

# **Growing Greener: Eco-Structure For Climate Resilience**

## **Chapter 4: Threats to Tree Health – Managing for Pests**



Credit: Flickr user Yinghai

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This guide was developed by Kara E. Reeve, Manager of National Wildlife Federation's Climate-Smart Communities Program, with support from additional NWF staff including Ian Evans, Patty Glick, Laura Hickey, Ryan Kingston, and Jennifer Murk. Information about NWF's Climate-Smart Communities Program can be found here: [www.nwf.org/climate-smart-communities](http://www.nwf.org/climate-smart-communities).

## Introduction

Whether you live in the city overlooking a park, grew up with a backyard tree house, or have hiked in a national forest, you undoubtedly know exactly what poet Joyce Kilmer was feeling when he wrote, "I think that I shall never see a poem as lovely as a tree." Trees are a vital part of our natural world, health, economy, and culture.

The ecological benefits of healthy trees, including the habitat, shelter, and food they provide for many birds and small wildlife, are widely known.

However, people living in urban areas may not immediately consider the ways in which healthy urban forests are **critical infrastructure** for *human* communities, too.



Credit: Charlie Archambault

For starters, trees are central components of green infrastructure, which is a natural and cost-effective approach that many communities are using to reduce flooding, manage stormwater, improve water quality, and even reduce urban heat. Green infrastructure includes a mix of landscape features including tree canopies, open space, parks, and wetlands, as well as low impact development (LID) approaches, such as rain gardens, green roofs, and permeable paving. Additionally, planting and fostering healthy trees helps reduce carbon pollution because as trees grow, they absorb carbon dioxide from the air and store carbon in their trunks, roots, and foliage. Furthermore, communities are already experiencing the effects of climate change, including extreme flooding, heat waves, and drought, and green infrastructure can provide critical, natural protection from these impacts now and into the future.

Green infrastructure not only provides resilience to climate change, but can also help communities be more resilient to economic shocks since designing, installing, and maintaining green infrastructure projects, like green roofs and rain gardens, can lead to new local job opportunities. Additionally, green infrastructure often costs less to install and maintain when compared to conventional "grey" infrastructure, such as building underground storage tanks to manage stormwater, and buildings with vegetated roofs benefit from lower heating and cooler costs.<sup>1</sup> Green infrastructure also improves the health and quality of life for residents by improving access to green spaces, connecting people with nature, and by providing recreational opportunities.

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<sup>1</sup>US EPA. *Reducing Urban Heat Islands: Compendium of Strategies*. Chapter on Green Roofs. URL: <http://www.epa.gov/heatisland/resources/pdf/GreenRoofsCompendium.pdf> (accessed 2 May 2013).

NWF partnered with King County, Washington, to help develop an on-line tool for landowners, called Urban and Community Forestry CPR - Climate Preparedness and Response (CPR).<sup>2</sup> Using CPR, landowners can view their own property using a Geographic Information System (GIS) tool. Once a property has been identified, the tool also quantifies and explains existing land and forest characteristics (e.g., total forest carbon stored at a particular site). Additionally, the website provides customized management recommendations through a Forest Health Assessment survey.

This guide is designed to help local governments, organizations, and others replicate the website and tool for their own communities, while also learning about the ways in which green infrastructure can provide natural protection from the impacts of climate change. The first section of this guide provides an overview of the ways in which climate change is impacting urban areas, and also describes how nature-based approaches, like enhancing and protecting the urban tree canopy, can help communities build resilience to climate impacts. The next section includes a case study of the King County Forest CPR development process, guidance for selecting data sources for the tool, and lessons learned from the King County project. Next, since climate change is impacting the survivability of urban trees, this guide also provides recommendations for integrating climate change considerations into the planning for and management of urban forests. This guide also includes a chapter about managing for pests in a changing climate, while the next section profiles National Wildlife Federation programs and resources that are designed to build healthy, resilient communities, including NWF's Certified Wildlife Habitat<sup>®</sup> program. The last sections include regionally-specific resources and information to help enhance forestry health and subsequently increase the amount of carbon that urban trees are able to sequester.

We have developed this guide to encourage cities and towns to recognize trees as critical, functional infrastructure —“**eco-structure**”—that is just as important as buildings and roads. We know that trees can survive and thrive in urban areas, while benefiting the humans that live there — we just need to place a premium on our trees and other green infrastructure and envision a greener, healthier future.

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<sup>2</sup> Forestry CPR can be accessed here: <http://gismaps.kingcounty.gov/ForestryCPR/>

#### 4. Threats to Tree Health – Managing for Pests

Herbivorous insects are often more abundant in urban environments than in the surrounding rural area. Several factors have been hypothesized to explain this, such as access to more vulnerable host plants and fewer predators, but recent research suggests the urban heat island effect is an important driver. In a paper published in March 2013, researchers observed higher abundances of a scale insect in hotter parts of the city. In related experiments, they controlled for plant health, watering the trees to ensure plants were not simply vulnerable due to heat. Results showed that regardless of other conditions, the insects thrived in hotter environments.<sup>3</sup>



As the climate warms and the urban heat island effect worsens, invasive insects will likely follow the model Meineke et al. has discovered. While these pests are already a threat to natural, healthy forests, urban forests are much more vulnerable due to the urban heat island effect and already harsh urban conditions. Active monitoring and proper management can, however, ensure a thriving urban forest even as the climate worsens. Below is a list of some common pests throughout the US, and resources that can be used to combat them.

The **Asian longhorned beetle** (ALB) is an invasive insect found attacking a variety of tree species in the U.S., namely throughout the northeast. First discovered in Brooklyn in 1996, this insect has spread throughout parts of New York, Massachusetts, New Jersey, Illinois, and Ohio. ALB was also discovered in warehouses containing wooden materials in states from California to Florida. ALB larvae tunnel through tree trunks, girdling stems and branches. Repeated attacks eventually cause the tree crown to dieback, resulting in the death of the tree. Although a complete host of trees has not been determined, the beetle prefers maple species (*Acer* spp.), including boxelder, Norway, red, silver, and sugar maples. Other preferred hosts include birches, Ohio buckeye, elms, horsechestnut, and willows. ALB has also been found in ashes, European mountain ash, London planetree, mimosa, and poplars. As of March 2013, the ALB has been eradicated from Illinois and New Jersey, after 10 years of constant management and vigilance from federal, state, and local governments.

Early detection, quarantines, removal and destruction of infected trees, and replanting of non-host species are the best way to limit and prevent the spread of this species. For more information, go to the USFS website: <http://www.na.fs.fed.us/fhp/alb/>

Current range: Northeast, Mid-Atlantic

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<sup>3</sup> Meineke EK, Dunn RR, Sexton JO, Frank SD (2013) Urban Warming Drives Insect Pest Abundance on Street Trees. PLoS ONE 8(3): e59687. Doi: 10.1371/journal.pone.0059687

Map:

[http://www.fs.fed.us/foresthealth/technology/invasives\\_anoplophoraglabripennis\\_riskmaps.shtml](http://www.fs.fed.us/foresthealth/technology/invasives_anoplophoraglabripennis_riskmaps.shtml)

The **emerald ash borer** (EAB) first entered Michigan from China at least 15 years ago, likely in solid wood packing material. EAB has since been found in several states and Ontario, Canada. EAB infects and kills trees in a manner similar to that of the ALB. Because this species is generally smaller in size, its boring holes may be smaller to detect.



**Emerald Ash Borer. Credit: USFS**

To limit the spread of this pest, states imposed quarantines and regulations on the transport of ash trees and ash wood products. Federal quarantines were imposed by USDA Animal and Plant Health Inspection Service and the Canadian Food Inspection Agency. For more information, go to the USFS website: <http://na.fs.fed.us/fhp/eab/>

Current range: Northeast, Great Lakes region, Appalachian region

Map: [http://www.emeraldashborer.info/files/MultiState\\_EABpos.pdf](http://www.emeraldashborer.info/files/MultiState_EABpos.pdf)

The **hemlock woolly adelgid** (HWA) is a tiny sap-sucking insect causing a decline of hemlock trees in the eastern United States. First discovered in VA in 1951, this pest has been found in states from northern Georgia to southern Maine. The HWA has few natural predators, and the native eastern hemlock species are not resistant or tolerant to their feeding.

In controlled environments, such as ornamental tree farms, insecticides can be used to control their spread. Research is currently being done on the potential use of biological controls, namely releasing natural predators into the wild. For more information, visit the USFS website:

<http://www.na.fs.fed.us/fhp/hwa/>

Current range: Appalachian region, from Georgia to Maine

Map: <http://na.fs.fed.us/fhp/hwa/maps/2011.pdf>



**Hemlock woolly adelgid. Credit: USFS**

**Oak wilt disease** was first considered an important disease in 1944 in Wisconsin, where in localized areas over half the oaks have been killed. This disease has since been discovered in 21 states. This disease is caused by a fungus, *Ceratocystis fagacearum*, that clogs the water conducting vessels of infected trees, causing them to wilt and die within a few weeks or months.

Transmission of this disease is accomplished with the help of small insects. Sap feeding beetles called nitidulids can carry fungal spores from infected oaks to healthy oaks, causing infection. Longer-distance transmission can occur when these beetles or spores are carried to other locations on firewood. The fungus can also spread through root grafts. Similar species of oaks growing in proximity often form interconnected root systems, where fungi can spread from tree to tree.



Oak Wilt. Credit: Paul Mistretta USDA Forest Service Bugwood.org

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There is no known way to cure an infected tree, so disease prevention is the best management method. If a tree shows signs of Oak Wilt, including browning leaves in summer months and the formation of fungal mats on the bark, a county agricultural agent, agricultural station, or local forester should be contacted to confirm infection and offer control recommendations. Control may involve burning or chipping the dead tree, breaking root grafts between diseased and healthy trees, and

using mechanical and chemical barriers to prevent the spread of the fungus.

Planting a diversity of tree species is another way to safeguard against oak wilt disease. No single species should compose a majority of the total tree population in any given area. Special consideration should be given to oak wilt resistant species such as bur, overcup, swamp chestnut and white. For more information, see the Forest Service site for your region: <http://na.fs.fed.us/fhp/ow/index.shtm>

Current range: Texas to Great Lakes region and east to PA to WV

Map: [http://na.fs.fed.us/fhp/ow/maps/ow\\_dist\\_fs.shtm](http://na.fs.fed.us/fhp/ow/maps/ow_dist_fs.shtm)

The **Southern Pine Beetle** is one of the most serious insect pests in the South. These tiny insects bore directly through tree bark and form networks of tunnels between the bark and wood. Lined with eggs, these tunnels eventually girdle and kill the tree. A fungus known as “bluestain” is often carried by these insects as well, causing further damage to the tree. Preferred hosts include loblolly pine, shortleaf pine, pond pine, and Virginia pine. Slash pine and longleaf pine are considered to be more resistant to attack, but may be at risk during severe outbreaks.



Southern Pine Beetle. Credit: USFS

Infestations typically begin in weak or somewhat unhealthy trees, such as those stressed by disease, old age, or storm damage. As climate change increases the frequency of droughts, this additional stress will further expose these trees. Once established in unhealthy trees, an outbreak can occur in which even healthy trees may be at risk. Outbreaks have typically occurred on six to twelve year intervals and last two to three years. Depending on climatic conditions and the presence of preferred hosts, these outbreaks may occur more frequently and last for longer periods of time.

Homeowners and forest managers can slow or prevent the spread of outbreaks by keeping host species healthy and planting more resistant native species of pine. Removing damaged trees, minimizing damage to healthy trees, and maintaining healthy soil and water levels help keep trees resistant to infestation. For more information, visit the US Forest Service website:

<http://www.fs.fed.us/r8/foresthealth/hosf/spb.htm> and the University of Florida fact page:  
[http://entnemdept.ufl.edu/creatures/trees/southern\\_pine\\_beetle.htm](http://entnemdept.ufl.edu/creatures/trees/southern_pine_beetle.htm)

Current range: Southeast U.S. from eastern Texas to Virginia

Maps: [http://www.fs.fed.us/foresthealth/technology/nidrm\\_spb.shtml](http://www.fs.fed.us/foresthealth/technology/nidrm_spb.shtml)

**Thousand Cankers Disease (TCD)** is a recently recognized disease discovered in the western United States known to infect certain walnut species. TCD is caused by a combination of the boring of the walnut twig beetle and a fungus it vectors, *Geosmithia* spp. It is believed that outbreaks of the twig beetle coincide with long term drought. In the western US, it has taken eight to ten years of continuous feeding by the beetle to kill an individual tree. While TCD is thought to be restricted to the western U.S. and its associated walnut species, eastern black walnut ecosystems may also be at risk if exposed to the disease.

Infected trees can be identified by crown thinning, the presence of isolated branches that show leaf yellowing, or sudden leaf wilting. The time between these symptoms and death may range from three to ten years, depending on climatic conditions and tree health. Examining branches with these symptoms may reveal the presence of the tiny walnut twig beetle.

Much research on TCD is still needed, as it has only recently been discovered. It is believed that drought has little to no effect on its spread, but because the twig beetle and fungus have developed in the warm southwest climate, a warmer climate may benefit their development and spread. There are currently no known ways to effectively control the walnut twig beetle. Although pesticides may be an effective control measure, other problems, like impacts on water quality, may result from their use. Like other diseases and pests, a healthy forest can be maintained by planting a variety of species to prevent a large die-off from a single pest. For more information and resources, see the Forest Service website:

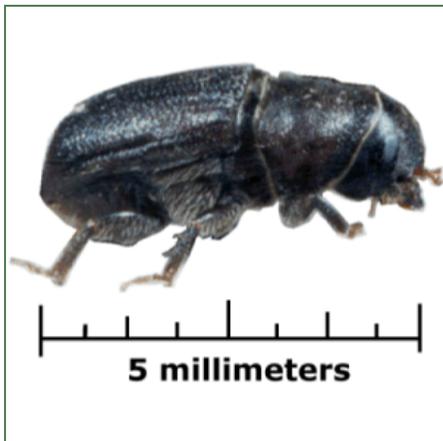
<http://www.fs.fed.us/foresthealth/fhm/sp/tcd/tcd.shtml>

Current range: Western U.S., Mid-Atlantic

Map: [http://www.thousandcankers.com/media/images/TCD\\_Confirmed\\_State\\_Map\\_2\\_2013.png](http://www.thousandcankers.com/media/images/TCD_Confirmed_State_Map_2_2013.png)

The **Mountain Pine Beetle (MPB)**, like many other bark beetles in the U.S., is a native species that causes severe harm to forests when outbreaks occur. Found in pine forests from Mexico to Canada, MPB outbreaks have grown more severe thanks to more frequent wildfires and drought weakening otherwise healthy trees. As the climate warms and wildfires become more intense, this beetle is expected to thrive.

**Mountain Pine Beetle. Credit: USFS**



Beetle attacks are manifest by discolored foliage in late Spring, the appearance of reddish pitch tubes on the trunk, discolored sapwood (often blue due to fungi), and the appearance of exit and entrance holes in the bark. If these factors are reported, a local forester or other resource should be consulted to identify and confirm an infestation.

Infected trees cannot be cured, but the further spread of beetles can be prevented with vigilance. Researchers at the U.S. Forest Service Rocky Mountain Research Station found that beetle larvae survival is drastically reduced when the bark is fully exposed to sunlight. By felling trees in potentially infected areas, beetle outbreaks can be slowed or prevented entirely.

The use of insecticides can also be used to protect high-priority trees, though this method may put desired insect species at risk. As with other pests, having a high diversity of trees in an urban forest can prevent the establishment and spread of the MPB. For more information and management options, see the Forest Service page:

<http://www.fs.fed.us/rm/landscapes/Solutions/Pinebeetle.shtml>

Current range: Rocky Mountains, from northern Mexico to Canada, and western regions from southern California to Washington.

Map and additional information:

[http://www.nps.gov/romo/naturescience/mtn\\_pine\\_beetle\\_background.htm](http://www.nps.gov/romo/naturescience/mtn_pine_beetle_background.htm)

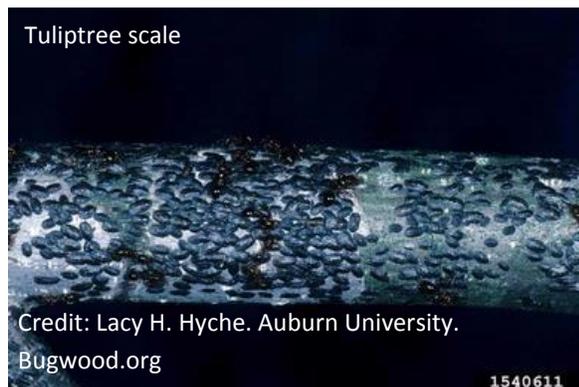
**Spring and Fall Cankerworms** are native to elm forests in the western U.S., where they have historically caused damage to native Siberian elm shelterbelts. These pests have been found primarily on Siberian and American Elms, but have also been known to feed on a broad range of other understory and hardwood plants. Repeated, constant feeding by cankerworms results in stunted growth of new twigs and the loss of leaves and bark. This often results in the death of the tree.

Cankerworm infestation can be identified by the presence of larvae on leaves from early May to the end of June. Early detection can save the trees, as biological controls, such as the bacterium *Bacillus thuringiensis*, can be applied to kill the larvae. For more information, see these resources:

<http://www.mortonarb.org/tree-plant-advice/article/764/cankerworms.html> and  
[http://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb5187552.pdf](http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187552.pdf)

Current range: Found throughout the continental U.S., this species is most severe in western states.

The **tuliptree scale** is a soft scale insect that attacks yellow poplar, magnolia, and occasionally linden species. This insect can be so prolific that they cover whole twigs and branches during feeding in spring and when new insects are born in fall. This overfeeding can weaken, distort, and kill trees, especially those with a diameter of less than 5 inches.



During the growing season, presence of this pest can be indicated by an abundance of honeydew secreted by developing soft scales. This often attracts ant and wasp populations that may be issues in and of themselves. Ants, for example, may need to be managed as they protect the soft scales from predation, allowing them to thrive. There are several management options for the tuliptree scale, including the use of biological controls. The pyralid moth is a natural predator of the soft scale, although they may not be viable for large scale infestations. Applying insecticides during the crawler stage, from mid-August through mid-September, is often an effective control measure.

Current range: New York and Connecticut to Florida, east of the Mississippi River. Some infestations have been found in yellow poplar in California.