

# Forest Insect Pests and Diseases

## Forest insect pests

The forest is home to an abundant diversity of organisms, including insects. The study of forest insects is called **forest entomology**. Many insects play important roles in a forest ecosystem by serving as food for wildlife, pollinating plants and even preying on forest pests. Some insects, however, cause tremendous damage to a forest. They reduce the growth rate of trees, transmit disease, weaken trees, or kill trees. Weakened trees are more susceptible to attack by other insects or diseases. Many forest insect pests were introduced from other countries and have become invasive species, primarily because they have no natural predators.



forest damaged by gypsy moths

Photo: Jeffrey A. Mai Aerial Survey & Aviation  
Safety Manager, Forest Health Protection USDA  
Forest Service

One way to classify insect pests is by the damage they cause. Each insect species has a preferred part of the tree on which it feeds. Some insects eat leaves; others suck juice from the leaves and some bore through the bark and wood trees.

**Defoliators** eat a tree's leaves or needles. Heavy infestations of these insects can strip the leaves from entire stands of trees. Without leaves or needles, trees cannot make the sugar they need to grow. Most deciduous trees can survive one year of defoliation, although their growth rate will slow. Several years of defoliation generally will kill them. Evergreen trees can be killed by just one year of defoliation. The gypsy moth is an example of a defoliator.



defoliation caused by gypsy moths

photo courtesy of  
<http://www.buckleytree.com/treeGalleryImage.asp?ID=45>



**Skeletonizers** eat all of the leaf except the veins. These insects dig between the upper and lower leaf surfaces or eat all but the upper surface, leaving only a thin layer of cells. Because a skeletonized leaf can still photosynthesize at a reduced level, these insects cause less damage than defoliators. The birch leafminer is an example of a skeletonizer.

skeletonized birch leaf

Photo: <http://www.foxtreeservice.com/insects-images/birch-leafminer/>

**Sapsuckers** are insects that draw sap and plant juices from trees using their hollow, straw-like mouth parts. They feed on needles, leaves, shoots or stems. Leaves will have a crinkled appearance and generally are smaller after the sapsuckers feed. Although this feeding does not kill the tree, it does reduce the ability of the damaged tree to make sugars. In heavy infestations, sapsuckers can kill a tree. The hemlock woolly adelgid is an example of a sapsucker.



hemlock woolly adelgid

<http://extension.umass.edu/landscape/factsheets/hemlock-woolly-adelgid>

**Bark borers** are insect pests that feed on the cambium and inner bark of a tree, disrupting the transport of water and nutrients. Many bark borers attack only trees weakened from disease or drought. Trees attacked by bark borers have small holes in the bark where adult beetles have exited. Some bark borers also carry tree diseases. The Asian longhorned beetle and emerald ash borer are examples of bark borers.



exit hole of adult emerald ash borer  
 Photo by Jessica Walliser  
<http://www.hobbyfarms.com/hobby-farms-editorial-blogs/jessica-walliser/emerald-ash-borer-damage.aspx>



exit holes of adult Asian longhorned beetle  
<https://www.flickr.com/photos/masseca/3971832773/in/photo-stream/>

## Forest Diseases

**Forest pathology** is the study of tree diseases. Diseases that affect trees cause damage that ranges from mild to very severe. Forest pathologists classify tree diseases by what causes them. They look at the disease signs and symptoms. Some of the most serious tree diseases are caused by fungi. Fungi attack various parts of the tree, including the leaves, branches, trunk and roots. Fungal diseases are grouped by the part of the plant that is infected, or the type of infection it causes. Two examples are vascular wilt disease and canker disease.



Dutch elm disease  
<http://www.forestryimages.org/browse/detail.cfm?imgnum=2251099>

Dutch elm disease is an example of a fungus that causes vascular wilt disease. This disease clogs vessels in trees preventing water and nutrients from reaching the leaves and sugars from reaching the roots.



vascular wilt disease  
<http://jrgm.com/news/jrgm-certified-arborists/0>



Chestnut blight is an example of a fungus that causes a canker disease. The chestnut blight grows in the inner bark and cambium. These cankers prevent the movement of water, nutrients and sugars at the affected areas. The blight eventually grows all of the way around the tree, girdling, or killing the tree.

chestnut blight  
<http://www.dinnerpartydownload.org/chestnuts/>



orange canker  
<http://americanorchard.wordpress.com/2013/10/06/what-im-reading-american-chestnut-the-life-death-and-rebirth-of-a-perfect-tree/>

# Management of Forest Insect Pests and Diseases

How can forest managers control harmful insects and diseases? Foresters concentrate their efforts on two areas, suppression and prevention:

## **Suppression**

Suppression controls existing insect populations and disease outbreaks using a variety of methods including biological, chemical, sanitation and mechanical controls.

- ❖ **Biological** controls can be used to reduce insect pest populations. These controls include the introduction of natural predators, competitors or diseases. Introduced predators attack the unwanted insects. Biological controls can be “specific” to the pest, destroying that insect without harming others.
- ❖ **Chemical** controls, called insecticides, can provide a quick response to insect infestations. Some insecticides function almost as a disease causing the insect pest to become sick and die. Other insecticides send signals that confuse insects so that they will not reproduce or cause the insects to gather in chemical traps. For diseases, chemicals are sometimes used to give individual trees resistance to a disease. All chemicals are regulated carefully and must be used properly to avoid damaging other forest organisms.
- ❖ **Sanitation** controls is the process of harvesting insect-infested or diseased trees. Loggers remove the trees from the forest and sell the wood to a mill, where it is made into products. Sanitation is aimed at removing the insects or diseases from an area, so they can’t spread to surrounding healthy trees.
- ❖ **Mechanical** controls include cutting down, chipping, peeling or burning affected trees to destroy insect habitats and sources of disease. Wood produced by these methods is seldom used commercially.



chemical

control <http://www.freedomspheonix.com/Article/031990-2008-04-03-population-to-be-sprayed-with-unregistered-pesticide.htm>



cutting down affected trees

## **Prevention**

Prevention is aimed at avoiding insect and disease outbreaks. Foresters are thinking ahead about the types of potential insect and disease problems a forest may have. Methods of prevention include regulatory and silviculture controls.

- ❖ **Regulatory** controls include laws that prohibit the transport and entry of insect pests or diseases. Quarantines prohibit the movement of affected material into an area. Containment policies are also used to prevent movement of insects or affected material out of an area.



- ❖ **Silvicultural** controls are aimed at optimizing a forest’s growing conditions so that it will not be susceptible to insect pests or tree diseases in the first place. Healthy trees are less attractive to some pests and to recover more quickly if pest or disease damage occurs.



healthy forest

[www.nrcs.usda.gov](http://www.nrcs.usda.gov)

## Tree Insect Summary

| <b>Tree Damage</b> | <b>Harmful Insects</b>  | <b>Envirothon Tree Species Most Affected</b>   | <b>Land of Origin</b>                         |
|--------------------|---|--|---|
| <b>Defoliators</b> | gypsy moth  | American chestnut, flowering dogwood, paper birch, pin oak, redbud, silver maple, slippery elm, tulip tree, white ash, Eastern hemlock, Eastern white pine | Europe & Asia                                 |
| <b>Skeltonizer</b> | birch leafminer   | paper birch  | Europe  |
| <b>Sapsucker</b>   | hemlock woolly adelgid  | Eastern hemlock  | Japan   |
| <b>Barkborers</b>  | Asian longhorned beetle<br>(see What is the Asian Longhorned Beetle?) | Norway maple, silver maple   | China   |
|                    | emerald ash borer<br>(see What is the Emerald Ash Borer?)             | white ash  | eastern Russian, northern China, Japan, Korea |

## Tree Disease Summary

| <b>Tree Disease</b>  | <b>Harmful Fungi</b>                                      | <b>Envirothon Tree Species Most Affected</b> | <b>Land of Origin</b> |
|----------------------|---|--|-----------------------|
| <b>Vascular Wilt</b> | Dutch elm disease<br>(vector is European elm bark beetle) | slippery elm                                 | Europe                |
| <b>Canker</b>        | chestnut blight   | American chestnut                            | China, Japan          |

# Chestnut Blight

**Damage:** Chestnut blight is a fungal infection in American chestnut trees. The fungus grows in the inner bark and cambium, eventually moving around the whole tree. That kills or girdles the tree. The fungus makes a canker, pictured.

**Life Cycle:** The blight enters the tree through small wounds mostly caused by insects feeding. The chestnut blight lives only in the trunk and branches. Root systems survive and new trees sprout before getting the blight and dying. Spores (the fruit of the fungus) can live in the soil for years before landing on a chestnut tree and infecting it.

**Control:** At this time, there is no forest-wide control. Various organizations are looking at trying to breed resistance to the chestnut blight into the gene pool, a silvicultural control. Another option is to locate the gene or genes that exhibit resistance in Chinese chestnut and implant them into the American chestnut DNA. This would also be a silvicultural control.



Photo courtesy of forestryimages.org



Photo courtesy of bioweb.uwlax.edu



Photo courtesy of columbia.org

# Hemlock Woolly Adelgid

**Damage:** The adelgid feeds on plant fluids which they suck from the needles. Moderate feeding results in unhealthy trees. Heavy feeding results in early needle drop, less twig growth, death of branches, and eventually death of the tree.

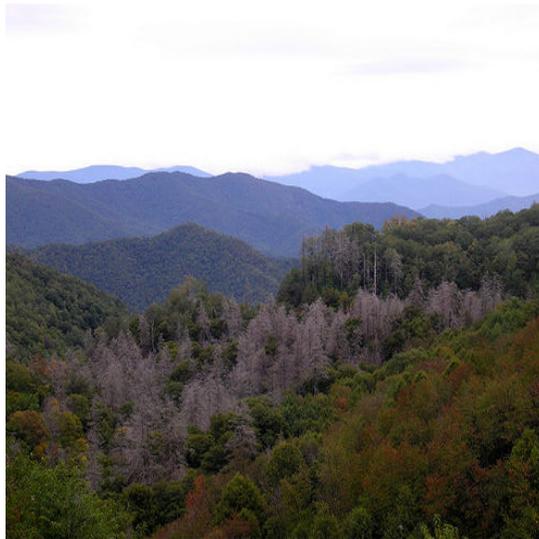
**Life Cycle:** Wingless adult females lay eggs in early spring to early June. The newly hatched nymphs crawl onto branches to feed. They feed by inserting their mouthparts into the needles. The nymphs continue to mature and become adults by fall. Adults overwinter on the tree. Adults are about 2 mm in size. Infestations can be identified by the white waxy spots on the underside of the needles.

**Control:** There are many chemical controls. Applying leaf insecticides in the fall targets overwintering adults. A June leaf applied insecticide targets feeding nymphs. Soil injections of insecticides are taken up by the tree roots and kill feeding adelgid. Currently, there are no controls that can be used in a forested setting. There is a quarantine on moving hemlock plants.



Adult hemlock woolly adelgid

(photo courtesy of Mark McClure, Brooklyn Botanic Garden)



Dead Eastern hemlock on the ridges.

(photo source: Flickr.com)

# Dutch Elm Disease

**Damage:** Early symptoms include “flagging”, when leaves on one or two branches wilt and yellow. The disease spreads rapidly throughout the tree resulting in death in 2-3 years. The fungus clogs the xylem. Xylem are the cells that carry water and nutrients through the tree. When the xylem is clogged, the tree starves to death.

**Life Cycle:** Dutch elm disease is a fungal infection of the tree’s xylem. The fungus may be transmitted through touching root systems or by insects carrying the fungus.

The Native Elm Bark Beetle and the smaller European Elm Bark Beetle lay eggs in the inner bark of the tree. After the eggs hatch and the beetles mature, they bore their way out of the tree. When they do this, they can pick up the fungus spores. They then go to other trees, carrying the fungus’ spores along.

**Control:** There are several methods of control depending on the situation. For trees that have been recently infected; dead and dying branches should be pruned and destroyed, a sanitation control. Insecticides, a chemical control, can be used to kill the beetles that spread the fungus. Fungicides, a chemical control, can be injected into the tree to kill the fungus. Another option is to plant disease tolerant or resistant elm trees, a silvicultural control.



flagging in an elm tree

(photo courtesy of Dr. Steve Katovich, USDA Forest Service, St Paul, MN)

# Gypsy Moth

**Damage:** Gypsy moth larvae cause extensive defoliation. A tree can leaf out a second time in the summer but this decreases the energy stored in the tree. These weakened trees are more susceptible to other diseases. Trees that are defoliated two or more times in successive years will be killed by the constant stress and loss of energy reserves.

**Life Cycle:** Gypsy moth larvae emerge from the egg masses in spring. Larvae will have five pairs of blue spots and six pairs of red spots on their back. Larvae feed on leaves, usually at night and rest during the day. However, when populations are very high, larvae will feed nonstop until the tree is completely bare. Then they crawl looking for a new food source. Larvae mature in mid-June or early July and go into the pupae stage. Adult moths emerge from the pupae in July. The female moths begin to lay eggs in July and August. The eggs are enclosed together in a hairy brown mass, called an egg mass.

**Control:** On a single tree, there are a variety of actions recommended to control gypsy moth populations. Egg masses can be destroyed by soaking them in soapy water, a mechanical control. Burlap placed around tree trunks will encourage larvae to hide there during the day. The larvae can then be killed, a mechanical control. Barrier bands prevent larvae from climbing up the trunk, a mechanical control. On a forest wide scale, pesticides, a chemical control, are effective on feeding larvae.



gypsy moth larvae  
(photo courtesy of PA DCNR)



female gypsy moth with egg mass  
(photo courtesy of USDA Forest Service)

## Birch Leafminer

**Damage:** The birch leafminer eats the cells between the upper and lower leaf surfaces. Leaves begin to turn brown as a result. They do not eat the veins of the leaf. Repeated leaf loss over the entire tree weakens the tree and makes it less resistant to other diseases.

**Life Cycle:** In the spring, adults emerge from the ground where they lived over the winter as mature larvae. Females lay eggs on the new leaves. The eggs hatch and the larvae feed in the leaves. Larvae are small, white, and slightly flattened. When the larvae mature, they drop to the ground where they turn into adults. Adults are small, black sawflies. There are two generations per year.

**Control:** Pesticides can be sprayed on the leaves when the adult black sawfly is active. Pesticides injected into the soil can be taken up through the tree roots to control the larvae. White barked Himalayan birch, Dahurian birch, and river birch are more resistant than other types and should be planted, a silvicultural control.



Birch leafminer damage

(photo courtesy of PennState Cooperative Extension, Woody Ornamental IPM)

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