting formats.

Even without the current enhancements, Alaska's Integrated Pest Management Program has been exemplary in using early detection, identification, and education in the fight against invasives since 1981. In fact, in 2003 IPM staff identified the western tent caterpillar that sneaked into the state on ornamental tree stock. Thanks to early detection, the insect was eradicated before it spread.



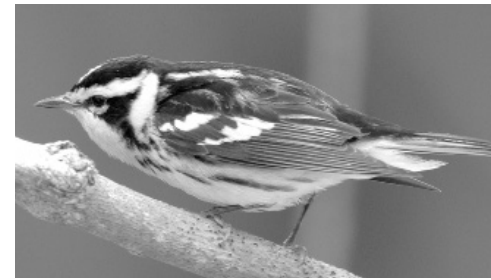
Early detection by professionals has already thwarted the invasion of one insect pest. Now citizen monitors are being trained to help in the effort of keeping unwanted invaders out of the "The Last Frontier."

# Ecological Impacts

John Muir once said, "When we try to pick out anything by itself, we find it hitched to everything else in the universe." So it is when an invasive insect or disease disrupts the natural ecology of our forests. For example, loss of hemlocks to the hemlock woolly adelgid can mean the loss of brook trout in nearby streams. Studies in Pennsylvania have shown that brook trout are four times as abundant in streams draining hemlock forests compared with streams draining hardwood stands. The dense canopies of hemlock stands moderate air temperatures by several degrees in both summer and winter, undoubtedly affecting a variety of plant and animal life. They also provide essential breeding habitat to certain song birds. Birds commonly associated with hemlock forests

include the Blackburnian warbler, black-throated green warbler, and the blue-headed vireo. These kinds of ecological relationships can be found wherever a native tree is impacted by an invasive pest.

In an intricate ecological web of life, the beautiful Blackburnian warbler becomes affected by the fate of hemlocks that fall victim to hemlock woolly adelgids.



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