

7. Forest Insects & Disease – Native and Invasive

As with all states, New Hampshire has its share of damaging forest insects and diseases affecting growth and productivity of forests, ultimately impacting people and economies that depend on them. While many native pests such as saddled prominent and spruce budworm cause serious forest damage today's critical threats are non-native invasive problems accidentally moved from around the world in a global economy. These invasive pests and diseases find host trees in NH where there are limited natural controls to slow their spread. As an example, there is a large suite of pathogens native to NH that destroy outbreaks of forest tent caterpillar or spruce budworm, but there is no known group of biocontrols to stop the emerald ash borer, woolly adelgid, Asian longhorned beetle or red pine scale.

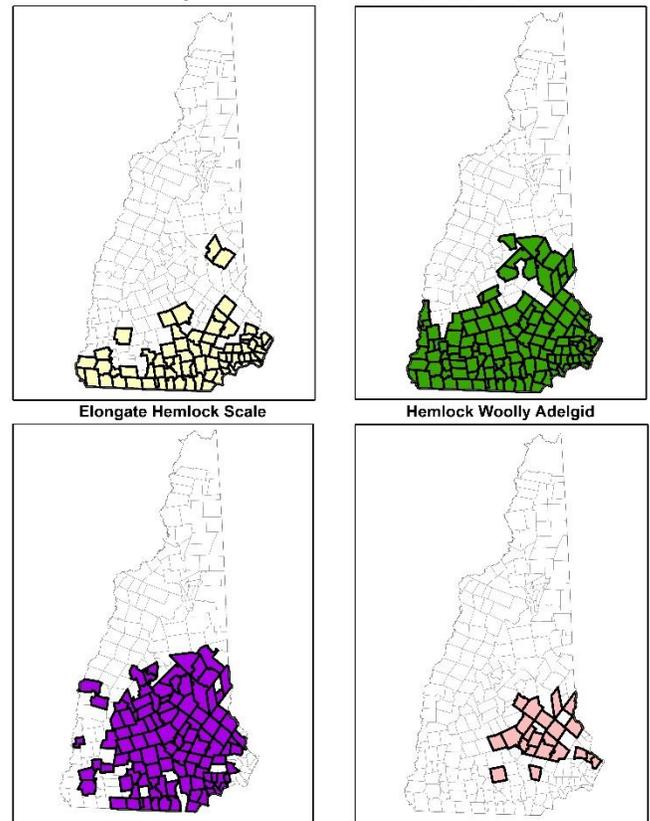
Insects:

Current insect outbreaks of greatest influence on New Hampshire forests include:

Hemlock Woolly Adelgid (HWA) is a non-native invasive from Asia. It feeds through piercing mouthparts in the phloem of small branches and can kill Eastern Hemlock trees. Populations fluctuate from year to year depending on late winter temperatures. In 2017, New Hampshire saw a decline in HWA population but populations are again building in 2020. Hemlock Woolly Adelgid, was first detected in Portsmouth in 2000. HWA is a tiny wingless insect with two generations per year. The majority of feeding takes place in the fall, winter and spring. Infestations can be heavy along the coast and in southern NH. Mortality can be severe when trees are stressed by drought or other insects and disease. As of 2020, the majority of tree mortality in NH is at sites where both HWA and elongate hemlock scale coexist. In southern states it's common to have 50% tree mortality where HWA has occurred for more than 10 years.

Elongate Hemlock Scale (EHS) is an exotic from Asia and feeds in a similar way as adelgid but in the foliage of hemlock rather than the twigs. Because it feeds on the needles and damages the photosynthesis capabilities it's considered more lethal to hemlocks in NH.

New Hampshire Invasive Insect Presence



NH Forest Health Program



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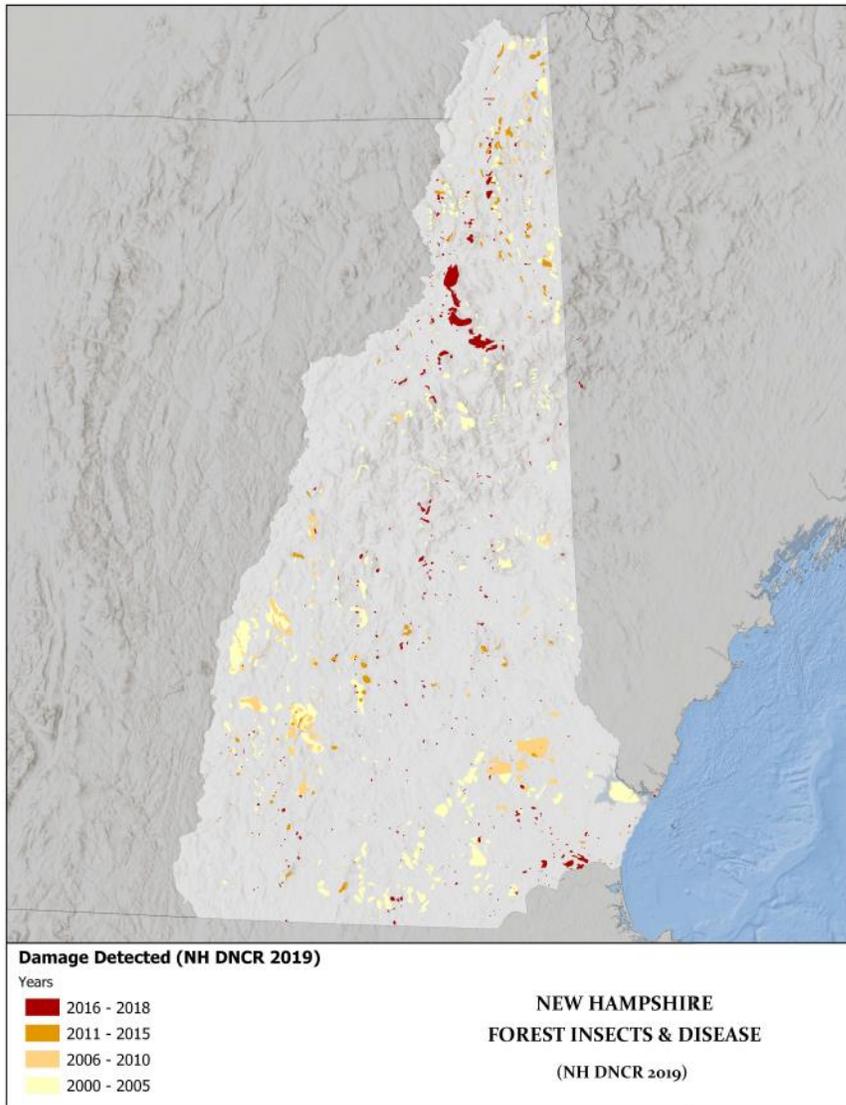


Figure 21 NH Insect and Disease Forest Damage

Source: NH Division of Forests and Lands

[Emerald Ash Borer \(EAB\)](#) is a non-native invasive beetle first discovered in North America in Michigan near Detroit in the summer of 2002. Emerald ash borer likely arrived in the United States on solid wood packing material carried in cargo ships originating in its native Asia. As of October 2019, it's found in 35 states, and the Canadian Provinces of Ontario, Quebec, New Brunswick, Nova Scotia and Manitoba. EAB was first detected in New Hampshire in 2013. The EAB is currently in more than 100 towns in NH and all Counties except Coos.

The adult beetles feed on ash foliage but cause little damage. Larvae (the immature stage) feed on the cambium and inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. All infested trees are eventually killed by larval feeding when high population levels completely girdle the cambium. EAB can fly several miles on it's own but the most common means of long distance spread is through the movement of infested firewood. After trees are cut, EAB can still emerge from the logs or firewood for several months if the material is not heat treated or debarked. Eventually all of NH's ash

forests will be challenged by EAB and the largest trees with thick bark and lots of cambium will die. There is a future for ash species in NH forests if young ash stands and ash regeneration is encouraged while work on biocontrol parasitoids continue to develop in our region.

In the meantime, slowing the spread with responsible adherence to best management practices and the out-of-state firewood quarantines will give more time for landowners to plan their response and give scientists more time to develop control strategies.

Forest Tent Caterpillar is a native insect that feeds on the leaves of hardwood trees in its larval caterpillar stage. Sugar maple stands are particularly preferred by the tent caterpillar in the northern Counties but oaks are highly susceptible in the southern Counties. At times it can cause extensive damage as it did between 2005 and 2008 and between 2015 and 2018. Generally, trees will recover after a forest tent caterpillar infestation but areas with droughty soils, high elevations or poor timber management practices can be severely damaged from two or more years of infestation.

Red Pine Scale was originally introduced to North America in the 1940's from Asia and found in NH at Bear Brook State Park in 2012. Red Pine Scale is an invasive insect that kills red pine trees by feeding in the small branches of the live crown. Adults are wingless, soft-bodied insects similar to adelgids with piercing sucking mouthparts. Red Pine Scale has two generations per year in NH as does the woolly adelgid. Red pine has no resistance to RPS and there are no established biocontrol agents. Mortality takes between two and four years depending on tree health at the time of infestation.

Spruce Budworm is a native moth that seriously impacted spruce-fir forests in northern New Hampshire and elsewhere in the region throughout the 1900's. The larvae feed on spruce and especially balsam fir needles. Spruce budworm populations are cyclical with a period of approximately 40 years between epidemics. The last New Hampshire outbreak ended in 1983 with severe defoliation in the late 1970s and early 1980s. Recently, populations in Quebec have increased with millions of acres defoliated in the last 6 years. To date, no elevated budworm populations have been seen in NH and it's unlikely to take place until there is substantially more mature contiguous stands of balsam fir.

Asian Longhorned Beetle is a non-native invasive wood-boring insect that feeds on a variety of hardwoods including maple, birch, elm, ash, poplar, horse chestnut, and willow, among others. Native to China and Korea, the beetles are approximately 1.5 inches long and shiny black, with white spots on their wing cases. Major outbreaks in New York and Massachusetts continue to cost millions of dollars annually to control. Because sugar maple is a preferred host any spread into NH would be devastating to the maple syrup industry, tourist industry and the urban forests where sugar maple is a key component.

Gypsy Moth is arguably the most damaging forest pest in NH's history but no major outbreaks have occurred in 30 years and there is no expectation that it will expand to landscape levels again. Gypsy moth can be found in every town of NH and we get periodic population increases that cause several hundred acres of defoliation but before the outbreak expands to something more serious it is controlled by a fungus (*entomophaga maimaiga*), and a virus (nucleopolyhedrosis virus). Both the fungus and the virus were introduced in NH more than 75 years ago and they are both found commonly in the naturalized population of gypsy moth today. Recent outbreaks in southern New England that caused thousands of acres of gypsy moth damage and severe mortality in oak stands, was exacerbated by droughty spring weather for several years in a row. The fungus and virus struggle to be effective in dry conditions.

Balsam Woolly Adelgid (BWA) is an exotic forest pest that has likely caused more tree mortality in NH the past 20 years than any other insect. BWA was introduced to Nova Scotia around 1900 and spread through

NH starting around 1960. Today it can be found in most fir stands below 2000' elevation. BWA feeds at the base of the buds and along the bole of the tree. Evidence of feeding at the buds would be gouty, disfigured, swollen branch tips giving the tree a "bottle brush" shape. Feeding along the bole of the tree is evidenced by patches of white dots that are cottony in texture and appearance. Heavy feeding by BWA causes overproduction of lignin in the wood structure and growth is suppressed to the point that drought and other stressors kill the tree.

Diseases:

White Pine Needle Damage or "needlecast" has been identified extensively throughout the range of white pine in New Hampshire and elsewhere in the northeast. This is not a single pathogen but a combination of native fungi found on white pine needles.

Needles of mature white pine trees become straw-colored to brown before they are prematurely shed from the canopy. In some cases, only a few main branches are symptomatic whereas on other trees, the entire canopy exhibits symptoms. One feature of the disease is that despite significant needle browning and premature shedding of two and three year old needles, the current season's needles are elongated and appear healthy.

Caliciopsis canker was first reported in New Hampshire in 1997 and is generally considered a weak perennial fungus, which attacks thin barked areas of the branch and bole. Cankers can be elongated depressions with profuse pitching on the stem or an extreme roughening of the bark just below the branch whorls. Black "hair like" fruiting structures persist throughout the year and the spores mature in late winter and spring. Spores are disseminated by wind and rain and typically enter through bark lenticels or small insect wounds. The highest incidence of disease to date has been noted on suppressed, understory trees and trees in very dense stands. Management practices which create increased sunlight and air-flow may decrease spore production and dissemination.

White Pine Blister Rust has traditionally been a major threat to white pines and their ecosystems. The rust is a non-native fungus (*Cronartium ribicola*) accidentally imported to North America on pine seedlings from Europe around 1900. All of the North American white pines are susceptible but in NH white pine is the species of concern.

In NH, from the 1920's to the 1970's thousands of field personnel spent millions of hours destroying various shrub species in the genus *ribes* to try and control the statewide outbreak. Ribes plants such as black currants and gooseberries are the alternate host for this rust disease so by removing the alternate host the disease cycle can be eliminated.

All species of white pine are susceptible at all ages; however seedlings and young trees are more easily infected and die more quickly as a result of infection. Spores drift in the wind and survive the longest close to the ground where moisture is trapped by dense foliage and brush. When pine grows in height and no live foliage is close to the ground risk of infection decreases.

Today, NH's white pine forests are predominately mature forests with a small percentage of trees in the seedling/sapling size class making the risk of blister rust infection much lower than the era of reforestation 100 years ago. The statewide infection rate is below 1% of all white pine and considered endemic. The NH Division of Forests and Lands, in cooperation with the NH Department of Agriculture, Markets & Foods has lifted the quarantine on several species of gooseberries and currants which can now be planted for

berry production. These approved species can be found at nhdfl.org and have been fully vetted as *ribes* species with low risk of contracting blister rust fungi that could in turn infect white pine.

Beech Bark Disease (BBD) is a tree disease affecting American beech in NH and it was first reported in NH around 1920. Today the leading edge of the outbreak is in the Midwest. All stands of beech in NH have some level of infestation. BBD is initiated by feeding on the bark by a species of scale insect accidentally introduced from Europe more than 100 years ago. Once the scale insect starts feeding the neonectria fungi use that site to penetrate into the tree and cankers start growing. As the cankers grow in size and coalesce the bark is severely disfigured and eventually causes structural failure and tree mortality. There are beech trees more resistant than others. Today's management strategies consist of trying to encourage more resistant trees and remove highly cankered trees through silvicultural practices or herbicides.

Oak Wilt is a disease caused by a fungus that disrupts the transport of water throughout a tree. It's a serious disease that affects all oak trees. Red oaks are most susceptible to oak wilt and can die within a few weeks to 6 months of infection. While it has been found in more than 20 states, oak wilt is not yet known in New Hampshire. The closest outbreak is in New York.

Oak wilt is spread most often between trees through the roots, although it can also be spread by beetles. When the roots of oak trees become fused together, they can share nutrients and some diseases. The oak wilt fungus *Ceratocystis fagacearum* grows in the water-conducting vessels of a tree and prevents the movement of water. As water movement slows, the leaves wilt and drop off, ultimately leading to death of the tree.

Control of oak wilt is possible so finding infected trees early is critical. It's much easier to control the spread around a quarter acre pocket versus a five acre infection court. Control includes cutting trees, trenching around infested areas to sever root grafts or using stump treatments of herbicides to kill roots of trees grafted to roots of infested trees.

8. Terrestrial Invasive Plants

According to the NH Department of Agriculture, Markets and Food, non-native invasive species have become an overwhelming problem resulting in impacts to the natural environment and managed landscapes. Invasive species typically possess certain traits that give them an advantage over most native species. The most common traits include the production of many offspring, early and rapid development, adaptability and tolerance of a broad range of environmental conditions and, the lack of natural controls to keep them under control. These traits combined allow certain non-native species

such as Oriental bittersweet - *Celastrus orbiculatus*, Japanese barberry - *Berberis thunbergii*, and others to become highly competitive and dominant in many of New Hampshire's natural and artificial landscapes. In some instances, species such as the Norway maple - *Acer platanoides* or Tree of heaven - *Ailanthus altissima*, rely on their ability to excrete toxic chemicals from their roots which interferes with or prevents the establishment of native species within its rooting zone. Furthermore, studies have shown that invasives can reduce natural diversity, impact endangered or threatened species, reduce wildlife habitat, create water quality impacts, stress and reduce forest and agricultural crop production, damage personal property, and cause health problems. Within the United States, the adverse economic impacts resulting from invasive species currently exceeds \$100 billion annually. Unfortunately, New Hampshire is not immune, every community in the state is impacted by at least

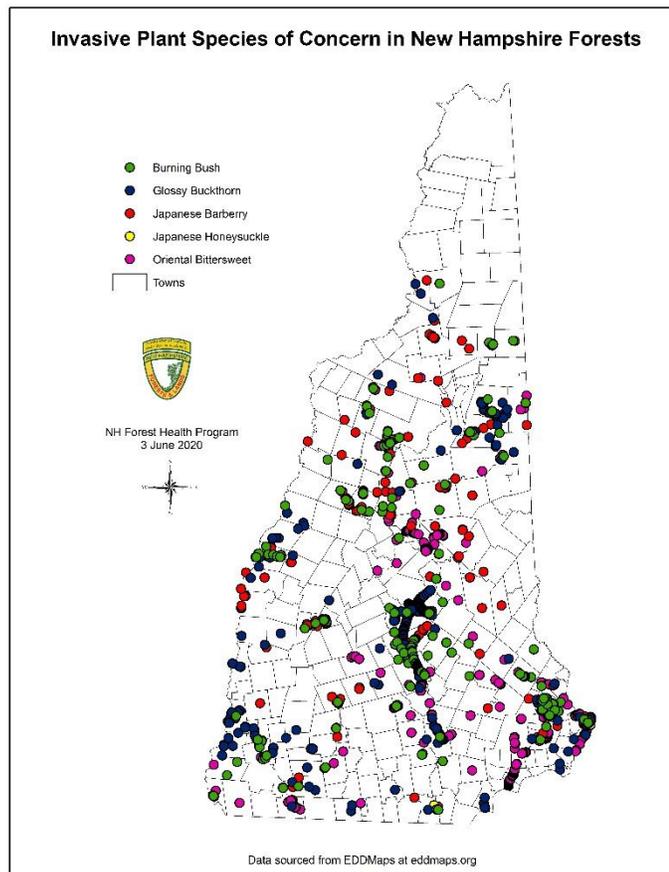


Figure 22 Invasive Plant Occurrences

Source: NH Division of Forests and Lands, Forest Health Program

one invasive plant and as the number of invasive populations grow so does the potential for greater dispersions. Figure 22 shows confirmed occurrences of several invasive plants that the general public has entered into a National database on invasive species called EDDMaps. By no means is this map a depiction of all outbreaks but it does illustrate that invasive plants are frequently found near population centers and disturbed ecosystems. The most threatening invasive plants in NH (listed below) are most common in southern NH where woodlots are smaller and there is more edge habitat between non-forest and forested habitat. The most disruptive invasive plants already existing in NH are here to stay and we need to focus efforts on slowing the spread to new locations and be diligent about best management practices that provide an opportunity for native species to compete.

Several of the most disruptive terrestrial invasive plants in NH forests include:

Glossy Buckthorn (*Frangula alnus*) is native to Europe and likely been in the Northeast for 200 years. Seed is most often spread by birds but forestry equipment, recreational vehicles and soil transportation can create new outbreaks. The forestry issue it creates is due to the dense canopy it creates under shaded environments. Natural regeneration does not compete well.

Oriental Bittersweet (*Celastrus scandens*, L.) is a vine native to Asia introduced to North America in the late 1800's. This species produces prolific amounts of seed each fall and all types of wildlife spread the seed. Bittersweet climbs trees and shrubs girdling the cambium or weighs down the tree crown causing branch breakage and shading of native foliage.

Japanese Barberry (*Berberis vulgaris*) is a shrub species introduced in the late 1800's from Japan because it was resistant to many rusts diseases and deer did not browse on it. It flushes leaves early in the spring and maintains foliage later than native shrubs giving it a distinct competitive advantage. Seed ripens in the fall and birds spread the plant. Barberry has the ability to grow well in all light conditions so it easily chokes out native seedlings and low vegetation.

Bush Honeysuckle (*Lonicera maackii*) is another introduced plant from Pacific Rim Countries for its ability to stabilize soils and produce fruit for wildlife. Unfortunately it escaped its plantings and grows in such dense formations that native plants can't compete. Foliage persists longer than native plants and wildlife inadvertently spread the seed.

Burning Bush (*Euonymus alatus*) was imported to North America more than 100 years ago from Asia due to its brilliant red fall foliage. Burning bush has several traits that make it invasive in our forests. It can thrive in all light conditions, produces yearly fruit, and can reproduce aggressively through vegetative reproduction when the parent plant is disturbed.

There are many invasive species emerging as threats to our forests such as Norway maple and tree of heaven to go along with all the invasive plants spreading closer to NH like kudzu and giant hogweed. The list of invasive grasses and sedges also continue to grow as more seed is accidentally spread by recreationist, wildlife, construction, forestry, and wind.

Strategies to slow the spread of invasive plants in NH and keep those not in NH from arriving need to focus on public education and local control. It's critical that people understand their role in creating the problem through landscape plantings, recreational activities, poor vegetative management and lack of knowledge.

A list of restricted or prohibited invasive plant species compiled by the NH Invasive Species Council can be found at <https://www.agriculture.nh.gov/divisions/plant-industry/invasive-plants.htm>. Agencies with authority for invasive upland plant species include the NH Department of Agriculture, Markets & Food (NHDAMF), Division of Plant Industry and for aquatic plant species, the NH Department of Environmental Services (NHDES) Exotic Species program.