

## **Forest Insects and Diseases**

### **General**

According to recent land use reports by the United States Department of Agriculture (USDA) Forest Services, Pennsylvania has more than 25,000 square miles of forest land, which comprises 59 percent of the entire Commonwealth. Because of this large amount of forest land, Pennsylvania is susceptible to the infestation of forest insects and diseases. Many insects live and feed on forest trees without harming the tree population. However, while most insects have a short life cycle and produce many offspring, almost all of the offspring die before reaching adulthood. When more than the usual number survive, an outbreak of forest insects develops. Certain species of insects, when their population reaches outbreak numbers, can cause significant damage to forests.

### **History**

Forest pests have been around for centuries. However, the outbreak of non-native pests and diseases threatens the health and lifespan of forests. According to the USDA, there are currently approximately 20 major introduced insects and eight introduced diseases attacking northeastern United States forests.

According to the Pennsylvania Department of Conservation and Natural Resources (DCNR), Pennsylvania tests approximately 17 million acres of public and private forest lands each year to determine the impact of forest pests and diseases.

The invasive Hemlock Woolly Adelgid was first detected in southeastern Pennsylvania in the late 1960s. To date, it is present in 49 of the Commonwealth's 67 counties, including Juniata County. According to DCNR, the severity of the Hemlock Woolly Adelgid infestation is high in Juniata County. The Commonwealth does use a chemical treatment to suppress the infestation of the Hemlock Woolly Adelgid.

Gypsy Moths are also monitored in Pennsylvania. According to DCNR, Gypsy Moths were responsible for the defoliation of more than 680,000 acres in 2007. Suppression programs were utilized in 29 of the Commonwealth's 67 counties, including Juniata County, in 2007. According to DCNR, 75 percent of the treated areas sustained less than 30 percent defoliation.

<b>Major Introduced Insects and Diseases in Northeastern United States Forests</b>		
<b>Insect</b>	<b>Origin</b>	<b>Year Introduced</b>
Elm Leaf Beetle	Europe	1834
Gypsy Moth	Europe	1869
Larch Sawfly	Eurasia	1880
Larch Casebearer	Europe	1886
Beech Scale	Eurasia	1890
Pear Thrips	Europe	1904
Balsam Woolly Adelgid	Europe	1908
Smaller Elm Bark Beetle	Europe	1909
Eur. Pine Sawfly	Europe	1914
Birch Leafminer	Europe	1925
Int. Basswood Thrips	Europe	1925
Red Pine Scale	Europe	1946
Hemlock Woolly Adelgid	Europe	<1953
Larger Pine Shoot Beetle	Europe	<1992
Asian Gypsy Moth	Europe/Asia	1992
Europ. Spruce Bark Beetle	Europe	1993
Asian Longhorned Beetle	Asia	?
<b>Disease</b>	<b>Origin</b>	<b>Year Introduced</b>
Beech Bark Disease	Europe	1890
Chestnut Blight	Asia	1904
White Pine Blister Rust	Europe	1906
Larch Canker	Europe	1927
Dutch Elm Disease	Europe	1930
Butternut Canker	Asia	1960
Sclerodermis Canker	Europe	1930
Dogwood Anthracnose	Japan	1976

*Source: PA Department of Conservation and Natural Resources*

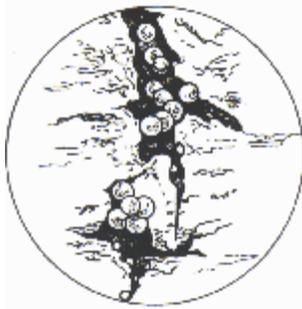
### **Vulnerability<sup>1</sup>**

DCNR lists 17 important insects and diseases in Pennsylvania. These pests can also be a nuisance to people who live, work, and recreate in the forestland. The following pages further explain each of the 17 important forest pests and diseases in Pennsylvania as outlined by DCNR.

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<sup>1</sup> Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, <http://www.dcnr.state.pa.us/forestry/pests/index.aspx>

### **Beech Bark / Beech Scale Complex**



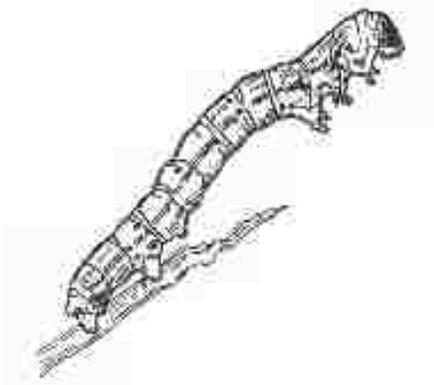
Beech bark disease is a canker disease caused by the *Nectria* fungus. Entry of the pathogen is facilitated by the beech scale insect in which the scale insect inserts a stylet (needle-like mouthpart) into the bark and into the underlying live tissues where sugars and other nutrients are sucked into the insect. These wound sites are available for colonization by the *Nectria* fungus, which produces spores that are transported passively by insects or wind. Under the right conditions, spores germinate and enter wounds created by the scale insect.

### **Eastern Tent Caterpillar**

The Eastern Tent Caterpillar constructs web nests in the forks of branches on black cherry, apple, and crabapple trees in the early spring. Overwintering eggs hatch in late April. Caterpillars are full grown by late May or early June. These caterpillars can become a nuisance when they migrate in search of foliage or pupation sites. The caterpillars are hairy, mostly dark with a white line down the middle of the back, five centimeters or more in length when fully grown. Pupation occurs in a cream-colored, oval cocoon. Adults emerge in late June or early July. The female moth lays eggs in a single layer encircling twigs of favorite hosts. A layer of black, spongy material covers the eggs. There is one generation a year.



### **Fall Cankerworm**



The Fall Cankerworm crawls up nearby objects (usually a tree) to mate and lay eggs on the trunk and twigs. Males are mostly gray, with a wingspan of 2.5 centimeters. The small cylindrical eggs are laid in single-layer masses. Eggs hatch at budbreak, and the young caterpillars crawl to new foliage to feed. Favorite host trees are maple, beech, apple, hickory, basswood, and oak. Larvae are hairless and vary between green with a darker green stripe down the back, to mostly black with a black stripe. Besides the three pairs of legs on the thorax, there are three pairs of primitive legs at the hind end. Larvae feed for about one month and attain a length of about two centimeters before spinning down to the ground.

### **Forest Tent Caterpillars**

The Forest Tent Caterpillar feeds on maples, beeches, aspens, and oaks as well as other hardwoods. It is a native insect and can be found throughout eastern North America. There have been several population outbreaks in the last 100 years, occurring at approximately 12-year intervals. When defoliation by forest tent caterpillars is severe and trees are stressed by other factors, such as drought or leaf anthracnose, inordinate tree mortality can be the consequence. Caterpillars and pupae are attacked by many parasites and some diseases.



### **Hemlock Woolly Adelgid**



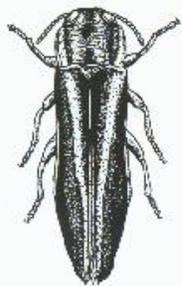
The Hemlock Woolly Adelgid feeds on hemlock, the Pennsylvania state tree, and can become numerous enough to stress ornamental and naturally growing trees, particularly those already suffering from drought, defoliation, or some such antagonist. The Hemlock Woolly Adelgid was first found in the eastern United States in Virginia in 1956 and Pennsylvania by 1969. It has few natural enemies in the eastern United States, although some lady beetles feed on them. The overall impact by the Hemlock Woolly Adelgid in Pennsylvania has not been great except where drought or defoliation by the hemlock looper has caused trees to be severely stressed.

### **Leafrollers**

There are about two dozen species of caterpillars, a couple species of weevils, and at least one species of wasp larvae which fold over parts of leaves or tie together adjacent leaves, thus forming a protected area in which to rest and feed. In Pennsylvania, an outbreak of the oak leafroller was detected in 1967, and at its peak, defoliation was visible on about one million acres. The outbreak collapsed in 1975. By that time over 60 million oak trees were killed as a result of stress from defoliation and subsequent attack by beetles and fungi.



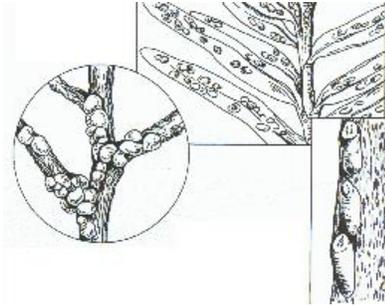
### **Twolined Chestnut Borer**



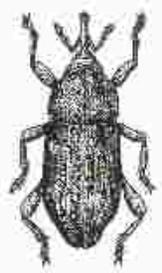
The Twolined Chestnut Borers are active for about two weeks in early summer. American chestnut was the primary host before chestnut blight killed most chestnut trees in the first half of the 1900s. Since then, oaks have been the preferred hosts. Trees stressed by drought, insect defoliation, and damage to the roots are more likely to be successfully attacked by this beetle. Therefore, damage by this beetle is best limited by reducing stress on the oak trees.

### **Scale Insects**

There are over 6,000 species of scale insects in the world. Each species feeds on one or a few species of trees or herbaceous plants. Sometimes scales become very numerous on their host and severely weaken or kill the host. Therefore, many scale insect species are important pests in agriculture, horticulture, and forestry.



### **White Pine Weevil**



Weevils are destructive beetles, with chewing mouthparts at the end of a snout. Adult White Pine Weevils feed on various parts of pine and spruce trees until late fall. After a leader dies as a consequence of larval feeding, one of the branches of the whorl below the killed leader becomes dominant and forms the future trunk. The result is a tree with a permanent crook, thereby reducing the value of the butt log and making the tree unsightly for ornamental plantings or Christmas trees.

### **Spruce Gall Adelgids**

There are two species of Adelgids that are problematic due to the galls they cause on spruce. Of these two, the most commonly observed species in Pennsylvania is the Eastern Spruce Gall Adelgid. This species is native to Europe and is common on Norway spruce. The Adelgids' feeding causes the formation of pineapple-shaped galls at the base of twigs. The Adelgids continue to feed and develop within the galls until late summer, when the cells of the gall open up. The emerging nymphs transform to winged adults in a couple of days.



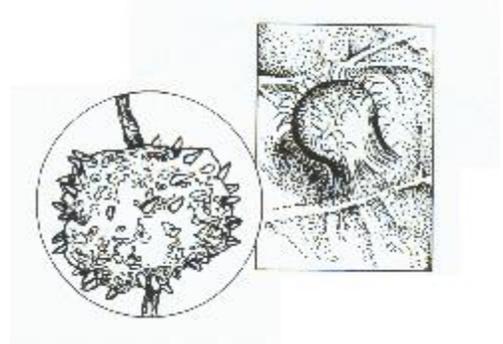
### **Maple Anthracnose**



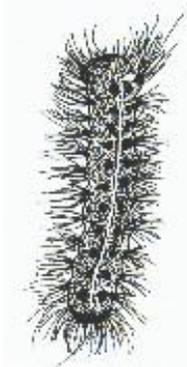
Maple Anthracnose is usually observed in the spring as young, succulent leaf tissue emerging during warm, moist periods and causing leaf, twig, and blight and, occasionally, branch dieback. Tree death in a northern hardwood stand normally ranges from one percent to three percent, but in 1995, tree death increased in many affected stands to 11 percent or higher. This combination of an insect outbreak followed by a disease outbreak in the short term occurs from time to time and can be destructive to our forests. Many trees do survive, however, and these genetically superior individuals form the basis for a new and more pest-resistant forest community.

### **Leaf Galls**

Leaf galls are deformations of plant foliage that occur in response to feeding or other stimulus by foreign organisms. Galls are formed in a wide array of shapes, sizes, and colors. Feeding of an insect or mite causes plant cells to die, but surrounding cells continue to grow, resulting in a cell in which the larva develops. Most gall-causing organisms feed on only one host species or genus, and the gall may be distinct for that species. Usually, leaf galls are not numerous enough to substantially disrupt the food-making capacity of the leaves.



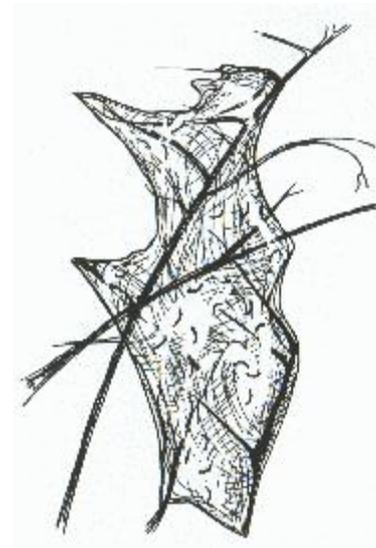
### **Gypsy Moth**



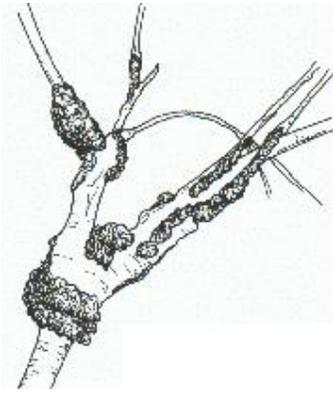
The Gypsy Moth gets its name from a behavior of its larger caterpillars, which generally migrate each day from the leaves and down the branches and trunk to rest in shaded spots on the tree or objects on the ground. It is fairly easy to identify Gypsy Moths because the colors of caterpillars, adults, and egg masses are so distinct. Caterpillars favor oak but will feed on the foliage of many tree species, including some conifers. However, there are some trees, such as ash, tulip poplar, dogwood, and black locust, on which they will not feed. Defoliation by caterpillars of Gypsy Moth weakens trees, because without leaves the trees are not able to manufacture food.

### **Fall Webworm**

Fall Webworms construct web nests in trees late in summer. They overwinter as pupa under leaf litter. In southern Pennsylvania there are two generations; the early summer generation is usually not numerous and therefore inconspicuous. Moths are white and medium size. In southeast Pennsylvania, females of the second generation lay eggs on the underside of leaves in late July. They have been most numerous on black cherry, walnut, hickory, and mulberry. Some years they are numerous enough to completely defoliate trees. Favored tree species growing in areas of poor air drainage and ample light exposure are defoliated more heavily. Damage is usually not significant because by the time the trees are fed on by fall webworm, they have already produced and stored the energy resources needed for their survival and growth.



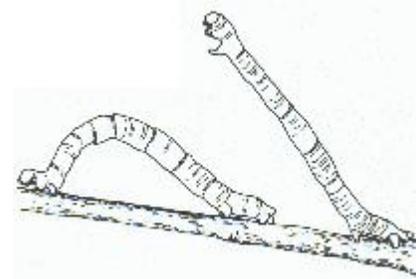
**Black Knot of Cherry**



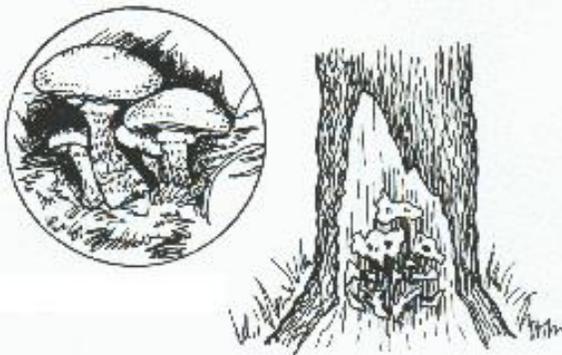
This fungus causes black warty growths on branches of cherry, plum, and occasionally apricot and peach trees. Branches become infected when windblown spores from previously formed galls are deposited on the current year's stems. Symptoms of infection may be visible late the same year but become much more visible during the next growing season. Initially, the warty growths are olive green but later turn black. In the spring of the second year following infection, the "knots" produce spores, which infect other sites on twigs. After spore release, the dead "knots" persist on the infected branches. To reduce chance of infection, prune out and burn "knots" during the winter or in early spring before budbreak.

**Elm Spanworm**

The Elm Spanworm is one of the inchworms that feed on northern hardwoods. This insect is capable of becoming very numerous and causing heavy defoliation over vast areas. Natural control usually occurs as a result of egg parasitism.



**Armillaria Root Disease**



This disease is caused by a group of mushroom-like fungi in the genus *Armillaria*, which typically live on dead plant tissue in soil. *Armillaria* fungi have the capability of causing a disease of roots and lower stem tissue on many species of woody plants, including conifer and broadleaf trees, throughout the temperate and tropical regions of the world. There is no control of this disease because *Armillaria* is widely distributed and can grow and survive on dead wood buried in soil. Trees that are in good health and growing vigorously are less susceptible to *Armillaria* root disease.

### **Probability**

With approximately 94 percent of Juniata County devoted to agriculture or forest, the probability of forest pests and diseases affecting Juniata County is high. However, the impact of this is relatively low, unless there is extensive infestation. Observation and monitoring should track the health of the forest land and the impacts these pests and diseases are having. Pennsylvania has seen a reduction in certain tree species due to pest infestations.

### **Maximum Threat**

The maximum threat of insect infestation in Juniata County forest land occurs when infestation is combined with other stressors such as pollution, insect defoliation, competition with other trees, and drought.

Certain pests and diseases have a severe impact on the health of the forest. Pennsylvania is currently monitoring the Emerald Ash Borer, a beetle native to Asia that attacks ash trees. It was first found in the United States in Michigan in 2002, and since has been responsible for the destruction of more than 25 million ash trees, according to DCNR. Currently, the Emerald Ash Borer has been detected in four counties in western Pennsylvania: Allegheny, Beaver, Butler, and Lawrence. Testing has taken place in Juniata County; however, the Emerald Ash Borer has not been detected.

### **Secondary Effects**

There are many secondary effects of the infestation of forest pests and diseases. Forests prevent soil degradation and erosion, protect watersheds and stabilize mountainous areas, and limit the greenhouse effect by absorbing carbon dioxide. Forests serve as natural habitats to many of earth's species and therefore are a key component of biodiversity. The loss of forest land can cause a decline in the population of many woodland species. Also, forests play a critical role in the hydrologic system. A decline in woodland can increase erosion and expand the effects of flooding. Forests are also a major economic factor in Pennsylvania, because they are a direct source of energy and raw materials.