



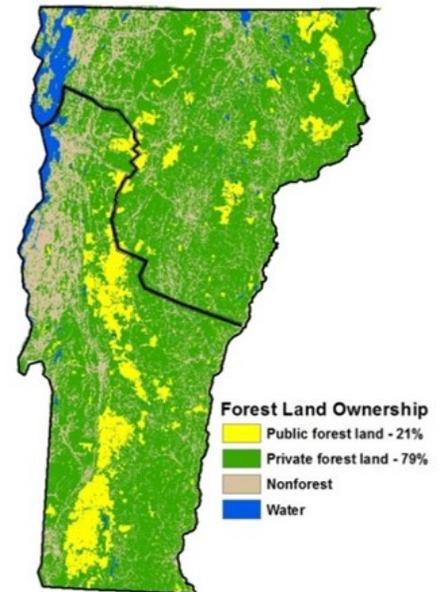
Forest Health VERMONT *highlights*

2016



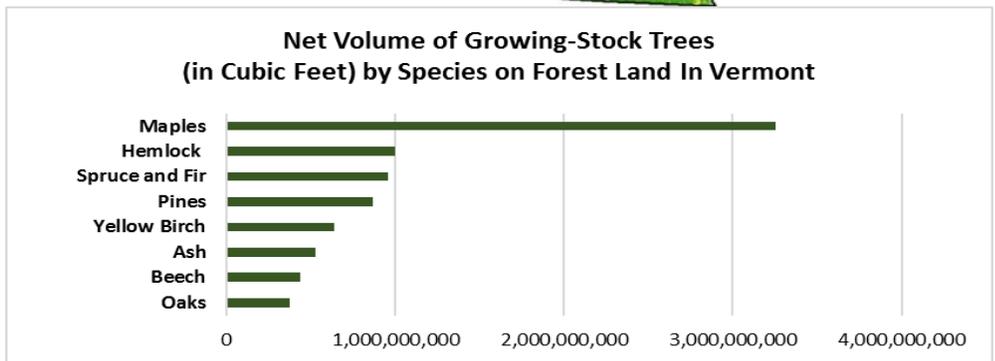
These highlights summarize information from the annual report on Forest Insect and Disease Conditions in Vermont. In addition to an overview of the forest resource in Vermont, this summary provides forest health program highlights, separate sections on hardwood and softwood insects and diseases which are native or well-established in the state, a section on exotic forest pests which are not known to occur in the state or which are recent invaders, a summary of activities related to non-native invasive plants, and our results from monitoring forest health.

The complete annual report, as well as other Vermont forest health information, is posted on-line at http://fpr.vermont.gov/forest/forest_health. To receive a copy by mail, for assistance in identifying pests or diagnosing forest health problems, to request on-site evaluations or insect population sampling, to obtain defoliation maps, management recommendations, and other literature, or to participate in invasive pest citizen monitoring, [contact us](#).



Forest Resource Summary

Forests cover 73% of Vermont. Seventy-nine percent of the State's forest land is privately owned with 10% under Federal management in the Green Mountain National Forest and 8% managed by the State of Vermont. Sugar and red maple, eastern hemlock, and white pine are the most common species by volume. More information on Vermont's forest inventory is at http://fpr.vermont.gov/forest/forest_business/forest_statistics/fia



Forest Land Area by Ownership: Morin, R.S.; Widmann R.H. 2016. Forests of Vermont, 2015. Resource Update FS-80. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.
Net Volume of Growing Stock Trees data presented are from Forest Inventory and Analysis (FIA) plots established by USDA - Forest Service. Estimates for Vermont totals were calculated using EVALIDator (v. 1.6.0.03) software (<http://apps.fs.fed.us/Evalidator/evalidator.jsp>), December 2016.



Forest Health Programs in the Northeast

Vermont Department of Forests, Parks and Recreation (FPR) works in partnership with the US Forest Service to monitor forest conditions and trends in Vermont and respond to pest outbreaks to protect the forest resource.

Forest Health Program Highlights

The Vermont Department of Forests, Parks and Recreation (FPR) conducts aerial and ground surveys to detect forest damage. In addition, long-term monitoring plots are inspected to evaluate forest health.

FPR and the Agency of Agriculture, Food and Markets (AAFM) collaborate with USDA agencies to survey and manage **Non-Native Forest Pests**, and with University of Vermont (UVM) Extension on education and outreach.

The website vtinvasives.org is getting a new look. The new site design will offer information on terrestrial plants, forest pests, and aquatics. Navigation will be easier, resources will be stored in a searchable hub, and news articles added weekly. You can also follow vtinvasives on Twitter and Facebook.



An updated version of vtinvasives.org is coming soon.

In 2016, 38 new volunteers, including tree wardens, conservation commission members, arborists and concerned citizens, attended Vermont's **Forest Pest First Detector** program training and received a new pocket-sized field guide to invasive pests developed by UVM Extension. Volunteers assisted in survey and outreach. In Lamoille County, volunteers formed a Regional Invasive Insect Preparedness Team (RIIPIT) and spent over 500 hours creating education [PSAs](#), newspaper ads, and ash tree inventories.

The Forest Pest First Detector program gained 38 new volunteers (Photo: G. Kozlowski), and a new pocket-sized field guide was developed.

The [PSAs](#) developed by Lamoille County volunteers are worth watching... and sharing.



Vermont's firewood rule went into effect in May 2016.

Vermont's **Firewood Rule** went into effect on May 1, 2016. Basic elements are:

- Firewood is defined as wood processed for burning and less than 48 inches in length. It does not include wood chips, pellets, pulpwood, or wood for manufacturing purposes.
- Untreated firewood cannot be brought into Vermont.
- Treated firewood must be treated to the highest USDA standard (160° F/71.1° C for at least 75 minutes), which kills Asian longhorned beetle among other pests.
- Treated firewood must be accompanied by certification of treatment, such as a phytosanitary certificate, invoice, bill of lading, or label stating that the firewood has been heat treated to the 160° F/75 minute standard.
- By written request, FPR can grant a waiver allowing untreated firewood to be moved into Vermont, but only if there is minimal threat to forest health, and not restricted by existing state or federal pest quarantines. Currently, waivers are being granted to import firewood from counties adjacent to Vermont, as long as the material complies with other quarantines, including EAB quarantine restrictions.
- Enforcement is through the Agency of Natural Resource's Enforcement Division. Firewood imported in violation of the rule may be confiscated or destroyed.

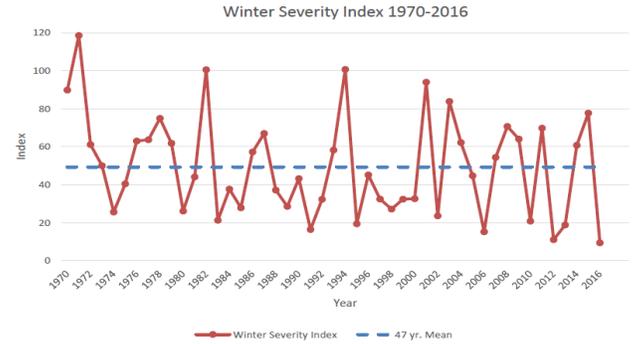
Don't Move Firewood outreach efforts are conducted in collaboration with the US Forest Service, USDA PPQ, the Vermont Agency of Agriculture Food and Markets, and UVM Extension. Letters were sent to private campgrounds and firewood producers, and posters were distributed to each of the 17 welcome centers and to 700 convenience stores.

A new leaflet, **Earthworms in Forests**, was produced jointly with the University of Vermont, and provides information on non-native worm identification and impacts.

2016 Weather Influences on Forest Health

Following multiple years during which tree health was shaped by wet springs and stormy summers, the primary influences in 2016 were the abnormally mild winter interrupted by a cold snap in mid-February, and dry weather starting in mid-May and continuing through the end of the growing season.

The cold snap in late February increased **winter injury to conifers**. It was so warm early in the month, that needles were beginning the process of de-acclimation, exchanging their cold-hardiness for a chance to get a jump on spring. Then the cold weather came and killed those no longer cold-hardy tissues. The fact that parts of Vermont were dry towards the end of 2015 may have played a role.



2016 started with an abnormally mild winter, the mildest recorded since the inception of the Winter Severity Index in 1970. (Data analysis and graph: Tim Appleton)

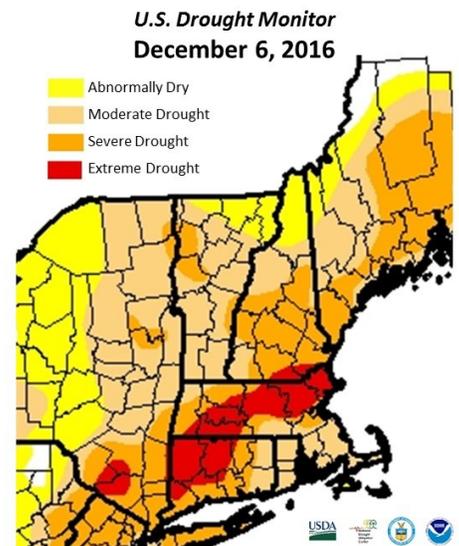


In the spring, winter injury was common on ornamental conifers and Christmas trees (Photo right: J. Horst).

By mid-summer, symptoms of **drought** became noticeable. These included early color on sugar and red maple, early symptom development on trees affected by beech bark disease, and poor refoliation of defoliated trees. Later in the summer, brown margins developed on a variety of hardwoods, especially on shallow sites. There was also an increase in interior needle drop of conifers and premature leaf drop of ash and other hardwoods. Mid-season browning or off-color foliage on hardwoods, attributed to drought, was mapped on 7,924 acres.



Dry conditions resulted in early color on maples and interior needle drop of conifers. By late fall, the entire state was abnormally dry or in drought. (Map Author: Anthony Artusa, NOAA/NWS/NCEP/CPC <http://droughtmonitor.unl.edu/>)



By late fall, the entire state was abnormally dry or worse, although conditions were more severe in southern New England. Dry fall conditions led to a number of difficult-to-extinguish ground fires. Despite (or perhaps because of) drought conditions (see [August Update](#)), fall foliage was particularly stunning in some areas, with red maples and red oaks demonstrating how they got their names.

Hardwood Insects and Diseases

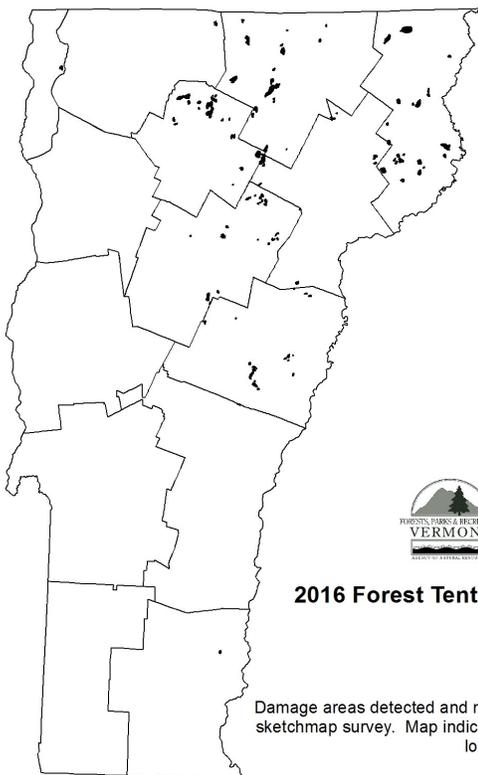
Populations of the native **forest tent caterpillar** (FTC) exploded, especially in north-central and northeastern Vermont; 24,278 acres of defoliation were mapped. The mapped area covers less than 1% of Vermont's northern hardwood forest type. By contrast, in 2006 at the peak of the most recent outbreak, about 10% of the northern hardwood forest type was defoliated. These defoliated areas mapped during 2016 aerial surveys are available on the [ANR Natural Resources Atlas](#). (The "Forest Tent Caterpillar (2016)" layer is available under the "Forests, Parks and Recreation" theme.) The [VT FPR Forest Tent Caterpillar Update](#) describes the current status of forest tent caterpillar, and provides management information for sugar makers, forest land managers, and others concerned about protecting tree health.

The defoliated area is likely to increase in 2017. Moth catches in all but one of our pheromone trap locations increased from 2015, with the statewide average trap catch in double digits for the first time since 2006. [Overwintering egg mass surveys](#) provide some indication of the risk of FTC defoliation for the following year. We are available to conduct these fall and winter surveys for maple sugar makers, by request. Sugar makers who may be interested in participating in a state-coordinated spray program, should contact the [Vermont Department of Forests, Parks, and Recreation](#) as soon as possible. The deadline to sign up is February 15th.

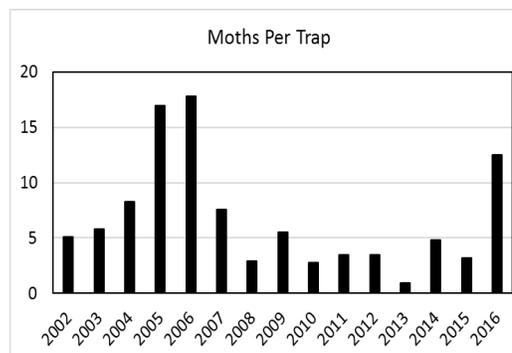


Forest tent caterpillar populations exploded in 2016. (Photo: R. Kelley)

Most trees can survive several years of defoliation. However, dry conditions last summer will be an important factor. While trees typically respond to early-season defoliation by sending out a new flush of leaves, this year, foliage remained thin because lack of water reduced refoliation success. Refoliated leaves were small, and sometimes, leaves were scorched or dropped to the ground, tender refoliated shoots wilted, and trees attempted a third flush of leaves. Even where refoliation was successful, dry conditions in 2016 have limited the new leaves' ability to replenish lost food. This will almost certainly affect wood production, and the amount of foliage and shoot growth next year. Prevent avoidable stress in defoliated stands by delaying thinning 1-3 years, using conservative tapping rates, and limiting vehicle use near crop trees.



Forest tent caterpillar defoliation was widespread in north-central and northeastern Vermont, but was observed in scattered locations statewide. Dry conditions reduced refoliation success (Photo right: M. Isselhardt)



The number of moths trapped in 2016 increased from 2015, indicating that defoliation will be more widespread next year.

Maple webworm became surprisingly ubiquitous in some locations. Webworm moths lay their eggs in leaves rolled or tied by other insects like FTC that feed earlier in the season. Increased numbers of maple webworm have coincided in past years with FTC outbreaks, and the insect was linked to an episode of "maple blight" in the 1950s. Maple webworm larvae can be found on trees from early July to October. At first, they feed where the eggs were laid, but later web leaves together and feed on surrounding leaves.



Maple webworm is common during forest tent caterpillar outbreaks. (Photo right: R. Kelly)

Other hardwood insects observed in 2016 included several that feed on sugar maple foliage. There were significant populations of **maple leafcutter** in some locations and lesser levels of injury by **maple trumpet skeletonizer** and **pear thrips**.

Non-native **satin moth caterpillars** caused scattered heavy defoliation on poplar and willow. Light damage by the beech leaftier was observed statewide, with noticeable browning of lower foliage tied together by the feeding larva. Damage by **oak twig pruner** was also common. Its larvae burrow in twigs, leaving dead shoots hanging in the crown.

Beech leaftiers were noticeable on lower foliage throughout the state. (Photo: L. French)



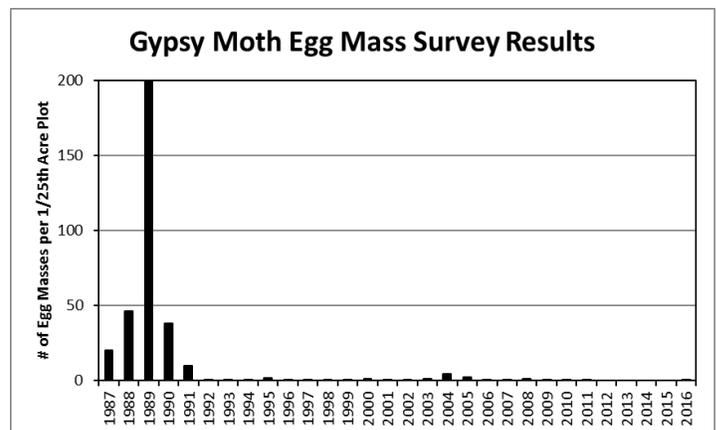
The oak twig pruner burrows in twigs, and leaves dead shoots hanging in the crown.

Gypsy moth defoliation was not observed in Vermont this year, although it was extensive elsewhere in New England. Egg mass monitoring plots indicate our populations will remain low in 2017.

The **browntail moth**, currently a serious pest in Maine, is not known to occur in Vermont. This non-native defoliator was here 100 years ago, with the last serious infestation in Vermont reported in 1917.

Thanks to dry conditions in spring 2016, there was very little anthracnose or other foliage diseases of hardwoods. An exception was **poplar leaf blight** on balsam poplar in riparian areas.

Beech bark disease remains a chronic cause of dieback and mortality, with damage mapped on 7,278 acres.



Egg mass monitoring plots indicate gypsy moth populations will remain low in 2017.

Softwood Insects and Diseases

White pine needle damage continued, with the condition even more widespread and severe than it has been in recent years. Although damage peaks in the spring, so was less noticeable during mid-summer aerial surveys, 30,666 acres were mapped. As summarized in a publication about [dramatic needle browning and canopy dieback of eastern white pine](#) produced by UMass, the cause is not fully understood.

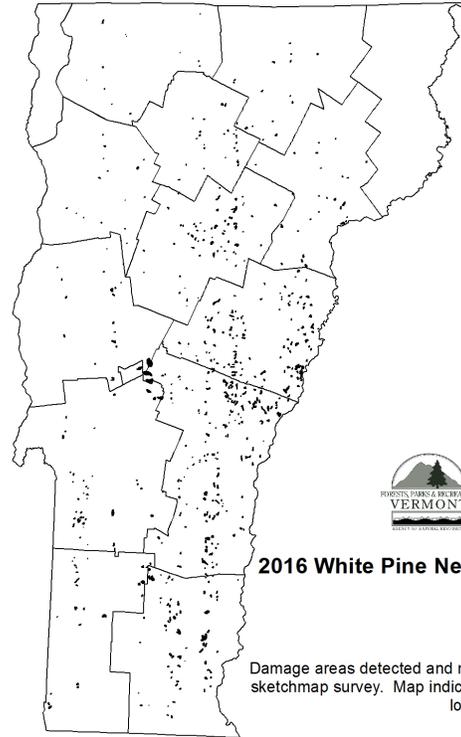
Similar symptoms have been observed throughout New England and in New York. The large footprint suggests that weather is an important factor. Several fungi have been associated with the disease. One of them, the brown spot needle blight, is more likely to spread when weather in June is wet, so that disease, at least, may be less severe in 2017. This recent episode of damage was first reported in 2005, with widespread symptoms occurring annually since 2010. Research is continuing at UNH and by the US Forest Service. Since 2009, there has been a 10 – 60% decline in annual wood growth on affected pines.



Browning and dieback on hard pines, particularly Scots pine, remained common, and 554 acres of damage were mapped. **Brown spot needle blight** has caused repeated defoliation of Scots pine wherever that species has been planted. Shoot blight diseases and other pests have also been associated with these symptoms.

Fir mortality caused by **balsam woolly adelgid** is continuing with acres mapped increasing to 5,616 compared to 2,263 acres in 2015. Currently active heavy populations are very widely scattered, and the infestation has already collapsed in many mortality areas. However, where fir mortality is occurring, especially on upland sites and where large-crowned trees are dying first, consider this insect could be the cause, even if it is inconspicuous. A [Vermont Forest Health leaflet](#) on this insect describes its symptoms, impact, and management considerations.

Six sites where the balsam woolly adelgid predator, *Laricobius erichsonii*, was released in the early 1960s were visited in late spring to see if that beetle could be recovered, but no evidence of the predator was found.



White pine needle damage has been widespread since 2010. Damage was particularly severe in 2016. Although damage was less visible by mid-summer, when aerial surveys were completed, 30,666 acres were mapped.



The white wool of balsam woolly adelgid (left) may be hard to find even where the insect has caused mortality (right). Balsam woolly adelgid is vulnerable to cold winters and doesn't survive on dead trees.

Reports of **red pine mortality** continued in 2016, with 743 acres mapped, scattered in eight counties. A research project, led by a doctoral student at the University of New Hampshire with funding from the US Forest Service, continues work to identify whether a primary pest or pathogen is responsible. The exotic insect, **red pine scale**, detected by this project in 2015 in Rutland and Orange Counties, continues to be a suspect.



Although it remains premature to say that red pine scale is the sole "cause" of this mortality, best practices would be to take precautions to reduce possible spread. Harvest declining red pine in winter when the insect is not capable of moving on its own, chip tops so twigs and branches dry out more quickly, and ensure equipment is free of plant material before leaving the site.

Research is underway to determine the cause of red pine mortality, which has been mapped in eight Vermont counties. (Photo: K. Beland)

While **spruce budworm** continues to cause widespread defoliation in eastern Canada the number of moths captured in our Vermont pheromone traps this summer remained low.

Drought effects were likely to have been the "last straw" leading to occasional mortality of blue spruce repeatedly defoliated by **Rhizosphaera needlecast**. The cause of thin crowns and occasional mortality in northeastern Vermont white spruce stands may be related to this disease, but as of now, the cause is undetermined.

Exotic Forest Pests

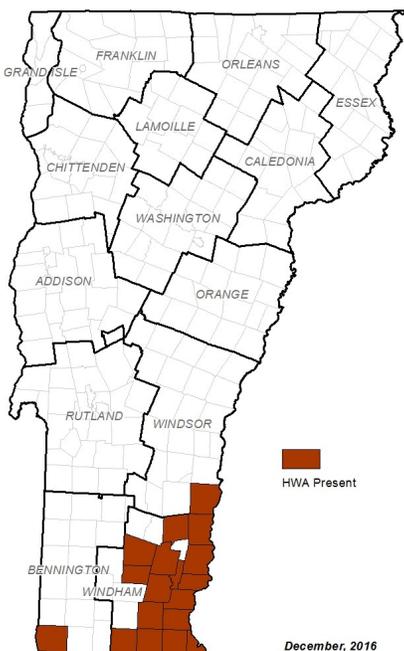
Vermont's **hemlock woolly adelgid** infestation remains centered primarily in Windham County, with small spots in Springfield and Pownal. We continue to conduct intensive surveys to delineate this infestation, and hemlock woolly adelgid was detected in Westminster for the first time in 2016. Fifty-five sites were surveyed, with volunteers completing nearly half of the survey work.

The limited spread is due in large part to an unexpectedly high winter mortality rate, which averaged 97% in our monitoring sites. High mortality throughout the northeast is attributed to the cold snap in late February. Earlier warm weather had prompted the insects to become less cold-hardy, making them vulnerable to the sudden cold.

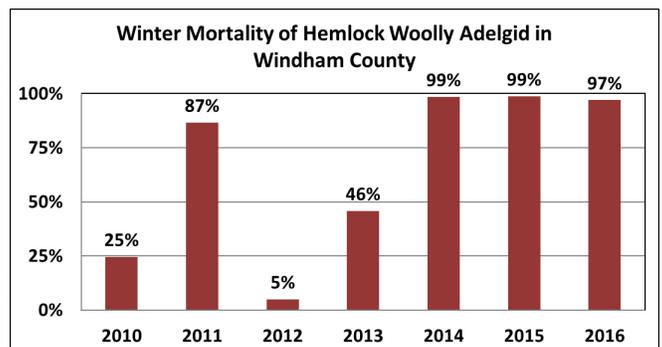
No predatory beetles, *Laricobius nigrinus*, were recovered during fall sampling of the three sites where they had been released, so the status of this introduction remains unknown.

While recent adelgid mortality rates have been high enough to slow its spread, trees are still threatened. Some stands of hemlock are in noticeable decline, with 322 acres mapped during aerial surveys, compared to 83 acres in 2015. Compounding the situation are the spread of **elongate hemlock scale** into southeastern Windham County, and the dry summer leaving the hemlock woolly adelgid infested area in drought conditions for a substantial period.

Recommendations are available in the publication [Managing Hemlock in Northern New England Forests Threatened by Hemlock Woolly Adelgid and Elongate Hemlock Scale](#).



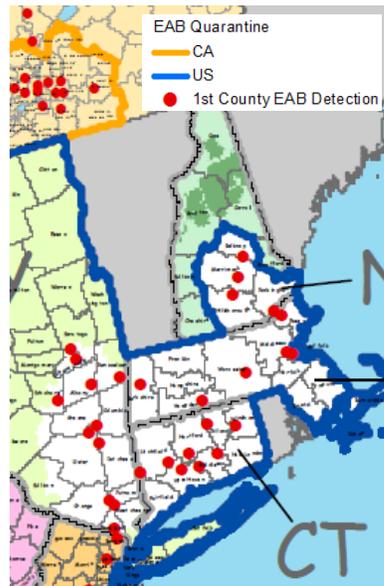
Hemlock woolly adelgid spread has been limited, with the only new town detection in Westminster. High overwintering mortality of the insect is attributed to the February cold snap following warm weather earlier in the winter. Some infested stands of hemlock are in noticeable decline (arrow).



Emerald ash borer (EAB) is not known to occur in Vermont and was not detected by survey. However, new counties were found to be infested in Massachusetts and Connecticut in 2016, and the insect is now reported from thirty states. Anyone using ash products from infested states should be aware of current regulations. Information is available by contacting USDA APHIS, AAFM, or an FPR office below.

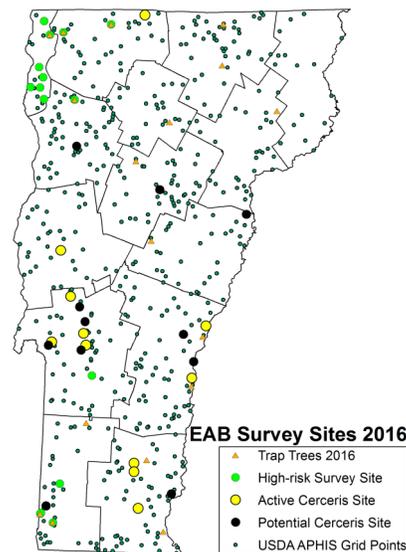
An aggressive emerald ash borer detection effort continues in Vermont. Building on the 2015 intensive trapping survey, with the assistance of volunteers we continued with 5 high risk sites in southwestern Vermont, and 10 new sites in the northwestern corner of the state. USDA APHIS continued its statewide survey by deploying an additional 515 purple traps throughout Vermont.

In 2016, wasp watchers made a total of 136 visits to 42 known and potential *Cerceris* nest sites. Twenty of the sites were active enough to warrant routine monitoring, but no emerald ash borers were found amongst 719 beetles that were collected. We are also using girdled trap trees as a detection tool. In 2016, 16 trap trees in high risk areas in ten counties were girdled in the spring, then harvested in November and peeled to look for signs of EAB.



As of December 2016, four counties in New Hampshire, and all of New York, Connecticut and Massachusetts are included in the emerald ash borer quarantine area.

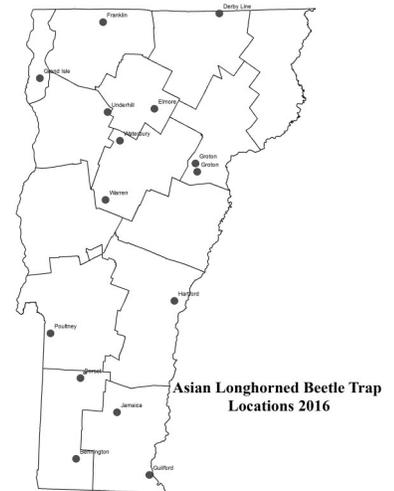
Map data from USDA APHIS, 12/20/16. For current information visit: www.aphis.usda.gov/plant_health/plant_pest_info/



Emerald ash borer has not been detected in Vermont

*in spite of intensive surveys. In 2016, 15 high risk sites in SW and NW Vermont were monitored with green and purple traps. USDA APHIS led the deployment of 515 additional traps statewide. Volunteers assisted with visiting 42 *Cerceris* sites (photo) and with peeling 16 trap trees.*

Asian longhorned beetle is not known to occur in Vermont, and was not found in any of the 15 traps deployed in 2016.



Asian longhorned beetle (ALB), is not known to occur in Vermont and no forest management changes are recommended in anticipation of the insect. The natural spread of ALB is relatively slow when compared to some other invasive species such as the emerald ash borer. Nonetheless, education and outreach, that can promote early detection, remain a priority. Early detection is particularly important with Asian longhorned beetle, since small, newly-discovered populations can be successfully eradicated. For the fourth year, we deployed panel traps in locations with a high risk that out-of-state firewood might have been in the area. Fifteen traps were checked bi-weekly between early July and late September, and no ALB were collected during the survey.

AAFM and USDA APHIS continue efforts to trap non-native forest insects.

Sirex woodwasp has been trapped in six Vermont counties since 2007. In 2016, it was trapped again in Addison, Rutland, and Windham Counties. No new observations of Sirex infesting trees were reported.

The **common pine shoot beetle**, which has been found in many Vermont counties since it was detected in 1999, was trapped this year in Chittenden County. By federal quarantine, pine material is free to move within Vermont and through most of the region. See [Pine Shoot Beetle Quarantine Considerations](#) for more information.

The **brown marmorated stinkbug** was also trapped in Chittenden County.

Dry conditions seem to have accelerated the symptoms of **Dutch Elm Disease**, with widespread observations of brown, curled leaves on flagging branches. Researchers at the US Forest Service Northern Research Station are working to identify American elms that are resistant and are requesting samples of diseased elms from which they can isolate fungi. To participate contact [Jessie Glaeser](#).

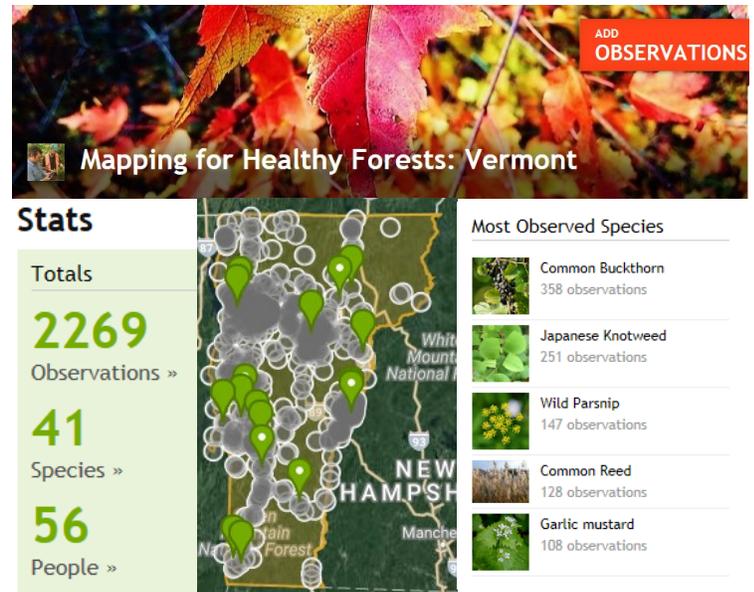
Other **Non-Native Insects and Diseases that Have Not Been Observed** in Vermont include winter moth, and the agents that cause oak wilt, thousand cankers disease, and sudden oak death.

Non-Native Invasive Plants

Non-native invasive plant management (NNIPM) efforts grew in 2016, with progress on mapping, control, outreach and education made possible through several grant funded opportunities, and varied strategies within local communities. The statewide invasive plant coordinator within FPR led over 28 workshops for a variety of stakeholders, and worked with multiple state departments and agencies to unify Vermont's approach to NNIPM. Department staff continued to provide outreach and information about invasive plants to the public and professionals, building the capacity to continue to manage invasive terrestrial plants on state lands across Vermont.

In 2016, invasive plant removal activities were conducted on 20 state-owned properties. Nearly 600 volunteers were involved with invasive plant management or education. (Photo: H. Ewing)

In 2016, over 20 state-owned properties were managed to remove NNIP. Some sites involved large-scale treatments while others required more localized means. Volunteer hours helped bolster these efforts in many cases – nearly 600 volunteers and over 2,000 volunteer hours were logged for either education or direct management of NNIP.



The [Mapping for Healthy Forests](#) website helps assess treatment areas for non-native invasive plant management on town and private lands.

The Mapping for Healthy Forests project continued efforts to provide a resource for tracking NNIP across the landscape. This citizen science project trains volunteers to assess and prioritize treatment areas for NNIPM on town and private lands. All the information from this project is stored on the iNaturalist website and is accessible through this link: <http://www.inaturalist.org/projects/mapping-for-healthy-forests-vermont>.

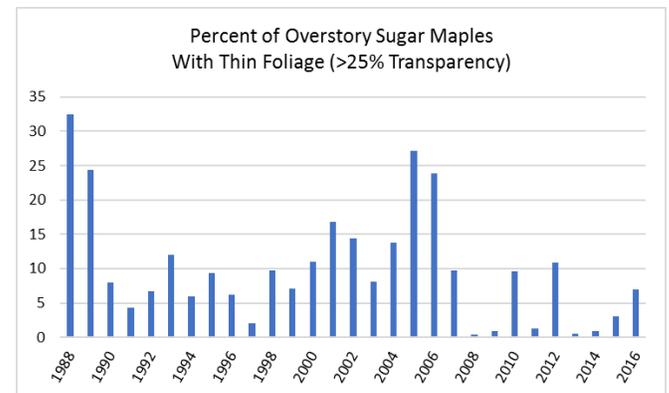
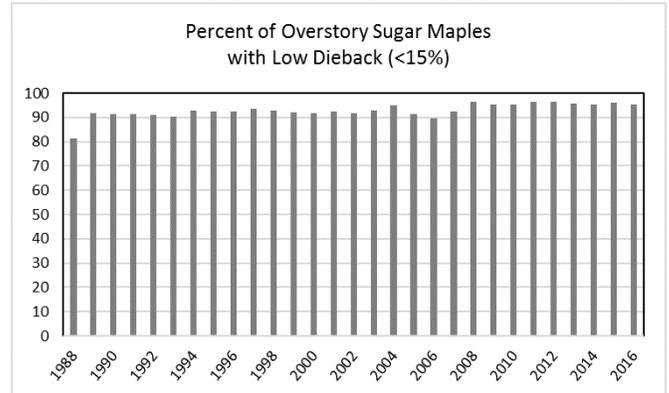


Monitoring Forest Health

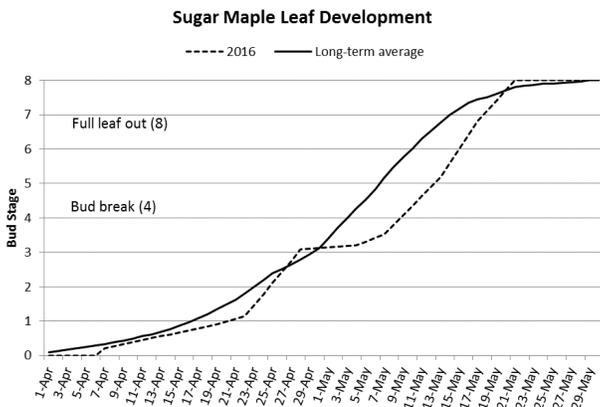
Vermont has continued to monitor sugar maple health in sugarbushes and in maple stands since 1988. In these North American Maple Project (NAMP) plots, 95% of trees were rated as having low dieback (less than 15%). Of the 36 plots, 8 had moderate-heavy defoliation (22%) due to forest tent caterpillar and 20 had light defoliation (55%). The frequency of thin foliage was similar to last year when frost injury affected foliage density. Foliage transparency is sensitive to current stress factors. Other spikes in transparency have been due to frost injury (2010, 2012, 2015), forest tent caterpillar defoliation (2004-2007), and pear thrips (1988-1989).

In addition, 42 forest health monitoring plots were sampled across Vermont as part of the Vermont Monitoring Cooperative. Dieback increased in the original 23 sites on Mount Mansfield and Lye Brook Wilderness Area. Foliage transparency remained steady. Unusual lack of snow cover the previous winter, combined with dry summer conditions were contributing factors to increased dieback.

As part of ongoing phenology monitoring, sugar maple trees were monitored for the timing of budbreak and leaf out in the spring. Leaf bud expansion was later than normal; budbreak on May 9th was nearly 6 days later than the long-term average following a cool spell in early May. However,



Over 95% of sugar maples were rated as having low dieback (<15%) in North American Maple Project plots . Thin foliage was mostly due to forest tent caterpillar defoliation.



In spring phenology monitoring plots, the timing of sugar maple budbreak was normal.

<p>For more information, contact the Forest Biology Laboratory at 802-879-5687.</p> <p>To contact Forest Resource Protection or County Foresters:</p>	<p>Windsor & Windham Counties.....</p> <p>Bennington & Rutland Counties.....</p> <p>Addison, Chittenden, Franklin & Grand Isle Counties.....</p> <p>Lamoille, Orange & Washington Counties</p> <p>Caledonia, Orleans & Essex Counties.....</p>	<p>Springfield (802) 885-8845</p> <p>Rutland (802) 786-0060</p> <p>Essex Junction (802) 879-6565</p> <p>Barre (802) 476-0170</p> <p>St. Johnsbury (802) 751-0110</p>
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<http://fpr.vermont.gov/>

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