FOREST INSECT AND DISEASE CONDITIONS IN VERMONT 2014

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STATE OF VERMONT

AGENCY OF NATURAL RESOURCES

DEPARTMENT OF FORESTS, PARKS & RECREATION

Michael C. Snyder, Commissioner

Steven J. Sinclair, Director of Forests

http://fpr.vermont.gov/

We gratefully acknowledge the financial and technical support provided by the USDA Forest Service, Northeastern Area State and Private Forestry that enables us to conduct the surveys and publish the results in this report. This report serves as the final report for fulfillment of the Cooperative Lands – Survey and Technical Assistance and Forest Health Monitoring programs.

FOREST INSECT AND DISEASE CONDITIONS IN VERMONT

CALENDAR YEAR 2014

PREPARED BY:

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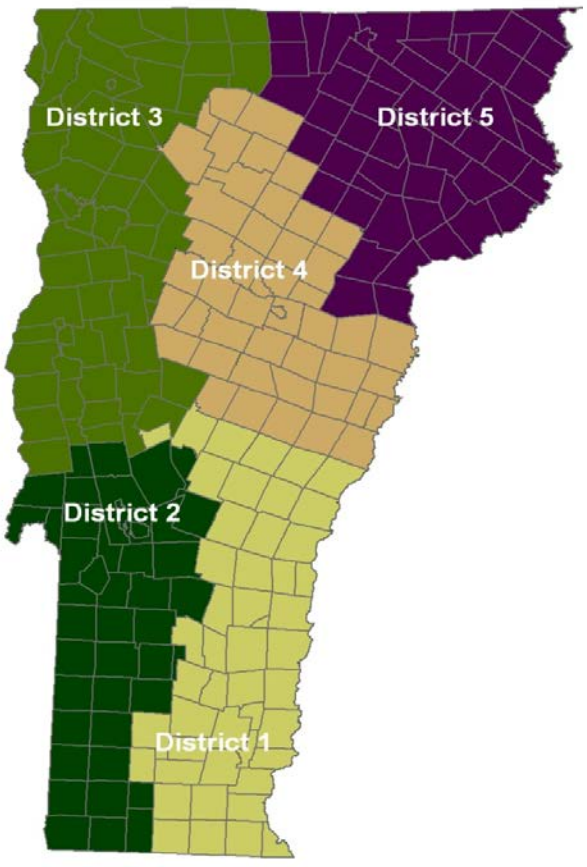

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INTRODUCTION

The report of Forest Insect and Disease Conditions in Vermont documents survey results and observations by Vermont Forestry Division staff in the calendar year. Activities were conducted in partnership with the US Forest Service, Vermont Agency of Agriculture, Food, and Markets, USDA-APHIS, the University of Vermont, the National Weather Service, cooperating landowners, resource managers, and citizen volunteers.

These reports have been produced annually since 1967. In prior years, observations were summarized in the Vermont Department of Forests and Parks Biennial Reports.

The year's most significant observations and activities are summarized at the front of the report in the stand-alone Forest Health Highlights. Details follow about weather and phenology, forest insects, forest diseases, animal damage, invasive plants, and trends in forest health.

Results are summarized from aerial surveys to detect forest damage. A statewide aerial survey to map late season defoliators and general forest conditions was flown between July 30th and August 29th. On June 24th, the U.S. Forest Service conducted an additional aerial survey over the Green Mountain National Forest.

Ground data include tree health and pest population survey results. Additional data and metadata are available through the Vermont Monitoring Cooperative Database website, or by request.

Also reported are insects and diseases of trees that were incidentally observed by our staff, the public and others. Except where indicated, the lack of an observation does not mean that the insect or disease was absent.

This report is available on-line at http://fpr.vermont.gov/forest/forest_health/current_health, or in hardcopy format. For additional information, including defoliation maps, management recommendations, and other literature, assistance in identifying pests, diagnosing forest health problems, on-site evaluations, and insect population sampling, or to participate in invasive pest citizen monitoring, contact Forest Resource Protection Personnel or your County Forester.

ACKNOWLEDGEMENTS

The **Forest Pest First Detector program** is in its third year. We thank the many continuing First Detectors, and welcome new volunteers, including Ali Kosiba, Alice Allen, Allaire Diamond, Amalia Torres, Amanda Gervais, Anastasia Gaszynski, Andrew Cappello, Andy McLean, Andy Reed, Anne Holdridge, Anne Zolotas, Annette Goyne, Annette Preiss, Ben Williams, Betsy Whittaker, Bill Conn, Bill Menning, Bob DeSiervo, Bob Everingham, Bob Hartwell, Bob Little Tree, Brenda Raleigh, Brian Daigle, Brian Sullivan, Candice Huber, Carl Mohlenhoff, Carol Truesdell, Charlie Hancock, Charlie Parant, Charlotte and William Kennedy, Chris Simpson, Chuck Kletecka, Corey Brink, Craig Lambert, Cynthia Greene, Dan Healey, Dan Steinbauer, Daniel Ruddell, Dave Tilton, Deb Lacroix, Diane Sedra, Doug Reaves, Earl Holtz, Elizabeth Eddy, Frank Fomkin, Fred Morgan, Fred Skwirut, Gary Coryer, Gary Salmon, Greg Campbell, Gregory Duggan, Gus Goodwin, Gwen Allard, Jack Sumberg, James Harding, Jan McCoy, Janet Kane, Jaysen Dickenson, Jeff Young, Jen Lyod Pain, Jeremy Tinker, Jesse Palmer, Jim Faughnan, Jim Frohn, Jim White, Jock Harvey, Joe Parent, John Akielaszek, John Snell, Jon Binhammer, Jordan Fletcher, Josh Wilcox, Judy Wiger-Grohs, Kathy Decker, Ken Parrot, Kurt Valenta, Lauren Eno, Lesley Porter, Linda Miller, Lindsay Cotnoir, Lisa & Elias Wyncoop, Lucinda Sayre, Marianne McGee, Marie Ambusk, Marie Louka, Marilyn Dupre, Mark Dillenbeck, Mark Winer, Marnie Barry, Martin Smit, Marvin Bicknell, Mary Houle, Matt Probasco, Michael Rosenthal, Michael Gray, Michael Quinn, Michelle Barth, Mike & Barbara Curran, Mike Clough, Mike Fallis, Mike White, Nancy Patch, Nilah Cote, Pam Loranger, Pamela Burlingame, Paul Brown, PeggyAnn Duckless, Pieter van Loon, Polly McEwing, Rachel Klatzker, Ray Toolan, Rhonda Mace, Rich Turner, Rick Kelley, Rick LaDue, Robert Zimmerman, Roland Payne Jr., Rory Lincoln, Ruth Addante, Ruth Ruttenberg, Sally Thodal, Sam Miller, Sara Kingsbury, Sarah Sincerbeaux, Sarah Whittman, Scott Hance, Seth Gillim, Shelby Perry, Steve Gerard, Steven Farnham, Sue Lovering, Susan Hindinger, Susan Leskin, Ted and Barbara Graham, Teri Lamphere, Thomas Harris, Thomas Warhol, Tim Moran, Trevor Evans, Veronica Norman, Vincent Royce, VJ Comai, Will Bunten, and Zapata Courage.

We're also thankful for the contributions of other volunteers who assisted with other surveys, such as **HWA detection, Phenology monitoring, ALB traps, Ash Tagging, and EAB biosurveillance,** including**:** Aiden, Liam, and Sheryl Fletcher, Alan Fowler, Alma Beals and her team, Betty Ward, Bruce Jenson, Cindy Mowry and students of Burr and Burton Academy, Christian Pezzino, Deborah Foote, Doug Burnham, Jaclyn Wilkinson, Jessica Dillner, Joan Waltermire, Judy Yogman, Kathleen Hacker, Kristin Armiger and Nate Williams with students at Vermont Academy, Kristin Gottschalk and students at Bellows Falls High School, Lisa Sheridan, the Londonderry Conservation Committee, Luke Curtis, Margaret and Patrick Daly, Mary Holland, Mary Lou Webster, Meg Woolmington, Pat Thompson and family, Pip Richens, Rod Lampey, Ruth and Patrick Kearney, Sandra Miller, Scott, Noah and Grace Diedrich, Susie Peters, and Virginia Barlow.

Thank you to volunteers who assisted the **Forest Biology Lab**, including Warren Kiel who has helped fill gaps in our insect collection Lepidoptera holdings; Ross and Joyce Bell, Don Chandler, Rod Crawford, Scott Griggs, Rick Hoebeke, Dan Jennings, Don Miller, Michael Sabourin and Dave Wagner who have provided taxonomic and other help; Jessica Dillner who helped with collection issues, and Patrick Thompson, a student from Saint Michael's College, who has assisted in many lab activities.

Support in many program areas was provided by staff of the US Forest Service Forest Health Protection; the Vermont Agency of Agriculture, Food, and Markets; University of Vermont; USDA APHIS; the U.S. Forest Service Northern Research Station; and VT State Parks, as well as many others in the VT Agency of Natural Resources.

SPECIAL ACKNOWLEDGEMENT

Tom Simmons Retires

Tom Simmons, Forestry Specialist with the Forest Resource Protection Section of the Vermont Forestry Division, retired in 2014. Tom has been pivotal in the success of numerous projects during his 41-year career, was involved in growing trees in the State Tree Nursery, addressing forest pests as they came and went, gathered daily weather records for the National Weather Service, and was one of the original cooperators with the Vermont Monitoring Cooperative (VMC). The VMC database lists Tom on 16 projects, officially, but he helped out on many more. Whether it was drilling holes in the soil with a euphemistically named "hand held" motorized post-hole digger for the base of the Forest Canopy Research Tower or hauling bulky or heavy items up Mount Mansfield to set up various monitoring/research plots, Tom always lent a hand.

Tom's organizational, observational, and problem-solving skills were instrumental in many forest health survey and management projects. His inventions included field photo viewers so crews could use stereo pairs of large-format transparencies in the field, and a set of lap tables for scrolling rolls of topographic maps in a small airplane. The accuracy of his observations on gypsy moth, pear thrips, forest tent caterpillar, and other pests guided management programs. He took the lead, within FPR, for making a butternut seed orchard a reality, and hopefully preserved genes that help trees survive butternut canker.

Mid-way through Tom's career, the National Forest Health Monitoring began in the New England states and Tom became a consistent force in this evolving program, first as a crew member and later as a first-rate forest health trainer. He was a life-long learner and took a special interest in learning lichen species as part of the ecosystem health monitoring. He was also instrumental in maintaining a National Weather Service site in Essex, translating his daily observations into a colorful yearly summary which for many years was a highlight of this report.

One of his signature data-sets, from a long-term monitoring perspective, is the nearly 25 year record of phenology data that Tom collected. Tom served as an indicator of sorts at the Proctor Maple Research Center where some of his phenology subjects grow. With his first appearance in early spring, spotting scope and clipboard in hand, it was a sure bet that sugaring season was soon to end. Data included detailed information on bud break and leaf out in the spring, followed by fall color and leaf drop of trees

and selected understory species in the spring, creating an invaluable long-term record which initially was used to study the impact of pear thrips on sugar maple bud development. These data also helped in understanding how individuals of the same species and different species fared at different elevations and how trees responded to weather events, such as early fall or late spring frosts. With the current focus on climate change impacts, these data are increasingly valuable as a foundation in understanding long term trends.

Tom's friends and colleagues at FPR,VMC and elsewhere are grateful for his long record of dedicated service and wish him a long, happy, and rewarding retirement. "Happy Trails!"

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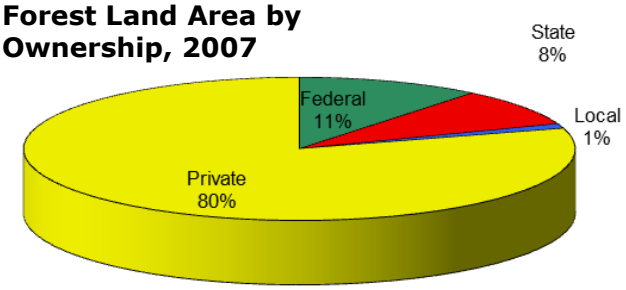
Forest Health VERMONT *highlights* 2014

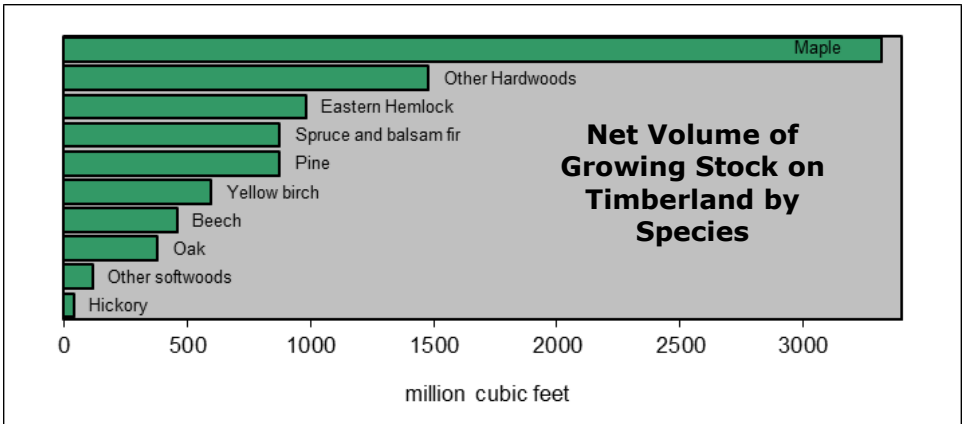
These highlights summarize information from the annual report on Forest Insect and Disease Conditions in Vermont. The complete annual report, as well as other Vermont forest health information, are posted on-line at http://fpr.vermont.gov/forest/forest_health/current_health. To receive a copy by mail, for assistance in identifying pests, diagnosing forest health problems, on-site evaluations, and insect population sampling, to obtain defoliation maps, management recommendations, and other literature, or to participate in invasive pest citizen monitoring, contact Forest Resource Protection Personnel or your County Forester.

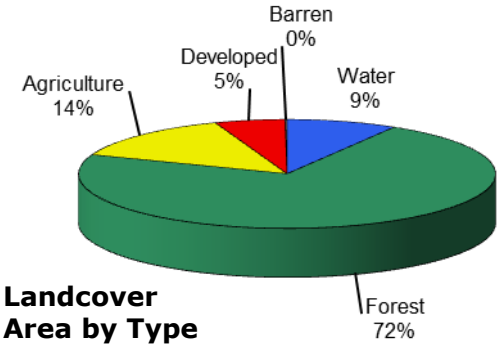
Forest Resource Summary

Forests cover 78% of Vermont. Over 83% of the state's forest land is privately owned with 8% under federal management in the Green Mountain National Forest and 7% managed by the State of Vermont. Sugar and red maple, eastern hemlock, and white pine are the most common species by number and volume. More information on Vermont's forest inventory is at http://www.fs.fed.us/ne/fia/index.html.

Forest Land Area by Ownership, 2007







Landcover Area by Type

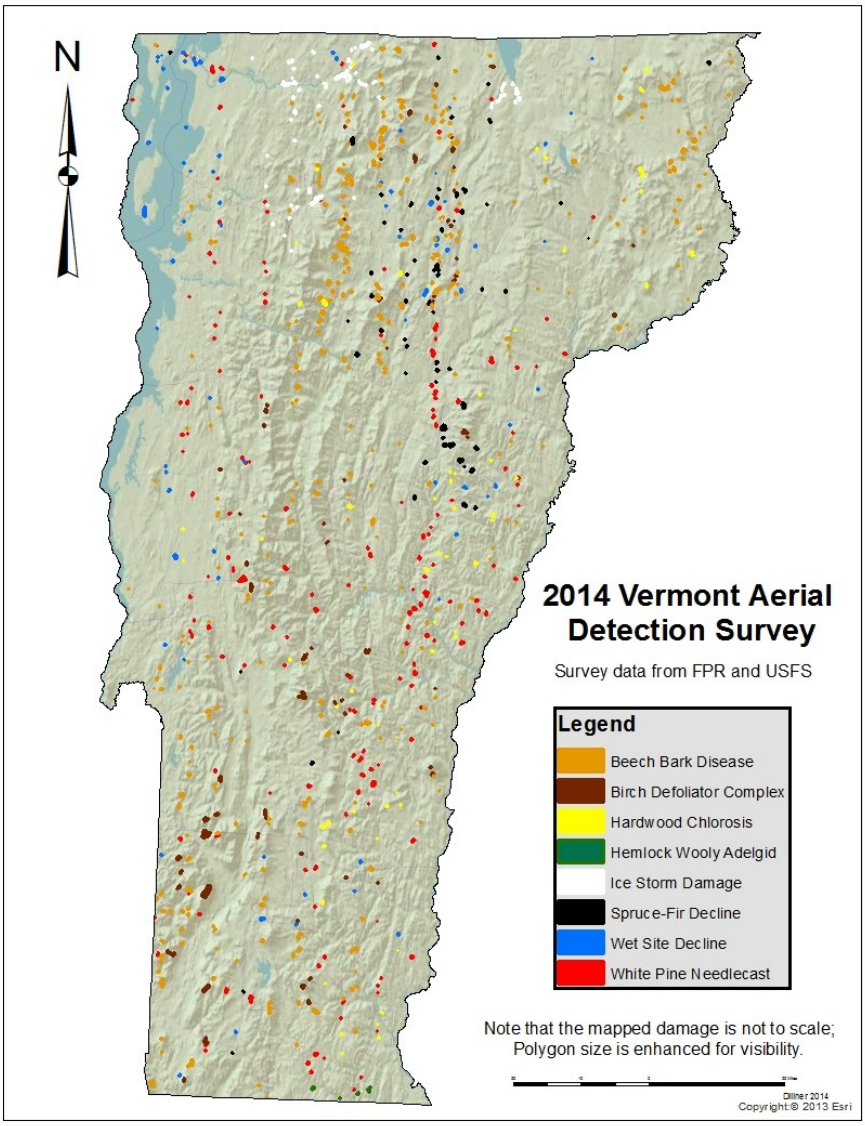
Forest Resource summary data from US Forest Service Forest Inventory and Analysis.

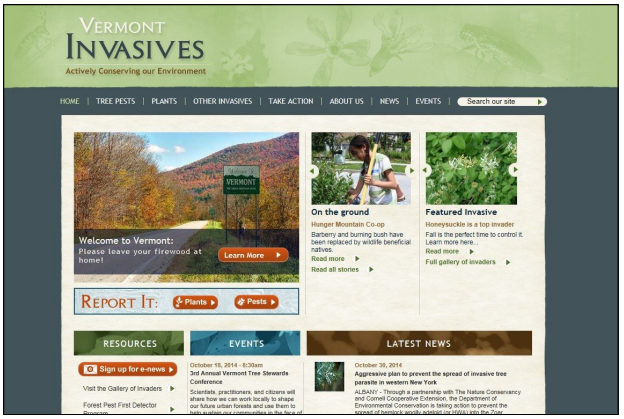
Forest Health Programs in the Northeast

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

Aerial Surveys

In 2014, 38,235 acres of forest damage were mapped statewide. This represents less than 1% of Vermont's forestland, and an 80% decrease from 2013. The non-native pest complex, beech bark disease, accounted for 36% of the area mapped.





The vtinvasives website provides information on invasive pests and suggests ways to take action.

outreach. An interagency Invasive Forest Pest Action Plan is updated every year. The website dedicated to invasives, vtinvasives.org, covers non-native plants and tree pests, and provides information on reporting suspects, spreading the word, and getting involved as a volunteer. In 2014, 29 new volunteers attended Vermont's Forest Pest First Detector Program training, bringing the statewide total of trained volunteers to 147.

Don't Move Firewood outreach continues. To reduce risk, State Park campgrounds exchanged out-of-state firewood with local wood. In Spring 2014, Act 112 was signed requiring regulations on importing untreated firewood by summer 2015.

A network of Forest Pest First Detectors, serving 122 communities, has conducted training, screening, outreach, surveys, and community preparedness activities.

Forest Health Program Highlights

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

Invasive Pests and Plants are a key threat to forest health in the region. The Department of Forests, Parks and Recreation and the Agency of Agriculture, Food and Markets collaborate with USDA agencies to survey and manage non-native forest pests, and with UVM Extension on education and

The **Forest Biology Laboratory** continues to provide invertebrate identifications, tree disease diagnoses and pest management recommendations. It also maintains an invertebrate collection and historical records which serve as an invaluable resource in evaluating forest health changes. With the assistance of volunteers and interns, we continue to make remedial progress in recovering this collection from losses due to tropical storm Irene.

Winter injury to conifers began to show up in the spring.

Climate Change adaptation remained a focus in 2014. A number of demonstration projects have been initiated on public and private lands. These are management units which provide on-the-ground examples of how the goal of creating resilient forests, along with other objectives, can be implemented. More details about these projects are available at http://forestadaptation.org/new-england/vt. The publication, *"Creating and Maintaining Resilient Forests in Vermont: Adapting Forests to Climate Change"* is another resource to assist with implementation, and will be available in 2015.

Resources for urban and community forest storm preparedness were compiled for tree stewards, and are available at http://www.vtcommunityforestry.org/resources/community-preparedness/storms.

The Department of Forests, Parks and Recreation is working with partners to develop **Voluntary Harvesting Guidelines** in support of forest health and sustainability, as directed by Act 24. The draft guidelines address a number of forest health concerns, including protecting soil health and productivity, maintaining biodiversity, and planning for uncertainty in the face of factors such as climate change, disturbance, non-native pests and invasive plants. The initial guidelines will be adopted by January 15, 2015.

2014 Weather Influences on Forest Health

The "old-fashioned" winter of 2013-2014 included cold temperatures and a substantial snowpack, and ended with a shorter than normal sugaring season. The deep, persistent snow cover over the winter gave rodents an opportunity to girdle apples and other hardwoods. Winter injury to ornamental cedar, yew, and other conifers, and desiccation of young conifer transplants, started to show up in the spring.

Spring leaf expansion was slow, but temperatures were generally moderate through the summer. There was nothing moderate about the storm activity, which included hailstorms on May 27 and on July 3, 23, and 27. These and other storms included strong, tree-damaging winds.

Several hail storms included strong tree-damaging winds.

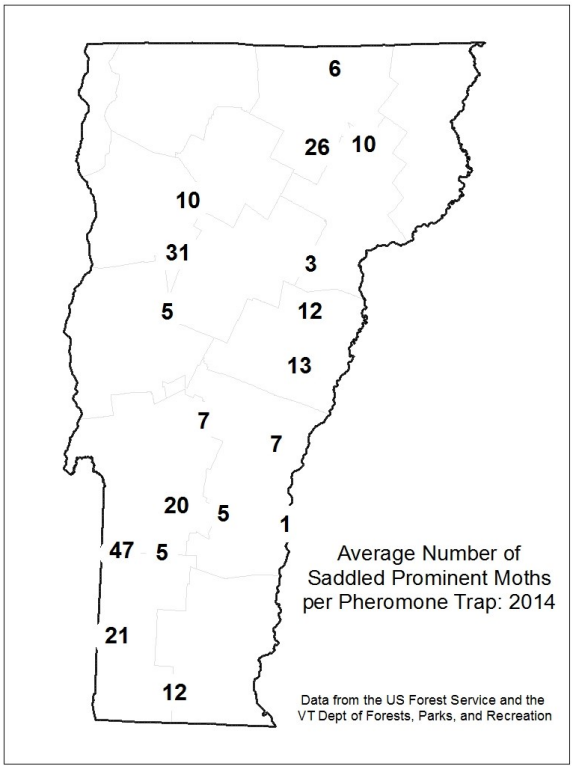
Precipitation in August and September was well below normal. In some areas, this led to rapid browning and premature leafdrop of ash, which is very sensitive to water availability. After widespread frost in mid-September, foliage season was spectacular.
Red oak acorns, a major food source for many wildlife species, were abundant. Early-fall visits to some oak stands practically required hardhats to avoid injury.

After a mid-September frost, foliage season was spectacular.

Hardwood Insects and Diseases

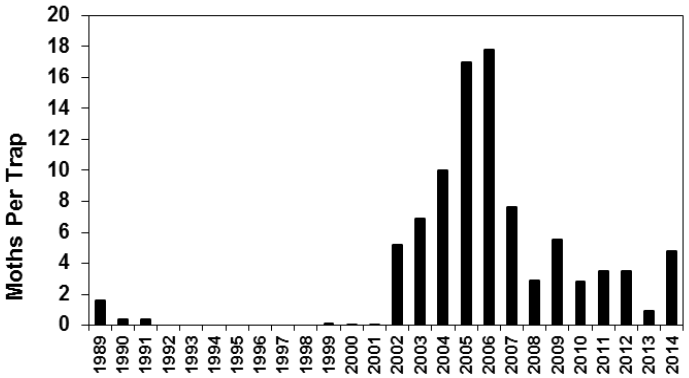
The most striking highlight regarding hardwood insects and diseases is what *didn't* happen. It was a year with remarkably few hardwood foliage problems. **Anthracnose** on maple, ash, and oak and **Septoria** on birch plummeted from recent years, with 6150 acres of damage by these diseases mapped, compared to 127,628 acres in 2013. Only balsam poplar and black willow, species that grow mostly in riparian areas, had notable defoliation by leaf fungi.

Major defoliating insects did not reach outbreak levels. **Saddled Prominent** pheromone traps were deployed statewide due to concern about building populations of this northern hardwood defoliator. Trap catches varied widely throughout the state, but subsequent defoliation was limited. There were many reports of saddled prominent caterpillars and their "frass rain", indicating that there may still be a threat of defoliation by these insects in 2015.



Saddled prominent moth catches varied throughout the state.

Individual larvae of **Forest Tent Caterpillar** were reported. Later in the season, moth catches in pheromone traps increased from previous years, making this another defoliator to watch for next year.



Forest tent caterpillar moth catches increased from previous years.

Other defoliators that were noticeable in 2014 included **Maple Trumpet Skeletonizer**, **Cherry Scallop-shell Moth**, and **Locust Leaf Miner**.

Maple trumpet skeletonizer (top) and cherry scallop-shell caterpillar (bottom) feed within protective shelters.

Dieback from **Beech Bark Disease** was mapped on 14,479 acres, a drop from the 25,150 acres mapped in 2013. Also on beech, we received reports of **Beech Blight Aphid** from multiple locations. These aphids sway from side to side when disturbed and, for that reason, have received the common name "Boogie-Woogie Aphid".

Softwood Insects and Diseases

White Pine Needle Damage was widespread this year throughout Vermont. Brown foliage continued to be obvious late in the season, and 4972 acres were mapped during aerial surveys. This damage has been widespread since 2010, and the current epidemic has been building at least since 2005. Although causes may vary, widespread episodes of white pine needle blights have been reported throughout the past century, including in 1908, in the mid-1950s into the 1960's, and between 1983-89.

The discoloration and defoliation of last year's needles is most severe in the lower crown and is attributed to fungi, which have been thriving due to consecutive wet springs. The primary causal agent is thought to be brown spot needle blight, *Mycosphaerella dearnessii),* but two needlecast fungi (*Canavirgella banfieldii* and *Bifusella linearis)* have also been identified.

The repeated damage to white pine needles is causing concern about its impact, because the heaviest damage occurs on the same trees from year to year. While most trees will be able to meet their needs for respiration (staying alive), shoot elongation and new wood production will be limited. Severely defoliated lower branches are likely to dry out and die, reducing crown length and live crown ratio.

Decline and mortality of white pine have been observed in stands which have had multiple years of needle damage where other stress factors are also present such as wet site conditions, wind impact, or wounding. Weak pests and pathogens, such as turpentine beetles, Caliciopsis canker, and Armillaria root rot have been observed in some stressed stands.

Where white pine needle damage is a concern:

- Evaluate individual trees; trees within a stand vary hugely in susceptibility. Check out the topmost branches; if they're okay, the tree probably will be too. Focus on disease-prone sites: low-lying or riparian areas and narrow valleys, and where trees are already stressed.
- Avoid disturbance that results in wounding. Red rot thrives in slow growing pines.
- Look for bark beetles. Turpentine beetles often show up first, making pitch tubes at the base of the tree. Trees may recover from light attacks by this insect. Other bark beetle species are more likely to indicate a tree near death.

The US Forest Service, in cooperation with UNH and affected states, continues to investigate this malady, including studies to clarify the roles of needlecast fungi and weather.

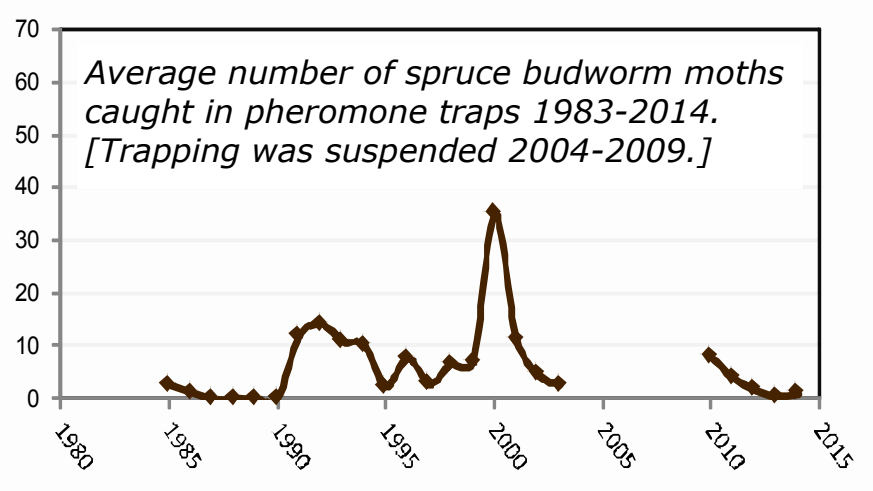
White pine branches with severe needle damage are likely to dry out, reducing crown length and capacity for tree growth.

Unexplained **Red Pine Decline** has been observed in multiple locations in Vermont. In some stands, the rapid progression and pattern of mortality suggest that a pest or pathogen may be involved. Similar symptoms have been reported elsewhere in New England. Through a research project being conducted out of UNH, we hope to clarify the causes decline. Sites will be examined for insects, pathogens, soil conditions, and other factors to determine if there is a pattern across the region.

Red pine decline has been observed in multiple locations within Vermont and elsewhere in New England.

Levels of several disease-causing fungi, including **Diplodia Tip Blight** and **Brown Spot Needle Blight,** continue to be unusually heavy on both red and Scots pines.

Spruce Budworm is causing widespread defoliation in Quebec, including south of the St Lawrence River, and populations are building in Maine and New Brunswick. However, the moth trap catch in Vermont remains low.



We have received an unusually large number of diagnostic calls about balsam fir symptoms this year, including landscape and forest as well as Christmas trees. Every year, **Fir Mortality** is captured during aerial surveys, but this year the percentage of dying trees within affected areas was often higher than normal. Some balsam fir decline is the result of stress caused by **Balsam Woolly Adelgid** making trees vulnerable to **Armillaria** root rot. **Rhizosphaera Needle Blight** has been confirmed in scattered locations.

Areas in the Northeast Kingdom continue to experience **Larch Decline**, often initiated by heavy larch casebearer and eastern larch beetle populations.

Balsam Fir symptoms were more common, including decline initiated by balsam woolly adelgid (left), and needle browning caused by Rhizosphaera needle blight (above).

Exotic Forest Pests

Sirex Woodwasp has been trapped in several Vermont counties over the past few years, but had never been seen in trees. In 2014, an infested red and Scots pine plantation in Jericho was brought to our attention. Sirex is quite destructive in southern hemisphere locations where it has been introduced, but has been less damaging in the northeastern US, where it mostly attacks suppressed trees.

Round Sirex woodwasp exit holes are evident in this infested red pine in Jericho.

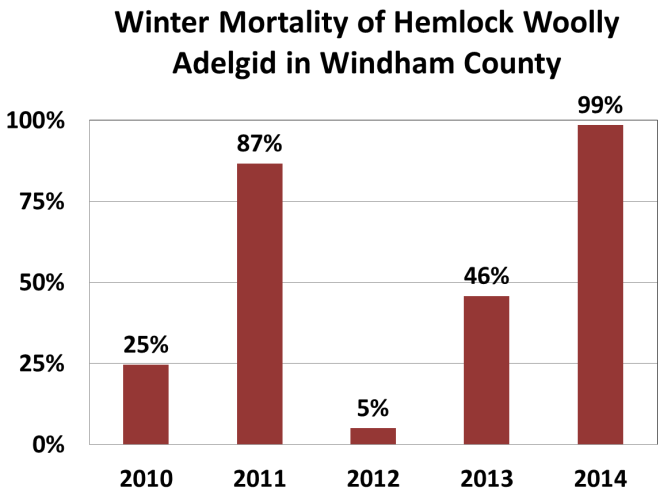
Elongate Hemlock Scale has moved into southeastern Windham County. It has been observed in several sites in Brattleboro and Guilford, occurring on both forest and ornamental hemlocks. Elongate hemlock scale has a reputation of teaming up with hemlock woolly adelgid to cause more severe damage to hemlocks. It also infests balsam fir and other conifers.

Elongate hemlock scale is established in several locations in southeastern Windham County. Scales are found on the underside of needles (top). In heavily-infested trees, yellow spots may be apparent on the upper surfaces of the needles (bottom).

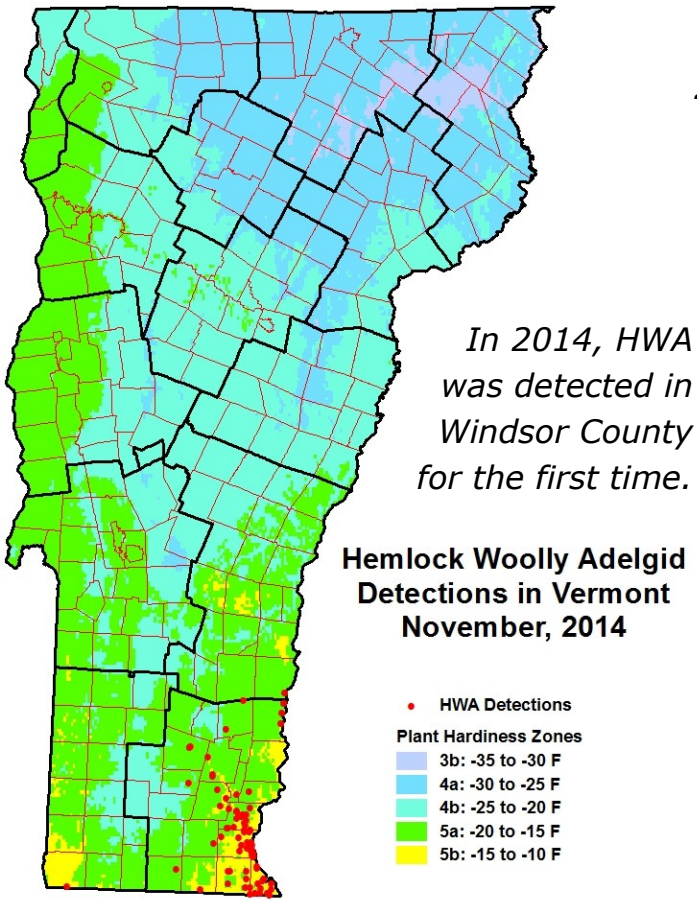
Hemlock Woolly Adelgid (HWA) has now been detected in 17 towns in Vermont, including 15 towns in Windham County and one in Bennington County (Pownal). It was found in a Windsor County town, Springfield, by volunteers in February 2014. This was close to a previous find in Rockingham.

In 2014, a total of 65 sites in 18 towns were surveyed to detect spread of HWA. There were 34 volunteers assisting in this effort.

HWA-infested twigs were collected in mid-March from four Vermont sites for winter mortality assessments. Mortality averaged 99%, the highest recorded over the past five winters.



Infested twigs collected during winter 2013-2014 had the highest % of dead HWA we have observed over the past 5 years.



In 2014, HWA was detected in Windsor County for the first time.

Five impact plots were established to monitor the effects of HWA infestation. These will complement similar plots elsewhere in New England, and help clarify the risk to trees as the insect spreads north. Feeding by hemlock woolly adelgid results in premature needle loss, and new shoots fail to develop. Once tree health declines, so do populations of HWA. When trees recover, HWA populations rebound, in a cycle that can repeat itself. Although many hemlocks have survived in other northeastern states, trees have been less likely to recover on dry slopes and shallow sites.

A pictorial guide for "*Managing Hemlock in Northern New England Forests Threatened by Hemlock Woolly Adelgid and Elongate Scale*" will be available in early 2015.

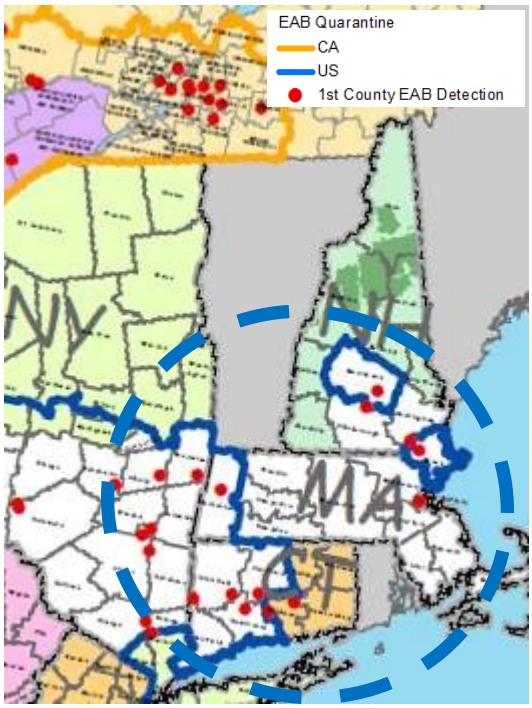
We continue to monitor the three sites where the predatory beetle *Laricobius nigrinus* has been released. Potential new sites are being evaluated for future releases and possible establishment of a beetle-rearing insectary.

In 2014, we had a sharp increase in reports of HWA-related tree decline. Thin crowns due to this insect were mapped for the first time during aerial surveys, with 175 acres delineated. We have known about hemlock woolly adelgid in Vermont since 2007, which means it has probably been in the state for about a decade. A similar lag time has been observed in other states between first detection and the onset of decline. In addition, hot, dry spells through the summer may have increased stress to trees on droughty sites.

There was a sharp increase in reports of HWA-related tree decline, with thin crowns mapped on 175 acres during aerial surveys.

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 New Hampshire, New York, Connecticut, and eastern Massachusetts in 2014.

In the northeastern US and in Canada, the regulated areas have expanded as well. As of early December, the quarantine includes 3 counties in NH, and all of Connecticut and Massachusetts. Anyone using hardwood firewood, ash sawlogs, or other ash products from infested states should be aware of current regulations. Information is available by contacting USDA APHIS, the VT Agency of Agriculture, Food, & Markets, or an FPR office below.

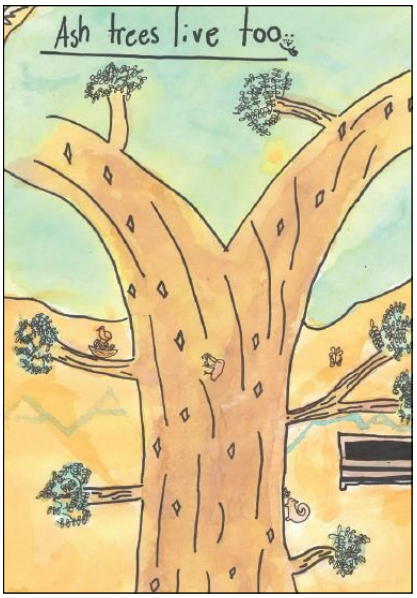


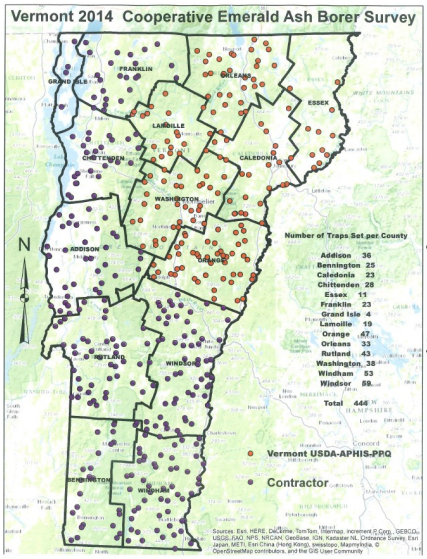
As of early December 2014, three counties in New Hampshire, and all of Connecticut and Massachusetts are included in the emerald ash borer quarantine area.

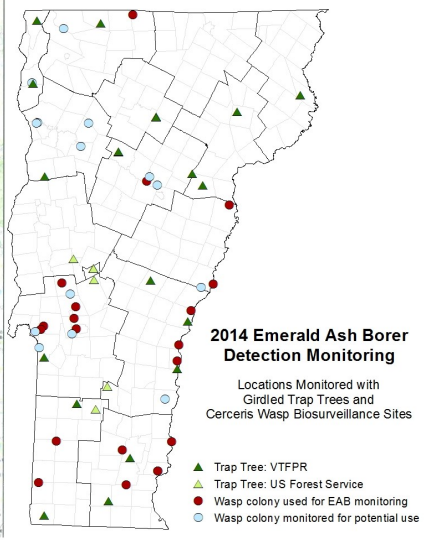
Map data from USDA APHIS, 11/20/14. For current information visit: www.aphis.usda.gov/plant_health/plant_pest_info/

An aggressive emerald ash borer detection effort continues in Vermont. Purple panel traps were deployed at 444 sites in an effort led by USDA APHIS. Wasp watchers assisted with monitoring 34 colonies of the predatory wasp *Cerceris fumipennis* in biosurveillance surveys. Although no emerald ash borer beetles were found, over 40 buprestids were collected at 13 of these sites. We are also using girdled trap trees as a detection tool. In 2014, trap trees were girdled in eleven counties in the spring, then harvested in November and peeled to look for signs of EAB.

A poster contest was conducted as part of Ash Awareness Week. This submission was from 4th grader Payton Kingsbury.







Emerald Ash Borer has not been detected in Vermont in spite of intensive surveys. In 2014, USDA APHIS led the deployment of 444 purple traps (left). Volunteers assisted with monitoring 34 Cerceris colony sites and with peeling 20 girdled trap trees. An additional 15 trap trees were located on the Green Mountain National Forest (right).

In cooperation with UVM Extension, we continue to work with Vermont towns in developing Community Preparedness Plans. Twenty-seven communities are working on, or have completed EAB plans, either as stand-alone documents or by completing street tree inventories and developing urban forest management plans that address EAB and other pests.

Emerald ash borer was featured during Ash Awareness Week April 27– May 3, drawing attention to the importance of our ash resource. Activities included tree taggings, ash tree walks hosted around the state, news coverage and other events that involved 130 volunteers and staff.

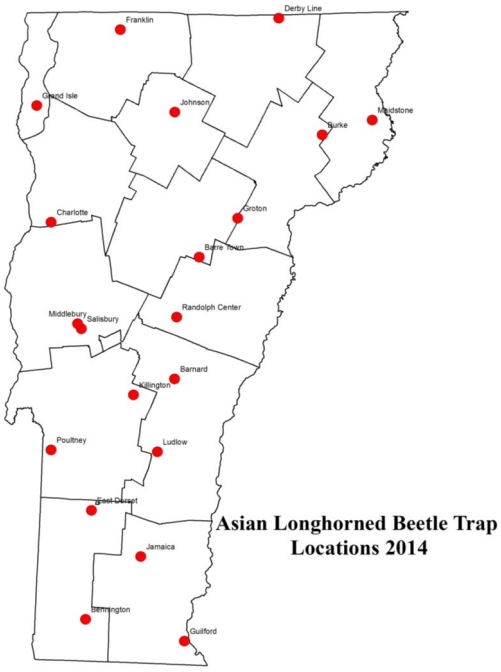
The **Common Pine Shoot Beetle** has been found in many Vermont counties since it was detected in 1999. By federal quarantine, pine material is free to move within Vermont and through most of the region. See Pine Shoot Beetle Quarantine Considerations for more information.

Asian Longhorned Beetle (ALB) is not known to occur in Vermont, and was not found in the panel traps deployed in 20 locations throughout Vermont and checked bi-weekly. We don't recommend any management adjustments in anticipation of this insect. However, early detection is especially important for Asian longhorned beetle; small populations in other states have been successfully eradicated.

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.

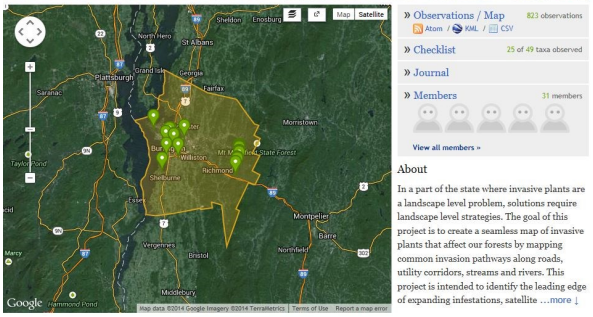
We continue to address the invasion of **Non-Native Plants** into forest ecosystems.

In southwestern Vermont, special funding has been supporting a project which combines invasive plant control with hands-on education and community service, and creates demonstration areas on state land to exhibit long-term management. This season 451 people were involved through a combination of invasive education and projects on state land, contributing about 2000 volunteer hours. In addition a habitat restoration crew controlled populations of invasive plants in critical areas.



Asian Longhorned Beetle Trap Locations 2014

Asian longhorned beetle is not known to occur in Vermont, and was not found in any of the 20 traps deployed in 2014.



In Chittenden County, we initiated a new project to map and manage invasive plants. Students from UVM and a few volunteer enthusiasts systematically mapped terrestrial invasive plants on 40 miles of roads in Richmond, Jericho, Hinesburg, Huntington and Bolton. These included 25 species and 823 observations, with information stored on the iNaturalist website. In addition, students have been refining a mapping protocol for volunteers.

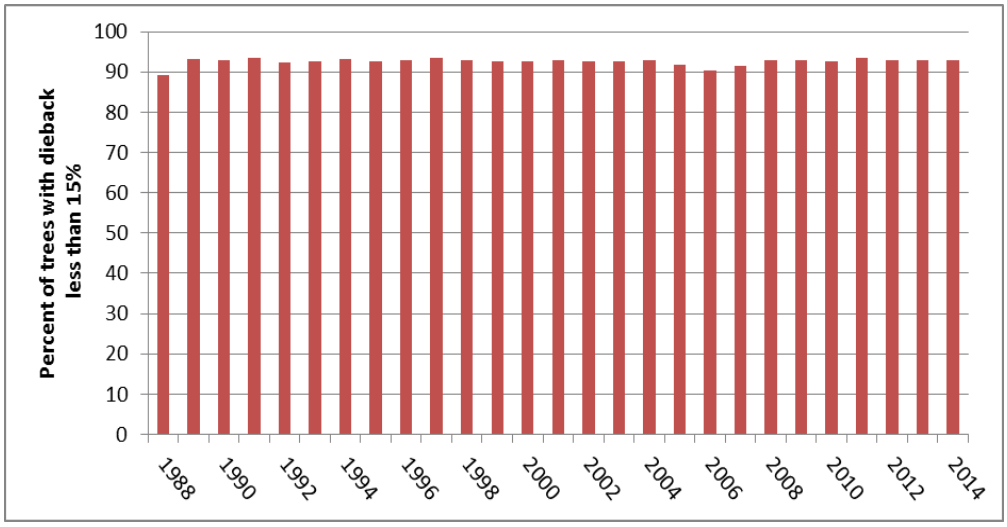
In southwestern Vermont, 451 volunteers have been involved with invasive plant control on state lands (left), and support efforts by a habitat restoration crew (above left).

In Chittenden County, a new project has been initiated to map invasive plants. Information is stored on the iNaturalist website (above right).

Monitoring Forest Health

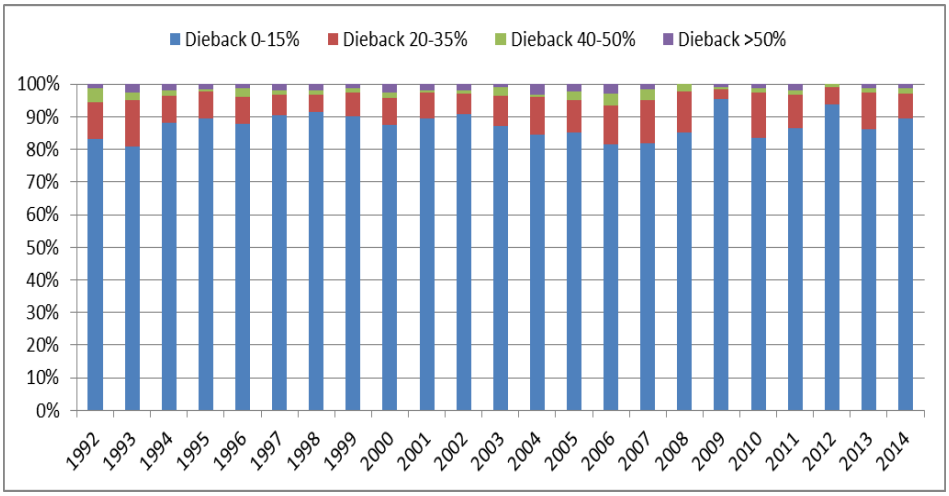
Over 90% of sugar maples were rated as having low dieback (<15%) in North American Maple Project plots.

In **North American Maple Project** (NAMP) plots, over 90% of sugar maples were rated as having low dieback (less than 15%). Foliage continued to be particularly dense this year.



The **Vermont Monitoring Cooperative** (VMC), Vermont's forest ecosystem monitoring and research collaborative, continued activities to collect and archive forest-related data and information. In 2014, VMC completed a study of forest growth on Mount Mansfield. The fourth year of data was collected as part of a long-term urban tree health monitoring project being conducted in collaboration with UVM staff. VMC also initiated a statewide expansion of forest health monitoring plots to better represent Vermont's forests.

Data storage and easy access has been a major focus for VMC. Access to graphing features for plot data and to spatial data such as aerial surveys of forest damages is being improved on the user interface.



Facilitating use of science in decision-making was part of a VMC workshop "Science to Policy: Benefitting from Actionable Science".

VMC has been monitoring tree condition in the Green Mountain biophysical region since 1992 (left). In 2014, a statewide expansion of forest health monitoring plots was initiated.

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

Forest Health Protection
USDA Forest Service
Northeastern Area State and Private Forestry
271 Mast Rd.
Durham, NH 03824
603–868–7708
http://www.na.fs.fed.us

Vermont Department of Forests, Parks, and Recreation
1 National Life Drive, Davis 2
Montpelier, VT 05620-3801
802-828-1531
http://fpr.vermont.gov/

Forest health programs in the Vermont Department of Forests, Parks, and Recreation are supported, in part, by the US Forest Service, State and Private Forestry, and conducted in partnership with the Vermont Agency of Agriculture, Food, and Markets, USDA-APHIS, the University of Vermont, cooperating landowners, resource managers, and citizen volunteers. In accordance with Federal law and U.S. Department of Agriculture policy, this institution is prohibited from discrimination on the basis of race, color, national origin, sex, age, or disability.

FIGURES AND TABLES

FIGURES

TABLES

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Esden, J. "Hemlock Woolly Adelgid Survey." Falls Area Community TV, Bellows Falls, Vermont. Television 4 Feb. 2014.

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WEATHER AND PHENOLOGY

Weather Summary 2014

Winter 2013-3014

The first snowstorm of the season dumped over a foot of fluffy powder across much of the state on December 15. Southern and eastern counties received from 8 to 18 inches. Northwestern, northern mountains and most of Essex County received 2 to 8 inches. Both alpine and Nordic ski enthusiasts across the east enjoyed the powder, and the newly fallen snow arrived just in time for VAST trails opening on December 16. Snowmobilers were happy too!

Frigid temperatures overnight on December 17 kept the snow in place at least for a short time. Eastern Vermont had the coldest temperatures of the season so far, with lows in the -30's in the Northeast Kingdom and negative teens and 20's for most of the rest of the eastern side of the state. The Champlain Valley and Windham County had temps in the single digits above zero.

2013 ended with an ice storm that damaged trees and powerlines, and left residents of Franklin and Orleans counties in the dark during the Christmas holiday. Rain started early on Saturday, December 21 in the Adirondacks and slowly spread east. Temperatures well below freezing were in place down the Champlain Valley from the Adirondacks to the Green Mountains and along the northern border towns. Rain lingered throughout the day on Saturday and Sunday the 22nd before finally changing over to snow by early Monday the 23th. Ice accumulations in the hardest hit areas of Franklin and Orleans counties, the northwestern slopes of the Green Mountains and the northern Champlain valley were from ½" in Berkshire, Barton and Lincoln to ¾" in Bakersfield, Cambridge and Milton to 1" in Jeffersonville.

Trees were damaged in the hardest hit areas and downed powerlines left 22,000 people without power at the height of the storm. Many had to wait several days before power was restored. Frigid temperatures following the storm and on Christmas eve and Christmas day kept the ice in place in the coldest spots. Where ice accumulations were not as severe, temperatures rose back above freezing by late Sunday morning through the day and night and the following Monday allowing for ice melt and resulted in little to no damage to trees.

In the week following the ice storm, below freezing temperatures kept the ice in place. Wind and additional snow resulted in many more power outages and continued damage to trees. Vermont Electric Coop (VEC) and Green Mountain Power (GMP) called in line crews from out-of-state to help restore power. As soon as power was brought back in one location, another tree broke on a line and more outages occurred. As of December 28, VEC had restored 46,000 outages since the ice storm began. It was a challenging week for line crews who worked through the Christmas holiday in icy and cold weather conditions.

Temperatures did warm above freezing to the upper 30's and low 40's across the area on December 29 through early morning on December 30 allowing for some ice melting. The Essex RAWS transmitted sporadic observations due to icing from December 22, 2013 to December 24 and no observations from December 25 – 27. On December 28, 100% of observations were transmitted when temperatures warmed above freezing.

In his annual end of year message to staff, Steve Sinclair stated… "I also want to publicly recognize the following employees who went to the aid of fellow Vermonters affected by the recent ice storm. Lars Lund, Chris Stone, Dave Wilcox, Dan Singleton, Bill Baron, Gary Sawyer, Tom Simmons, and Dick Greenwood worked on Christmas Eve with the Town of Enosburg to open up roads for utility companies

to restore power. Many of these employees didn't get home until the early evening. It is that level of selflessness that makes the Division what it is!"

More information about tree damage from winter storms is under Diebacks, Declines, and Environmental Diseases.

The first part of the winter of 2013-2014 was a wild roller coaster ride with temperature swings from frigid to warm and back again, snow, rain and ice with ice jam flooding and an occasional glimpse of the sun. Snowstorms came and brought substantial snow leaving snow lovers ecstatic, only to have it erased a week later when temperatures warmed and rain melted the snow leaving ice and standing water in its place. Temperature fluctuations occurred in mere days from a frigid -30 in Island Pond on January 4 to a balmy 51^0 just up the road at the Nulhegan RAWS on January 11.

January 3, 2014 brought a substantial snowstorm to much of the state especially southern Vermont. Snow totals ranged from 1 to 4 inches in the north, 6 to 8 inches in central Vermont and 8 to 17 inches in Bennington and Windham counties. Following the snowstorm, temperatures bottomed out again with morning lows on January 4th of -30 in Island Pond and negative 20's in colder pockets to negative teens into southern Vermont. The next day, temperatures warmed and rain started overnight freezing on contact with the frigid ground. By the morning commute on Monday, January 6 roads were glazed in many locations especially secondary and back roads causing lots of school closures. Temperatures warmed through the day into the mid to upper 30's and even into the 40's and 50's in the Champlain valley before a flash freeze by the evening commute. A frigid day followed with highs in the single digits and a blustery wind keeping the wind chill deep in the negative numbers.

Following the Arctic blast, a warm up began with daytime highs in the teens and 20's and lows above 0 in the single numbers and teens. On January 11, rain began with temperatures near freezing, glazing roadways once again, and causing accidents, road closures, and lots of icy surfaces. As the day progressed, temps rose through the 30's into the upper 40's and even low 50's. The Nulhegan RAWS had a maximum temperature on January 11th of 51^0 (Readings from the rest of Vermont's RAWS: Essex – 53^0; Elmore – 47^0; Danby – 56^0; Woodford – 52^0).

Rainfall amounts from .5" to over 2" fell across the state with highest amounts in southern counties (RAWS total rain amount from storm on January 11-12: Nulhegan - .99"; Elmore - .68"; Essex - .87"; Danby – 1.72"; Woodford – 1.59"). With all the rain came melting snow, causing ice jam flooding in various locations around the state, closing some roads completely for a time, or reducing roadways to one lane. Field flooding was common.

This series of icing events had another consequence… an increase in fractures and even some head injuries from people falling on the ice.

The deep freeze in the Northeast was mild compared to the Artic outbreak in the Midwest and southern U.S. The coldest temperatures recorded in the past 20 years plunged thermometers to negative 30 in the northern sections with wind chills in the -60's and -70's and late morning temperatures in the single digits as far south as Georgia, teens as far south as Mississippi and Alabama and 20's on the Gulf Coast and into northern Florida.

The term "polar vortex" was used repeatedly during this stretch of days in early January responsible for the country's deep freeze. Polar vortex is a circulating pattern of cold, strong winds flowing around a low-pressure system, which normally sits over the Arctic during winter. The effect of such a vortex is to keep the cold air circulating within the polar region. However, when the vortex breaks down or becomes distorted, it can send very cold air further south. (link to "The Polar Vortex explained in 2 minutes")

On February 5, Vermont and much of the eastern U.S. were hit with more snow. This widespread storm stretched from Maine back through the Ohio valley. Snowfall totals ranged from 6 to 14 inches statewide with southern Vermont hardest hit.

Another widespread storm left havoc in its wake from South Carolina to Maine on Valentine's Day. Vermont received from 8 to 24 inches of snow. Both these storms caused the usual headaches of bad roads, accidents and school closures, but for the most part, Vermonters took them in stride.

Rain overnight and through the day on Friday, February 21st caused some problems with icing, especially on back roads, and some pockets of freezing rain early in the day. The rain was absorbed by the heavy snowpack, so run off and ice jam flooding was not an issue this time. By the end of the weekend, a return to single digit lows, and highs in the teens, remained in place for the upcoming week.

And then came March…March 2014 was COLD. Multiple cold temperature records were set, including the coldest March on record for Montpelier, Mt. Mansfield and Rutland and the 2nd coldest for St. Johnsbury. Numerous records were also set for the coldest the minimum temperature and coldest maximum temperature.

In addition to below normal temperatures, a parade of clipper systems dropped a fresh inch or two of snow on a regular basis and a late season snowstorm started on the afternoon of March 12. Southern Bennington and Windham counties saw 6" or less but up to 2 feet fell in northern areas. The snow started out heavy and wet but became lighter and drier as the storm progressed into the following morning. Blustery winds and near blizzard conditions caused drifting and white outs. Travel was difficult and over 500 schools closed for the day on March 13th after an early departure the day before. Ski areas and snow machine riders once again rejoiced while everyone else shoveled and dug out silently wishing spring could arrive on March 20th as the calendar suggested.

By the end of March, 8 to 12 inches of snow was on the ground in the valleys, 3 feet plus in the higher elevations and over 6' in the mountains.

Sugarmakers were tapped and ready for a break in the weather pattern. With April just around the corner, they still had not had a run and were beginning to wonder if the season would end before it got started. Heating fuels were still in demand, woodpiles were dwindling and wood pellets were scarce. Potholes were growing and frost heaves were everywhere…but on the plus side, longer days with the sun higher in the sky began a slow melting process. With the extensive snowpack in place, the potential for flooding from rapid snow melt was high.

Spring, 2014

Snow melted slowly during the beginning of the month. Sugarmakers were finally able to bring in the gold…that new batch of maple syrup. After a slow start, sap finally began to flow and syrup producers were back in business. Overnight temps below freezing, and warming during the day, kept the sugaring season on track for the short but sweet season. Sugarmakers pulled the plug by mid-month.

A storm on April 15 left ½ to 1 ½ inches of rain across the state. Snowmelt accelerated and rivers rose. Roads were closed due to high water; field flooding was common. Lake Champlain went above flood stage. A drying trend began after the mid-month rain, and less than a week later, as dead grasses and leaves dried out, fire danger rose and fires were reported all over the state. On April 24th a red flag warning for high winds, low relative humidity and dry fuels was issued for Bennington, Windham, Orange, Windsor, Western Rutland, Western Addison counties.

Cool, damp weather ended the month. The only remaining snow was at the highest elevations and left over snow banks here and there. Some greening of lawns and mowed fields began, lilacs budded and other signs of spring were a welcome sight after a long, cold winter.

May started out chilly and wet but ended up warmer than normal, for most of Vermont, for the first time since October 2013. Damp or rainy days were frequent. A localized severe storm moved through central Vermont on the afternoon of May 27. Tornado warnings were issued but none were confirmed. The storm did produce damaging winds up to 75 mph in Bridport that toppled trees. Penny and golf ball sized hail was reported in several locations in Addison and Rutland counties and torrential rain left standing water in places along Route 7. (NWS in Burlington posted a detailed report on this event at http://www.weather.gov/media/btv/events/2014-05-27/Isolated_Supercell.pdf)

Leaves were slow to expand but by month's end, most species except for ash had completely developed. Lush full crowns of maples were a common sight except where hail damaged caused extensive defoliation in Rutland County.

Summer, 2014

For much of Vermont, the summer of 2014 was quite pleasant. June was pretty average, July somewhat stormy and August somewhere in the middle. There were no extended periods of oppressive heat, plenty of sunny, dry days and pleasant nights but enough rain to keep things growing and green. Most tree species in much of the state kept their foliage intact with little damage from weather or insects and disease. Stormy events were short-lived, developed quickly, got briefly intense, then disappeared, only to be replaced by new storms.

June weather averaged nearly normal across most of Vermont with temperatures and rainfall just above or just below normal. The exceptions were in northwestern Vermont where temperatures and rainfall were above normal and in southeast Vermont where rainfall was above normal. A significant rain event occurred on June 25-26 across the state. Rainfall amounts from 3/4" to over 2" were reported with the highest amounts in the northwest and southern counties.

While June was nearly average, July was quite the opposite. A series of stormy events began with a second round of significant hail damage in Rutland County on July 3. Major defoliation was noted in areas hit by hail. Following the May 27th storm, the Cold River Road near Rutland was covered by three inches of green leaves leaving the foliage of hail-damaged trees looking very light. By the second hailstorm, some trees were already refoliating from the previous barrage. To have this happen twice in one location is unusual.

On July 8, a long swath of severe thunderstorms with damaging winds brought down trees and powerlines leaving 30,000 people in northern Vermont without power during the height of the storm. Winds were estimated between 60 and 80 mph across many locations in Vermont, including the greater Burlington area. On July 9, additional severe storms brought down trees and produced heavy rain from Middlebury to Montpelier, Plainfield and Cabot. (NWS in Burlington posted a detailed report on these events at http://www.weather.gov/media/btv/events/2014-07-08/Damaging_Wind.pdf)

Thunderstorms also developed early in the day on July 23, spreading northwest to southeast. Damage was reported in Washington, Berlin, Woodbury, Stowe, Berkshire, and Eden and in Rutland and Windsor counties.

Severe weather occurred once again during the afternoon and evening of July 27. Frequent lightning and high winds brought down trees and powerlines in scattered locations including Charlotte, Peacham,

Danville, Walden, Cabot, and St. Johnsbury. Hail damage was reported as well. Pea sized to golf ball sized hail was reported in South Burlington, Williston, Milton, Westford, North Ferrisburgh, Pittsford, Mendon and Andover. A tennis ball sized hailstone, 2.5 inches in diameter, took the prize in Charlotte.

To top off the month, torrential rain fell across most the state from late on July 27 through July 28. A nearly stationary thunderstorm caused isolated flash flooding in southern Windsor County on July 28 during the afternoon. Hardest hit areas of Chester and Andover had over 4" of rain in a short period of time.

On August 5, localized storms with hail were reported in Fair Haven and West Haven, trees came down in Fair Haven, Middletown Springs and Poultney, and there was heavy rain in Bennington on that date. Further north, Huntington had an inch of rain in ½ hour and an additional 1.31 inches during the rest of the night.

From August 8-13, a stretch of mild, dry, perfect summer weather came to an end with moderate to heavy rains across the state. Windham and Windsor Counties were hardest hit with reports from 1 to nearly 3" of rain. Cooler, below-normal temperatures followed on August 14-17. From August 19-26, conditions in northern Vermont remained dry, while the southern four counties, along with Orange County, were wetter.

Statewide, August precipitation was below normal by 3" for all except Windham and most of Orleans Counties. Temperatures were below normal from 1 to 4 degrees.

Fall, 2014

September featured many sunny days and very little rain. Seven times during the month, temperatures in Burlington got into the 80s, and a record high of 83 was set on September 28. While the month started and ended on a warm note, overall it averaged about normal, with northern Vermont just below and southern Vermont and the Champlain Valley just above normal. Precipitation was about 3" below normal statewide for the month and about 4" below normal since August 1.

The ideal growing conditions and health of the canopy through the summer and especially during September set the stage for the most spectacular fall foliage season in recent memory, if ever. An early season widespread frost on September 19th tied the 1959 record in Burlington when the temperature dipped to 32^{0}. This was the first time in 14 years Burlington had a freeze in September, and it was the earliest fall frost in at least twenty years. St. Johnsbury also tied their low record on that date with 29^{0}.

This first frost was followed by cool nights and warm, sunny days during September, the perfect recipe for gorgeous foliage. Reds were especially vibrant this year and even species that don't normally turn any shade of red, like poplar and birch, had an orangey tint.

October was warm, the 5th warmest on record in Burlington, 5.4 degrees above normal. The average temperature on October 15th was 74^{0} with a high of 80 and low of 68, tying the record. A 68^{0} low is warmer than the normal low for July and is quite rare! St. Johnsbury stayed above 60^{0} that day as well. Montpelier, St. Johnsbury, and Springfield all averaged 3^{0} warmer for the month.

October was also wetter than normal by about an inch for much of the state. Since we were quite dry though, the rain was welcome and the sun was plentiful. Winds were mostly light extending the beautiful foliage season well into October.

A powerful Nor'easter caused havoc to the eastern U.S. on November 2 when areas of the Carolinas received nearly 2' of snow, the earliest on record and early than Burlington, Vermont. Northern Maine was also hit hard by this storm again much earlier than normal. Had the storm tracked further west, Vermont would have measured snow in feet.

We were not so lucky when another potent storm the day before Thanksgiving brought heavy wet snow to much of Vermont during the busiest travel day of the year. Southern, central and northeastern Vermont received from 8 to 16 inches. Northwestern Vermont saw less than 6". The snow caused travel and power issues especially in southern Vermont that lingered into Thanksgiving Day. In New Hampshire, 200,000 customers lost power, the 4th greatest power outage in state history. (NWS in Burlington posted a detailed report on these events at http://www.weather.gov/media/btv/events/2014-11-26/2014-11-26_SnowStorm.pdf .)

Winter Storm December 9 to 11, 2014

A well-publicized Nor'easter arrived in Vermont on schedule during the day on Tuesday December 9. This slow moving storm brought snow, sleet, freezing rain and rain to the region and caused trouble during the afternoon commute and overnight with slippery roads, downed trees laden with heavy wet snow and extensive power-outages. Snow totals on the morning of December 10 varied with the heaviest amounts in the towns on both sides of the Greens receiving between 1' to over 1 ½'. Lesser amounts but still substantial were recorded in the higher elevations east of the Greens and points to the west with between 5 and 12". Mostly rain fell in the Connecticut River valley and eastern parts of the NEK with little snow accumulation.

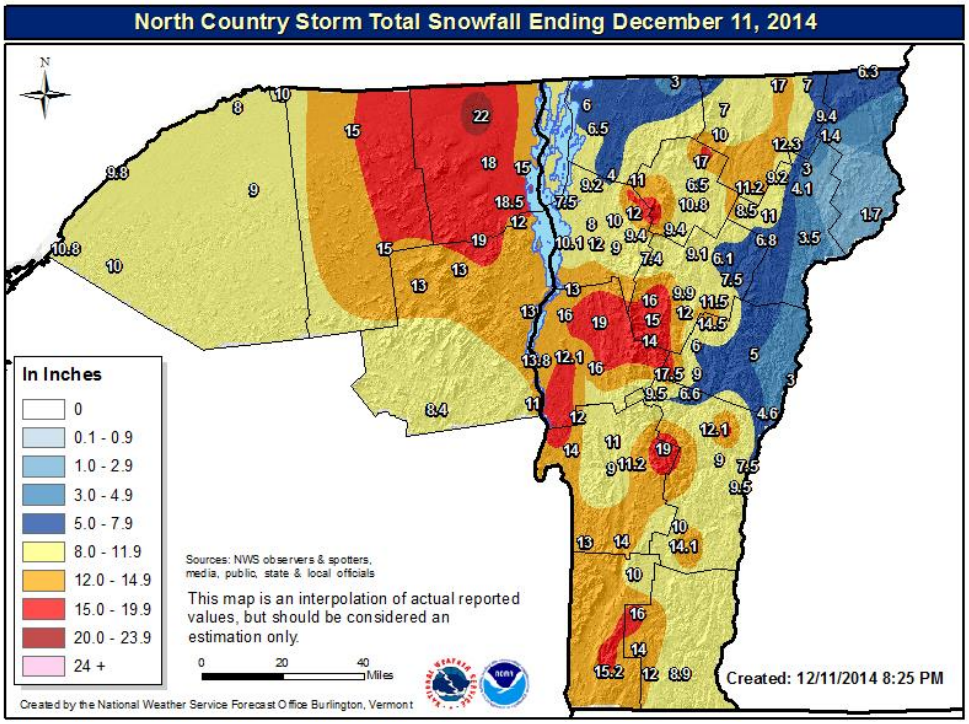


Figure 1. Total snowfall map from storm ending December 11, 2014.

During the day on December 10, Wednesday, light mixed precipitation fell in most areas and by the evening commute another batch of heavy wet snow blanketed parts of Vermont. Hardest hit areas during round 2 were again the higher elevations and locations west of the Greens including Grand Isle County. Additional amounts varied from a dusting to 5 plus inches. Sleet, freezing rain and rain fell elsewhere.

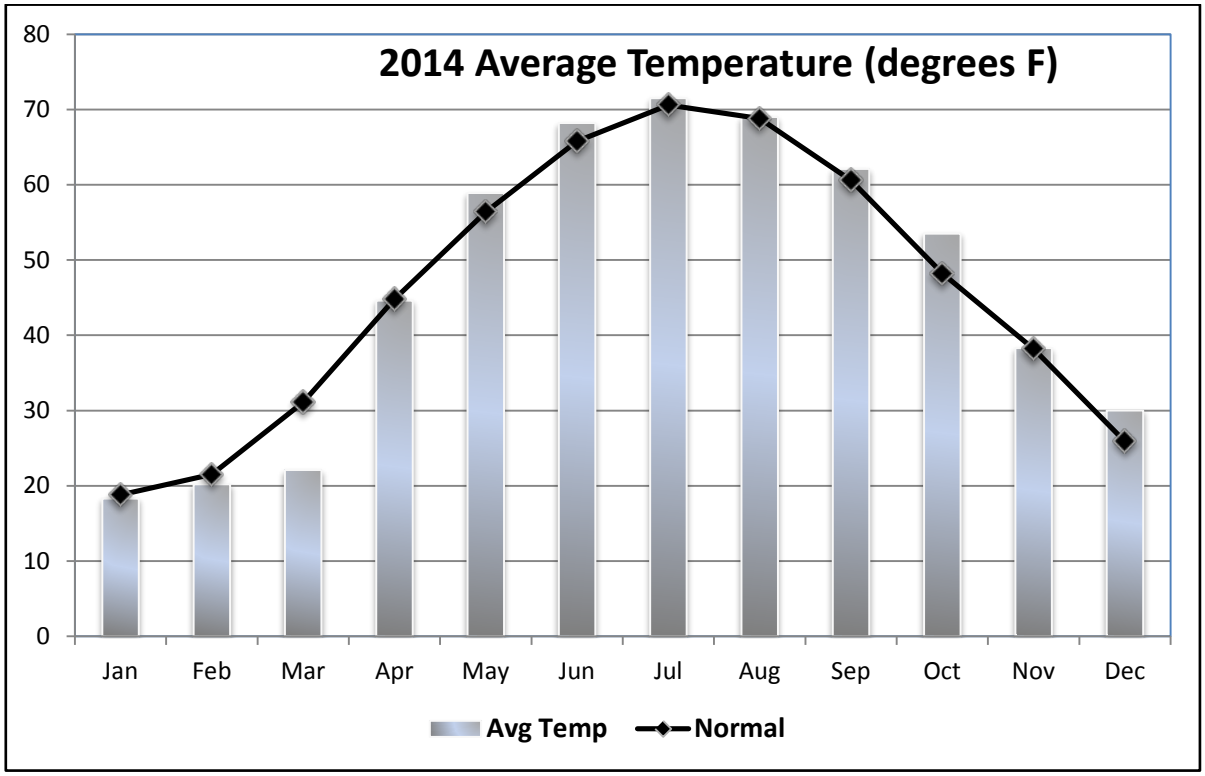
Travel was difficult with varying road conditions and hundreds of accidents bringing traffic to a standstill especially on the interstates and during the afternoon commute in Burlington on Wednesday afternoon. Some schools remained closed for 3 straight due to travel conditions and power outages.

Trees and power lines snapped under the weight of the snow leaving thousands without power. Green Mountain Power and Vermont Electric Cooperative had the most power outages reported, with up to 34,000 initially, but every county in the state had customers in the dark. Restoring power was difficult due to the second wave of the storm which brought trees down on lines that had been previously repaired. Snow and ice remained on lines and trees throughout the following week. As the snow unloaded, power was lost. Restoration efforts lasted well over a week and overall over 170,000(?) power customers have had outages. This storm has been the most costly on record for Vermont power companies, more than Hurricane Irene or the Ice Storm of 1998.

On Saturday, December 13, the Vermont Department of Emergency Management and Homeland Security called with a request for FPR to assist tree cutting crews from Green Mountain Power following power outages from this storm. Protection Forester Dan Dillner, State Lands Forester Mike Johnson, and Chittenden County Forester Keith Thompson responded to the request. Work was done clearing remote power lines in Starksboro. They utilized FPR2, the Northern Fire Response Vehicle, for this detail. This vehicle with tools, equipment, communications and GIS proved invaluable.

An assessment of tree damage has not yet been done but will likely be extensive.

Figures 2-16 and Tables 1-2 *provide details on 2014 temperatures, precipitation and phenological observations.*



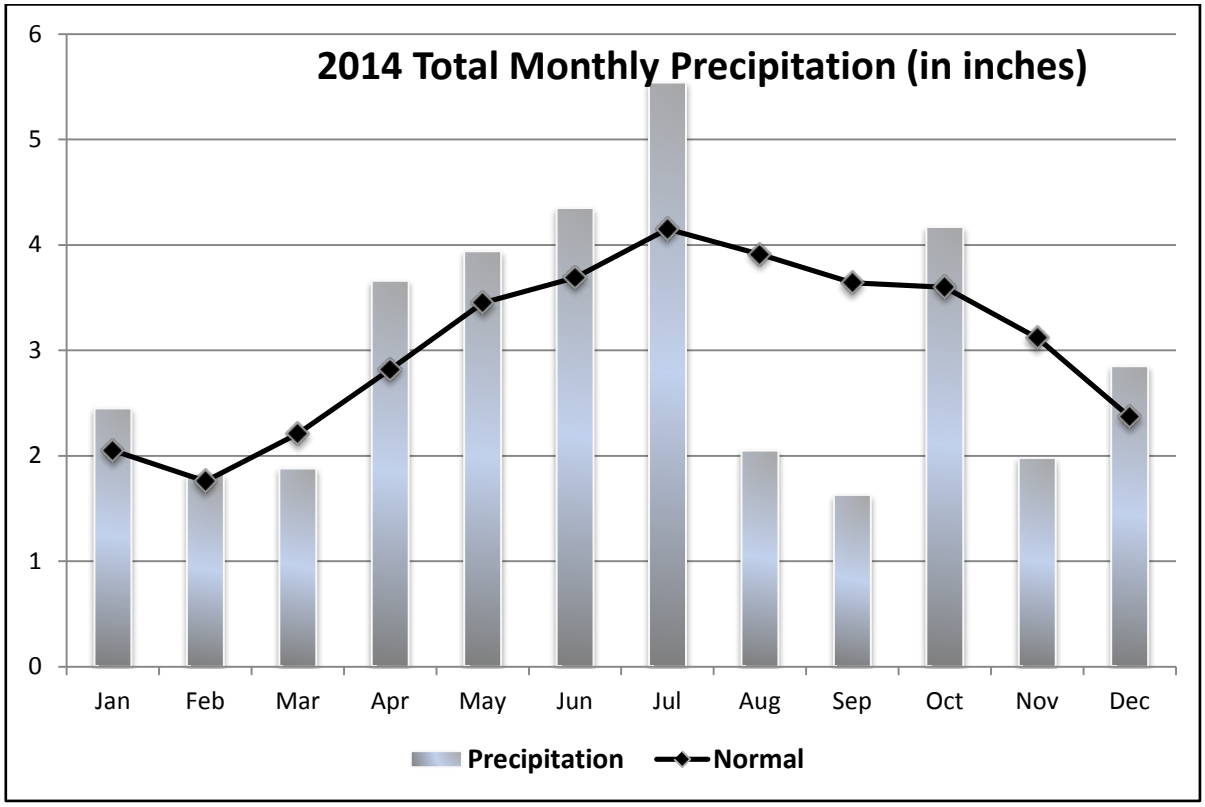


Figure 2. Monthly average temperature and total monthly precipitation in 2014, compared to normal for Burlington, Vermont. (Normals are for years 1981-2010.) *Source: National Weather Service, Burlington.*

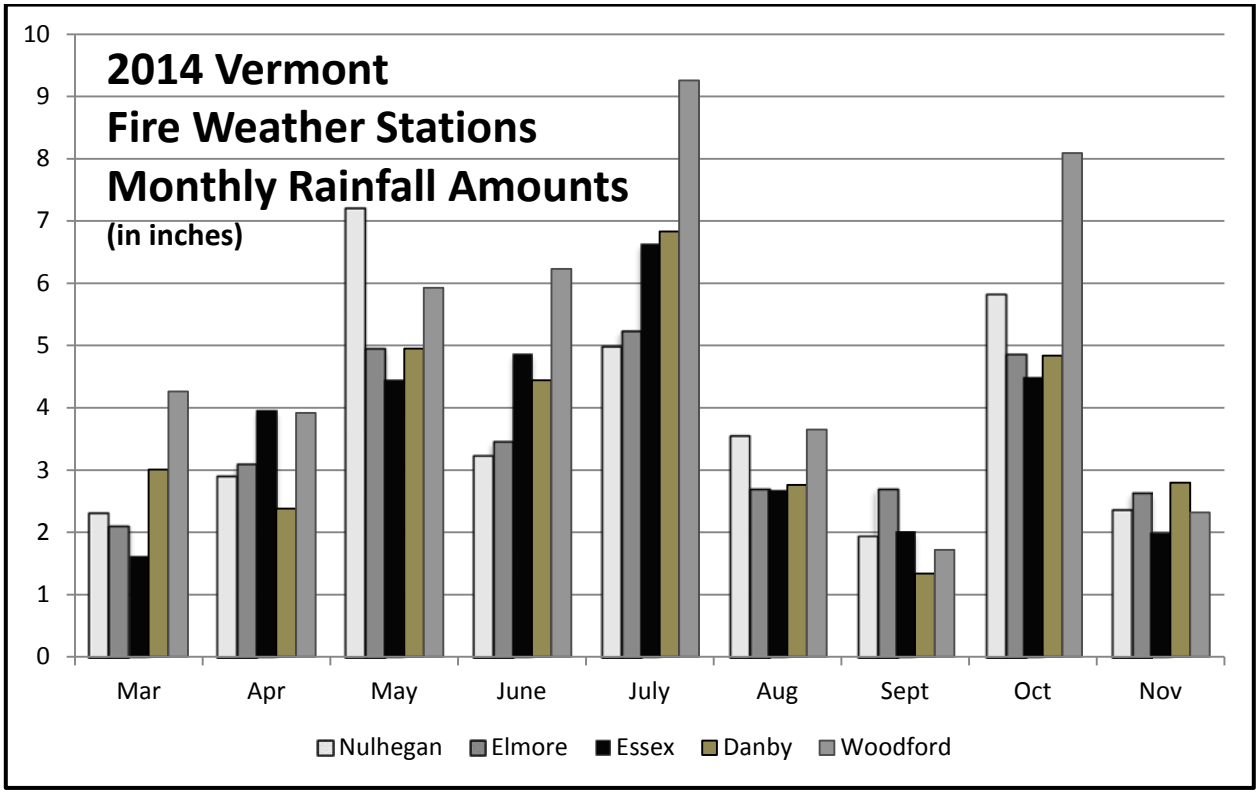


Figure 3. Monthly rainfall amounts (in inches) at Vermont fire weather observation stations through fire season, March-November, 2014.

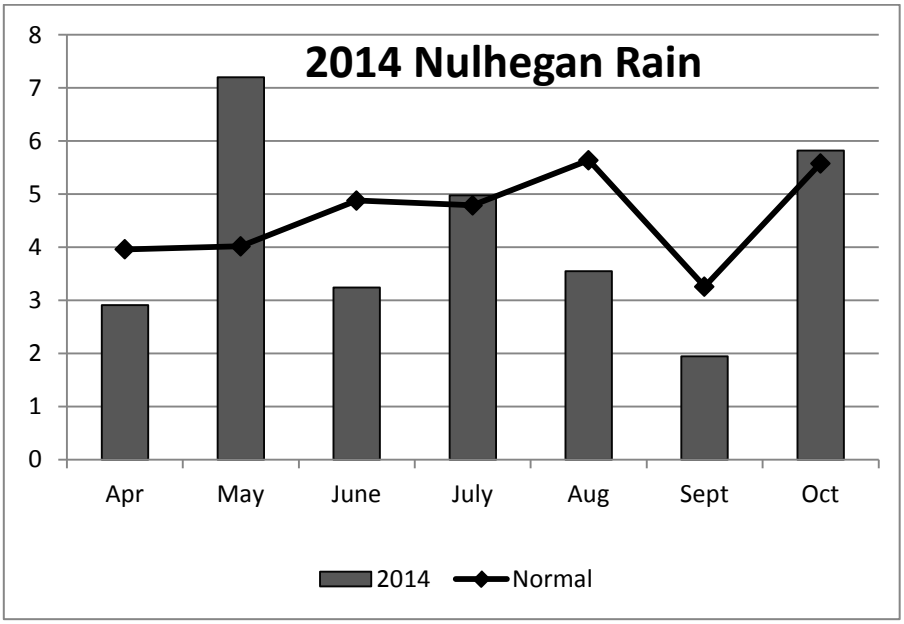


Figure 4. Monthly rainfall amounts (in inches) at the Nulhegan fire weather observation station in Brunswick, Vermont compared to normal through fire season, April-October, 2014. Normal is based on 12 years of data.

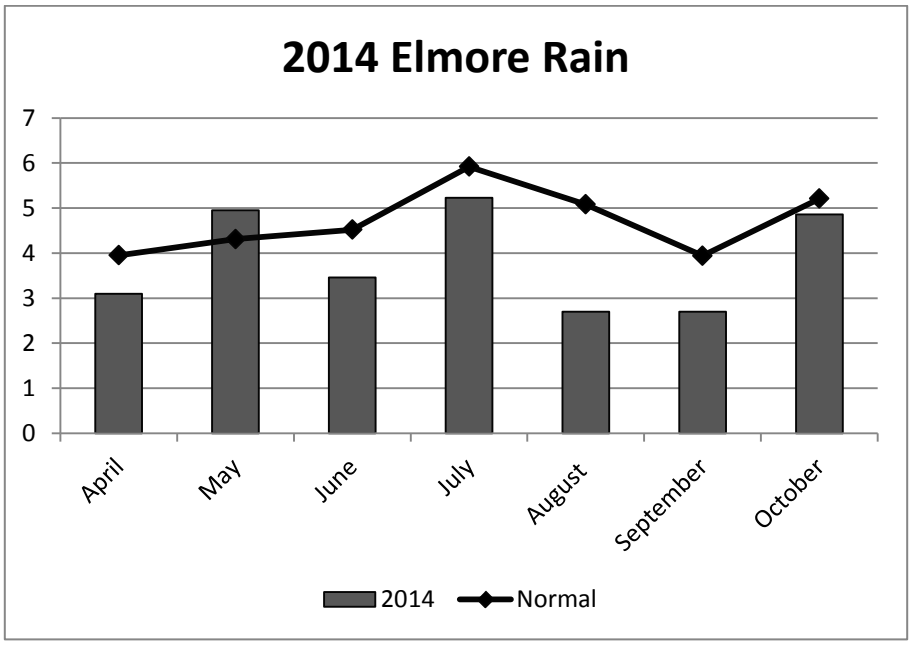


Figure 5. Monthly rainfall amounts (in inches) at the fire weather observation station in Elmore, Vermont compared to normal through fire season, April-October, 2014. Normal is based on 20 years of data.

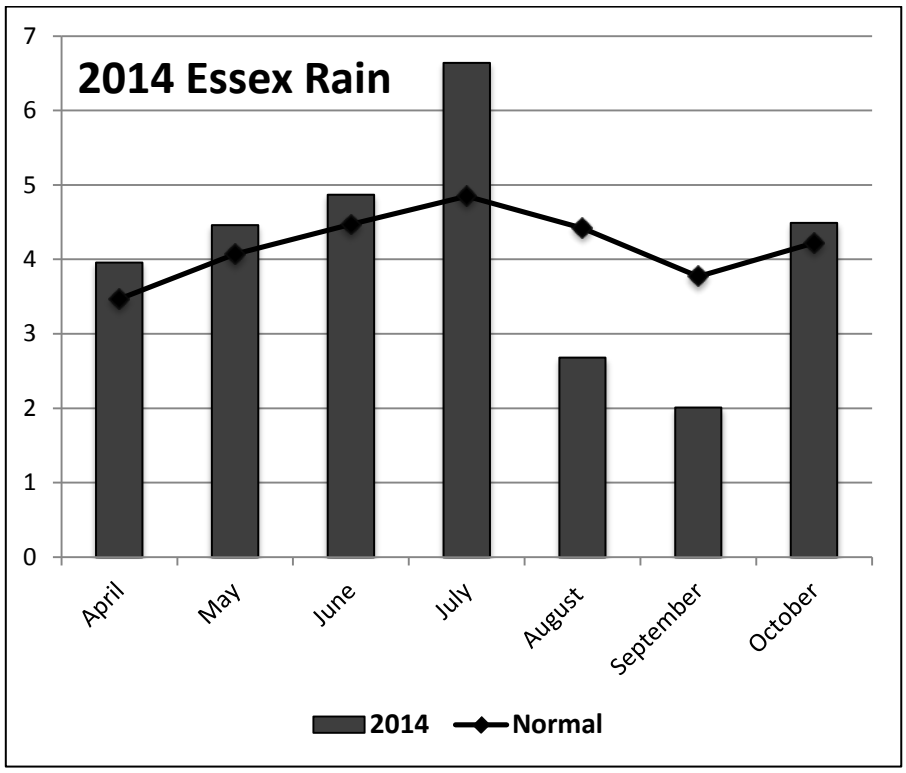


Figure 6. Monthly rainfall amounts (in inches) at the fire weather observation station in Essex, Vermont compared to normal through fire season, April-October, 2014. Normal is based on 21 years of data.

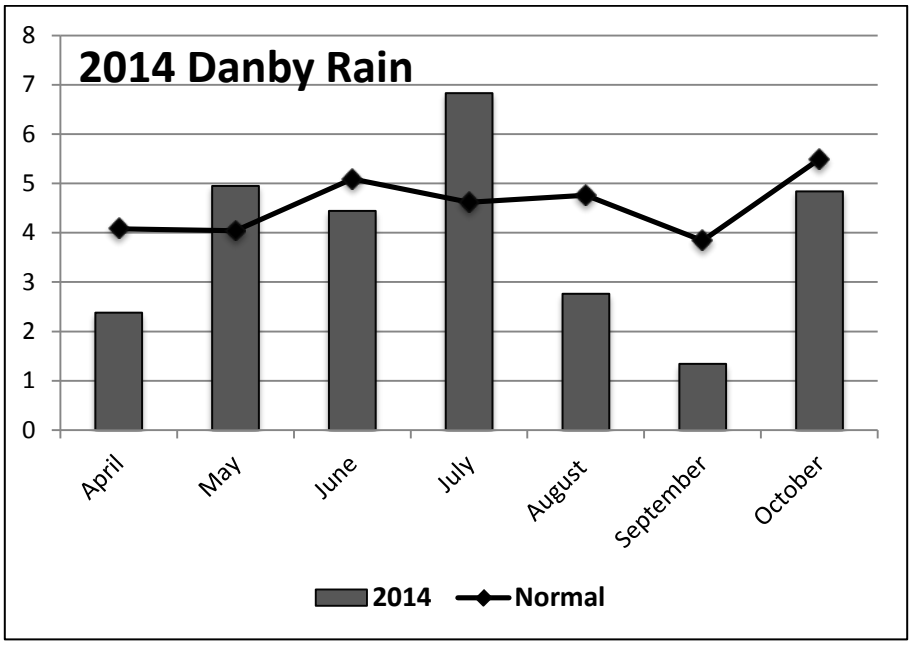


Figure 7. Monthly rainfall amounts (in inches) at the fire weather observation station in Danby, Vermont compared to normal through fire season, April-October, 2014. Normal is based on 17 years of data.

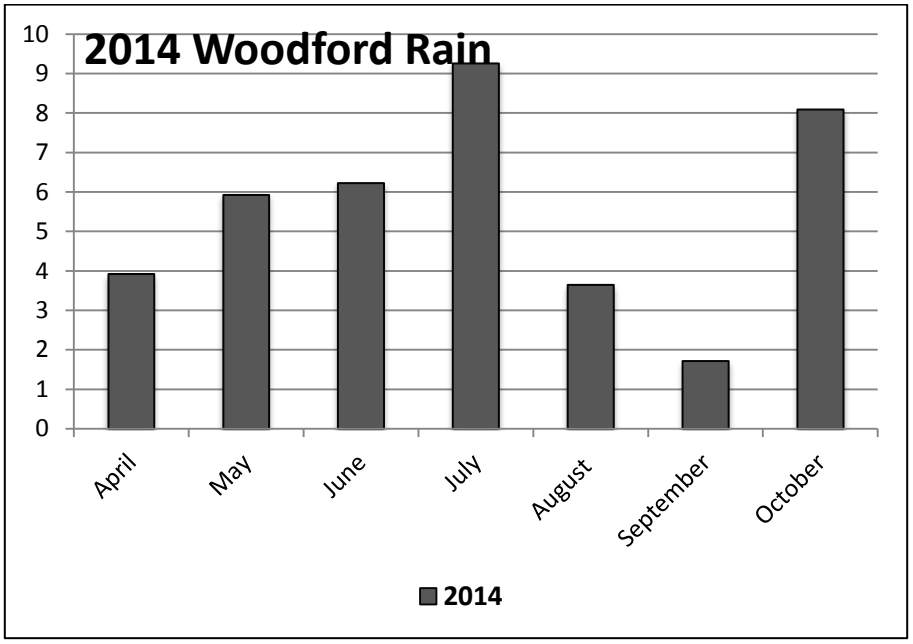


Figure 8. Monthly rainfall amounts (in inches) at the fire weather observation station in Woodford, Vermont through fire season, April-October, 2014.

Spring Budbreak and Leaf Out At Mount Mansfield

Sugar maple trees were monitored for the timing of budbreak and leaf out in the spring at the Proctor Maple Research Center in Underhill as part of the Vermont Monitoring Cooperative. Sugar maple leaf bud expansion was slower than normal in 2014. Budbreak on May 2nd was nearly 8 days later than the long-term average, and full leaf-out was 2 days later than the long-term average (Figures 7 & 8).

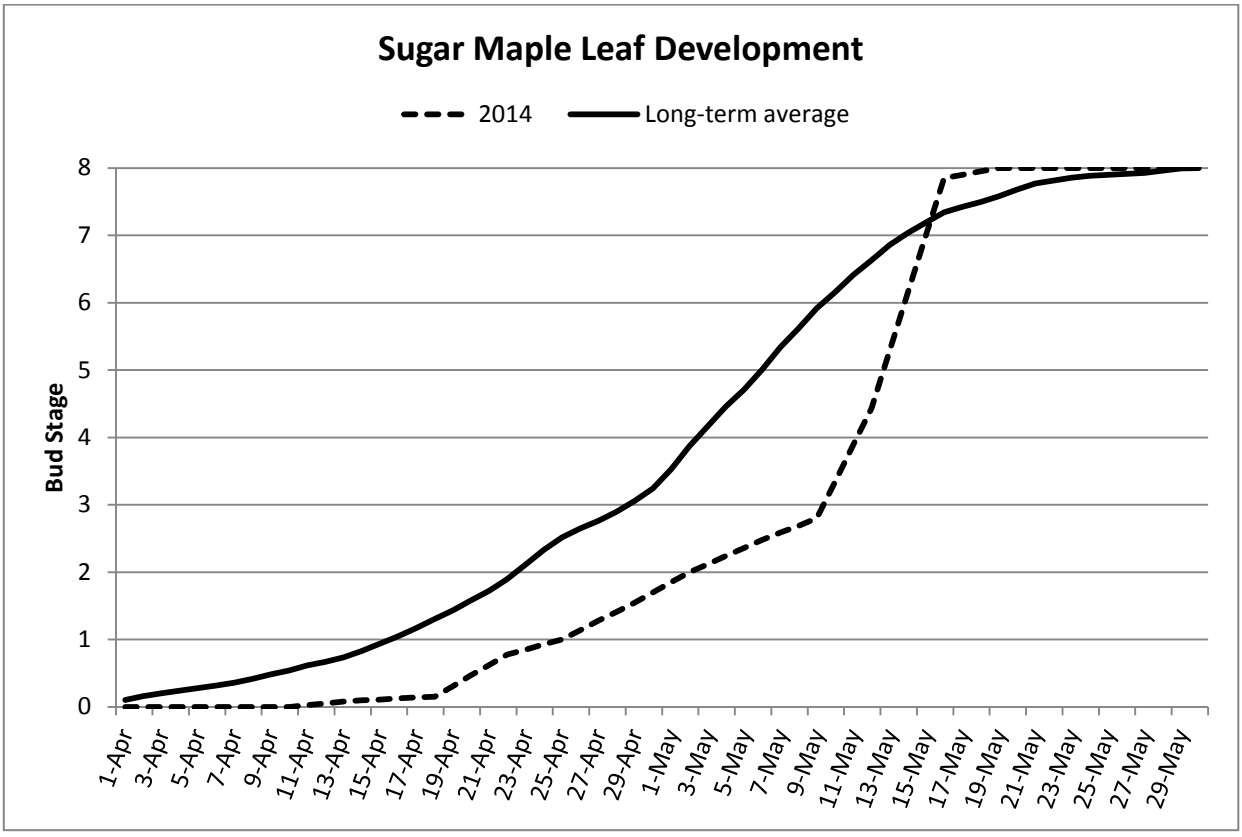


Figure 9. Timing of sugar maple bud development on trees compared to the long term average (23 years) at the Proctor Maple Research Center in Underhill. Buds are rated weekly using standards for vegetative and flower buds (Skinner, M. & Parker, B. L. 1994. "Field Guide for Monitoring Sugar Maple Bud Development"), where Bud Stage 4 is bud break, and Bud Stage 8 is full leaf expansion.

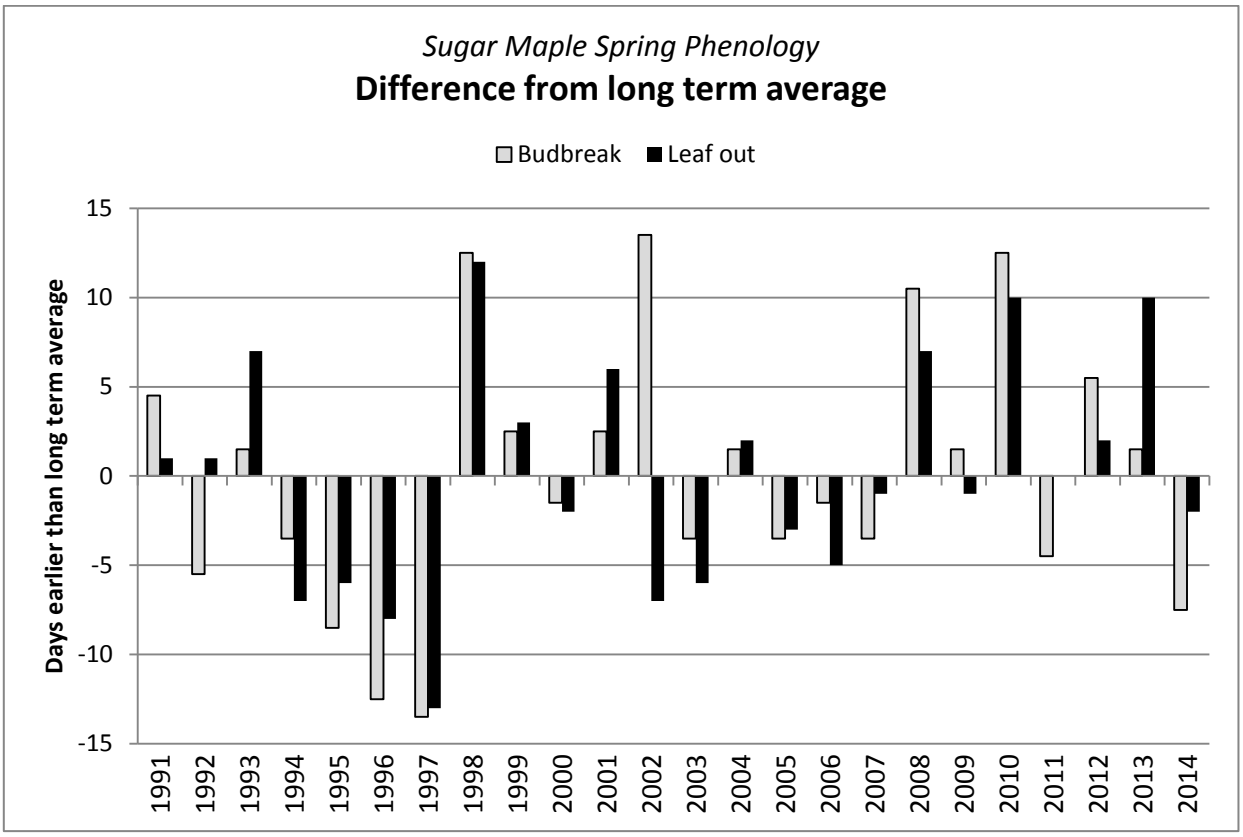


Figure 10. The timing of sugar maple budbreak and leaf out compared to the long term (23 year) average of trees monitored at the Proctor Maple Research Center in Underhill.

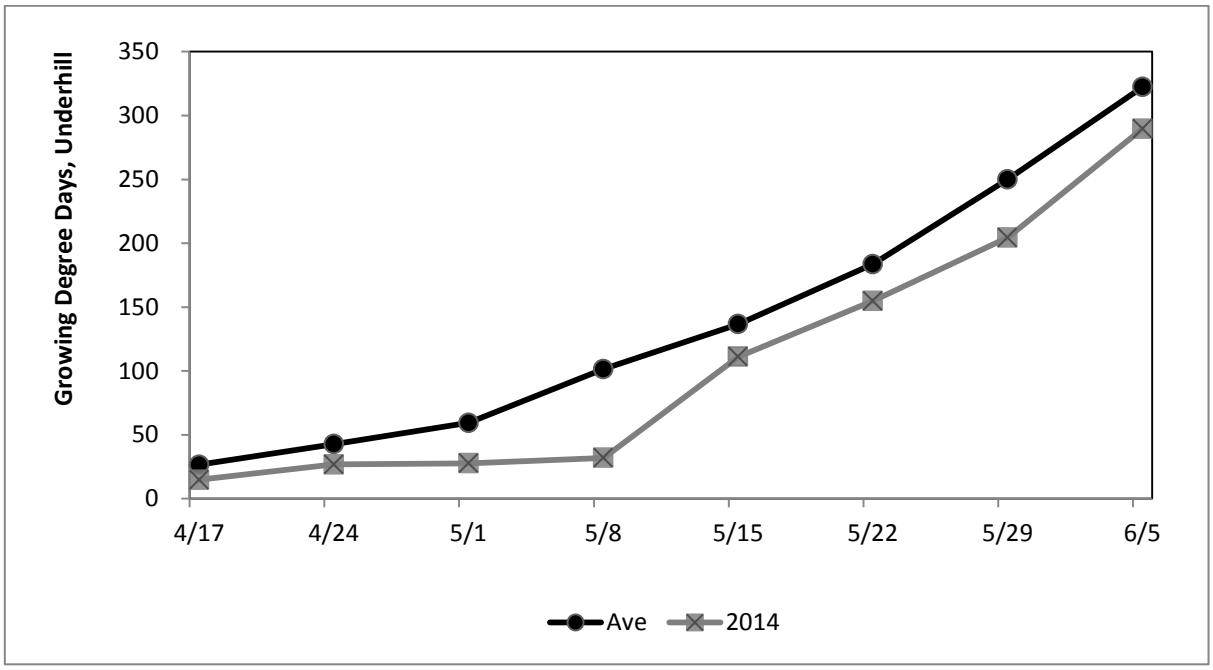


Figure 11. Weekly spring cumulative growing degree days for Underhill, Vermont, in 2014 compared to mean 1993-2014 accumulations. 50°F was used as the threshold of development.

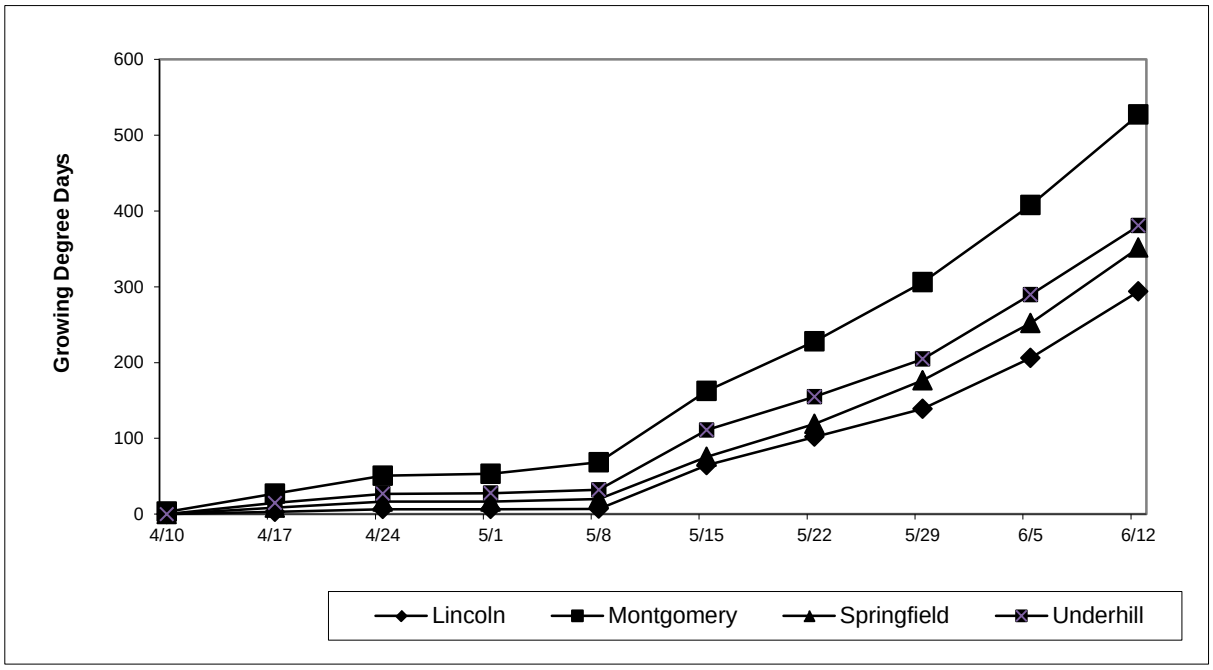


Figure 12. 2014 weekly spring cumulative growing degree days for Springfield, Underhill, Montgomery, and Lincoln, Vermont. 50°F was used as the threshold of development.

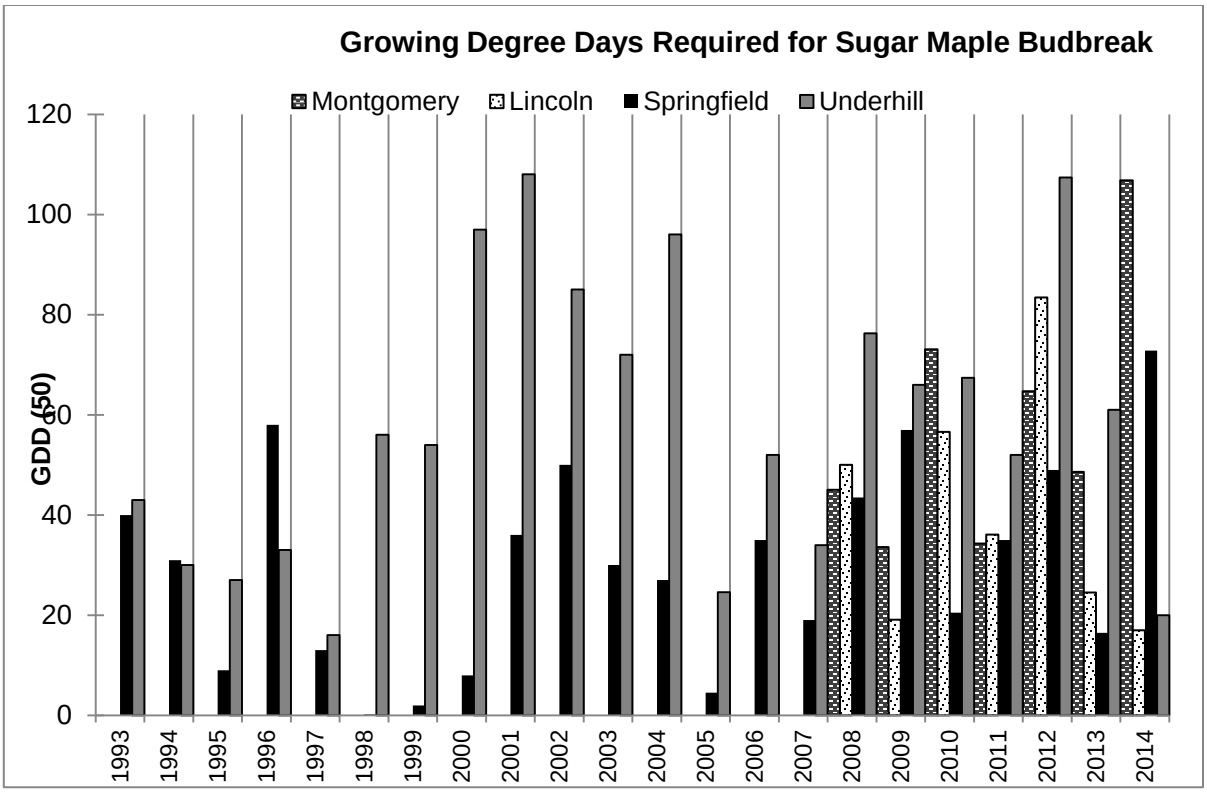


Figure 13. Growing degree days for sugar maple budbreak in Springfield and Underhill 1993-2014, and for Montgomery and Lincoln 2008-2014.

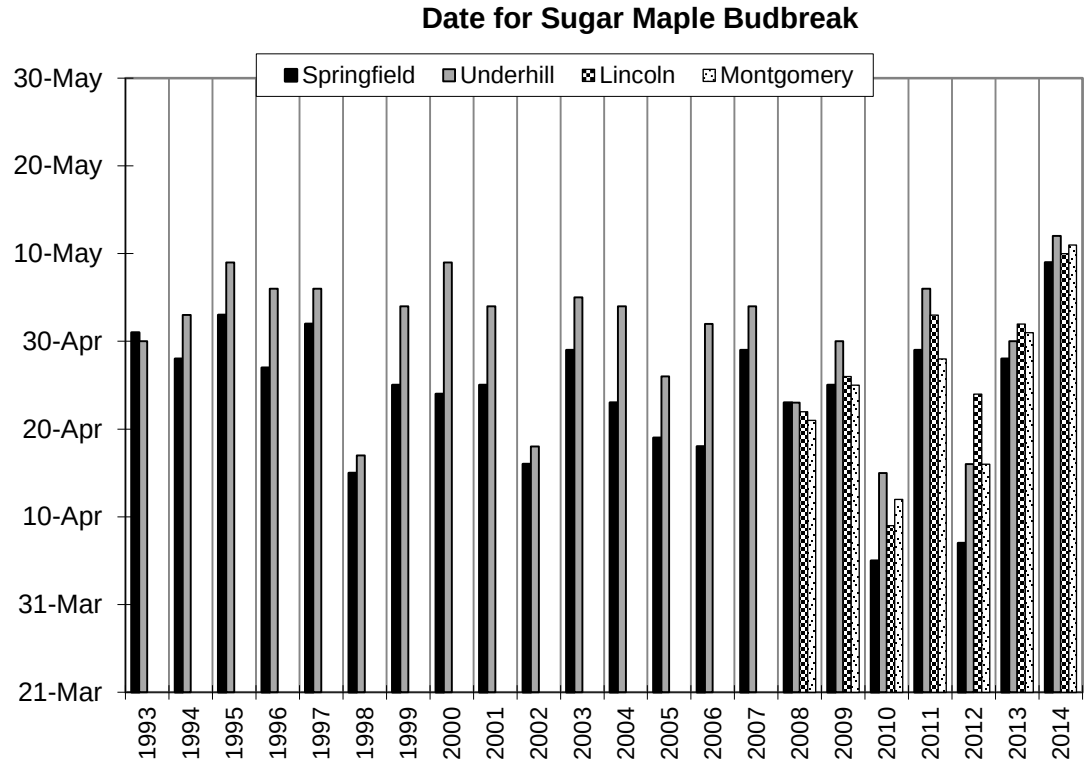


Figure 14. Dates of sugar maple budbreak in Springfield and Underhill 1993-2014 and for Montgomery and Lincoln 2008-2014.

Table 1. First observation dates of phenological development and growing degree day accumulations from 4 sites in Vermont for 2014. 50°F is used as the threshold of development.

Biological Indicator	Lincoln	Montgomery	Springfield	Underhill
PLANT DEVELOPMENT				
Showing Green				
Fir, Balsam	5/17 (90)			
Spruce, Red		6/8 (452.8)		
Budbreak				
Ash, White	5/22 (102.0)	5/18 (199.9)	5/9 (20)	5/16 (127)
Aspen, Quaking	5/8 (7.0)	5/4 (68.7)		
Cherry, Black	5/7 (7.0)	5/3 (66.1)		
Cherry, Choke		5/3 (66.1)		
Fir, Balsam	5/21 (95.5)	5/22 (228.4)		5/19 (132)
Hemlock		5/25 (259)		5/23 (160.7)
Lilac	4/2 (8)	4/28 (50.7)		
Maple, Red	5/9 (12.0)	5/18 (199.9)		
Maple, Sugar	5/10 (17.0)	5/11 (106.8)	5/5 (20)	5/12 (72.8)
Oak, Red		5/20 (203.3)	5/9 (20)	
Spruce, Red	5/9 (12.0)	6/11 (512.2)		
Flowers of Deciduous Trees and Shrubs				
Ash, White		5/18 (100.9)		
Aspen, Quaking		4/21 (31.5)	4/22 (13.5)	
Cherry, Choke		5/23 (241.5)		
Lilac (first flowers)	5/21 (95.5)	5/21 (209.9)		5/23 (160.7)
Maple, Red	4/28 (6.5)	4/23 (50.7)	4/10 (0)	4/29 (26.8)
Maple, Silver				
Maple, Sugar		5/11 (106.8)		
Shadbush	5/12 (29)			5/14 (92.7)
Wildflowers (Budbreak)				
Marsh Marigold	5/12 (29)			
Virginia Spring Beauty	4/28 (6.5)			
Wildflowers (First Flowers)				
Virginia Spring Beauty		4/30 (53.2)		4/22 (26.8)
Wild Strawberry		5/22 (228.4)		
INSECT DEVELOPMENT				
Eastern tent caterpillar (first tent)				
Pear thrips (first adults)	5/12 (29.0)			4/18 (14.8)
OTHER OBSERVATIONS				
Spring peepers calling		4/22 (43.9)		
Full green up		6/11 (512.2)	6/14 (371.5)	

Fall Color Monitoring at Mount Mansfield

Trees at 3 elevations in Underhill at the base of Mount Mansfield were monitored for the timing of fall color and leaf drop (15a-15i and 16a-16i). Sugar maple trees at the Proctor Maple Research Center (1400 feet) were slightly later than the long term median (1991-2013) for both timing of color and leaf drop. Upper elevation yellow and white birch trees showed early color and leaf drop. White ash trees at PMRC had slightly later than normal leaf drop, but observations from other locations showed early leaf drop of ash due to dry conditions.

Figure 15. Timing of fall color (Figure 15a-15i) and leaf drop (Figure 16a-16i) is monitored at three elevations on Mount Mansfield: 1400 feet at the Proctor Maple Research Center, and 2200 and 2600 feet above the Underhill State Park. Five species are monitored: sugar maple, red maple (male and female trees), white ash, white birch and yellow birch.

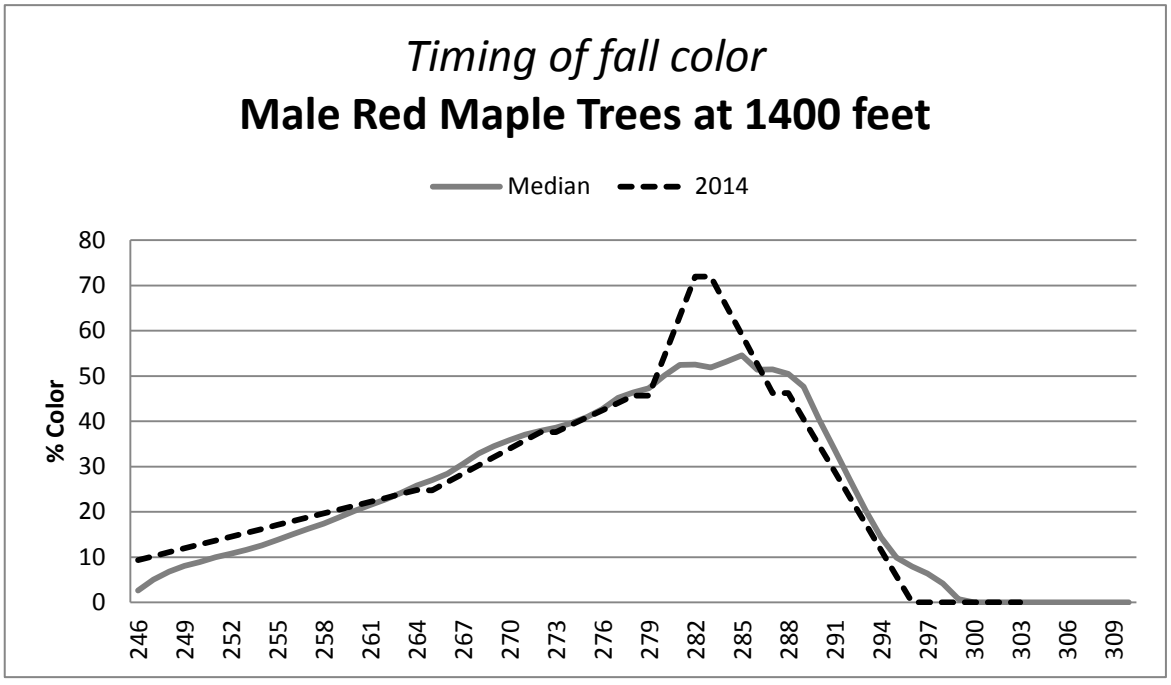


Figure 15a.

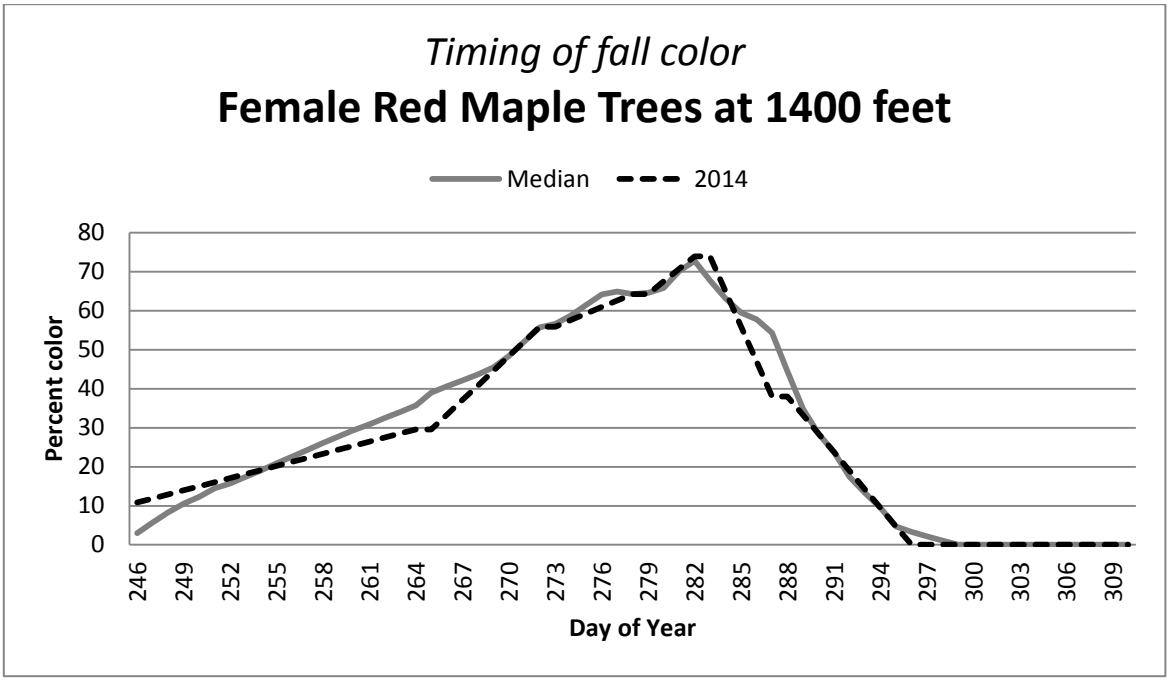


Figure 15b.

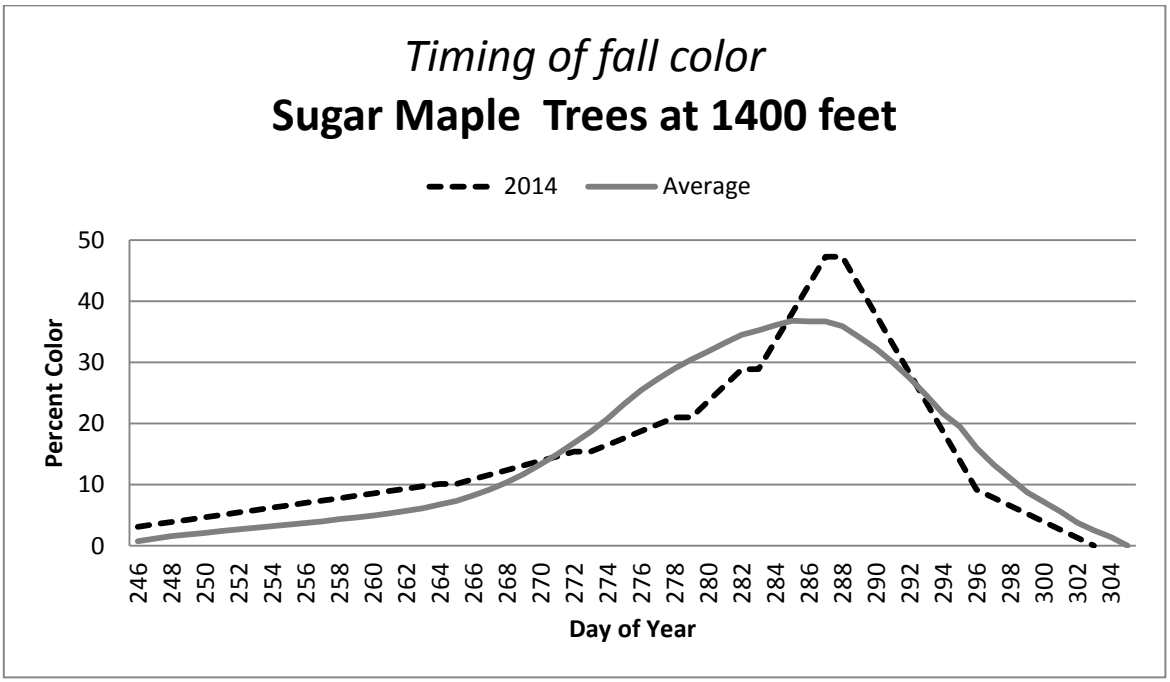


Figure 15c.

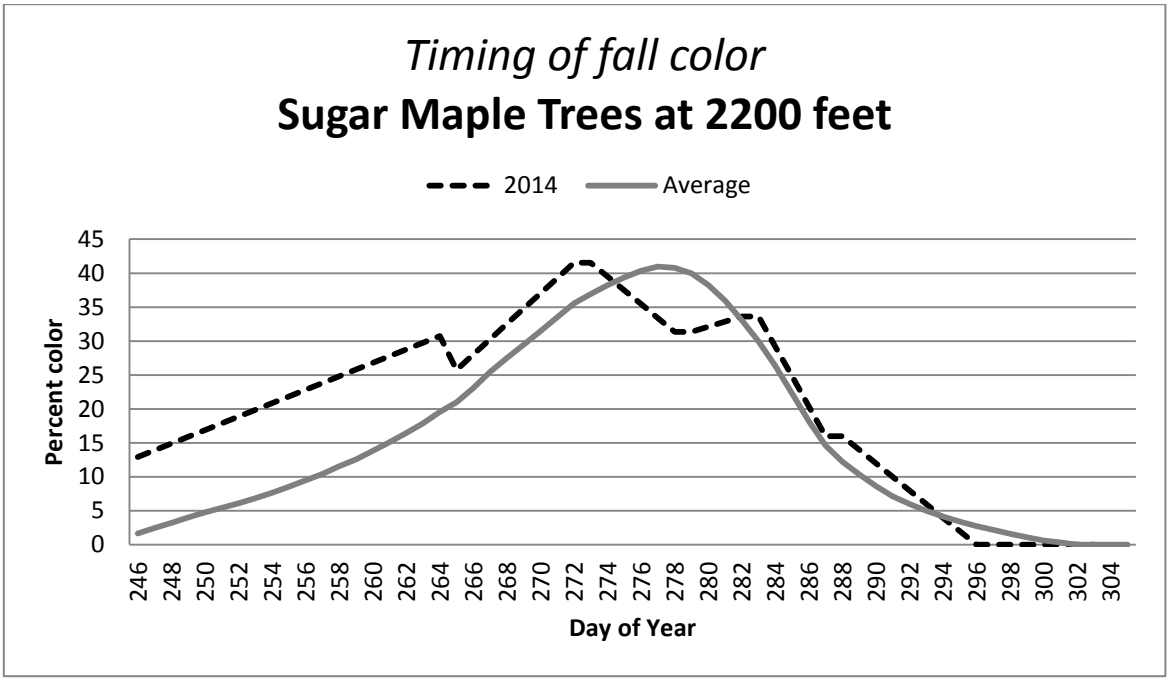


Figure 15d.

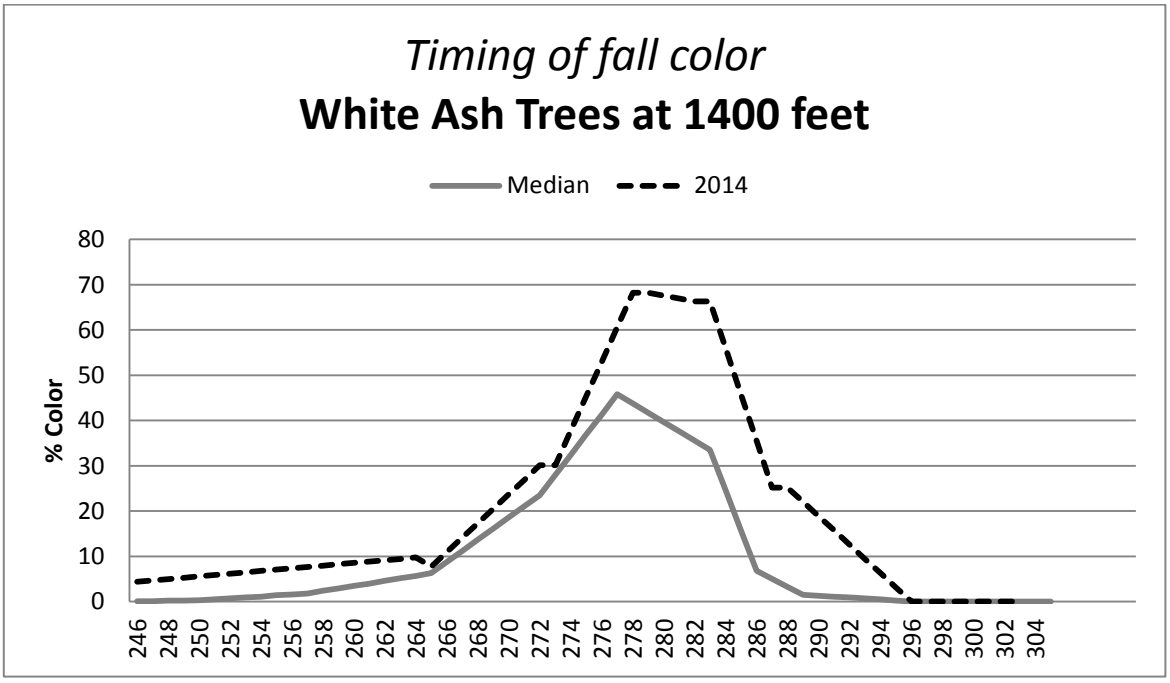


Figure 15e.

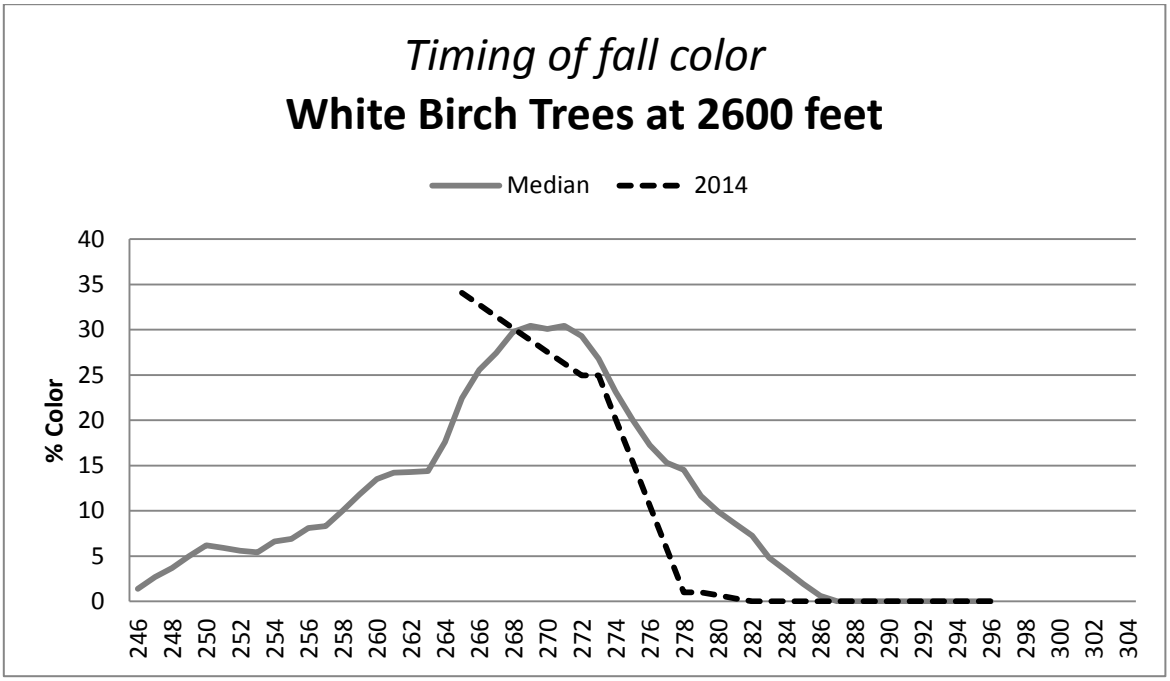


Figure 15f.

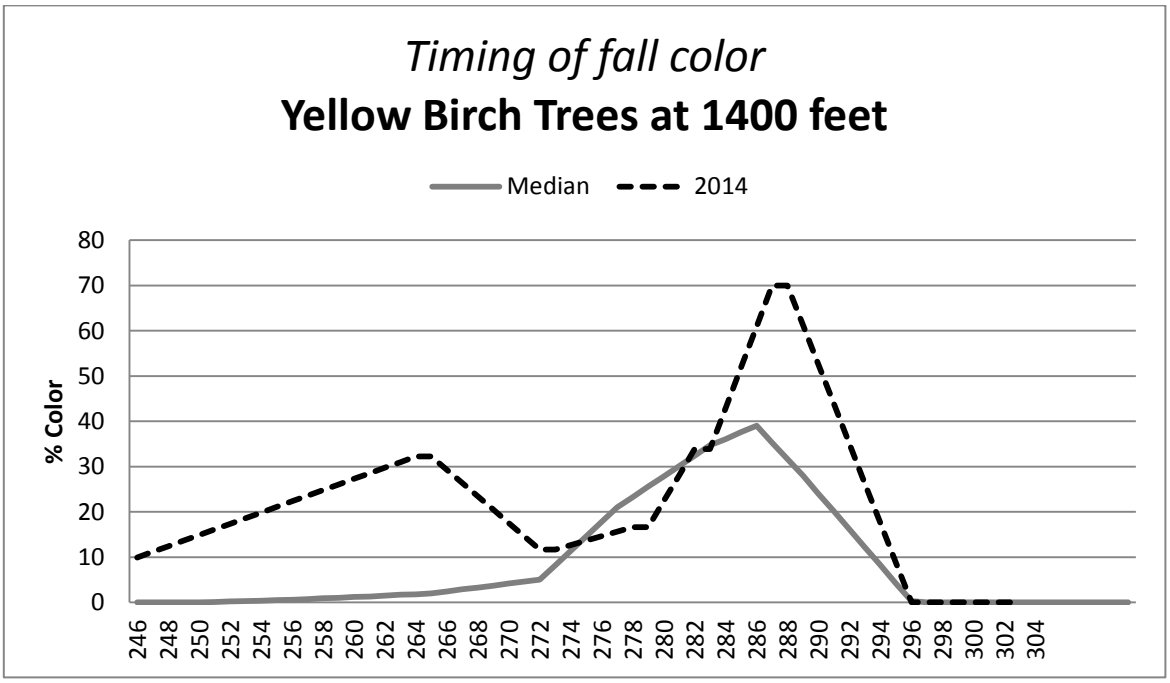


Figure 15g.

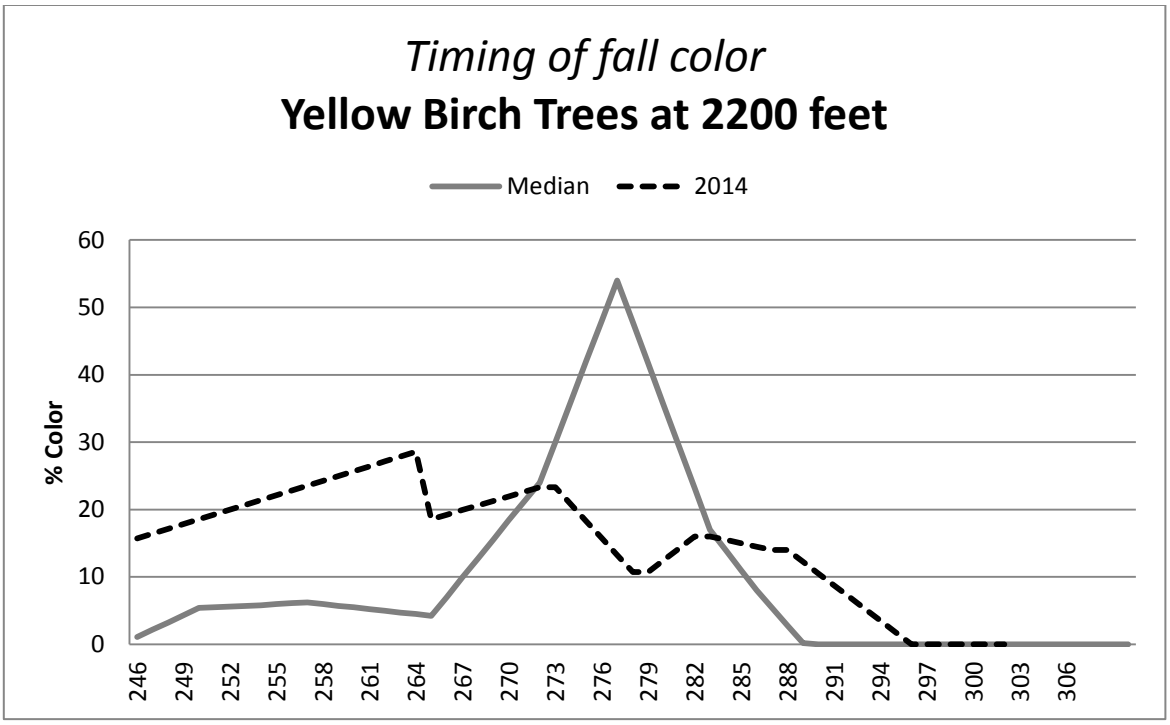


Figure 15h.

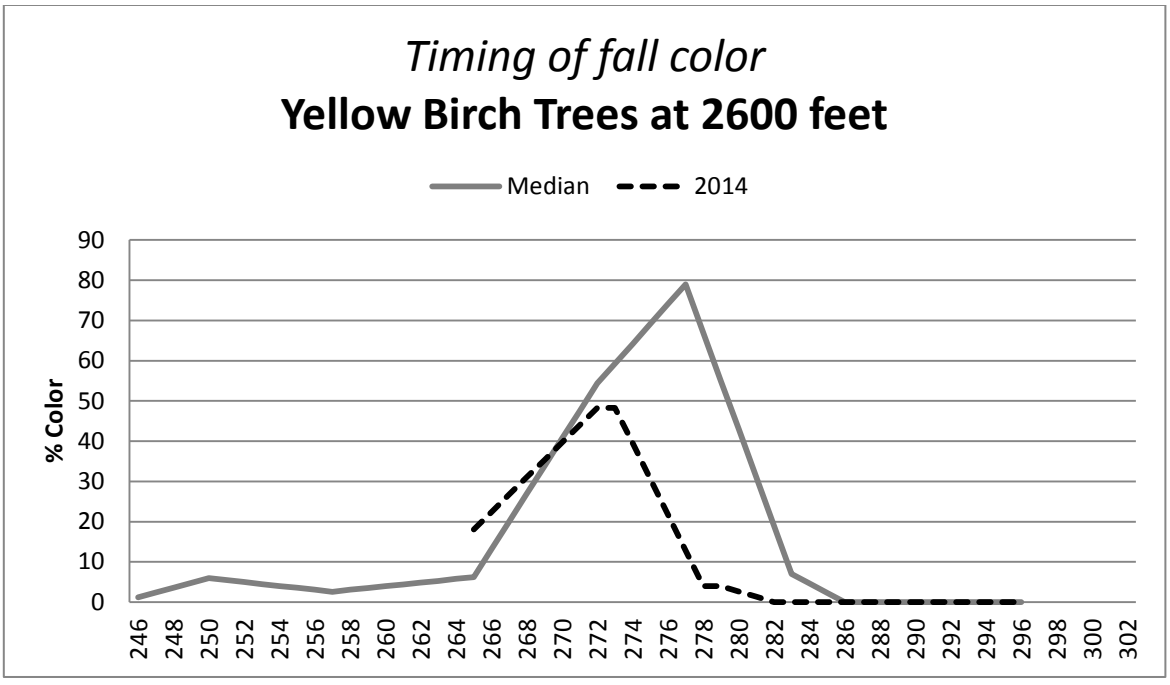


Figure 15i.

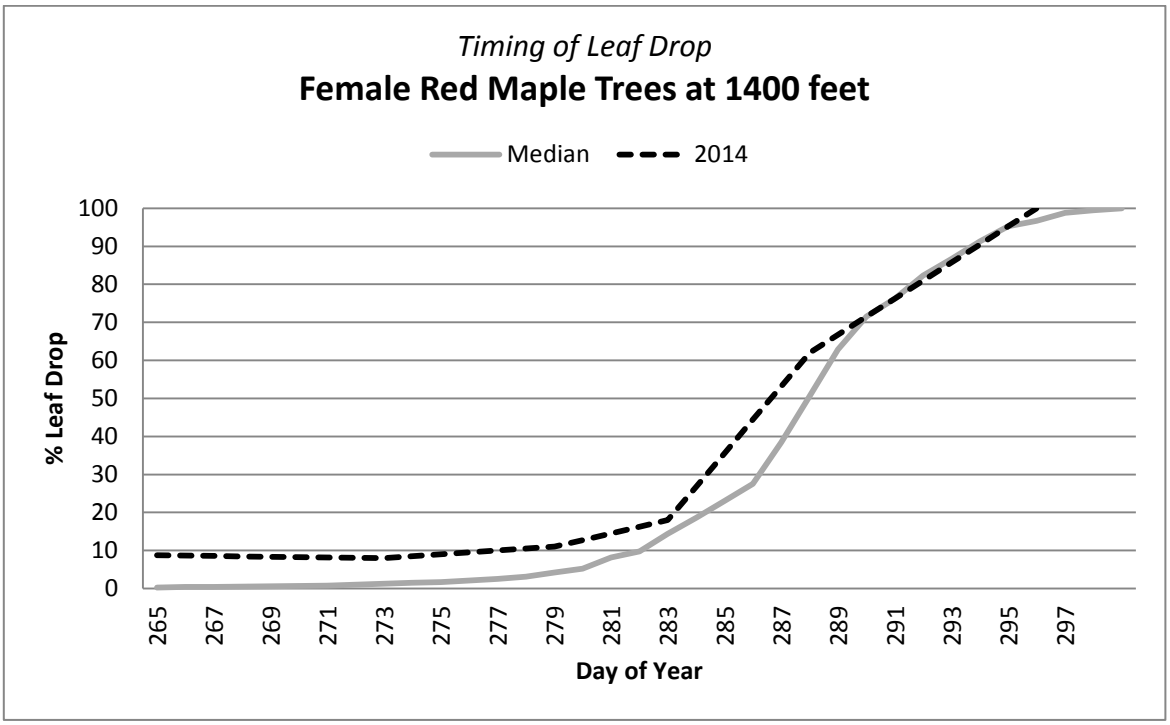


Figure 16a.

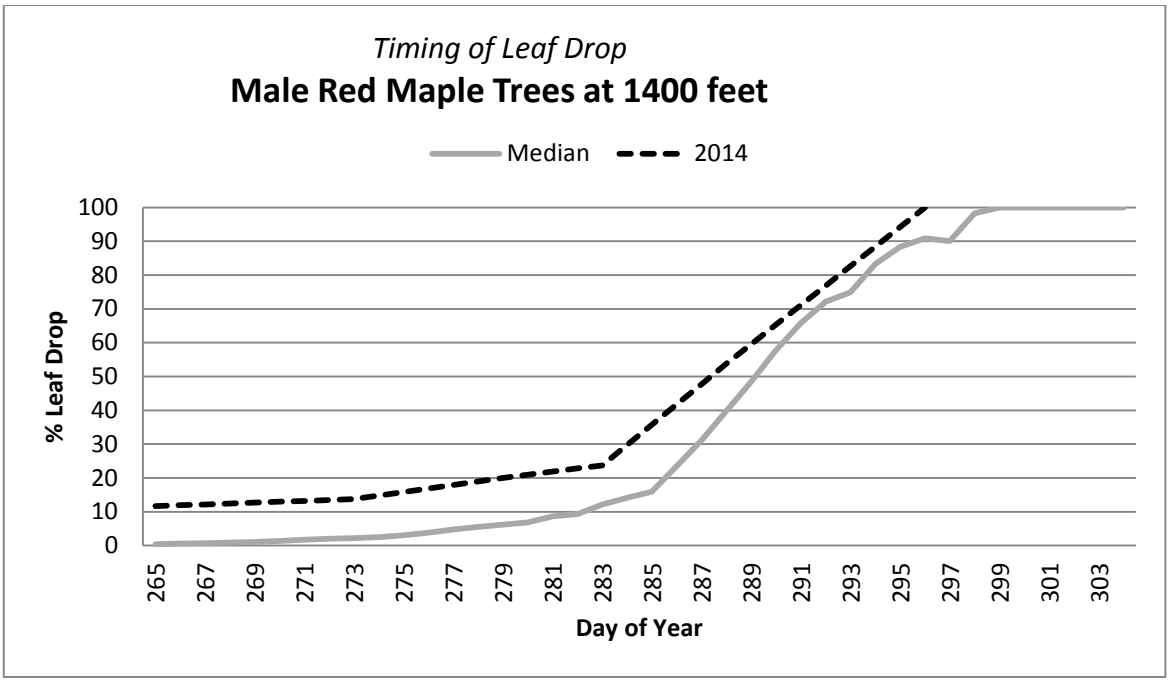


Figure 16b.

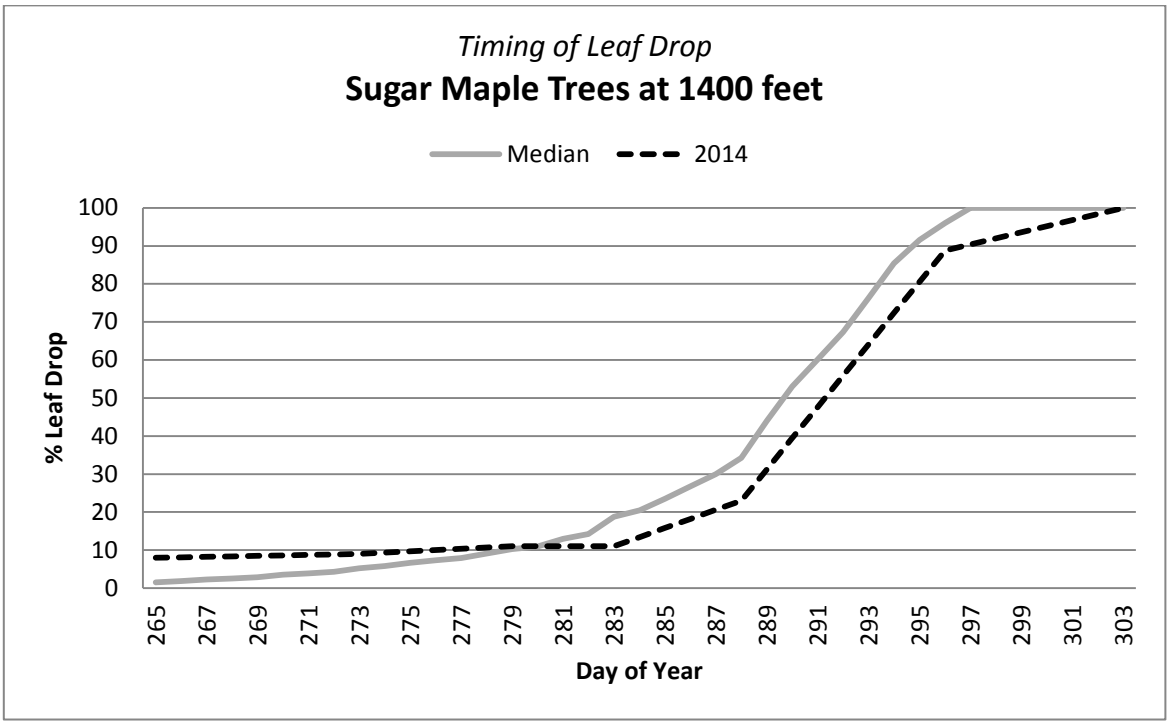


Figure 16c.

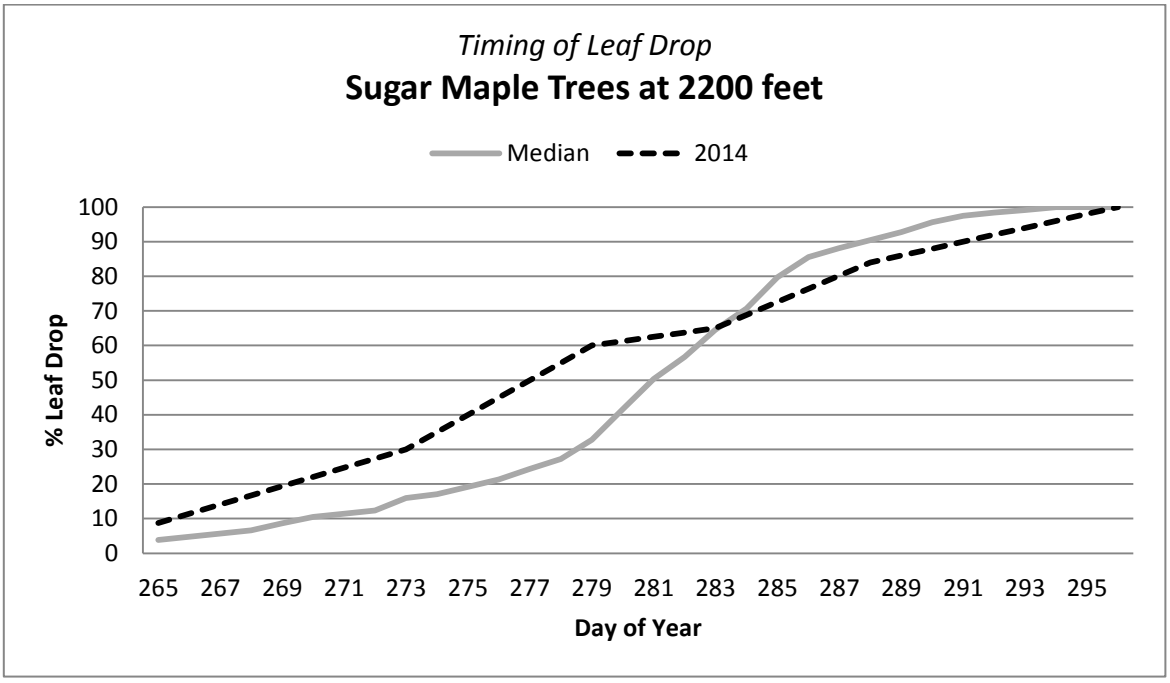


Figure 16d.

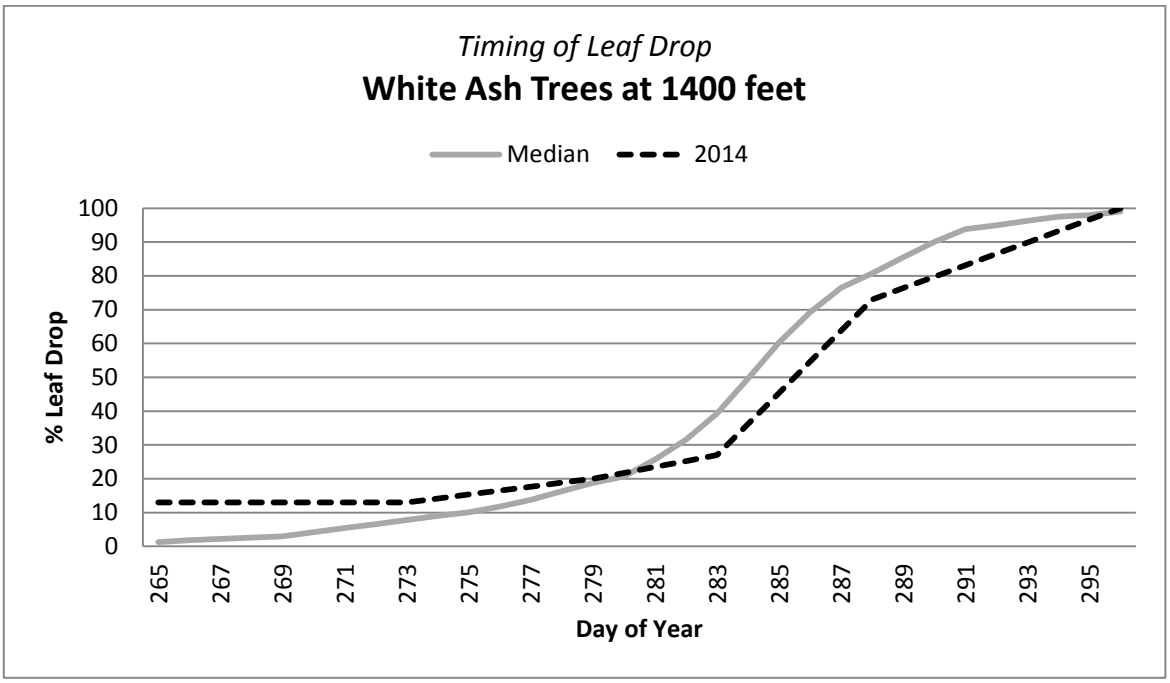


Figure 16e.

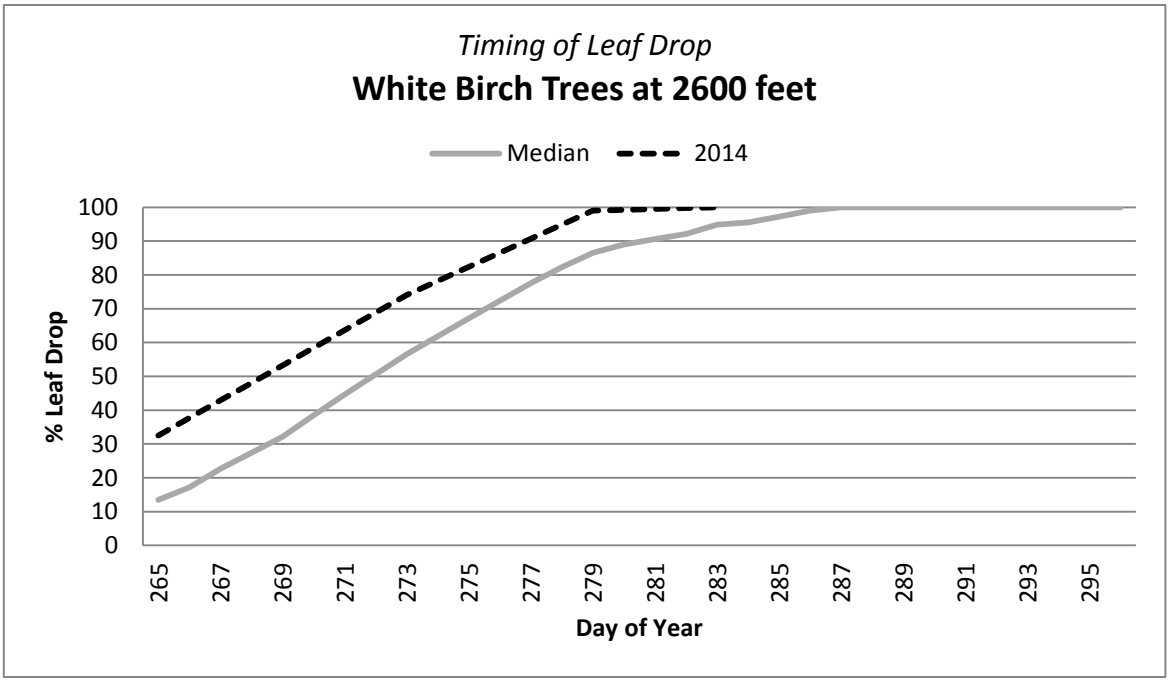


Figure 16f.

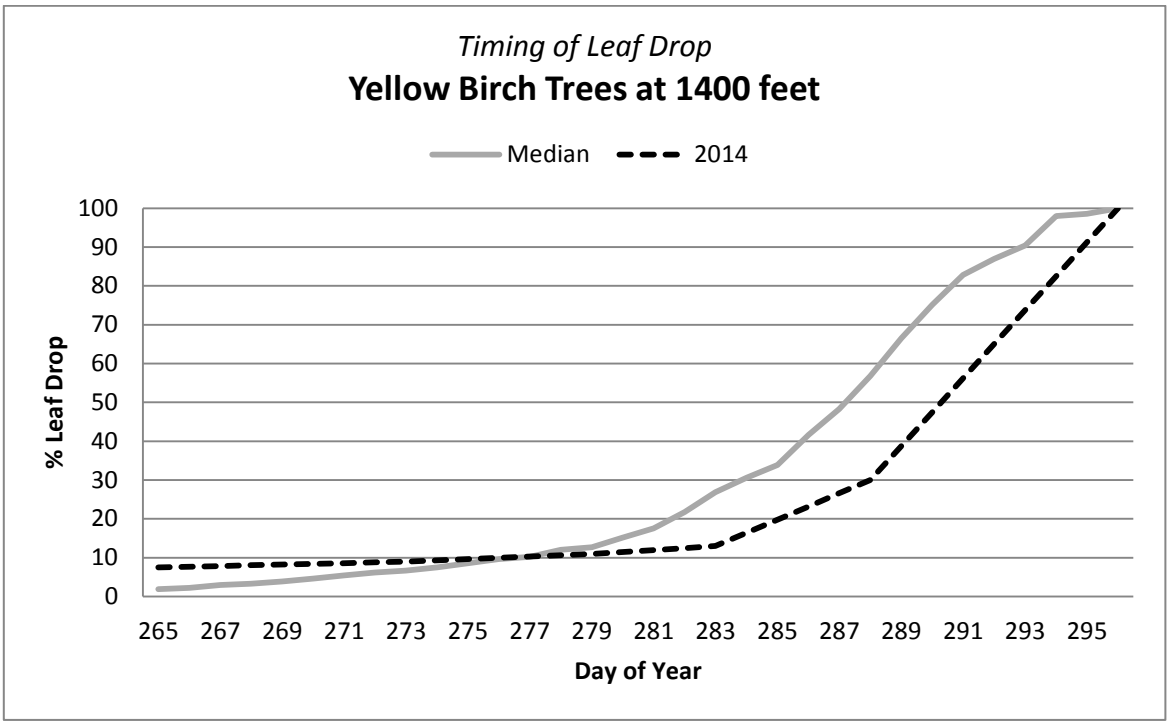


Figure 16g.

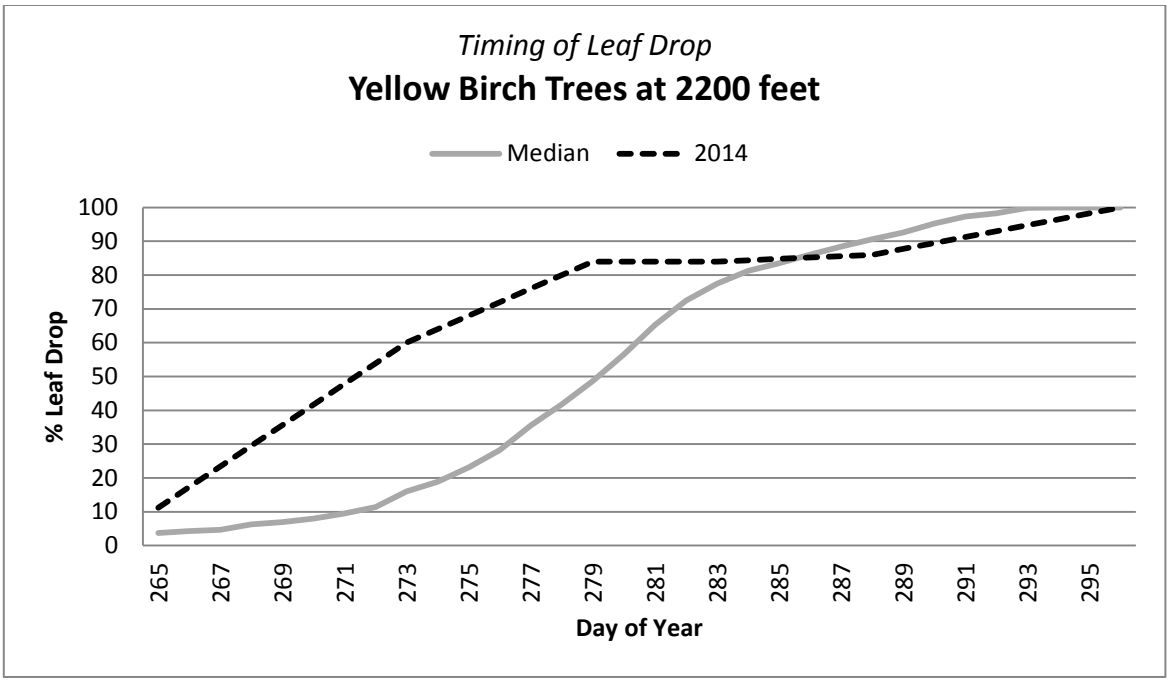


Figure 16h.

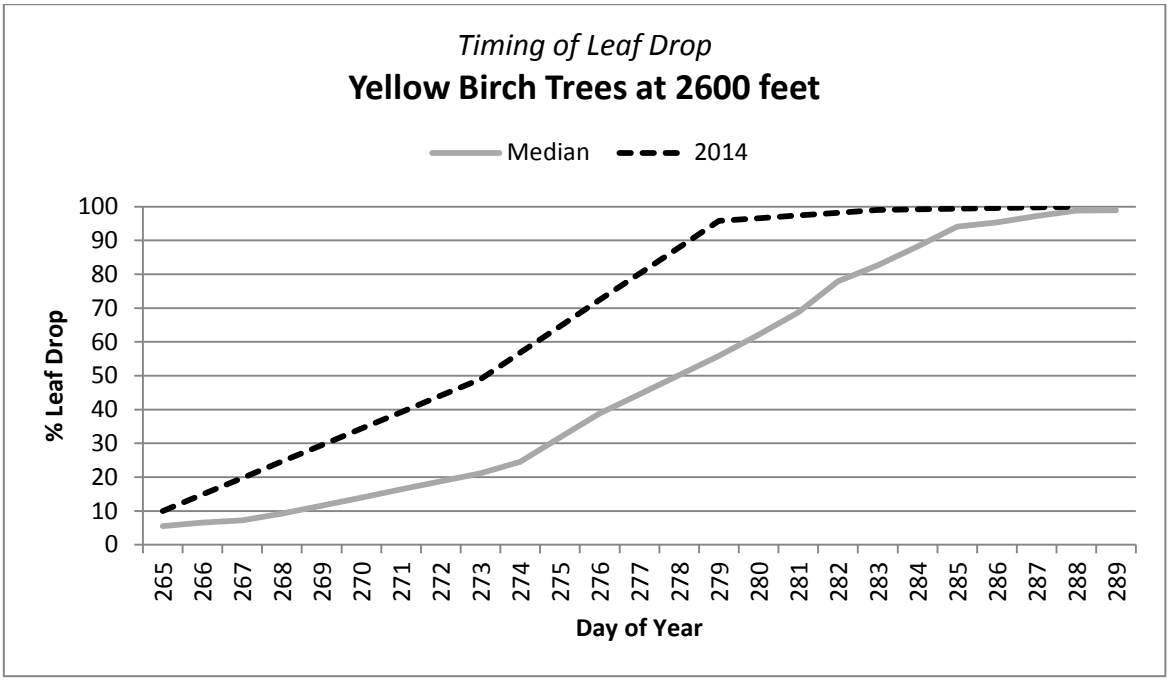


Figure 16i.

Table 2. Average dates of sugar maple bud break, end of growing season (leaf drop) and length of the growing season at the Proctor Maple Research Center in Underhill.

Year	Date of Bud break	Date of End of Growing Season	Length of growing season (days)
1992	5/7	10/13	159
1993	5/4	10/18	167
1994	5/6	10/14	161
1995	5/13	10/19	159
1996	5/14	10/22	161
1997	5/16	10/14	151
1998	4/17	10/15	181
1999	5/5	10/19	167
2000	5/9	10/17	161
2001	5/4	10/15	164
2002	4/18	11/5	201
2003	5/9	10/28	172
2004	5/4	10/27	175
2005	5/2	10/27	178
2006	5/2	10/16	167
2007	5/7	10/22	168
2008	4/22	10/15	175
2009	4/30	10/29	182
2010	4/22	10/26	187
2011	5/7	10/19	163
2012	4/16	10/16	186
2013	5/3	10/15	165
2014	5/12	10/20	161
Long term Average (1991-2014)	**5/3**	**10/20**	**170**

HARDWOOD DEFOLIATORS

Birch Defoliation, mostly caused by Septoria leaf spot but likely also involving some birch-feeding insects, was considerably less than recent years in 2014, with only 5,334 acres defoliated as opposed to 98,329 acres observed in 2013. (See Foliar Diseases.)

Forest Tent Caterpillar, *Malacosoma disstria*, defoliation was not reported, but larvae were observed in scattered locations. Average moth catch in pheromone traps was up in all but one of 13 survey locations.

Table 3. Average number of forest tent caterpillar moths caught in pheromone traps, 2002-2014. Three multi-pher pheromone traps baited with PheroTech forest tent caterpillar lures were deployed at each survey location in 2014. Three traps were not recovered, one in Waterville (Codding Hollow/Locke), one in Rochester (Rochester Mountain), and one at Underhill State Park (VMC 2200).

Site	Year												
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Castleton	----	----	----	17	17.3	8	1	4.7	1	1.7	0.3	2.3	1.7
Fairfield (NAMP 29)	----	1.3	1.7	----	4.3	4.7	4	10.3	2.0	6	4	1.7	3.3
Huntington (NAMP 027)	9.2	6.7	10	15.7	16	6.3	4.3	4.3	2.7	6.3	6	1.7	2.7
Killington/Sherburne (Gifford Woods)	6.9	9.7	20	15.3	21	17.3	7.3	8	2.7	0	1.0	0.7	6.0
Manchester (new site in 2008)							0	5.7	3	1	0.7	0.3	1.3
Rochester (Rochester Mountain)	5.0	4.7	9	4.7	29	10.3	0.7	----	0.3	0	0	0	3.5
Roxbury (Roxbury State Forest)	16	14.7	13.3	7.3	22	22.7	8.0	2.7	7.0	2	1.5	1.7	6.3
SB 2200 (Stevensville Brook)	3.8	11.7	18.3	23.3	35.3	6.3	5.7	10	2.7	6.3	8	0.3	5.3
Underhill (VMC 1400)	3.6	3	0.3	7.3	9.3	2.7	1.3	8.3	5.7	8.3	7.7	0.3	5.7
Underhill (VMC 2200)	3	7	6.3	11.7	6.3	4.7	1.3	4.3	2	2.7	4.7	0.3	2.5
Stowe (VMC 3800)	1	2.7	10.3	26	5.7	5	1.3	1.7	0.7	2	2	1.3	1.7
Waterbury (Cotton Brook)	2	0.7	1.3	41	22.3	0.3	1	5	3.3	4.3	7	0.3	9.3
Waterville (Codding Hollow/Locke)	0	2	1.3	17.7	24.7	2.7	2.3	1.3	3.0	4.3	3	1	12.5
Average	**5.1**	**5.8**	**8.3**	**17**	**17.8**	**7.6**	**2.9**	**5.5**	**2.8**	**3.5**	**3.5**	**0.9**	**4.8**

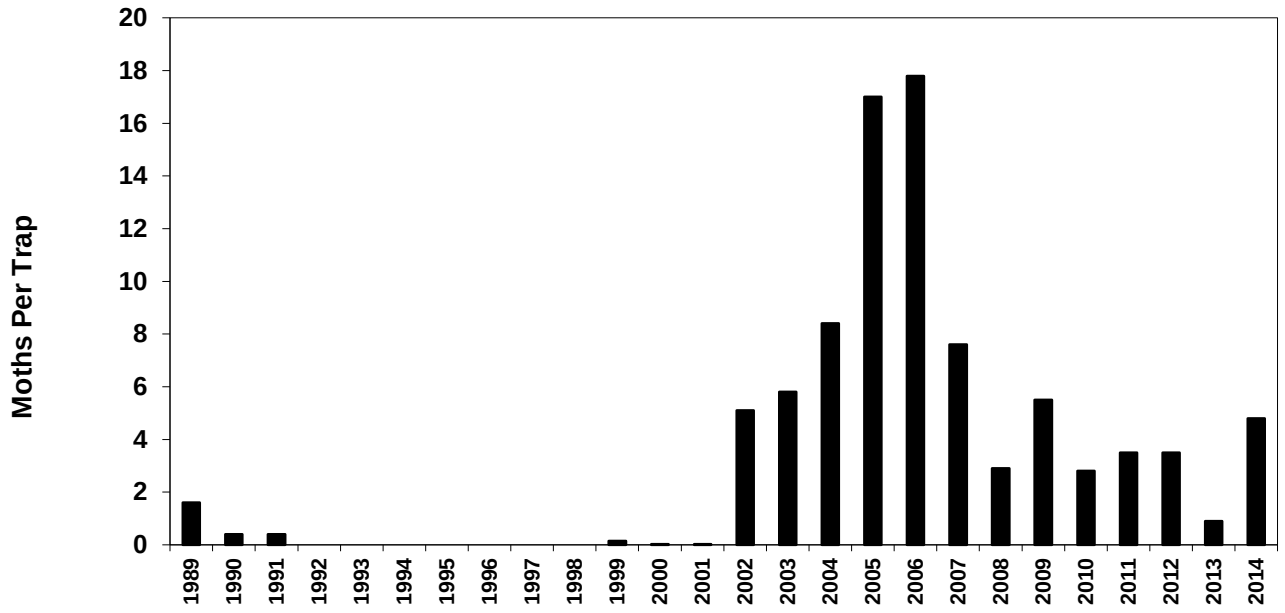


Figure 17. Average number of forest tent caterpillar moths caught in pheromone traps 1989-2014. Three multi-pher pheromone traps per site, with PheroTech forest tent caterpillar lures, were used in 2014.

Gypsy Moth, *Lymantria dispar*, caterpillars or single egg masses were occasionally observed, but, with a noted exception, feeding was minimal. The exception was heavy defoliation of spruce in a single site in Whiting in Addison County. Damage on the east side of trees was significant, and caterpillars were also found crawling on the front and north sides of the house at this location. For the third year in a row, no egg masses were observed in focal area monitoring plots (Table 4 and Figure 18).

Table 4. Number of gypsy moth egg masses per 1/25th acre from focal area monitoring plots, 2003-2014. Average of two 15-meter diameter burlap-banded plots per location in 2014.

Site	Town	Year											
		2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Arrowhead	Milton	1.5	2.5	0	0	0	2.5	0	0	0.5	0	0	0
Brigham Hill	Essex	2.5	2	1.5	0	0	0	0	0	0	0	0	0
Ft. Dummer	Guilford	0	-----	0	0	0	0	0	0	0.5	0	0	0
Minard's Pond	Rockingham	0.5	2	0	0	0	0	0.5	0	0	0	0	0
Mount Anthony	Bennington	1.5	0	0	0	0	0	0	0	0	0	0	0
Perch Pond	Benson	0	0	0.5	1	0	0.5	0	0.5	0	0	0	0
Rocky Pond	Rutland	0	0	0.5	3	3	0.5	0	0	0	0	0	0
Sandbar	Colchester	3	1.5	0	0	0	2.5	0.5	0	0	0	0	0
Tate Hill	Sandgate	0	30	18	3	0	1.5	0.5	0	0	0	0	0
Average		**1**	**4.4**	**2.3**	**0.8**	**.3**	**.8**	**.2**	**0.06**	**0.11**	**0**	**0**	**0**

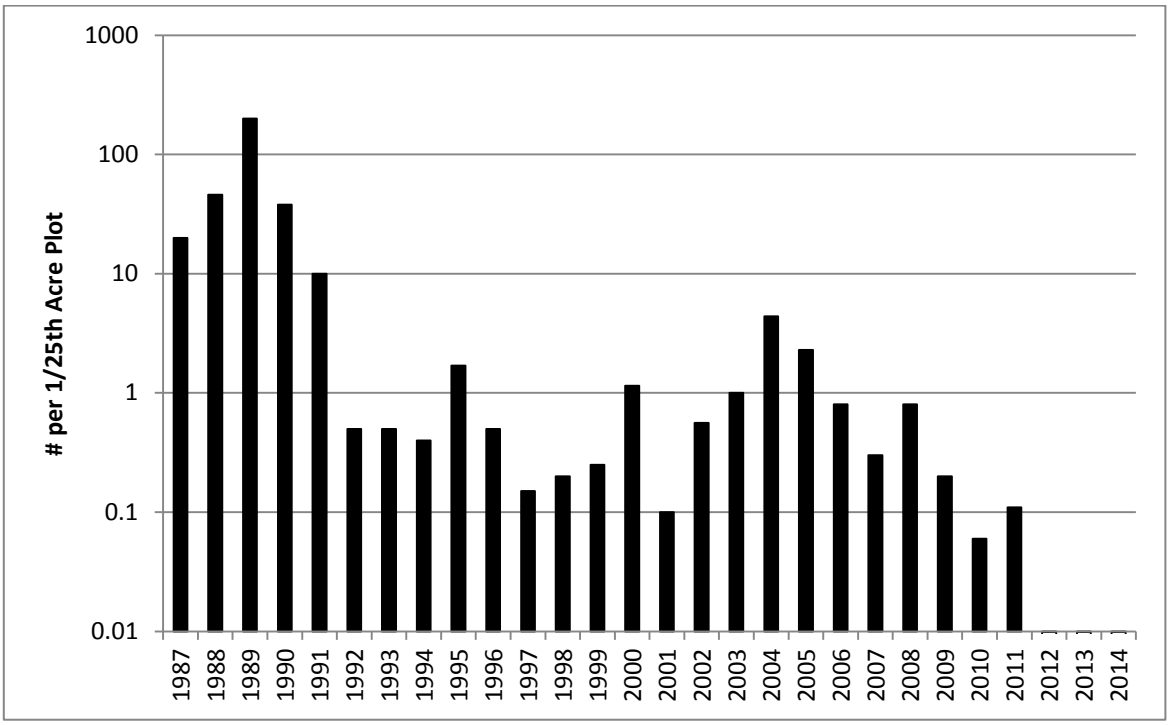


Figure 18. Number of gypsy moth egg masses per 1/25th acre from focal area monitoring plots, 1987-2014. Average of ten locations, two 15-meter diameter burlap-banded plots per location, in 2014. No egg masses were found in any plots in 2014.

Saddled prominent, *Heterocampa guttivitta*, pheromone traps were deployed statewide following concern about building populations of this northern hardwood defoliator (Table 5 and Figure 19). Sets of three traps were deployed at each site. The Vermont Forest Resource Protection staff surveyed in 13 locations in Vermont and the US Forest Service (USFS) worked in five sites in the Green Mountain National Forest. Traps were deployed on May 14-16 and retrieved between July 15 and 24.

Trap catches varied widely throughout the state (Figure 20), but subsequent defoliation was limited. There were many reports of saddled prominent caterpillars and their "frass rain", indicating that there may still be a threat of defoliation by these insects in 2015.

Table 5. Sites where saddled prominent pheromone traps were deployed in 2014. Data include location, town, county, coordinates, trapping dates and average number of moths per site.

Location	Town	County	Lat	Long	Date Out	Date In	Ave # SP moths/trap
Willoughby S.F.	Sutton	Caledonia	44.71037	-72.03985	5/14/2014	7/23/2014	
			44.71028	-72.03975	5/14/2014	7/23/2014	
			44.71026	-72.03963	5/14/2014	7/23/2014	
							10.3
Bartley/NAMP 6	Derby	Orleans	44.96356	-72.17169	5/14/2014	7/17/2014	
			44.96355	-72.17177	5/14/2014	7/17/2014	
			44.96369	-72.17158	5/14/2014	7/17/2014	
							6
Shelton/NAMP 9	Glover	Orleans	44.70073	-72.20975	5/14/2014	7/22/2014	
			44.70075	-72.20950	5/14/2014	7/22/2014	
			44.70050	-72.20956	5/14/2014	7/22/2014	
							26
Groton S.F.	Peacham	Caledonia	44.31163	-72.28882	5/15/2014	7/24/2014	
			44.31163	-72.28851	5/15/2014	7/24/2014	
			44.31142	-72.28871	5/15/2014	7/24/2014	
							3.3
Ascutney	Windsor	Windsor	43.43856	-72.40720	5/15/2014	8/21/2014	
			43.43847	-72.40735	5/15/2014	8/21/2014	
			43.43840	-72.40745	5/15/2014	8/21/2014	
							1.3
Camp Plymouth	Ludlow	Windsor	43.47553	-72.69430	5/15/2014	8/19/2014	
			43.47555	-72.69389	5/15/2014	8/19/2014	
			43.47548	-72.69372	5/15/2014	8/19/2014	
							5.7
Spring Lake Ranch/NAMP 16	Shrewsbury	Rutland	43.48305	-72.90993	5/16/2014	7/15/2014	
			43.48334	-72.90930	5/16/2014	7/15/2014	
			43.48268	-72.90977	5/16/2014	7/15/2014	
							20
Smoky House/ NAMP 17	Danby	Rutland	43.35054	-73.06024	5/16/2014	7/15/2014	
			43.35047	-73.05970	5/16/2014	7/15/2014	
			43.35022	-73.06024	5/16/2014	7/15/2014	
							47.3
Hagelberg/NAMP 40	Arlington	Bennington	43.06350	-73.17630	5/15/2014	7/15/2014	
			43.06379	-73.17591	5/15/2014	7/15/2014	
			43.06337	-73.17632	5/15/2014	7/15/2014	
							21.3
Honey Hollow	Bolton	Chittenden	44.34702	-72.90996	5/16/2014	7/21/2014	
			44.34684	-72.90979	5/16/2014	7/21/2014	
			44.34682	-72.91024	5/16/2014	7/21/2014	
							31
VMC 1400-PMRC	Underhill	Chittenden	44.52405	-72.86510	5/16/2014	7/18/2014	
			44.52377	-72.86452	5/16/2014	7/18/2014	
			44.52372	-72.86519	5/16/2014	7/18/2014	
							10

Location	Town	County	Lat	Long	Date Out	Date In	Ave # SP moths/Trap
Smith/NAMP 37	Vershire	Orange	43.96919	-72.34424	5/14/2014	7/21/2014	
			43.96884	-72.34407	5/14/2014	7/21/2014	
			43.96925	-72.34374	5/14/2014	7/21/2014	
							13
Butterfield/NAMP 39	Topsham	Orange	44.17331	-72.29451	5/14/2014	7/21/2014	
			44.17310	-72.29453	5/14/2014	7/21/2014	
			44.17278	-72.29510	5/14/2014	7/21/2014	
							11.7
Gale/Orvis (USFS)	Lincoln	Addison	44.15115	-72.95627	5/14-16/2014	7/22-24/2014	
			44.15109	-72.95618	5/14-16/2014	7/22-24/2014	
			44.15100	-72.95578	5/14-16/2014	7/22-24/2014	
							4.3
Begin (USFS)	Stockbridge	Windsor	43.78548	-72.78468	5/14-16/2014	7/22-24/2014	
			43.78552	-72.78507	5/14-16/2014	7/22-24/2014	
			43.78528	-72.78531	5/14-16/2014	7/22-24/2014	
							6.7
Harrington (USFS)	Pomfret	Windsor	43.70858	-72.44882	5/14-16/2014	7/22-24/2014	
			43.70880	-72.44872	5/14-16/2014	7/22-24/2014	
			43.70914	-72.44884	5/14-16/2014	7/22-24/2014	
							6.7
Griffith (USFS)	Mt. Tabor	Rutland	43.34282	-72.97840	5/14-16/2014	7/22-24/2014	
			43.34287	-72.97830	5/14-16/2014	7/22-24/2014	
			43.34320	-72.97832	5/14-16/2014	7/22-24/2014	
							4.7
Sprague (USFS)	Searsburg	Bennington	42.87462	-72.91520	5/14-16/2014	7/22-24/2014	
			42.87450	-72.91529	5/14-16/2014	7/22-24/2014	
			42.87419	-72.91541	5/14-16/2014	7/22-24/2014	
							12

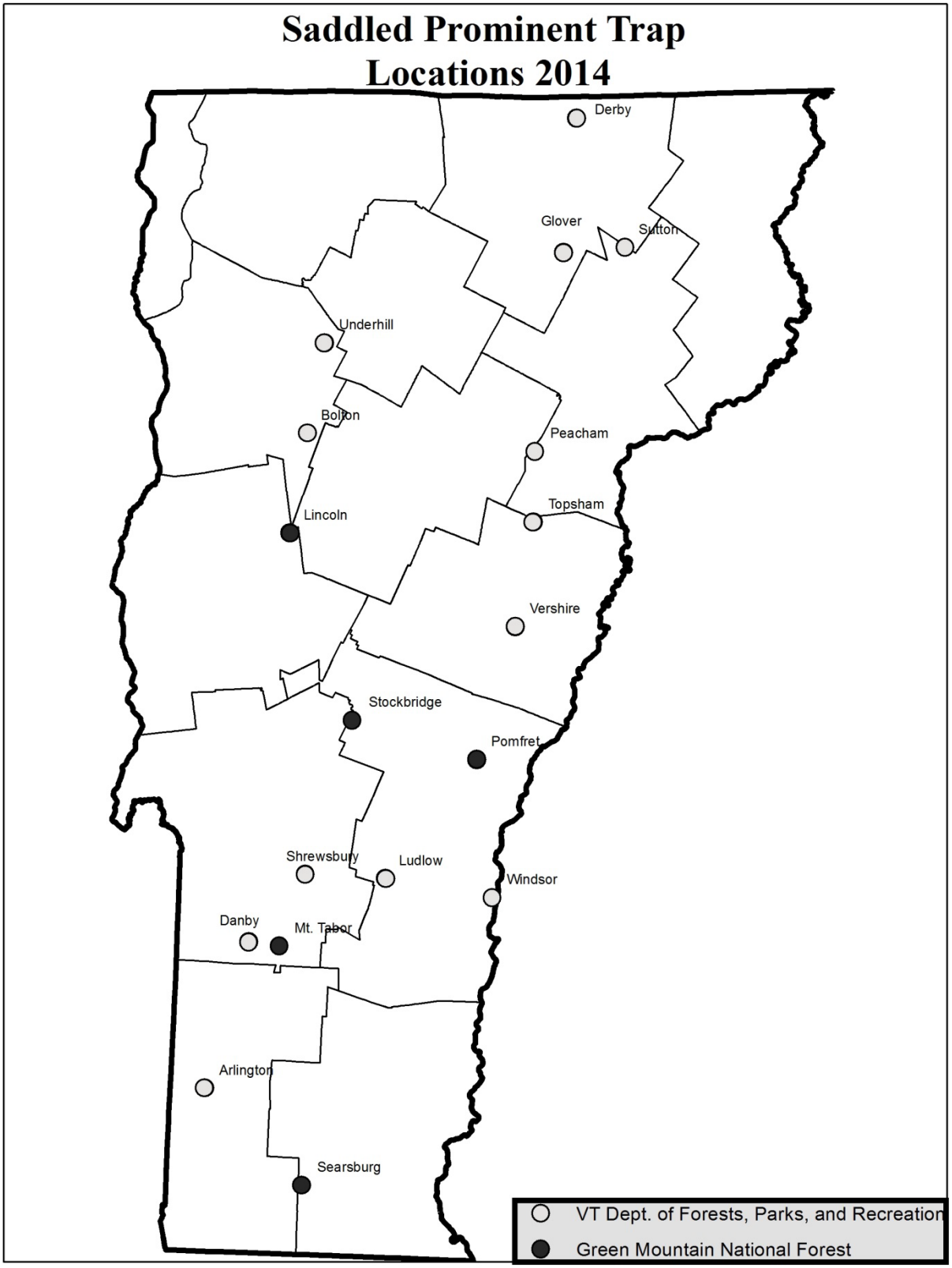


Figure 19. Location of saddled prominent pheromone traps set in Vermont in 2014 by Vermont Forest Resource Protection staff and the USFS.

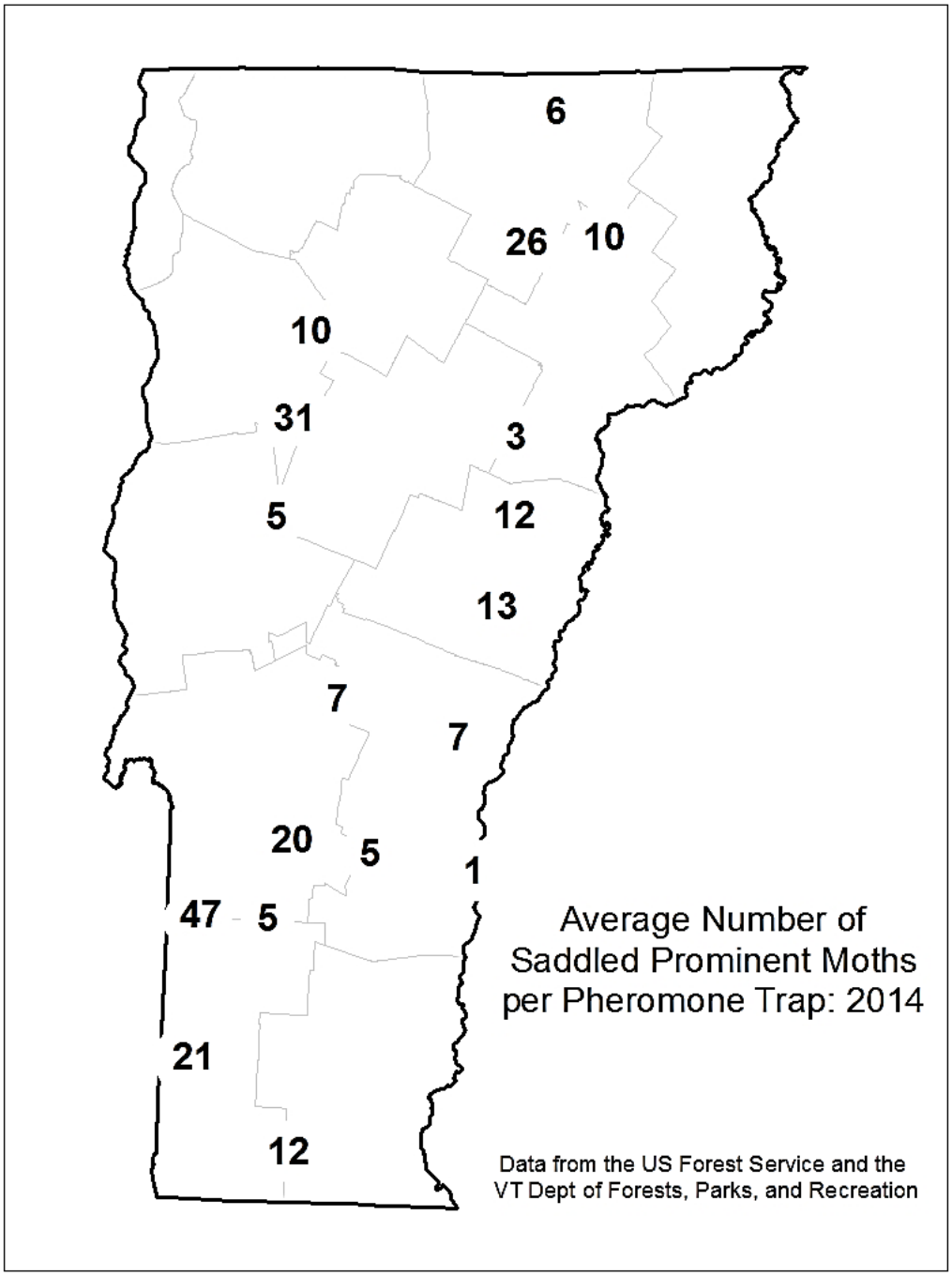


Figure 20. Average number of saddled prominent moths per pheromone trap in 2014. Three traps were deployed at each of 18 sites in Vermont.

OTHER HARDWOOD DEFOLIATORS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Bruce Spanworm	*Operophtera bruceata*	Sugar maple, aspen, beech and other hardwoods	Statewide	Few moths noticed during flight period.
Cherry Scallop Shell Moth	*Hydria prunivorata*	Black cherry	Statewide	Widely scattered with generally light damage, though heavy damage noted on one hillside in Cabot and in another location in Danby.
Dogwood Sawfly	*Macremphytus tarsatus*	Dogwood	Barnet	Noted on ornamentals.
Eastern Tent Caterpillar	*Malacosoma americanum*	Cherry and apple	Throughout	Few nests observed.
Elm Sawfly	*Cimbex americana*	Elm, maple, birch, willow and basswood	Montgomery	Individual larvae observed; no damage noted.
European Snout Beetle	*Phyllobius oblongus*	Maples and yellow birch	Widely scattered	Beetles occasionally observed.
Fall Webworm	*Hyphantria cunea*	Hardwoods	Throughout	Light, scattered populations; not as many as last year.
Forest Tent Caterpillar	*Malacosoma disstria*			See narrative.
Gypsy Moth	*Lymantria dispar*			See narrative.

OTHER HARDWOOD DEFOLIATORS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Hickory Tussock Moth	*Lophocampa caryae*	Various hardwoods	Scattered	No damage, but individual larvae observed in several locations.
Imported Willow Leaf Beetle	*Plagiodera versicolora*	Willow	Statewide	Some light skeletonizing observed on defoliated willow. Fungus disease primary cause.
Japanese Beetle	*Popillia japonica*	Many	Statewide	Common throughout.
Locust Leafminer	*Odontata dorsalis*	Black locust	Scattered	Heavy damage noted in Hartford area.
Maple Eyespot Gall	*Acericecis ocellaris*	Red Maple	Dummerston, Woodstock	More obvious than in 2013.
Maple Leaf Cutter	*Paraclemensia acerifoliella*	Maples	Statewide	Very light. Evidence of feeding uncommon.
Maple Trumpet Skeletonizer	*Epinotia aceriella*	Sugar maple	Statewide	More commonly observed than recent years, but with light damage.
Maple Webworm	*Tetralopha asperatella*	Sugar maple	Widely scattered	Very light, but occasionally observed.
Pear Sawfly	*Caliroa cerasi*	Red oak	Montpelier	On ornamental.
Red-humped Caterpillar	*Schizura concinna*	Blueberry and red-osier dogwood	Springfield, Orwell	Larvae feed on wide range of woody plants, from many different families.
Rose Chafer	*Macrodactylus subspinosus*	Various	Scattered	Noted on blueberries.
Saddled Prominent	*Heterocampa guttivata*	Sugar maple		See narrative.

OTHER HARDWOOD DEFOLIATORS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Satin Moth	*Leucoma salicis*	Poplar	Starksboro	Completely defoliated large tree; host later refoliated.
Variable Oakleaf Caterpillar	*Lochmaeus manteo*	Apple	Danville, Springfield	Minor feeding.
Viburnum Leaf Beetle	*Pyrrhalta viburni*	Viburnum	Scattered	On occasional ornamentals.
White-marked Tussock Moth	*Orgyia leucostigma*	Various	Scattered	Less obvious than usual.
Winter Moth	*Operophtera brumata*	Hardwoods		Not known to occur in Vermont.

Hardwood defoliators not reported in 2014 include Birch Leaf Folder, *Ancylis discigerana* ; Birch Leaf Mining Sawflies, *Fenusa pusilla, Messa nana;* Birch Skeletonizer, *Bucculatrix canadensisella;* Green-striped Mapleworm, *Dryocampa rubicunda* ; Mountain Ash Sawfly, *Pristiphora geniculata* ; Oak Skeletonizer, *Bucculatrix ainsliella* ; Orange-humped Mapleworm, *Symmerista leucitys* ; Pale Tussock Moth, *Halysidota tessellaris;* Uglynest Caterpillar, *Archips cerasivorana* .

SOFTWOOD DEFOLIATORS

Spruce Budworm, *Choristoneura fumiferana*, is causing widespread defoliation in Quebec, including south of the St. Lawrence River, and populations are building in Maine and New Brunswick. However, the moth trap catch in Vermont remains low. In 2010 - 2014, traps were deployed in Orleans, Caledonia, Essex and Chittenden Counties. The traps in Holland, Walden, and Underhill showed very slight increases; Norton numbers dropped and counts in Lewis and Burke were identical to those of 2013. (Table 6 and Figures 21-22). We do not anticipate defoliation by the spruce budworm in 2014.

Table 6. Average number of spruce budworm moths caught in pheromone traps, 1991-2014. Trapping had been discontinued 2004-2009. There were 3 traps per location, one location per town in 2014.

County and Town	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2010	2011	2012	2013	2014
Essex - Norton	3	10.7	5.7	2.3	1	1	1.3	26	34.7	29.7	17.7	1.3	2	5.3	1	1.3	0.7	0
Orleans - Holland	3.3	11	2.3	1.3	0	1.7	1.3	5	4.7	29.3	5	5.7	3.7	6	8.0	1	0.7	1.7
Caledonia - Walden	17.7	17.7	13	14.3	3	6.3	2	4.3	5	85	16.7	9.7	3.7	6.7	1	0.7	0	0.3
Essex - Lewis	2.0	2.7	0.67	2	0	0.67	0	8	4.3	14	6.7	1.3	1.7	5.7	0.3	0	0	0
Chittenden - Underhill	31.7	29	16	53	11.7	30.3	3.7	6	13.3	24.7	11.3	14.7	3.7	19	11.3	8	1.3	3.7
Caledonia - Burke	3.5	2.3	6	3	0	2	3.7	7.3	6	30	15	3	1.7	4	1.7	0	0.3	0.3
Average	10.2	12.2	7.3	12.7	2.6	7.0	2.0	9.4	11.3	35.5	12.1	6.0	2.8	7.8	3.9	1.8	0.5	1.0

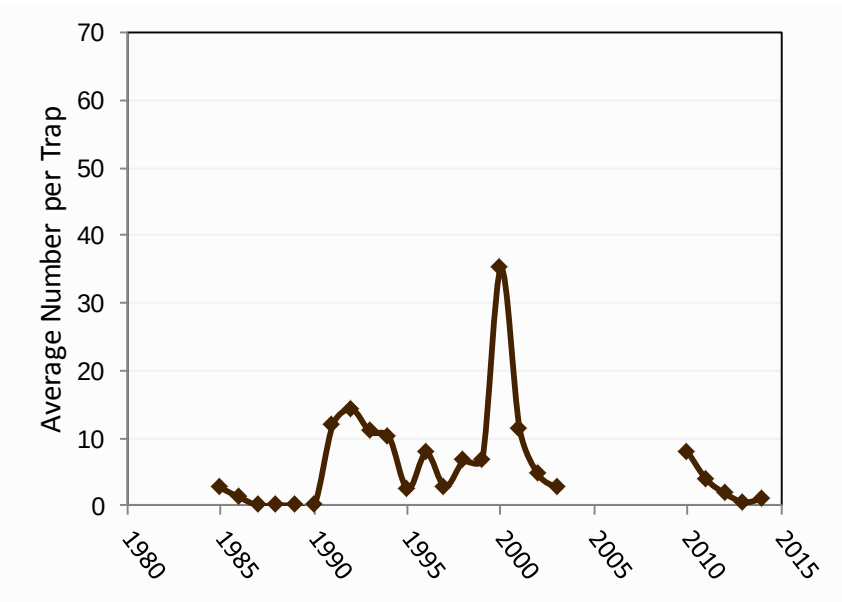
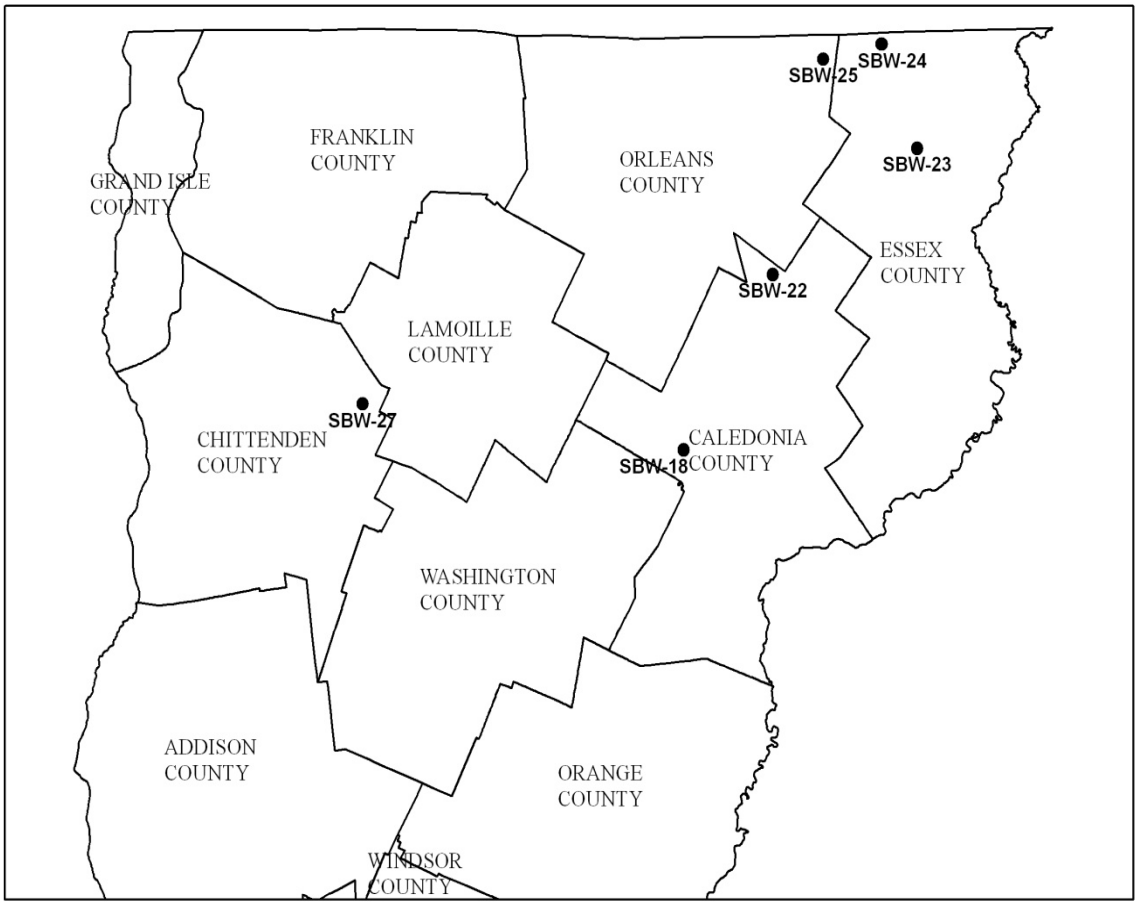


Figure 21. Average number of spruce budworm moths caught in pheromone traps 1983-2014. Trapping was discontinued, 2004-2009. Average of six locations in 2014.

Spruce Budworm Trap Locations



Trap #	Trap Location	Town	Latitude	Longitude
SBW-18	Steam Mill Brook WMA	Walden	44.48385	-72.25364
SBW-22	Willoughby S.F.	Burke	44.69555	-72.03616
SBW-23	Tin Shack/Silvio Conte	Lewis	44.85915	-71.74222
SBW-24	Black Turn Brook S. F.	Norton	44.99521	-71.81300
SBW-25	Holland Pond WMA	Holland	44.97610	-71.93103
SBW-27	VMC 1400	Underhill	44.52570	-72.86477

Figure 22. Locations of spruce budworm pheromone traps in 2014. Coordinates are NAD83.

OTHER SOFTWOOD DEFOLIATORS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Arborvitae Leaf Miner	*Argyresthia thuiella*	Arborvitae	Scattered	No significant damage reported.
Eastern Spruce Budworm	*Choristoneura fumiferana*	Balsam fir and spruce	Statewide	See narrative.
Fall Hemlock Looper	*Lambdina fiscellaria*	Hemlock	Windham County	Larvae seen, but no visible damage observed.
Larch Casebearer	*Coleophora laricella*	Larch	Northeast Kingdom	Only light damage observed.
White Pine Sawfly	*Neodiprion pinetum*	White pine	Montgomery	Sudden defoliation of a small lanscape white pine.

Softwood defoliators not reported in 2014 included European Pine Sawfly, *Neodiprion sertife* r, Introduced Pine Sawfly, *Diprion similis* .

SAPSUCKING INSECTS, MIDGES, AND MITES

Balsam Twig Aphid, *Mindarus abietinus*, damage was very light to non-existent in most plantations. Exceptions included plantations in Essex, New Haven and Waterbury. The light 2014 damage follows a year in which populations appeared to be rising dramatically. Perhaps the harsh see-saw winter affected the overwintering eggs in all but the warmest regions. Winter injury and needlecast disease also appeared to be contributing to condition of balsam fir in the New Haven location.

Elongate Hemlock Scale (EHS), *Fiorinia externa*, was detected in 2014 in Brattleboro and Guilford in conjunction with hemlock woolly adelgid. The identification was originally made by the UMass Plant Diagnostic Clinic. The Brattleboro site involved urban trees near a parking lot, while the Guilford site was a forest stand. This find was the first detection in Vermont in natural stands and long-established ornamentals. Trees were declining significantly at both locations, with thinning crowns where co-occurring with HWA. Plans were in place to treat the Brattleboro trees chemically; the Guilford site was scheduled to be logged. EHS was not known to be established in Vermont prior to 2014, though it had been recently detected in a planted landscape in Charlotte, VT. At that time, no scale infestations were found in a survey of conifer hosts in the surrounding area, and the infested trees were treated.

Hemlock Woolly Adelgid (HWA), *Adelges tsugae*, has now been detected in 17 towns in three counties: Windham (15 towns including Brattleboro, Brookline, Dummerston, Grafton, Guilford, Halifax, Jamaica, Marlboro, Newfane, Putney, Rockingham, Townshend, Vernon, Wardsboro, and Whitingham), Bennington (town of Pownal) and Windsor (town of Springfield) (Figure 23). The Springfield detection, which is close to a previous find in Rockingham, was made by volunteers in February 2014.

Surveys to detect the spread of HWA continued in 2014, with 65 sites in 18 towns examined. A total of 34 volunteers assisted in this effort.

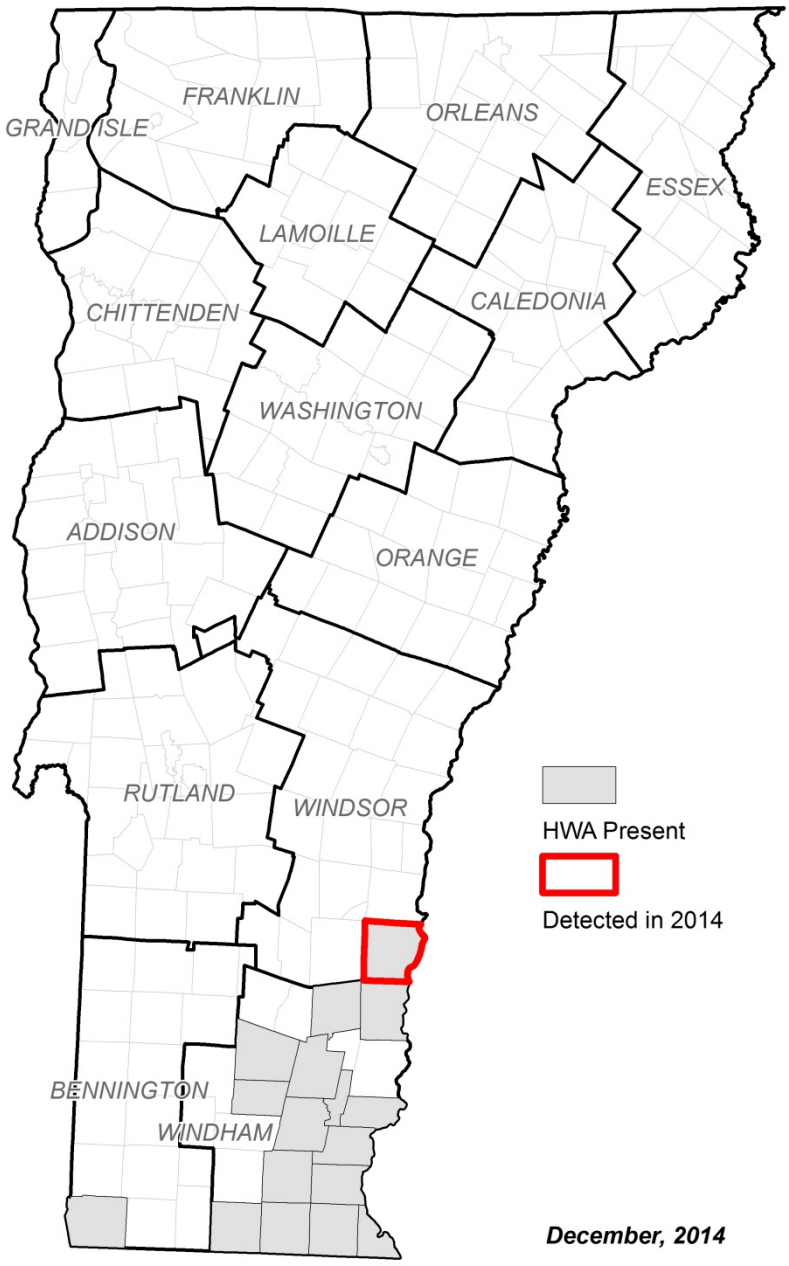


Figure 23. Towns known to have hemlock woolly adelgid-infested trees in 2014.

Assessments of 2013-2014 winter mortality were made in mid-March from HWA collected at four Vermont sites. Infested branch sections 1 – 2' in length were cut from several trees at each site. The goal was to collect enough branches to have 100 to 500 HWA to examine at each site. Branch samples were transported to our Forest Biology Lab for evaluation. HWA-laden twigs were retained in a cool location and were examined within 48 hours of field collection.

HWA viability is ascertained by using a dissecting microscope to examine HWA on new growth. Live HWA are plump, have ample fresh wool, and will move their legs when gently touched. Leg movement is considered the best indication of life, and if no movement occurs within 10 - 15 seconds, the insect is considered dead. The study protocol mandates that care was taken to count as dead only those adelgids

that are similar in size to live HWA, still retain fluid, and are somewhat plump but have no leg movement. Temperature data were collected at each site using iButton data loggers. Mortality averaged 98.4%, the highest recorded over the past five winters. (Tables 7-8 and Figures 24-25).

Table 7. Assessment of hemlock woolly adelgid winter mortality over the winter of 2013-2014. Data include location of study site, date hemlock wooly adelgid was collected, coordinates, elevation, number of dead and live adelgids, and percent mortality.

Location/Site	Date HWA collected	Latitude	Longitude	Elevation (m or ft.)	# HWA alive	# HWA dead	Percent Mortality
Vernon	3/17/2014	42.80219	-72.89278	117	6	294	98.0% mortality
Brattleboro South	3/17/2014	42.82897	-72.55176	307	1	322	99.6% mortality
Townshend	3/17/2014	43.04165	-72.69247	559	9	415	97.8% mortality
Jamaica	3/17/2014	43.10877	-72.77489	747	9	445	98.0% mortality

Table 8. Percent of hemlock woolly adelgid sistens that were dead in March 2014 at four Windham County sites, compared to minimum ambient temperature in the previous winter. Temperature readings for the Townshend site came from an iButton data logger. For the Jamaica site, data were taken by Army Corps of Engineers at the Ball Mountain Dam, just a few miles away. South Brattleboro and Vernon sites readings were taken at the Brattleboro Cooperative Observer Station.

Town	Winter 2009-2010		Winter 2010-2011		Winter 2011-2012		Winter 2012-2013		Winter 2013-2014	
	Min. Temp. ^{0}C	% Dead	Min. Temp. ^{0}C	% Dead	Min. Temp. ^{0}C	% Dead	Min. Temp. ^{0}C	% Dead	Min Temp ^{0}C	% Dead
Brattleboro (South)	-17	14%	-26	96%	-22	1%	-19.5	41%	-25	99.6%
Vernon	-17	13%	-24	56%	-19	11%	-20	42%	-25	98%
Townshend	-18	9%	NA	89%	-21	11%	-19.5	39%	-23	97.8%
Jamaica	-19	13%	-24	98%	-22	2%	-18.5	49%	-24	98%
Average	**-18**	12%	**-25**	85%	**-21**	6%	**-19.4**	43%	**-24.3**	**98.4%**

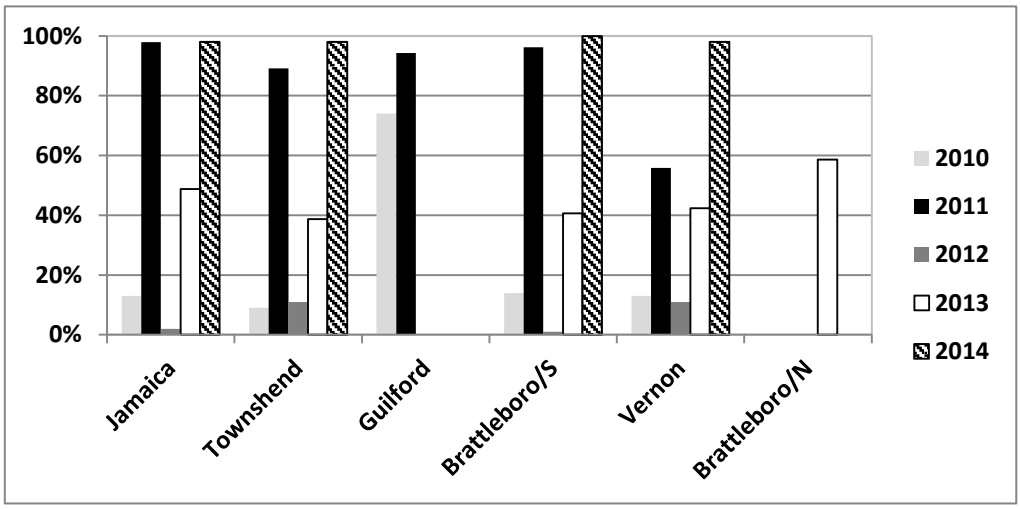


Figure 24. Comparison of mortality of hemlock woolly adelgid sistens at Windham County sites 2010-2014.

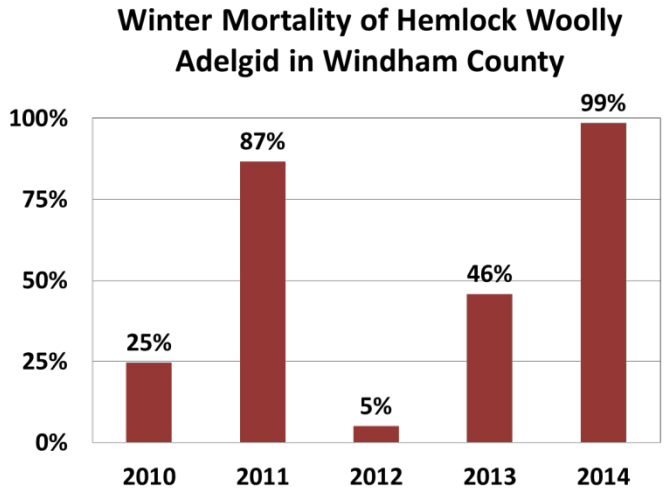


Figure 25. Overwintering mortality of hemlock woolly adelgid in Windham County 2010 - 2014.

Recognizing that the winter cold may have a significant impact on HWA populations, the community of HWA Initiative partners cooperated to document this impact and ascertain the recovery of the next generation. In addition to winter mortality, partners in Vermont, Maine, New Jersey and Virginia collected data on sisten and progredien density and minimum temperature. The work in Vermont was done with assistance from the students of the Mountain Campus of Burr and Burton Academy and a student from Green Mountain College.

The report confirmed that many adelgids in the sisten generation were killed. It also showed that the density of subsequent progrediens generation was 2 - 97 percent lower than their parent density (Table 9). The report went on to warn that "based on the density of progrediens, HWA will likely recover to

densities seen during normal temperature years within the coming year if temperatures remain normal, although areas with reported 100% mortality may take longer to recover."

Table 9. Density of sistens and progrediens in studies conducted in 2014 and earlier in four states. (From a report for hemlock woolly adelgid researchers and managers in the eastern U. S. entitled "Hemlock Woolly Adelgid Sistens Mortality During the Winter of 2013 - 2014 and Progrediens Recovery" by T. J. McAvoy *et. al.*)

						Density		
State	**Site**	**Year**	**Trees n**	**BioSIM Min. Temp. °C**	**Reported % sistens mortality**	**Sistens**	**Progrediens**	**% change**
2013 - 2014[1]								
Maine	Cape Elizabeth	2014	10	-24.2	81	91	73	20
	Freeport	2014	10	-26.1	67	76	27	64
	Wiscasset	2014	10	-26.0	78	54	13	76
New Jersey	Peters Canoe camp	2014	5	-21.6	95	81	28	65
	Stokes State Forest – Lake Ocquittunk	2014	5	-22.6	91	88	86	2
	Stokes State Forest – Stony Lake	2014	5	-22.7	98	70	28	60
	Townshend SP	2014	5	-25.6	98	77	21	73
Vermont	Jamaica SP	2014	5	-25.0	98	62	25	61
	Vernon	2014	5	-25.1	98	66	2	97
Virginia	Hussey Mt.	2014	2	-20.7	100	98	11	89
	Kentland[2]	2014	64	-20.1	88	5	3	35
Prior to 2013 - 14								
Virginia	Kentland[2]	2013	64	-12.7	-	2.06	28.60	1,388
	Mt. Lake[3]	2001	37	-17.9	-	1.63	2.00	123
		2002	55	-15.6	-	1.49	3.29	222
		2003	110	-19.9	-	0.04	0.03	14
		2004	115	-23.3	-	0.04	0.05	153
		2005	125	-20.3	-	0.10	0.02	81
	Olean[3]	2000	54	-16.1	-	1.30	1.71	132
		2001	54	-11.7	-	0.22	0.21	5

[1] Sistens and progrediens density values are an index value from 1 – 100.
[2] HWA density per 30 cm of foliage.
[3] HWA density per cm of foliage.

Reports from foresters of hemlock decline caused by HWA sharply increased in 2014. We have known about hemlock woolly adelgid in Vermont since 2007, which means it has probably been here for about a decade. A similar lag time has been observed in other states between first detection and the onset of decline.

Thin crowns due to this insect were mapped for the first time during aerial surveys, with 175 acres delineated. In addition, hot, dry spells through the summer may have increased stress to trees on droughty sites.

Five impact plots were established to monitor the effects of HWA infestation. These will complement similar plots elsewhere in New England, and help clarify the risk to trees as the insect spreads north. The plots are located in the Roaring Brook Wildlife Management Area in the towns of Guilford and Vernon, Fort Dummer State Park in Brattleboro, Townshend State Park in Townshend, Black Mountain Reserve in Dummerston (The Nature Conservancy) and Atherton Meadows Wildlife Management Area in Whitingham. Data from these sites will add to the understanding of forest impacts of HWA, and will be analyzed along with information collected in Maine and New Hampshire. All measurements and crown assessments have been completed.

A pictorial guide for "Managing Hemlock in Northern New England Forests Threatened by Hemlock Woolly Adelgid and Elongate Scale" will be available in early 2015.

We continue to monitor the three sites where the predatory beetle *Laricobius nigrinus* has been released. Potential new sites are being evaluated for future releases and possible establishment of a beetle-rearing insectary. So far, no *Laricobius nigrinus* have been recovered in Vermont release sites.

In a project funded by the U.S. Forest Service and the Northeastern State Research Cooperative, personnel at the UVM Entomology Research Lab, with assistance in identifying experimental sites from our staff, continued investigating the potential use of a native insect-killing fungus, *Myriangium* sp., for biocontol of HWA. A recent presentation about the project can be viewed at: http://www.brattleborotv.org/dummerston-conservation-commission/dcc-hemlock-woolly-adelgid-111814.

Early detection, appropriate management, and quarantine compliance rely on well-informed and engaged citizens. Recommendations for landowners and other informative materials are available on the Vermont Forestry Division website, vtforest.com, and at the Vermont Invasives website, vtinvasives.org. Hemlock woolly adelgid is a consideration for several communities completing an Invasive Forest Pest Preparedness and Response Plan.

Pear Thrips, *Taeniothrips inconsequens*, damage was not detected in 2014. In long-term monitoring plots at Proctor Maple Research Center in Underhill, the first thrips appeared on yellow sticky traps during the week of April 10. Traps caught their highest numbers of the season during the week of April 25 through May 2, with an average of 22 thrips per trap.

Overall thrips populations increased at the monitoring location in 2013, with a total of 304 thrips as compared with 205 in 2013 (Table 10). Thrips counts on sticky traps by year for 1993-2014 appear in Figure 26.

Table 10. Total pear thrips counts on yellow sticky traps at Proctor Maple Research Center in Underhill, VT, from 2009-2014. Sticky traps are deployed in sets of four. Traps are evaluated and replaced each week and monitored throughout pear thrips emergence.

2009		2010		2011		2012		2013		2014	
Sampling Dates	Number of Thrips	Sampling Dates	Number of Thrips	Sampling Dates	Number of Thrips	Sampling Dates	Number of Thrips	Sampling Dates	Number of Thrips	Sampling Dates	Number of Thrips
3/27 – 4/3	1					3/19 – 3/26	121				
4/3 – 4/9	0	4/2 – 4/7	408	4/6 – 4/12	0	3/26 – 4/2	6	3/29 - 4/5	0	4/1 – 4/10	0
4/9 – 4/16	25	4/7 – 4/15	100	4/12 – 4/21	2	4/2 – 4/9	7	4/5 - 4/15	0	4/10 – 4/18	2
4/16 – 4/23	111	4/15 – 4/23	102	4/21 – 4/29	191	4/9 – 4/16	84	4/15- 4/22	23	4/18 – 4/25	60
4/23 – 4/30	39	4/23 – 5/3	175	4/29 – 5/6	10	4/16 – 4/23	23	4/22 - 4/30	125	4/25 – 5/2	88
4/30 – 5/7	19	5/3 – 5/11	151	5/6 – 5/13	9	4/23 – 4/30	8	4/30 - 5/7	18	5/2 – 5/9	38
5/7 – 5/14	55	5/11 – 5/18	43	5/13 – 5/20	16	4/30 – 5/7	53	5/7 - 5/13	27	5/9 – 5/16	29
5/14 – 5/21	33	5/18 – 5/24	36	5/20 – 5/27	15	5/7 – 5/14	65	5/13 - 5/20	11	5/16 – 5/23	65
5/21 – 5/28	11	5/24 – 6/1	4	5/27 – 6/2	5	5/14 – 5/21	25	5/20 - 5/28	1	5/23 – 5/30	16
5/28 – 6/4	2	6/1 – 6/7	2			5/21 – 5/30	16	5/28 - 6/3	0	5/30 – 6/6	6
						5/30 – 6/4	1				
	296		**1,021**		**248**		**409**		**205**		**304**

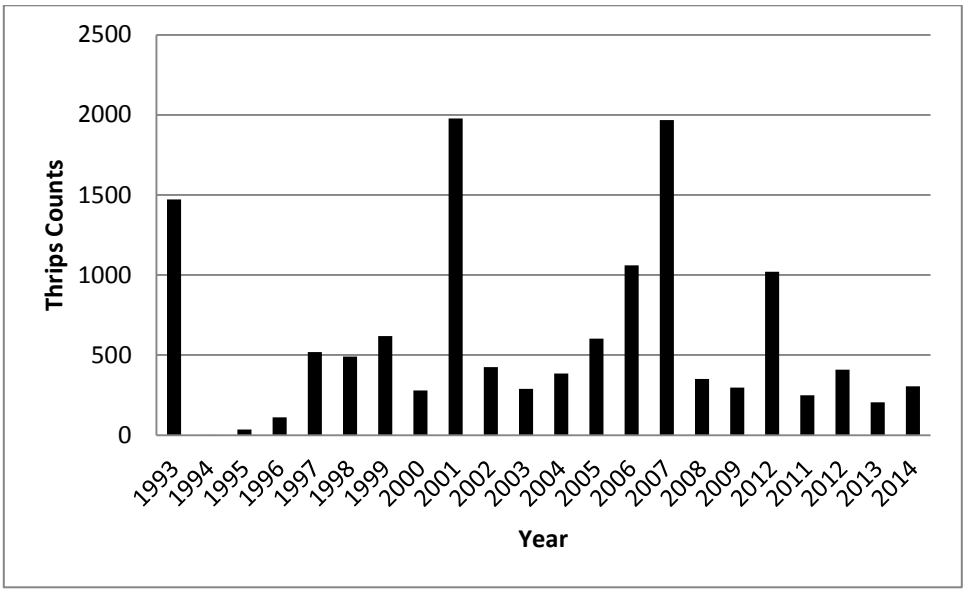


Figure 26. Total number of thrips collected at Proctor Maple Research Center in Underhill, VT on sets of four sticky traps, 1993-2014.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Ash Flowergall Mite	*Aceria fraxiniflora*	Ash	Springfield	Light, scattered damage.
Balsam Twig Aphid	*Mindarus abietinus*	Balsam fir		See narrative.
Balsam Gall Midge	*Paradiplosis tumifex*	Balsam fir	Scattered	Very light despite building populations in some plantations last year.
Balsam Woolly Adelgid	*Adelges picea*	Balsam fir and Fraser fir	Statewide	Active populations widely scattered. An arborist in Chester reported 12 heavily-infested ornamental trees.
Beech Blight Aphid	*Grylloprociphilus imbricator*	Beech	Scattered	Species-specific sooty mold, *Scorias spongiosa* , observed with aphids at some sites.
Beech Scale	*Cryptococcus fagisuga*	Beech	Statewide	See Beech Bark Disease narrative.
Birch Aphid	*Betulaphis quadrituberculata*	Birch	Springfield	This is an inconspicuous leaf-feeding aphid on birches in North America and Europe, now recorded on paper birch. (Tentative identification.)
Boxelder Bug	*Leptocoris trivittatus*	Boxelder	Scattered	Several reports of large numbers around boxelder trees and in and around homes; no damage to trees reported.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Brown Marmorated Stink Bug	*Halyomorpha halys*	Wide variety of hosts, including apples	Records exist for Bennington, Chittenden, Lamoille, Washington, Windham and Windsor Counties.	UVM Extension recommends closely monitoring agricultural crops including tree fruits and grapes as this emerging new pest can can cause significant damage throughout the growing season.
Cinara Aphids	*Cinara spp.*	Pine	Hyde Park	Observed, with tending ants, on scattered trees.
Conifer Root Aphid	*Prociphilus americanus*	Firs, including Fraser and Canaan Christmas trees	Scattered	Found affecting young trees in a few new plantations.
Cottony Maple Scale	*Pulvinaria innumerabilis*	Maple	Montpelier	On ornamental.
Elongate Hemlock Scale	*Fiorinia externa*	Ornamentals	Brattleboro, Guilford	See narrative.
Hemlock Woolly Adelgid	*Adelges tsugae*	Hemlock	Windham, Bennington and Windsor	See narrative.
Pear Thrips	*Taeniothrips inconsequens*	Hardwoods	Statewide	See narrative.
Pine bark Adelgid	*Pineus strobi*	White pine	Statewide	Only scattered individuals or small colonies observed in widely scattered locations, including on small ornamental white pines in Bennington.
Spotted Poplar Aphid	*Aphis maculatae*	Quaking aspen	Duxbury	Blue-black spotted aphids feed on Populus shoot tips in late July to leaf fall, then generally move to dogwood trees to overwinter.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Spruce Gall Adelgids	*Adelges spp.*	Spruce	Scattered	Commonly oberved in higher elevations of Windham county while looking for HWA.

Sapsucking Insects, Midges and Mites that were not reported in 2014 include Lacebugs, *Corythuca spp* .; Lecanium Scale, *Lecanium spp* .; Oystershell Scale, *Lepidospaphes ulmi* ; Pine Leaf Adelgid, *Pineus pinifoliae* ; Pine Needle Scale, *Chionapsis pinifoliae* ; Pine Spittlebug, *Aphrophora parallela;* Spruce Spider Mite, *Oligonychus ununguis* ; Woolly Alder Aphid, *Paraprociphilus tessellatus.*

BUD AND SHOOT INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Common Pine Shoot Beetle	*Tomicus piniperda*	Pines	Throughout	Found in many Vermont counties since it was detected in 1999. By federal quarantine, pine material is free to move within Vermont and through most of the region.
Pine Gall Weevil	*Podapion gallicola*	Red Pine	Widely scattered	Occasionally heavy in unhealthy red pine stands
White Pine Weevil	*Pissodes strobi*	White pine and Colorado blue spruce	Throughout	Common at low levels.

Bud and Shoot Insects not reported in 2014 included Balsam Shootboring Sawfly, *Pleroneura brunneicornis* ; Eastern Pine Shoot Borer, *Eucosma gloriola* ; Maple Petiole Borer, *Caulocampus acericaulis;* Oak Twig Pruner, *Elaphidionoides parallelus* .

ROOT INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Broadnecked Root Borer	*Prionus laticollis*			Larvae, though not commonly observed, feed on the roots of various live woody plants. Presence of the large adult beetles is usually what draws attention to their presence, especially when the male beetles are attracted to lights.
Conifer Root Aphid	*Prociphilus americanus*	Firs, including Fraser and Canaan Christmas trees	Scattered	Found affected young trees in a few new plantations.
Japanese Beetle	*Popillia japonica*	Many	Throughout	Numbers observed quite variable from one location to another.
June Beetle	*Phyllophaga* spp.	Many	Scattered	Few reports received in 2014.

Root Insects not reported in 2014 included Conifer Swift Moth, *Korsheltellus gracillis* .

BARK AND WOOD INSECTS

Asian Longhorned Beetle (ALB), *Anoplophora glabripennis*, attacks a variety of healthy and stressed deciduous hardwood tree species. The pest is not known to occur in Vermont, but in the Northeast control efforts by USDA APHIS continue against infestations in Massachusetts and New York. Early detection of ALB remains critical because eradication of small populations is a practical and feasible response.

For the second year, we deployed flight intercept/pheromone traps in Vermont for detection of ALB (Table 11, Figure 27). Lures used in the traps were comprised of a combination of six different pheromones and volatiles. Locations selected for survey work included state and private campgrounds throughout the state that were potentially at high risk based on the chance that infested firewood might have been in the area. The 20 traps were deployed in late June-early July, checked every two to three weeks, and taken down in September-early October. The earliest "out" date was June 30, and the latest "in" date was October 2. There was one lure change mid-season.

No Asian Longhorned Beetles were collected in the traps and we don't recommend any management adjustments in anticipation of this insect. There were 25 non-ALB cerambycids in the 2014 ALB traps including *Anelaphus moestus*, *Astylopsis macula*, *A. sexguttata*, *Monochamus scutellatus*, *M. notatus Neandra brunnea*, *Trigonarthris proxima*, and *Urographis fasciatus.* We continue to discourage the movement of firewood and other wood products that may be routes of entry for ALB. (See Firewood section below.)

Table 11. Location of Asian Longhorned Beetle traps deployed in Vermont in 2014. Data include county, town, location, tree species, coordinates, dates of deployment and number of trap checks.

County	Town	Location	Tree Species	Latitude	Longitude	Date Out	Date In	Number of Trap Checks
Addison	Middlebury	Kampersville	Red Maple	43.92396	-73.08395	7/1/2014	9/22/2014	6
Addison	Salisbury	Branbury State Park	Sugar Maple	43.90548	-73.06496	7/7/2014	9/29/2014	6
Bennington	Bennington	Woodford State Park	Red Maple	42.88771	-73.03626	7/2/2014	9/22/2014	6
Bennington	East Dorset	Emerald Lake State Park	Sugar Maple	43.26999	-73.01112	7/2/2014	9/26/2014	5
Caledonia	Burke	Burke Mountain	Sugar Maple	44.58527	-71.89420	7/7/2014	9/30/2014	6
Caledonia	Groton	Kettle Pond State Park	Sugar Maple	44.29481	-72.30829	7/9/2014	10/2/2014	6
Chittenden	Charlotte	Mt Philo State Park	Sugar Maple	44.27810	-73.21584	7/7/2014	9/28/2014	6
Essex	Maidstone	Maidstone State Park	Sugar Maple	44.63565	-71.64814	7/8/2014	9/30/2014	6
Franklin	Franklin	Lake Carmi State Park	Red Maple	44.95487	-72.88320	7/7/2014	9/29/2014	6
Grand Isle	Grand Isle	Grand Isle State Park	Sugar Maple	44.68682	-73.29166	7/11/2014	9/29/2014	6
Lamoille	Johnson	Maplewoods Campground	Sugar Maple	44.66644	-72.61543	7/2/2013	9/16/2014	5

County	Town	Location	Tree Species	Latitude	Longitude	Date Out	Date In	Number of Trap Checks
Orange	Randolph Center	Lake Champagne Campground	Sugar Maple	43.94823	-72.60467	6/30/2014	10/1/2014	5
Orleans	Derby Line	Derby Line Welcome Center	Sugar Maple	44.99443	-72.10335	7/7/2014	9/6/2014	4
Rutland	Killington	Gifford Woods State Park	Sugar Maple	43.67511	-72.81165	7/3/2014	10/1/2014	6
Rutland	Poultney	Lake St. Catherine State Park	Sugar Maple	43.48074	-73.20694	7/2/2014	9/26/2014	5
Washington	Barre Town	Lazy Lions Campground	Sugar Maple	44.15820	-72.49590	6/30/2014	9/22/2014	6
Windham	Guilford	I-91 Visitor Center	Sugar Maple	42.81279	-72.56615	7/3/2014	9/25/2014	6
Windham	Jamaica	Jamaica State Park	Sugar Maple	43.10871	-72.77487	7/3/2014		
Windsor	Barnard	Silver Lake State Park	Sugar Maple	43.73188	-72.61408	7/3/2014	9/21/2014	5
Windsor	Plymouth	Camp Plymouth State Park	Sugar Maple	43.47614	-72.69638	7/3/2014	9/21/2014	5

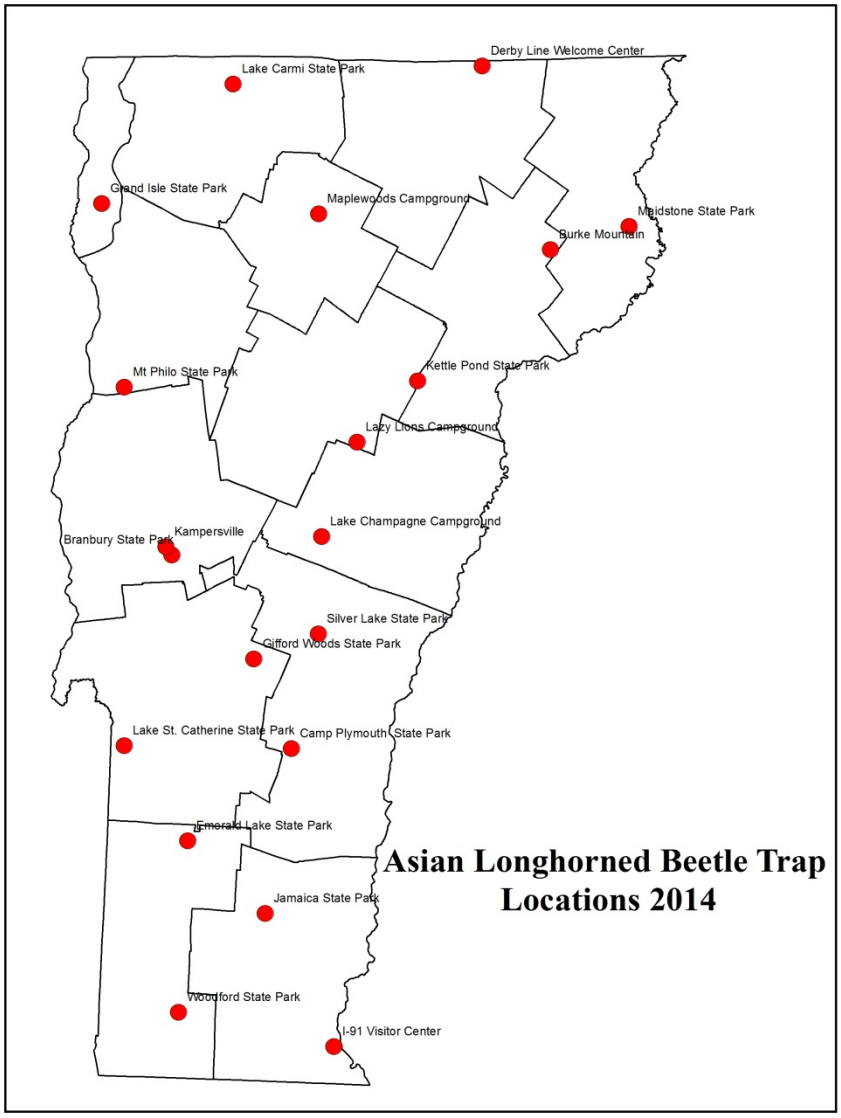


Figure 27. Asian Longhorned Beetle trap locations in 2014. There was a single trap at each location.

Emerald Ash Borer (EAB), *Agrilus planipennis*, is not known to occur in Vermont and was not detected by survey. However, it has now been detected in 24 states; Arkansas, Colorado, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin. In 2014, new county detections were made in New Hampshire, New York, Connecticut, and eastern Massachusetts.

Regulated areas have expanded in northeastern U.S. and in Canada. As of early December, the quarantine includes 3 counties in New Hampshire, and all of Connecticut and Massachusetts. Anyone using hardwood firewood, ash sawlogs, or other ash products from infested states should be aware of current regulations. Information is available by contacting USDA APHIS, the VT Agency of Agriculture, Food, & Markets, or an FPR office.

2014 Vermont EAB survey efforts included deployment of purple prism traps, evaluation of girdled trap trees, and monitoring of *Cerceris fumipennis* wasp nest sites in biosurveillance surveys.

Purple prism traps were deployed at 444 locations in Vermont in 2014 (Figure 28). USDA APHIS PPQ deployed and serviced traps in the 6 northeast counties of VT for a total of 171 purple traps, and a contractor took care of the remainder of the state for a total of 273. No EAB were found, but a total of 88 other buprestids were recovered from the traps.

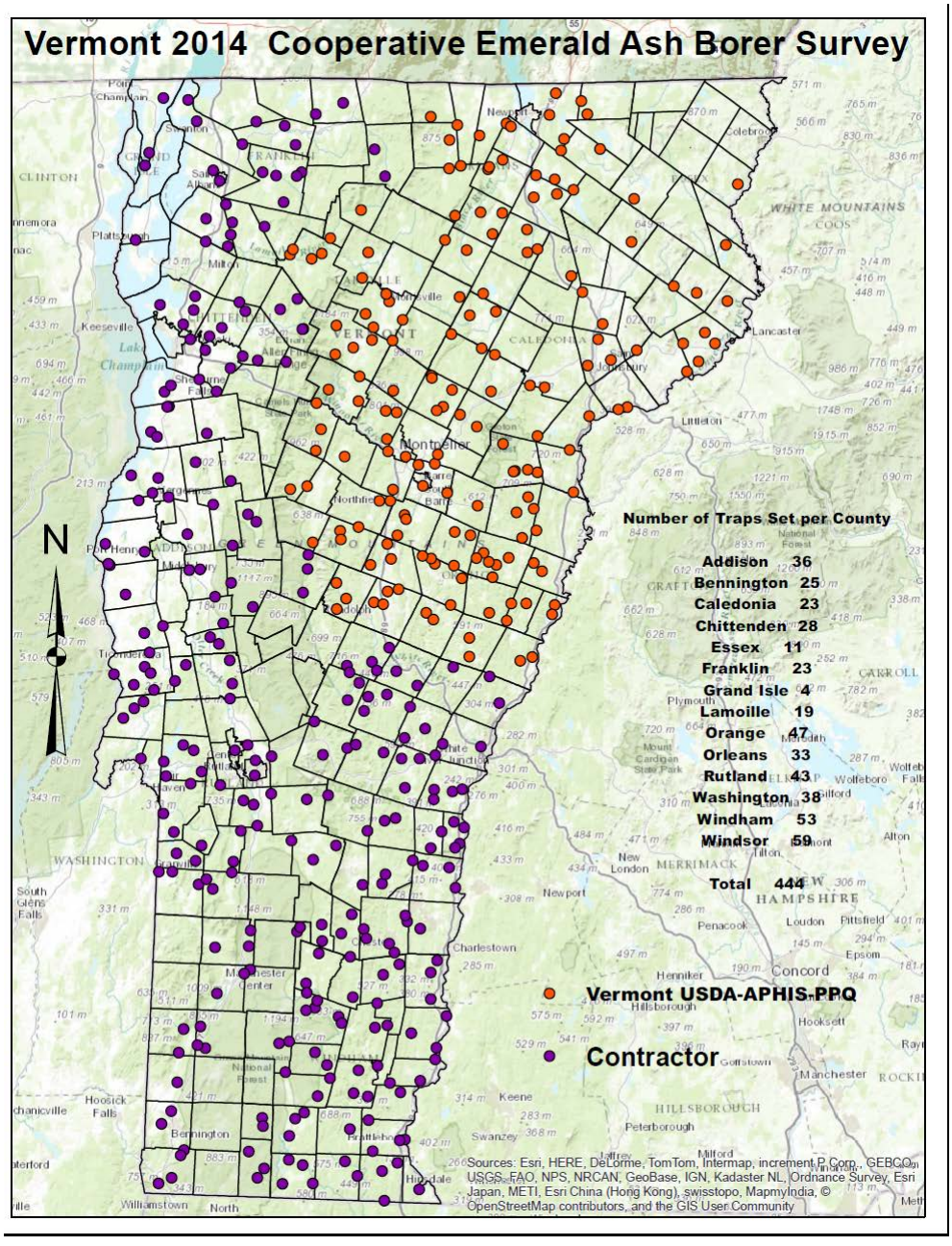


Figure 28. Location of emerald ash borer purple panel traps deployed in 2014. *Map credit: Rhonda Mace, USDA APHIS.*

Twenty girdled white ash trees from high risk areas in eleven counties were selected as trap trees. As in past years, ash trees 4-10 inches in diameter that were exposed to the sun were girdled with a pruning saw to make two parallel cuts, 8-12 inches apart. A drawknife was used to remove the bark between these cuts.

In 2014, the trees ranged in diameter from 4.2" to 10.7". All trees were girdled between May 19 and June 26. Trees were cut within two weeks of peeling, and one three-foot section per 1 inch DBH was collected from each tree and peeled to look for signs of emerald ash borer. Peeling was done by FPR staff and volunteer First Detectors over a two day period, November 12-13. In addition, three trees (7 – 13" in diameter) were girdled at each of five campgrounds on the Green Mountain National Forest, and peeled in the fall by the US Forest Service. No emerald ash borer or indications of emerald ash borer were discovered, but evidence of a few native wood borers was found.

Table 12. Locations of girdled trap trees used to survey for emerald ash borer in 2014. Data include district, town, county, coordinates and tree identification number.

EAB Trap Tree Locations - 2014						
District	**Site**	**County**	**Latitude**	**Longitude**	**Observer**	**Tree Number**
FPR District 1	Townshend SP	Windham	43.04084	-72.68918	Esden	14-1-1
FPR District 1	Ft Dummer SP	Windham	43.82382	-72.56665	Esden	14-1-2
FPR District 1	Ascutney SP	Windsor	43.43370	-72.40481	Esden	14-1-3
FPR District 1	I-91 Exchange	Windsor	43.64364	-72.33865	Esden	14-1-4
FPR District 2	Molly Stark SP	Windham	42.85158	-72.81612	Lund	14-2-1
FPR District 2	Pine Hollow Campground	Bennington	42.78470	-73.19955	Lund	14-2-2
FPR District 2	Emerald Lake SP	Bennington	43.28041	-73.00786	Lund	14-2-3
FPR District 2	Lake St. Catherine SP	Rutland	43.48313	-73.20953	Lund	14-2-4
FPR District 3	Grand Isle SP	Grand Isle	44.68921	-73.29041	Dillner	14-3-1
FPR District 3	Mud Creek WM	Grand Isle	44.96606	-73.27113	Dillner	14-3-2
FPR District 3	Mt. Philo SP	Addison	44.28070	-73.21488	Dillner	14-3-3
FPR District 3	Lake Carmi SP	Franklin	44.95733	-72.87492	Dillner	14-3-4
FPR District 4	Elmore SP S27	Lamoille	44.54507	-72.53133	Lackey	14-4-1
FPR District 4	Elmore SP S10	Lamoille	44.54427	-72.53234	Lackey	14-4-2
FPR District 4	Little River S19	Washington	44.38963	-72.76451	Lackey	14-4-3
FPR District 4	Little River Willow Lean-to	Washington	44.39302	-72.76199	Lackey	14-4-4
FPR District 5	Maidstone SP	Essex	44.63639	-71.64413	Greaves	14-5-1
FPR District 5	Ricker Pond SP	Caledonia	44.24350	-72.24610	Greaves	14-5-2
FPR District 5	Kettle Pond SP	Caledonia	44.29392	-72.31049	Greaves	14-5-3
FPR District 5	Lyndonville Rest Area I91-S	Caledonia	44.56611	-72.03476	Greaves	14-5-4
GMNF: North	Moosalamoo CG	Addison	43.918	-73.035	USFS	3 trees
GMNF: North	Chittenden Brook CG	Rutland	43.825	-72.910	USFS	3 trees
GMNF: North	Bingo Brook	Addison	43.876	-72.914	USFS	3 trees
GMNF: South	Greendale	Windsor	43.354	-72.824	USFS	3 trees
GMNF: South	Hapgood CG	Bennington	43.255	-72.895	USFS	3 trees

We continued to visit *Cerceris fumipennis* wasp sites in 2014 in what is popularly referred to as biosurveillance for EAB. A crew of about 45 volunteers assisted with this effort, and over 220 hours were contributed in 2014 to monitoring known *Cerceris* nest sites and searching for new locations. The volunteer group changes somewhat each year, with a handful of new recruits coming on board, while some seasoned waspwatchers give up biosurveillance to take on other projects.

Over 45 potential nest sites were visited, and *Cerceris* wasps were found in 27 sites, representing seven counties (Figure 29 and Table 13). This is the same number of sites and counties as 2013, but there was a slight change in active sites; some new ones were added and others dropped because of wasp inactivity.

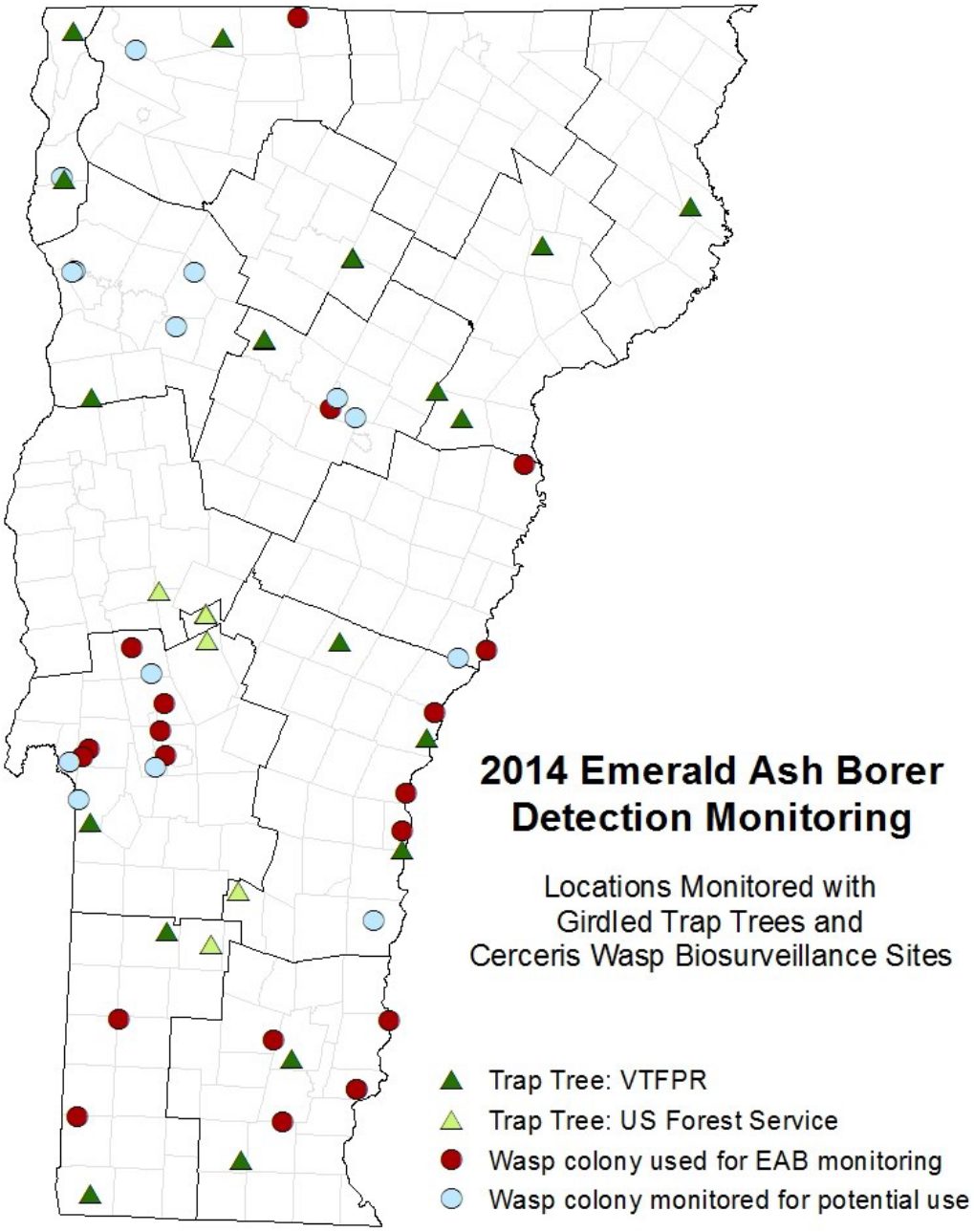


Figure 29. Location of girdled ash trap trees and *Cerceris fumipennis* colonies monitored in 2014 as part of Vermont's survey for emerald ash borer.

Table 13. Vermont sites where *Cerceris fumipennis* nests were found in 2014. Data include county, town, site, coordinates, and numbers of buprestid beetles collected at each site.

County	Town	Site	Latitude	Longitude	# Buprestids
Bennington	N. Bennington	Lake Paran Baseball Field	42.92998	-73.23571	24
Bennington	Sunderland	Jones Quarry	43.11211	-73.13010	29
Franklin	Richford	Richford Playground	44.99370	-72.67763	50
Orange	East Thetford	Cedar Circle Farm and Education Center	43.80632	-72.18617	52
Orange	Newbury	Newbury Green	44.04429	-72.03331	4
Orange	Thetford	Union Village Dam	43.79323	-72.25990	1
Orange	Tunbridge	Tunbridge Rec Field	43.53433	-72.29030	1
Orange	Wells River	Blue Mountain Union High School	44.15575	-72.08399	50
Rutland	Brandon	Estabrook Field	43.81058	-73.10345	44
Rutland	Brandon	Otter Valley Union	43.45561	-73.03052	2
Rutland	Castleton	Castleton Hubbardton Elementary School	43.61962	-73.21140	56
Rutland	Hydeville	Hydeville Ball Field	43.60496	-73.22995	27
Rutland	Pittsford	Lothrop School	43.70545	-73.01867	27
Rutland	Poultney	Poultney Elementary	43.31308	-73.14168	6
Rutland	Proctor	Proctor Junior/Senior High School	43.65561	-73.02802	53
Rutland	Rutland Town	Dewey Field	43.60718	-73.01324	17
Washington	Montpelier	Montpelier High School	44.26038	-72.58925	87
Washington	Montpelier	Montpelier Rec Field	44.27976	-72.57146	53
Washington	Montpelier	U-32 High School	44.24299	-72.52633	9
Windham	Bellows Falls	Bellows Falls Union High School	43.11172	-72.43839	42
Windham	Jamaica	Stephen Ballantine Memorial Field	43.07638	-72.73369	63
Windham	Marlboro	Augur Hole	42.92210	-72.71030	50
Windham	Putney	Sand Hill Pit and Road	42.98276	-72.52088	87
Windsor	Hartland	Hartland Elementary School	43.53853	-72.39258	28
Windsor	Norwich	Dothan Brook School	43.68898	-72.32139	19
Windsor	Springfield	The Commons	43.17566	-72.28413	1
Windsor	Windsor	Windsor Town Rec Field	43.46924	-72.40329	77
Total					959

No emerald ash borer beetles were found, but 959 buprestid beetles were collected at *Cerceris* sites in 2014. We met our per-site goal of 50 beetles at 11 of the 27 sites.

Buprestids beetle identifications for 2014, including both those taken at *Cerceris* nest sites and those recovered from purple prism traps, are not yet complete, but we can now report on identifications of

buprestids collected during the 2012-2013 *Cerceris* season. We added 14 new species of buprestids to our holdings over that period. (Table 14).

Table 14. Buprestid beetles collected 2012-2013. Data include species within each subfamily, numbers collected each year, and which are new species records for the Forest Biology Laboratory Collection.

Species of Buprestid Beetles	2012	2013	Total	New to our list?
Subfamily Agrilinae				
Agrilus anxius Gory	44	67	111	
Agrilus arcuatus (Say)	14	17	31	
Agrilus bilineatus (Weber)	1	4	5	
Agrilus corylicola Fisher	1	3	4	*
Agrilus juglandis Knull	1	0	1	*
Agrilus obsoletoguttatus Gory	4	0	4	*
Agrilus politus (Say)	2	39	41	
Agrilus putillus Say	0	4	4	*
Agrilus ruficollis (F.)	0	1	1	
Agrilus spp. undet.	6	18	24	
Eupristocerus cognitans (Weber)	2	3	5	
Subfamily Buprestinae				
Buprestis consularis Gory	1	6	7	*
Buprestis maculativentris (Say)	8	9	17	
Buprestis striata F.	78	18	96	
Dicerca asperata (Laporte & Gory)	2	0	2	*
Dicerca caudata LeConte	15	32	47	
Dicerca divaricata (Say)	497	622	1119	
Dicerca dumolini (Laporte & Gory)	1	0	1	*
Dicerca lurida (F.)	55	39	94	
Dicerca punctulata (Schoenherr)	0	1	1	
Dicerca tenebrica (Kirby)	10	28	38	
Dicerca tenebrosa (Kirby)	12	8	20	
Dicerca tuberculata (Gory & Laporte)	32	5	37	
Phaenops fulvoguttata (Harris)	65	36	101	
Poecilonota cyanipes (Say)	20	80	100	
Spectralia gracilipes (Melsheimer)	1	0	1	*
Subfamily Chalcophorinae				
Chalcophora fortis LeConte	0	1	1	*
Subfamily Chrysobothrinae				
Chrysobothris azurea LeConte	2	3	5	*
Chrysobothris dentipes (Germar)	0	3	3	*
Chrysobothris femorata (Olivier)	5	5	10	
Chrysobothris harrisi (Hentz)	0	1	1	
Chrysobothris rotundicollis Gory & Laporte	8	4	12	*

Species of Buprestid Beetles	2012	2013	Total	New to our list?
Subfamily Chrysobothrinae				
Chrysobothris scabripennis Gory & Laporte	0	1	1	*
Chrysobothris sexsignata (Say)	38	20	58	
Chrysobothris spp. undet.	0	4	4	
Chrysobothris verdigripennis Frost	0	3	3	*
Subfamily Trachyinae				
Brachys aerosus (Weber)	1	2	3	
TOTALS	**926**	**1087**	**2013**	

In addition to those listed, other species in our Forest Biology Laboratory Buprestid Collection include *Agrilus granulatus* (Say), *Agrilus sayi* Saunders, *Buprestis aurulenta* L., *Buprestis nutalli* Kirby, *Actenodes acronis* (Say), *Chrysobothris chlorocephala* Gory, *Chrysobothris cribraria* Mannerheim.

An interagency Invasive Forest Pest Action Plan is updated every year. The website dedicated to invasives, vtinvasives.org, covers non-native plants and tree pests, and provides information on reporting suspects, spreading the word, and getting involved as a volunteer. In 2014, 29 new volunteers attended Vermont's Forest Pest First Detector Program training, bringing the statewide total of trained volunteers to 147 (Figure 30).

Other outreach through VTInvasives E-News and Facebook has increased public awareness of threatening exotic-invasive organisms in Vermont. Collectively, First Detectors spent a total nearly 450 hours surveying, screening, and conducting other outreach about emerald ash borer, Asian longhorned beetle, and hemlock woolly adelgid.

In cooperation with UVM Extension, we continue to work with Vermont towns in developing Community Preparedness Plans. As of the end of the year, 27 communities are working on, or have completed EAB plans, either as stand-alone documents or by completing street tree inventories and developing urban forest management plans that address EAB and other pests (Figure 30). For more information, visit http://vtinvasives.org/tree-pests/community-preparedness.

Emerald ash borer was featured during Ash Awareness Week April 27– May 3, drawing attention to the importance of our ash resource. Activities included tree taggings, ash tree walks hosted around the state, news coverage and other events that involved 130 volunteers and staff.

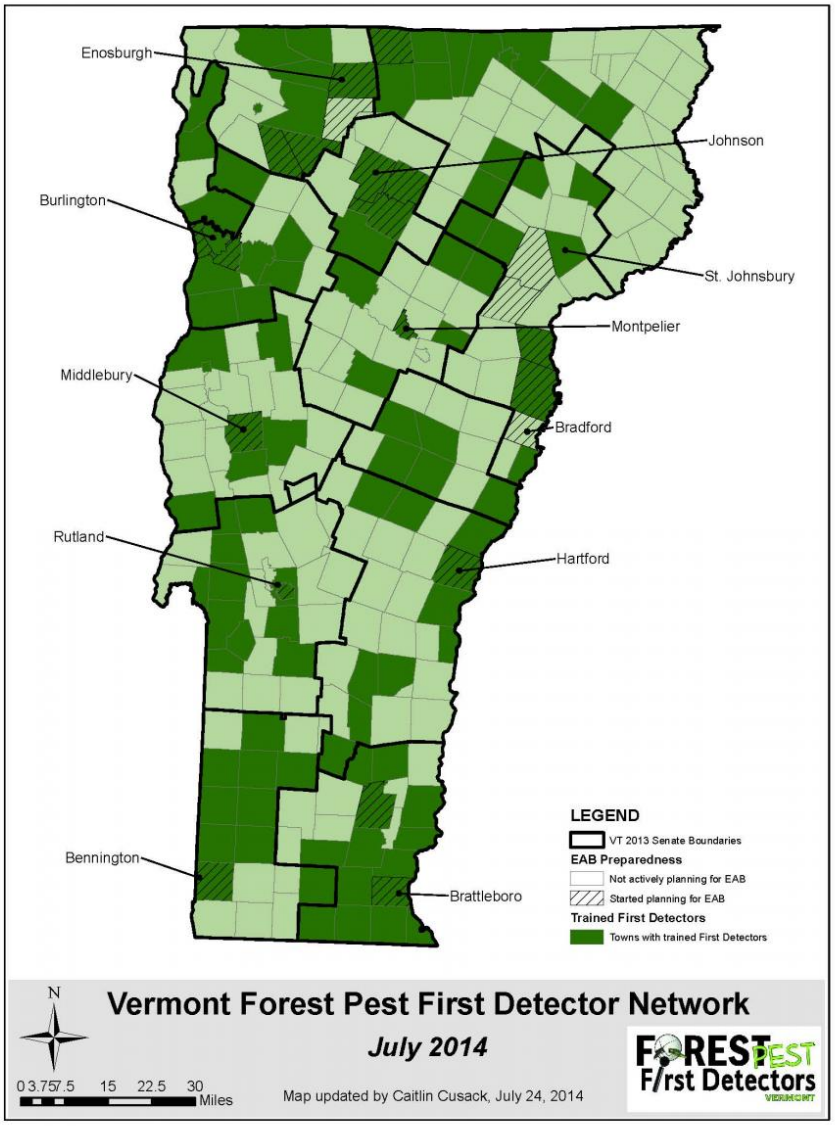


Figure 30. The Vermont Forest Pest First Detector Network. Map shows towns with trained First Detectors and towns that have started actively planning for Emerald Ash Borer.

Firewood

In an effort to reduce the possibility of introducing non-native forest insects and diseases into Vermont, our Don't Move Firewood outreach continues in Vermont State Parks. In support of Department policy #24: Importation of firewood, the 2014 camping season was the sixth year that our State Parks exchanged firewood with campers who brought wood in from out of state. This year the total number of bags of firewood collected statewide was 51 (1.5 cords). This is the lowest amount of firewood collected since the program began (Table 15) and is a sign that campers appear to be getting the "Don't move firewood" message. The parks that collected the most wood this year were: Little River (16 bags), Elmore (13) and Quechee (10). Parks that collected 5 or fewer bags were: Maidstone, Jamaica, Townshend, Molly Stark, Silver Lake, Woodford and Branbury. Firewood brought into our parks this year came from New Hampshire, New York, New York City, Maine, Massachusetts, Connecticut and Florida. Most of these

states have current firewood quarantines that ban removal of firewood from some of their counties. Forest Protection staff opened and examined all bags of firewood for signs of invasive pests. No signs of targeted pests were found. All of firewood collected has been donated to state-owned wood burning facilities for use during the current heating season.

Table 15. Numbers of bags of firewood brought into Vermont State Parks during the 2009-2014 camping seasons. From 2009-2012, firewood from over 50 miles away was exchanged. Beginning in 2013, all out-of-state firewood was included in the exchange program.

Year	Number of Bundles of Firewood
2009	212
2010	379
2011	158
2012	136
2013	148
2014	51

Exotic Wood Borer/Bark Beetle National Survey

In 2014, the USDA and the Vermont Agency of Agriculture conducted surveys, using pheromone traps, for a variety of exotic woodboring beetles as part of the Exotic Wood Borer/Bark Beetle National Survey. A total 68 traps were deployed in high risk sites such as mulch manufacturers, rest areas, lumber yards, sawmills, log yards, wood chip producers, wood chip fired power plants, college campuses, state parks, campsites, and stump dumps, as well as others.

Table 16. Number of traps deployed in Vermont counties in 2014 as part of the exotic wood borer survey conducted by the USDA and the Vermont Agency of Agriculture.

Number of Traps Set per County	
Addison	9
Bennington	0
Caledonia	15
Chittenden	16
Essex	0
Franklin	1
Orange	1
Orleans	9
Rutland	2
Washington	9
Windham	4
Windsor	2
Total	**68**

Traps at each site were baited with various lures (Table 17). The alpha-pinene and ultra-high release ethanol lures are attractive to a number of species, including target exotics such as *Hylurgops palliates* (Lesser spruce shoot beetle), *Hylurgus ligniperda* (Red-haired pine bark beetle), and *Tomicus destruens* (a pine shoot beetle). Target species *Tetropium fuscum* (Brown spruce longhorned beetle) is lured to the "BSLB" concoction that consists of a spruce blend, geranyl acetol and ultra-high release ethanol. *Ips sexdentatus* (Six-toothed bark beetle), *Ips typographus* (European spruce bark beetle), and *Orthotomicus erosus* (Mediterranean pine engraver) respond to a triple compound Ips lure. A lure attractive to *Sirex noctilo* (the Sirex woodwasp) completed the trapping effort. Traps were separated by about 30 yards, as specified in the trapping protocol, and checked every two weeks. None of the target species was collected.

Table 17. Number of traps set per lure type in Vermont during 2014 as part of the exotic wood borer survey conducted by the USDA and the Vermont Agency of Agriculture.

Number of Traps Set per Lure Type	
Alpha pinene & ETOH	22
BSLB	24
Ips	18
Sirex	4
Total	**68**

OTHER BARK AND WOOD INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
A Horntail Wasp	*Urocerus albicornis*	Sugar maple	Cavendish	Found in declining maples.
A Longhorned Beetle	*Clytus ruricola*	Conifers	District 1	No significant damage observed, but receive frequent calls; specimens brought in throughout season.
Asian Longhorned Beetle	*Anoplophora glabripennis*	Various hardwoods		Not observed or known to occur in Vermont. See narrative.
Bark Beetles	*Subfamily Scolytinae*	White pine	Barre Town	Secondary in declining trees.
Black and Red Horntail	*Urocerus cressoni*	Trap survey	Southern Vermont	Known hosts include fir, spruce, and pine.
Black Timber Beetle	*Xylosandrus germanus*	Sugar maple	Charlotte	Native to Asia, now widespread in NA; attacks a very wide range of host plants, including both deciduous and coniferous trees. An emerging pest in nurseries.
Bronze Birch Borer	*Argrilus anxius*	Birch	Scattered throughout	Mortality in small naturalized stand of European birch; a few trees affected at Little River State Park where borer was considered secondary.
Black Spruce Beetle	*Tetropium castaneum*	Spruce, pine, fir and larch		Not observed or known to occur in Vermont.
Brown Spruce Longhorned Beetle	*Tetropium fuscum*	Spruce, pine and fir		Not observed or known to occur in Vermont.
Clearwing Moth	*Podesia* sp.	Ash	Chester, Townshend	Clearwing borer larvae tunnel deeply into wood as larvae and leave large round holes when they emerge as adults.

OTHER BARK AND WOOD INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Eastern Ash Bark Beetle	*Hylesinus aculeatus*	Ash	Scattered reports	Beetles encountered as they emerged from firewood and logs; galleries observed in downed ash.
Eastern Larch Beetle	*Dendroctonus simplex*	Larch	Northeast Kingdom	Associated with scattered larch decline.
Emerald Ash Borer	*Agrilus planipennis*	Ash		Not observed or known to occur in Vermont. See narrative.
European Woodwasp	*Sirex noctilio*	Red and Scots pine plantation	Jericho	Though trapped in several Vermont counties over the past few years, this was the first observation of infested trees.
Hemlock Borer	*Phaenops fulvoguttata*	Hemlock and occasionally other conifers	Colchester, Fairfield, North Hero,	Some affected trees appear to have been stressed from 2011 spring flooding prior to borer infestation. Others have limited root systems. Collected by *Cerceris fumipennis* wasps during biosurveillance surveys.
Japanese Cedar Longhorned Beetle	*Callidiellum rufipenne*	Arborvitae, eastern redcedar, juniper and others		Not observed or known to occur in Vermont.
Leopard Moth	*Zeuzera pyrina*	Ash	Southern Vermont	Reared from larva in wood.
Northeastern Sawyer	*Monochamus notatus*	Conifers	Scattered	Adults observed during flight period; some adults showed up in Asian longhorned beetle traps.
Pigeon Tremex	*Tremex columba*	Sugar maple	Scattered throughout	Commonly observed in declining trees or turning up while splitting firewood.

OTHER BARK AND WOOD INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Redheaded Ash Borer	*Neoclytus acuminatus*	Ash	Springfield, Chester	Overwinters in infested tree trunks, probably as pupae; adults emerge in early spring and lay eggs under bark of recently dead trees.
Shothole Borer	*Scolytus rugulosus*	Black Cherry	Shelburne	Attacks damaged branches and trunks of many broadleaves, including fruit trees.
Sugar Maple Borer	*Glycobius speciosus*	Sugar maple	Scattered throughout	Signs of activity commonly observed throughout the state.
Whitespotted Sawyer	*Monochamus scutellatus*	White pine and other conifers	Common throughout	Adults commonly observed.

Other Bark and Wood Insects not reported in 2014 included Allegheny Mound Ant, *Formica exsectoides;* Elm Bark Beetle, *Hylurgopinus rufipes* and *Scolytus multistriatus* ; Locust Borer, *Megacyllene robinae* ; Red Turpentine Beetle, *Dendroctonus valens;* Round-headed Apple Tree Borer, *Saperda candida.*

FRUIT, NUT AND FLOWER INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Asiatic Garden Beetle	*Autoserica castanea*	Many	Scattered observations	Light damage where populations were kept in check manually.
Dusky Firefly	*Ellychnia corrusca*	Apple	Lincoln	Adults observed feeding in damaged fruit on apple tree.
Rose Chafer	*Macrodactylus subspinosus*	Many	Statewide	Present, but not reported as particularly numerous in 2014.
Western Conifer Seed Bug	*Leptoglossus occidentalis*	Conifers	Statewide	No damage to Vermont conifers has been recorded, but a common household invader. Fewer reports as people have become accustomed to their appearance.

Fruit, Nut and Flower Insects not reported in 2014 included Butternut Curculio, *Conotrachelus juglandis;* Fir Coneworm, *Dioryctria abietivorella;* Green Stink Bug, *Chinavia hilaris;* Pine Coneworm, *Dioryctria reniculelloides;* Plum Curculio, *Conotrachelus nenuphar* .

STEM DISEASES

Beech Bark Disease, caused by *Cryptococcus fagisuga* and *Nectria coccinea var. faginata*, was the primary cause of dieback and mortality on 14,479 acres (Table 18, Figure 31), a drop from the 25,150 acres mapped in 2013. This non-native pest complex remains the most common cause of decline and mortality mapped during aerial surveys, and accounted for 36% of the area mapped. Observers reported that the severity level of beech bark disease was similar to 2013.

Table 18. Mapped acres of Beech Bark Disease in 2014.

County	Acres
Addison	403
Bennington	1,618
Caledonia	300
Chittenden	123
Essex	1,358
Franklin	1,351
Grand Isle	4
Lamoille	3,527
Orange	365
Orleans	884
Rutland	958
Washington	1,713
Windham	895
Windsor	982
Total	**14,479**

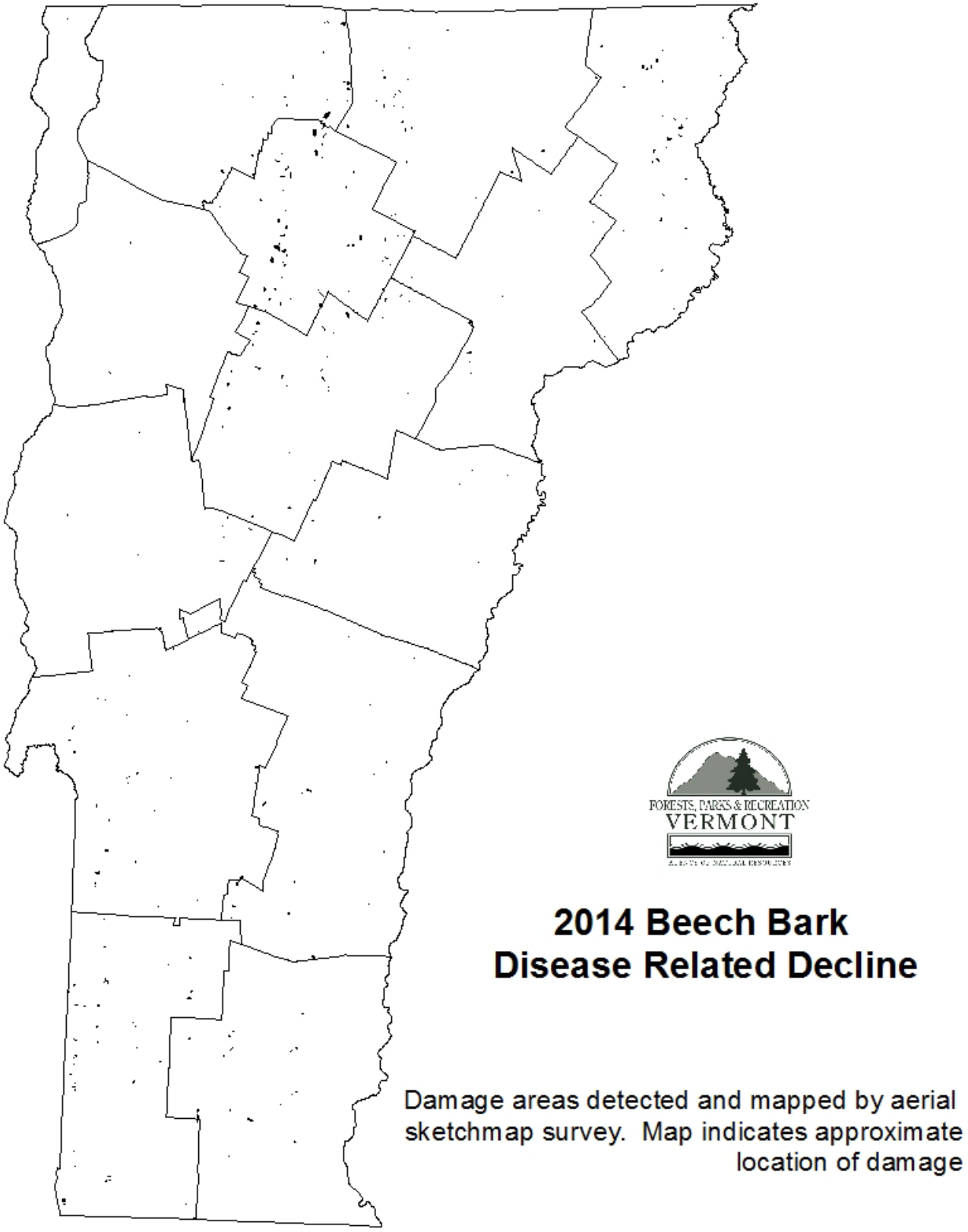


Figure 31. Beech Bark Disease related decline mapped in 2014. Mapped area includes 14,479 acres.

Diplodia Shoot Blight, caused by *Sphaeropsis sapinea,* is of increasing concern. Shoot blight continues to be severe on widely scattered red and Scots pine, and Diplodia has been confirmed in some of these plantings. Its role in the severe Red Pine decline, observed in widely scattered pockets, is unclear, but under study (see Diebacks, Declines, and Environmental Diseases).

OTHER STEM DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Ash Yellows	*Candidatus Phytoplasma fraxini*	White ash	Southern and Northwestern Vermont	Remains heavy in scattered locations.
Beech Bark Disease	*Cryptococcus fagisuga and Nectria coccinea var. faginata*			See narrative.
Black Knot	*Dibotryon morbosum*	Cherry	Scattered throughout	Common at normal levels.
Butternut Canker	*Sirococcus clavigignenta-juglandacearum*		Widespread	Remains stable, with most butternuts showing signs of the disease.
Caliciopsis Canker	*Caliciopsis pinea*	White pine	Widely scattered	Associated with decline where trees are stressed by recurrent needle diseases.
Cedar Apple Rust	*Gymnosporangium juniperi-virginianae*	Red Cedar	Ferrisburg	
Chestnut Blight	*Cryphonectria parasitica*	American chestnut	Southern Vermont, Champlain Valley	Observed on sprouts. The American Chestnut Foundation remains active in establishing seed orchards in Vermont.
Cytospora Canker	*Leucostoma kunzei*	Blue spruce	Widely scattered	Damage levels remain low.
Delphinella Tip Blight of Fir	*Delphinella balsamae*	Balsam fir	Widely scattered	Christmas trees.
Diplodia Shoot Blight	*Sphaeropsis sapinea*			See narrative.
Dutch Elm Disease	*Ophiostoma novo-ulmi*	Elm	Throughout	Some reports suggest dead trees have been increasingly common along roadsides.

OTHER STEM DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Hypoxylon Canker	*Hypoxylon pruinatum*	Poplar	Widely scattered	Damage levels low.
Nectria Canker	*Nectria galligena*	Hardwoods	Scattered throughout	
Oak Wilt	*Ceratocystis fagacearum*		Not observed or known to occur in Vermont.	
Phomopsis Blight	*Phomopsis sp.*	Juniper	Northeastern Vermont	Ornamentals.
Red Ring Rot	*Phellinus pini*	White pine	Scattered throughout	Common in unthrifty stands, especially where basal area is high and soils are poorly drained.
Sapstreak	*Ceratocystis coerulescens*	Sugar maple	Northfield	Causing an enlarging pocket of mortality in a stand on a shallow site originally stressed by forest tent caterpillar, with infection courts produced through multiple entries.
Sirococcus Blight	*Sirococcus conigenus*	Red Pine	Woodstock	
Sirococcus Shoot Blight	*Sirococcus tsugae*	Hemlock	Widely scattered	Observed on ornamentals and understory hemlocks.
White Pine Blister Rust	*Cronartium ribicola*	White pine	Statewide	Levels remain higher than normal. 80 acres of scattered mortality mapped during aerial surveys.
Woodgate Gall Rust	*Endocronartium harknessii*	Scots pine	Northern Vermont	Present in pockets of unthrifty roadside Scots pine.

OTHER STEM DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Yellow Witches Broom Rust	*Melampsorella caryophyllacearum*	Balsam fir	Widely scattered	Continues to be more noticeable than normal, especially in northeastern Vermont.

Other Stem Diseases not reported in 2014 included Eastern Dwarf Mistletoe, *Arceuthobium pusillum* ; Scleroderris Canker, *Ascocalyx abietina;* Verticillium Wilt, *Verticillium albo-atrum.*

FOLIAGE DISEASES

Anthracnose, caused by *Gloeosporium sp*. and other fungi, was much less noticeable than it has been in recent years. During the late summer aerial surveys, 1,488 acres of brown and defoliated hardwoods were mapped (Table 19, Figure 32) compared to 49,299 acres in 2013.

Table 19. Mapped areas of brown and defoliated hardwoods mapped in 2014.

County	Acres
Addison	167
Bennington	22
Caledonia	38
Chittenden	10
Essex	206
Franklin	265
Lamoille	39
Orleans	230
Rutland	127
Washington	74
Windham	87
Windsor	223
Total	**1,488**

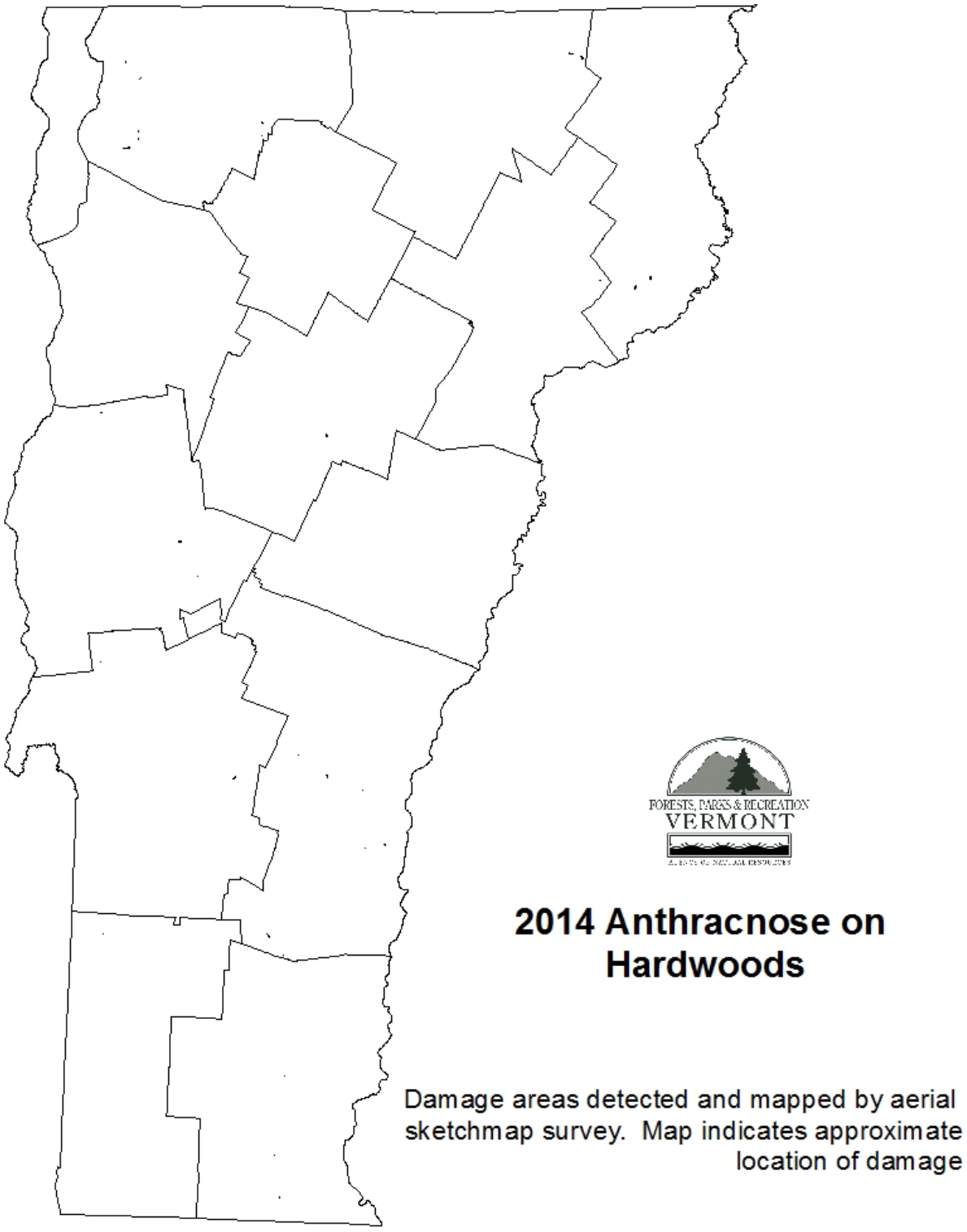


Figure 32. Browning and defoliation of hardwoods mapped in 2014. Mapped area includes 1,488 acres.

Needle Diseases of White Pines, primarily attributed to the Brown Spot Needle Blight fungus, *Mycosphaerella dearnessii,* but also two needlecast fungi (*Canavirgella banfieldii* and *Bifusella linearis),* continued to be widespread, with an increase in damage from 2013. More of the brown 2013 needles were retained late in the season than previous years, but thin crowns were observed statewide due to early casting and consecutive years of disease. During aerial surveys, 4,972 acres were mapped. Because the June survey covered only the Green Mountain National Forest, and the damage was harder to detect by the August survey when a statewide survey was conducted, this acreage is a small percentage of the total area affected.

These diseases are most severe in the lower crown where fungi have been thriving due to multiple wet springs. The damage has been widespread since 2010, and the current epidemic has been building at least since 2005. Decline and mortality of white pine have been observed in stands which have had multiple years of needle damage where other stress factors are also present such as wet site conditions, wind impact, or wounding. Weak pests and pathogens, such as turpentine beetles, Caliciopsis canker, and Armillaria root rot have been observed in some stressed stands.

The U.S. Forest Service, in cooperation with UNH and affected states, continues to investigate this malady, including studies to clarify the roles of needlecast fungi and weather. As part of this project, we are monitoring plots in Plymouth, Richmond, St. Johnsbury, and Springfield (Figure 33).

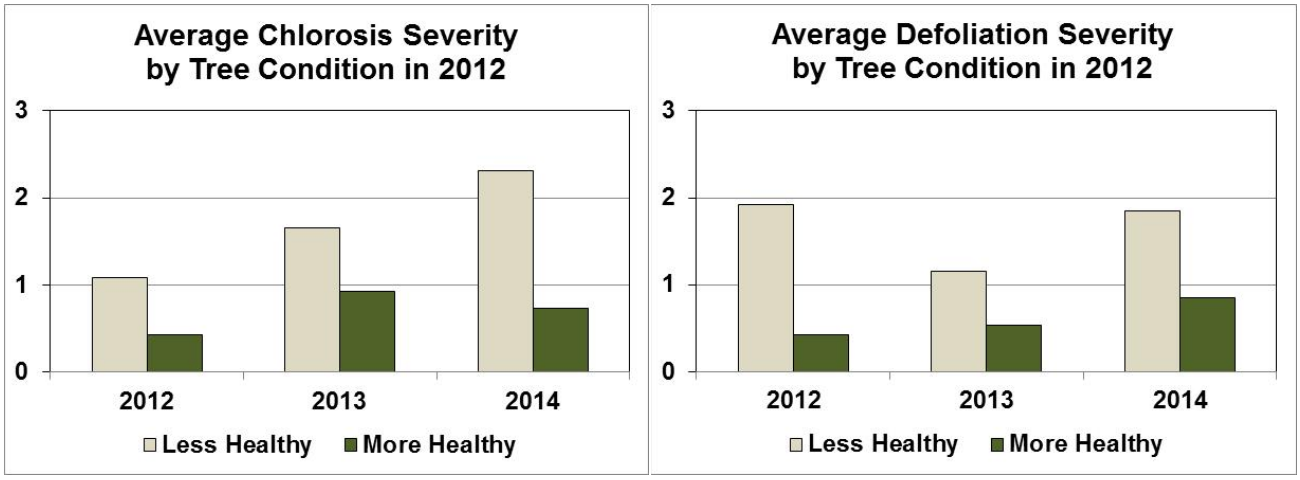


Figure 33. Average white pine chlorosis and defoliation severity ratings at needlecast monitoring sites in 2012-2014, by overall condition when monitoring was initiated in 2012. Symptoms rated as **1**=<1/3 crown affected, **2**=1/3 to 2/3 crown affected, and **3**=more than 2/3 affected. Data are from 52 trees in 4 sites (Plymouth, Richmond, St. Johnsbury, and Springfield). These data are part of a multi-state project coordinated by the U.S. Forest Service.

Septoria Leafspot on Birch, caused by *Septoria betulae*, decreased substantially with 5,335 acres mapped during aerial surveys, compared to 98,329 acres in 2013 (Table 20, Figure 34). High elevation birch decline remains common, and may be linked to previous defoliations by Septoria (see Diebacks, Declines, and Environmental Diseases).

Table 20. Mapped acres of birch defoliation in 2014.

County	Acres
Addison	218
Bennington	2,166
Caledonia	110
Chittenden	93
Essex	10
Franklin	10
Lamoille	133
Orange	204
Orleans	324
Rutland	1,482
Washington	127
Windham	223
Windsor	235
Total	**5,335**

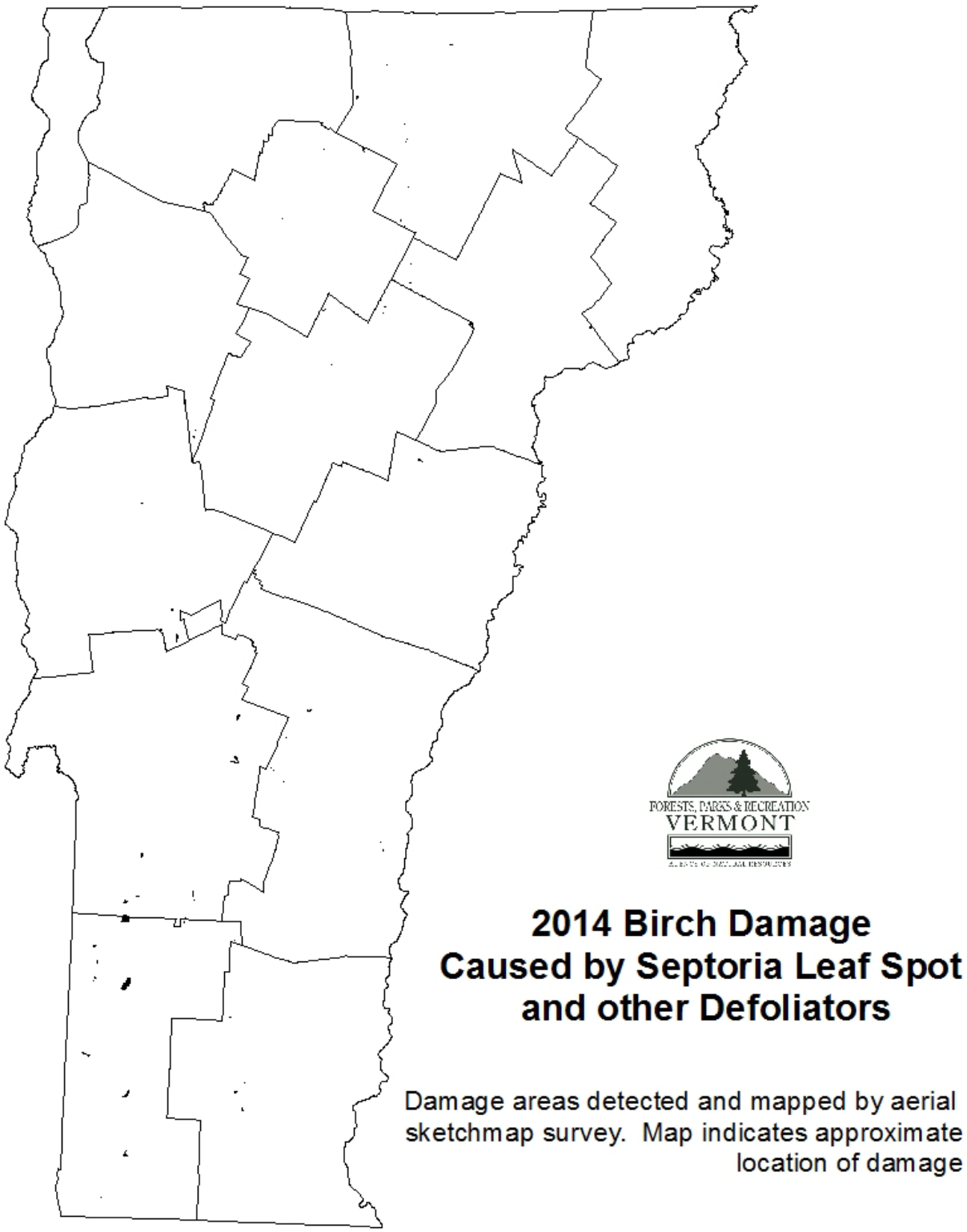


Figure 34. Birch damage caused by Septoria leaf spot and other defoliators mapped in 2014. Mapped area includes 5,335 acres.

OTHER FOLIAGE DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Anthracnose	*Gloeosporium Glomerella spp. Apiognomonia spp.*			See narrative.
Brown Spot Needle Blight		Red pine	Statewide	475 acres of browning mapped during aerial surveys is attributed, in part, to this disease. Role in red pine decline is unclear (see Diebacks, Declines, and Environmental Diseases).
		Scots pine	Statewide	Continues to be very noticeable. Contributing to decline of ornamentals.
		White pine	Statewide	See White Pine Needlecast.
Canavirgella Needlecast	*Canavirgella banfieldii*			See White Pine Needlecast.
Cedar Apple Rust	*Gymnosporangium juniperi-virginianae*	Apple	Widely scattered in western VT	Several reports from ornamental and wildlife plantings.
Cercospora Leaf Spot	*Cercospora sp.*	Flowering Dogwood	West Rutland	Wild population.
Dogwood Anthracnose	*Discula destructiva*	Flowering Dogwood	Dorset	Ornamentals. Samples from wild dogwood in West Rutland tested negative for Dogwood Anthracnose.
Fir-Fern Rust	*Uredinopsis mirabilis*	Balsam fir	Widespread	Continues to be common. Occasional moderate damage to Christmas trees. Yellow foliage on forest trees noticeable on lower branches and understory.

OTHER FOLIAGE DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Giant Tar Spot	*Rhytisma acerinum*	Norway maple	Statewide	Continues to be noticeable, but only light damage observed.
Maple Anthracnose	*Gloeosporium sp.*			See narrative.
Poplar Leaf Fungus	Attributed to *Marssonina spp.*	Balsam poplar	Widespread	Heavy defoliation continues in riparian areas, but less noticeable than 2013. The role of *Melampsora larici* , has not been investigated.
Rhizosphaera Needle Blight	*Rhizosphaera pini*	Balsam fir	Scattered statewide	Increase in reports on ornamentals.
Rhizosphaera Needlecast	*Rhizosphaera kalkhoffi*	Blue spruce	Scattered statewide	Continues to cause current defoliation, perhaps at reduced levels. Some mortality of ornamentals has been observed, caused by repeated defoliations in the past.
Septoria Leaf Spot on Birch	*Septoria betulae*			See narrative.
Septoria Leaf Spot on Maple	*Septoria aceris*	Sugar maple	Northeastern Vermont	Only light damage.
Weir's Cushion Rust	*Chrysomyxa weirii*	Blue spruce	Norwich, Plymouth	Ornamentals.
Willow Blight	Attributed to *Venturia saliciperda*	Black Willow	Statewide	Willow defoliation increasingly widespread in riparian areas. Fungus identity has not been confirmed. 127 acres mapped during aerial surveys.

Foliage Diseases not reported in 2014 included Cyclaneusma Needlecast, *Cyclaneusma minus* ; Larch Needlecast, *Mycosphaerella sp.* ; Lophodermium Needlecast, *Lophodermium seditiosum* ; Rhabdocline Needlecast, *Rhabdocline pseudotsugae;* Swiss Needlecast, *Phaeocryptopus gaeumannii.*

ROOT DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Annosus Root Rot	*Heterobasidion annosum*			No new infection centers reported.
Armillaria Root Rot	*Armillaria spp.*	Balsam fir	Scattered statewide, especially northeastern VT	Decline sometimes initiated by balsam woolly adelgid. Percentage of dying trees in areas of mapped balsam fir mortality was higher than most years.
		White pine	Widely scattered	Associated with white pine decline where trees are stressed by recurrent needle diseases.
		Hardwoods	Statewide	Commonly found on declining trees. Associated with red oak mortality in stands with previous defoliation by the leaf roller complex.
Feeder Root Diseases	*Phytophthora cinnamomi, Fusarium spp.*	Balsam fir, Fraser fir	Scattered statewide	Losses continue in Christmas tree plantations previously known to be infected.

Ice Storm Damage

Ice and heavy snow damage to forest trees was mapped on 2,449 acres during aerial surveys. A majority of this damage was a result of a December 2013 storm in northwestern Vermont. Sugarmakers reported significant damage to tubing lines affected by falling branches and trees. Additional tree breakage from a December 2014 storm was significant statewide, but the extent of forest damage will be assessed during 2015 surveys.

Table 21. Mapped acres of tree and branch breakage from ice storms in 2014.

County	Acres
Chittenden	44
Franklin	1,434
Lamoille	549
Orleans	424
Total	**2,449**

Eight locations were visited in 2014 to survey for **ozone injury** to sensitive plant species (**Table 22**). Symptoms of ozone injury (stippling on upper leaf surface) were recorded at two locations, Woodstock and Orange, on only one plant at each site (one white ash and one milkweed, respectively). This follows recent trends towards lower ozone concentrations and reductions in foliar symptoms on bioindicator plants. No ozone damaged forests were mapped during aerial survey.

Table 22. Ozone bioindicator sites visited in 2014 and observed ozone injury.

Town	Ozone Injury
Rupert	None
Sudbury	None
Clarendon	None
Dover	None
Woodstock	Positive (one white ash)
Lunenburg	None
Orange	Positive (one milkweed)
Groton	None

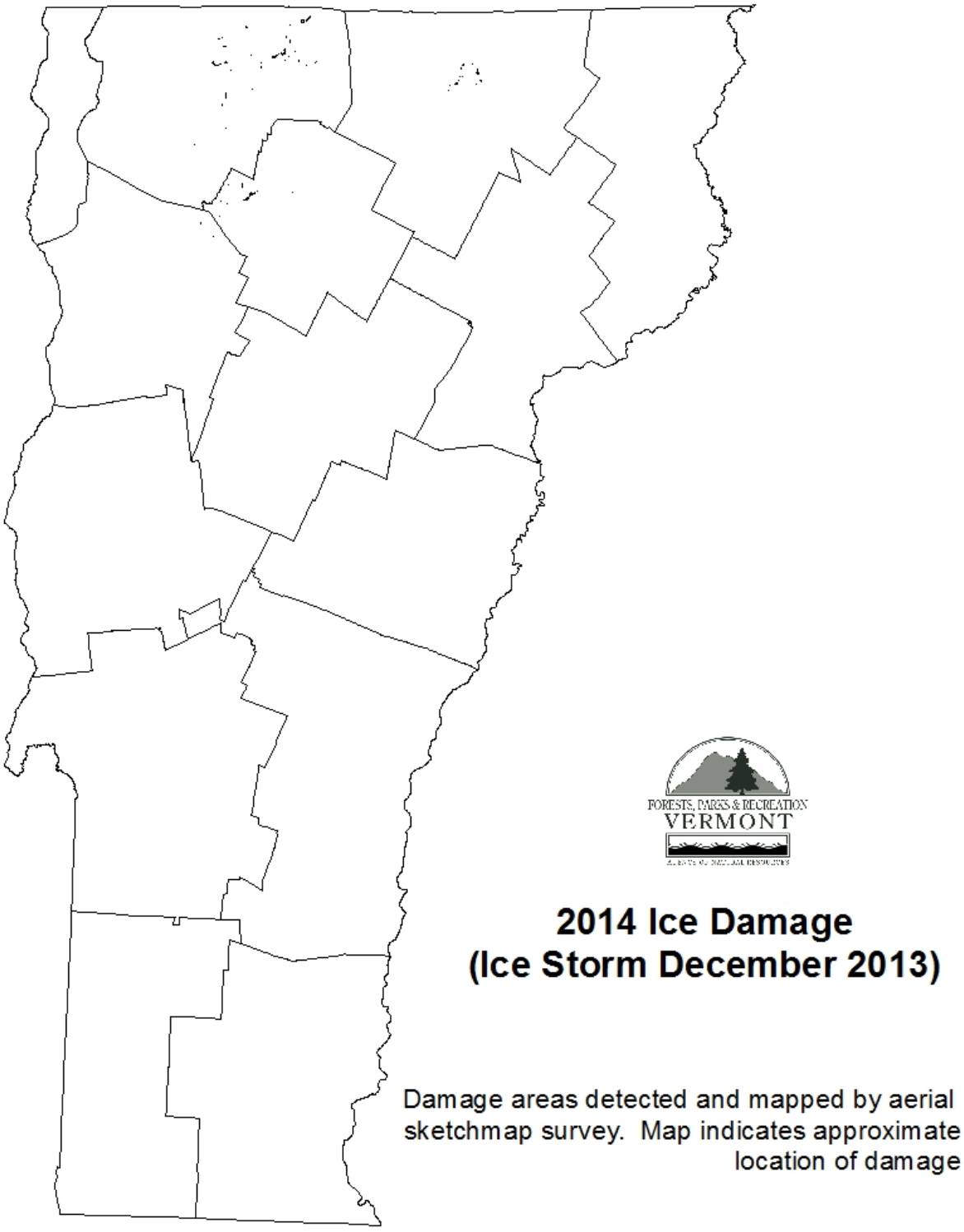


Figure 35. Ice storm damage mapped in 2014. Mapped area includes 2,449 acres.

Red pine decline from unknown causes was severe in scattered regions throughout the state. Researchers from the University of New Hampshire have visited red pine stands across Vermont, and elsewhere in New England, to examine them for insects, pathogens, soil conditions, and other factors which may be causing the decline. More information on conclusions is expected in the future.

Spruce and fir decline was mapped on 2,675 acres in 2014. While this is an increase from 2013, it is considerably less than 2005 when over 16,000 acres of decline was reported. Orange County in particular had a sizable increase, from 112 acres in 2013 to over 1,000 in 2014. While we often see "red" balsam during aerial surveys, the percentage of trees affected within the mapped areas, have typically been low (5-10%). In 2014, the percentage of red trees was often higher than normal.

We received an unusually large number of diagnostic calls about balsam fir problems in 2014, including landscape and forest as well as Christmas trees. A variety of pests and pathogens were associated with balsam fir decline including Rhizosphaera needle blight, balsam woolly adelgid, and Armillaria root rot.

Table 23. Mapped acres of spruce and fir decline in 2014.

County	Acres
Bennington	12
Caledonia	201
Essex	39
Grand Isle	21
Lamoille	541
Orange	1020
Orleans	287
Rutland	38
Washington	497
Windham	12
Windsor	6
Total	**2,675**

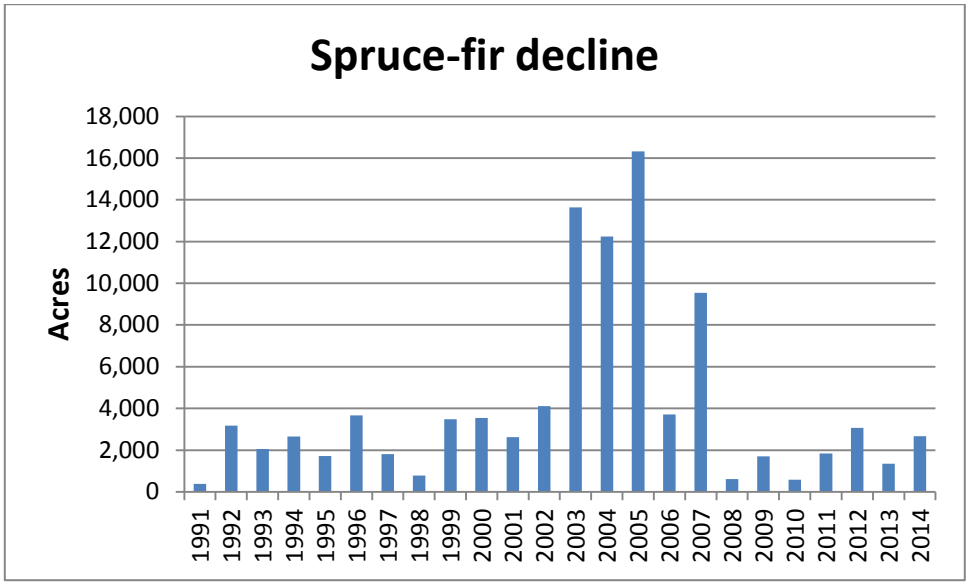


Figure 36. Trend in acres of spruce and fir decline since 1991. In 2014, 2,675 acres were mapped during aerial survey.

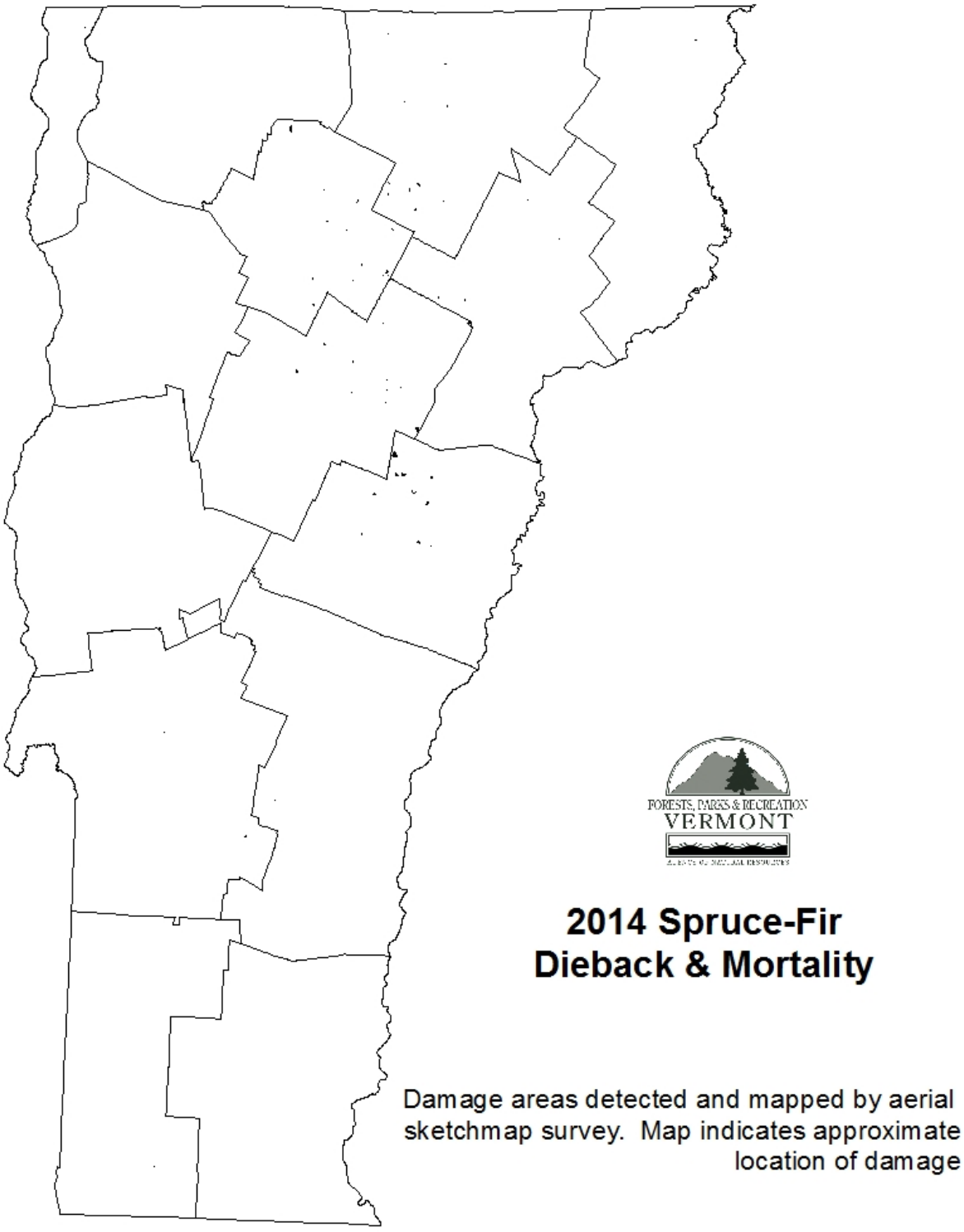


Figure 37. Spruce and fir decline mapped in 2014. Mapped area includes 2,675 acres.

Extreme weather events affecting forests in 2014 have been documented in the Weather and Phenology Section of this report and in Table 24. Winter weather resulted in more than usual winter burn, especially on landscape conifers due to fluctuating temperatures from periods of warm sunny days and cold nights. In addition to winter winds and ice storms, the May 27th hail storm in Addison and Rutland Counties left damaged foliage in its wake. A second hail storm on July 3rd compounded damage in Rutland County resulting in major defoliation. Trees refoliating from the May hail were especially vulnerable to the resurgence of hail. Additional July storms with strong winds and heavy downpours affected each corner of the state, and by the time a stationary thunderstorm dropped torrential rains in Southern Windsor County on July 27-28, flash flooding resulted.

Table 24. Trend in acres of forest damage from weather events and major factors involved mapped during aerial surveys.

Year	Total acres from weather damage	Extensive Damage Factors	Other Damage Factors
1991	64,529	Drought	
1992	17,790		Flooded sites, drought, frost
1993	54,067	Spruce winter injury	Flooded sites
1994	10,780		Flooded sites
1995	17,365		Flooded sites, drought
1996	19,324		Spruce winter injury, wet sites
1997	10,557		Flooded sites
1998	1,031,716	Ice storm, flooded sites	
1999	122,024	Drought	Ice, flooded sites, wind
2000	10,634		Flooded sites
2001	180,494	Drought	Flooded sites
2002	210,534	Drought	Flooded sites
2003	106,238	Spruce winter injury, flooded	Wind, drought
2004	19,877		Flooded sites
2005	11,078		Flooded sites
2006	6,786		Flooded sites
2007	21,656		Drought, flooded sites, wind
2008	2,401		Flooded sites
2009	15,315		Winter injury, flooded sites
2010	417,180	Frost	
2011	10,029		Flooded sites
2012	55,872	Frost	Flooded sites
2013	15,332*	Frost, ice*	Flooded sites, wind
2014	4,848		Flooded sites, wind, ice storm, hail damage

*A December 2013 ice storm was mapped during aerial survey in 2014.

Wet or Flooded Sites were mapped on 2,080 acres in 2014, a slight decrease from 2,181 acres recorded in 2013. A series of heavy rain storms in May-July provided excess moisture and June precipitation was above normal in northwestern Vermont. A stationary thunderstorm the end of July created flooding situations, especially in the Chester and Andover area. Higher than normal precipitation in recent years continued to cause problems in Christmas tree plantations, particularly to Fraser fir.

Table 25. Mapped acres of forest decline associated with flooded or otherwise wet sites.

County	Acres
Addison	270
Bennington	166
Caledonia	41
Chittenden	91
Franklin	410
Grand Isle	308
Lamoille	271
Orange	130
Orleans	139
Rutland	38
Washington	58
Windham	63
Windsor	47
Total	**2030**

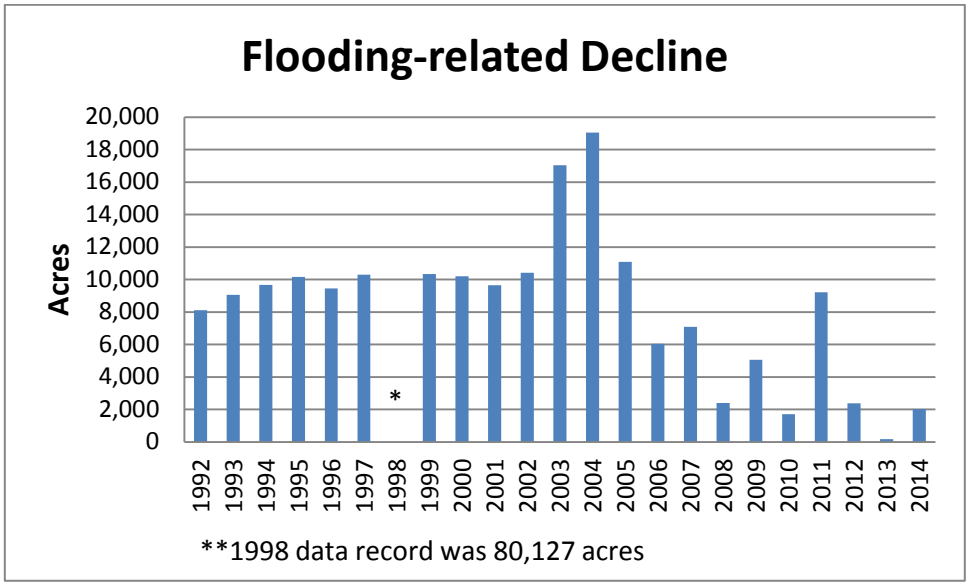


Figure 38. Trend in acres of forest decline related to wet or flooded sites. In 2014, 2,030 acres were mapped during aerial survey.

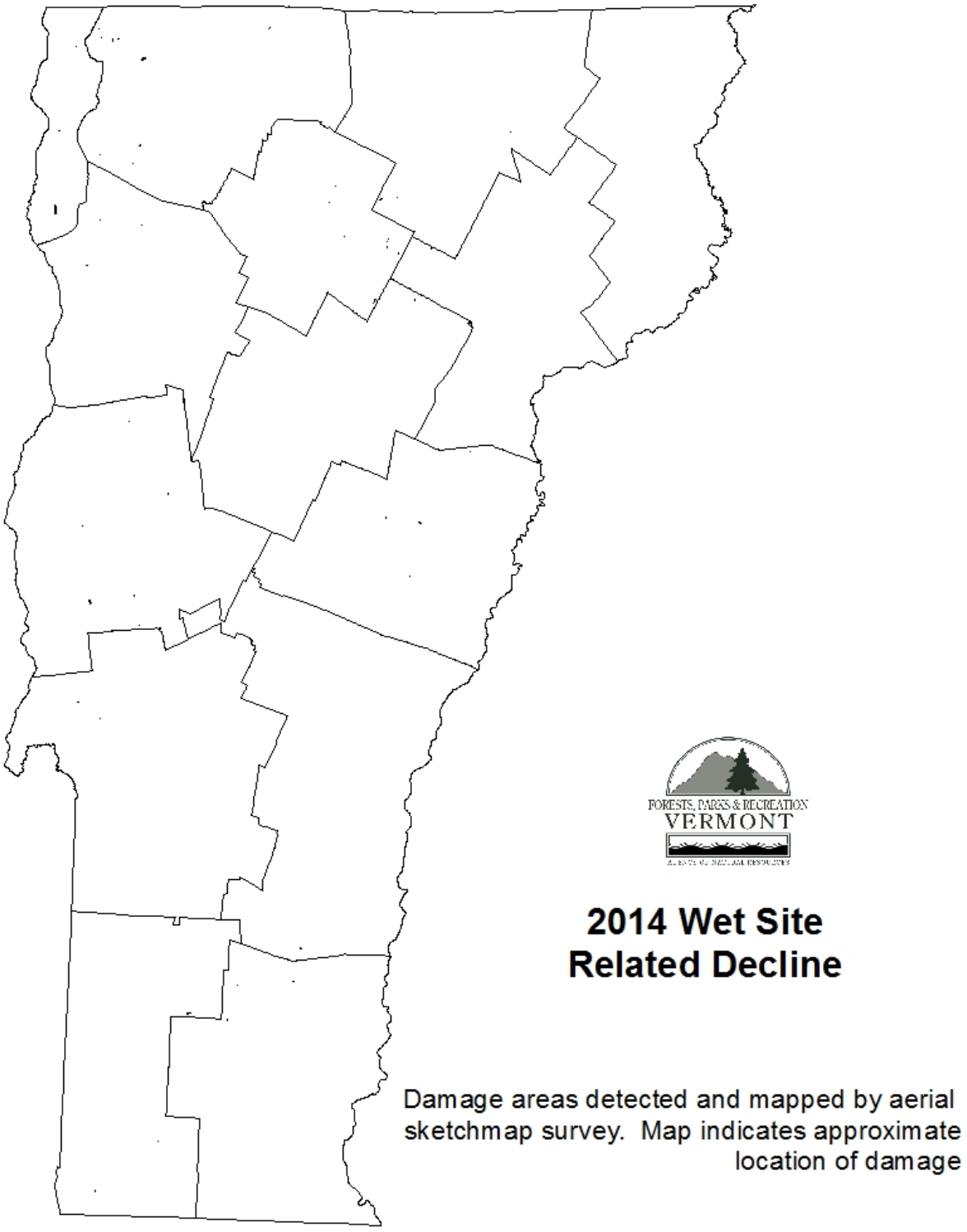


Figure 39. Wet or flooded site related decline mapped in 2014. Mapped area includes 2,030 acres.

Wind Damage from a variety of storms affected forests across the state. Caledonia and Orleans Counties had the largest areas affected, and a total of 369 acres were mapped statewide in 2014. This was an increase from 161 acres mapped in 2013.

Table 26. Mapped acres of wind damage in 2014.

County	Acres
Caledonia	145
Chittenden	13
Essex	59
Orleans	120
Rutland	8
Windsor	25
Total	**369**

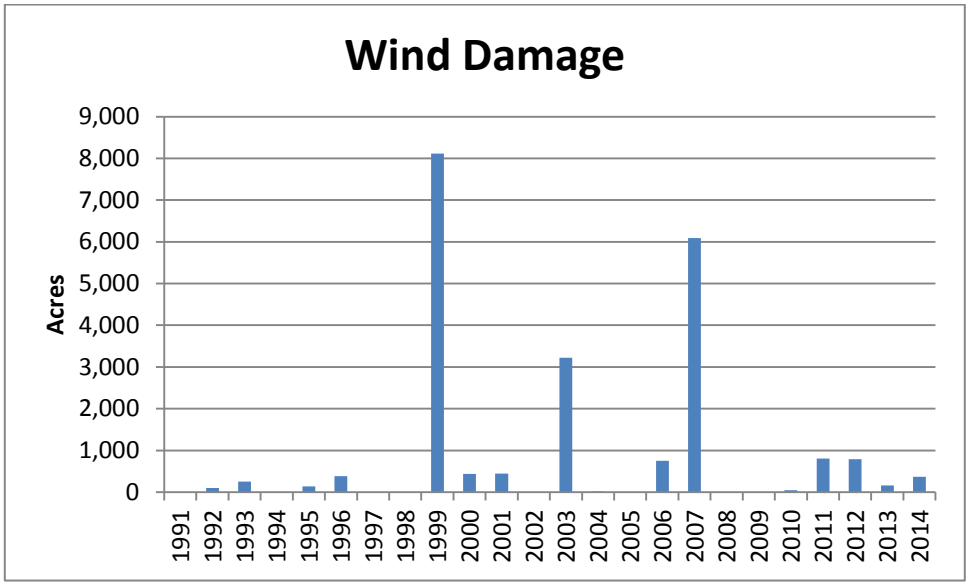


Figure 40. Trend in acres of tree damage from wind events. In 2014, 369 acres of wind damage were mapped during aerial survey.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

CONDITION	HOST	LOCALITY	REMARKS
Air Pollution Injury	White ash Milkweed	Woodstock Orange	Individual plants on bioindicator plots affected by ozone (see narrative).
Ash Decline	White Ash	Southern counties, Grand Isle, Randolph	Ash decline is has been widely reported, as concern increases about emerald ash borer. Causes include ash yellows and fluctuating water table. Other causes are unknown.
Birch Decline		Statewide	Areas of old birch mortality continue to be visible at upper elevations. Early birch defoliation, which contributes to decline, is at lower levels than recent years (see Brown birch in Disease section).
Chemical Injury	Fraser fir	Shrewsbury	Unknown cause.
Drought	Ash	Statewide	Early leaf drop.
Frost Damage			None reported.
Hardwood Decline and Mortality			None reported.
Heavy Seed	Red oak	Southern counties	While seed was heavy, it was not associated with crown thinning.
Ice Damage	Hardwoods	Orleans, Franklin and Lamoille counties	See narrative.
Improper planting		Widely scattered	Continues to be a common cause of landscape tree decline.
Larch Decline	Larch	Northeastern counties	Scattered.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

CONDITION	HOST	LOCALITY	REMARKS
Lightning	Pine	Townshend & Camp Plymouth State Parks	
	Ash Birch	Ascutney State Park Maidstone State Park	
Mechanical Injury	White pine	Morrisville	Weed whacker damage.
Pine Decline	Red pine	Statewide	Cause not completely understood (see narrative).
Snow Damage			None reported.
Spruce/Fir Dieback and Mortality	Balsam fir	Statewide	Increase in reports and observations of fir mortality (see narrative).
Wet or Flooded Sites			See narrative.
Wind Damage			See narrative.
Winter Injury	Conifers	Statewide	Ornamental cedars, yews, and young fir Christmas trees.

ANIMAL DAMAGE

ANIMAL	SPECIES DAMAGED	LOCALITY	REMARKS
Beaver	Many	Scattered throughout	Damage levels stable.
Deer	Regeneration	Statewide	Damage uncommon in the northeastern counties and common in southern Vermont.
Moose	Many	Northern Vermont	
Porcupine	Many	Statewide	Uncommon.
Sapsucker	Many	Statewide	Decrease in observations and reports of damage.
Squirrel			Uncommon. Grey squirrel numbers expected to increase following heavy acorn year.

INVASIVE PLANTS

2014 was a very productive year regarding invasive plant efforts statewide. Through several grant-funded opportunities, progress has been made in mapping and management of invasive plants.

Invasive Plant Mitigation on State Land in Vermont: Education, Volunteer Outreach & Capacity Building

The focus area for this effort is on State Land in southwestern Vermont. Three seasonal staff were hired to support this effort. One serves as coordinator of volunteers and lead educator and the other two support the educational programming and volunteer work. Collectively they are called the Habitat Restoration Crew. When there are no volunteers scheduled in a given day, the 2-person crew does invasive control work in state forests and state parks throughout southwestern Vermont.

Goals of these efforts are to combine invasive plant control with hands-on education and community service and to create demonstration areas on state land to exhibit long-term management. Successes include providing 134 students and staff from the Castleton Village a hands-on learning experience about invasive species at Bomoseen State Park. Despite off and on rain, these middle-schoolers pulled honeysuckle, buckthorn, garlic mustard and European spindletree. The group pulled 1,000+ honeysuckle and 10 large contractor bags of garlic mustard. Follow-up emails from school administrators summed up the day: "*Thank you for yesterday! It was awesome. The kids were still buzzing around today… Thank you for making a difference in many kids lives… The overwhelming consensus was that it was an awesome day and we want to do it again next year…*

My 6th graders are already scheming on prescriptions to treat our Japanese knotweed patch at school. The trip really got them thinking. You did an excellent job creating a powerful experience that they will remember."

The Crew has also worked with nearly 330 volunteers in 2014. Examples of local community groups and businesses that have participated in projects include: Fair Haven High school, Grace Congregational Church, 1st Baptist Church, the Vermont Country Store, Orvis, Green Mountain Coffee Roasters, Shrewsbury Conservation Commission, Merck Forest and Farmland Center, Smokey House, Green Mountain Club – Bennington, Camp Abnaki, Camp Greylock and Job Corps.

Invasive Terrestrial Plant Treatment on Working Forests and Conserved Natural Areas in Vermont's Forest Priority Areas

Via the Vermont Chapter of The Nature Conservancy, progress includes monitoring and treating invasive terrestrial plants on priority conserved lands. Contractors completed follow-up invasives treatment on 40 acres first treated the fall of 2013 at the LaPlatte River Marsh Natural Area. This consisted of spot treating of small bush honeysuckle (*Lonicera sp),* Japanese barberry (*Berberis thunbergii*) and cutting and treating the stumps of a few common buckthorn (*Rhamnus cathartica*). At Raven Ridge Natural Area, cut-stump and basal bark herbicide treatment were completed on large common buckthorn (*Rhamnus cathartica).*

Assessment of invasive plant abundance and distribution was conducted on three private forestland parcels in the area around the Equinox Highlands in Rupert, Sandgate, and Dorset, VT. In all, approximately 3000 acres of forestland were assessed. This information will be used to make recommendations to landowners regarding priorities for invasive plant management on these properties.

The contractor attended the Bennington County Sustainable Forestry Consortium meeting to address the idea of establishing a Cooperative Invasive Species Management Area (CISMA) within the project boundary. A number of potential partners, including private, regional, state, and federal organizations, expressed interest.

Prioritization of Treatment Areas

Terrestrial invasive plants have been systematically mapped on 40 miles of roads in Richmond, Jericho, Hinesburg, Huntington and Bolton. This was accomplished by utilizing several University of Vermont students as well as volunteers. These assessments are comprised of 25 species and 823 observations. Each individual observation is linked to a spatial location, photos, information on seed production, and level of infestation of the specific observation. All of this information is stored on the iNaturalist website and accessible through this link: https://www.inaturalist.org/projects/mapping-for-healthy-forests-chittenden-county-vermont. The observations have been downloaded and converted to a shapefile for use for mapping outside of the iNaturalist website.

The UVM students have been refining a mapping protocol for volunteers and are looking at other improvements to the process. These data are valuable for understanding the breadth of the species present and, to some degree, frequency of occurrence. At the recent Municipal Day at National Life, these data were already very useful in illustrating to municipal officials the scale of the terrestrial invasives problem and the importance of prioritization and strategic planning.

Sugar Maple Health in 2014

Sugar maple tree health, based on the amount of twig dieback, remained high in 2014, with 95% of trees rated as having dieback ≤ 15% on the 30 monitoring plots formerly part of the North American Maple Project (NAMP) (Figure 41).

Foliage was particularly dense this year (Figure 42), and little defoliation was observed. Trace to light defoliation was recorded at 13 of the 30 sites. One site (Sheldon) had light defoliation caused by gypsy moth feeding for the second year in a row. Other sites were defoliated by maple leaf cutter, pear thrips, and saddled prominent. Weather damage affected trees at 20% of sites, and 13% of sites recorded logging damage to tree boles. New mortality of overstory sugar maple trees was 1.5%.

Vigor ratings incorporate several tree health measures into a more comprehensive view of a tree's photosynthetic capacity. Vigor ratings have held steady for the past few years (Figure 43).

Stand density can influence crown health by determining the level of competition between trees. NAMP plot's basal area per acre, a measure of stand density, shows relative differences between the density of live sugar maples compared to all trees (Figure 44). Sites 8 and 17 have high basal areas suggesting overcrowding, while Sites 6 and 31 have low stocking of sugar maple.

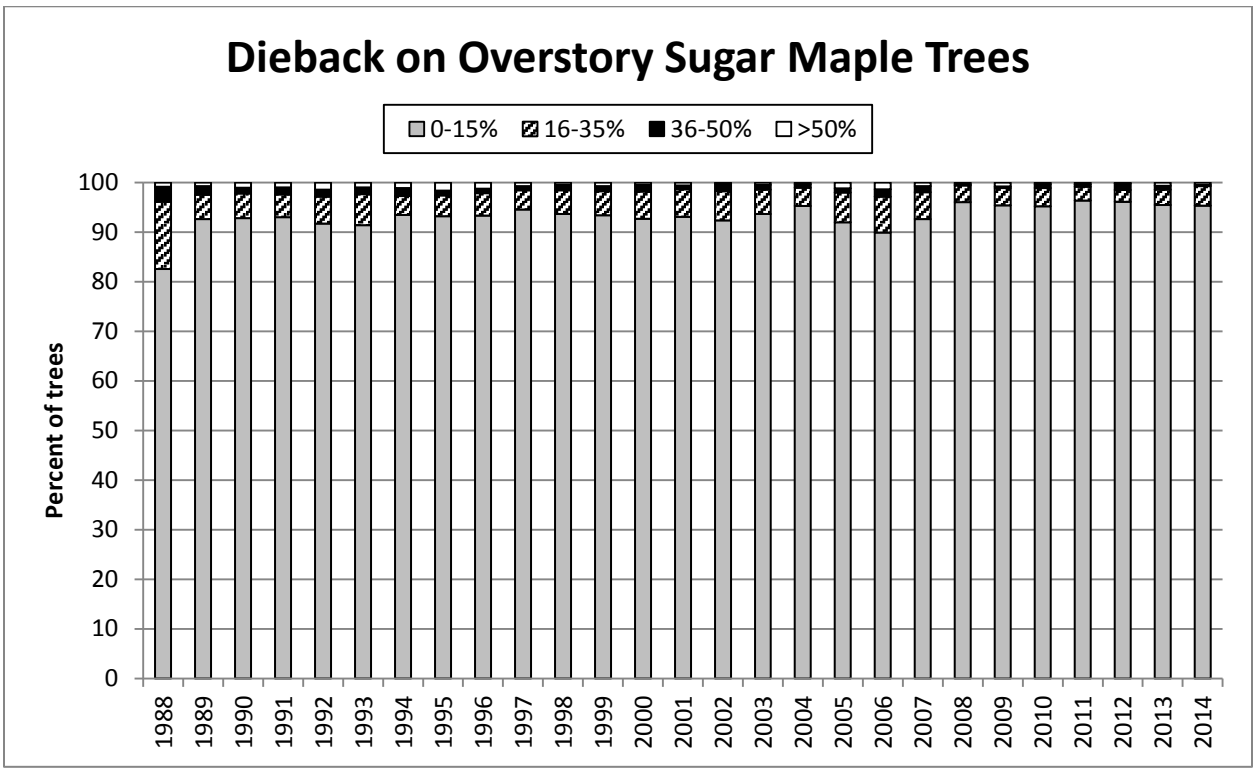


Figure 41. Percent of overstory sugar maple trees on NAMP plots with various levels of crown dieback. N=991 trees at 30 sites.

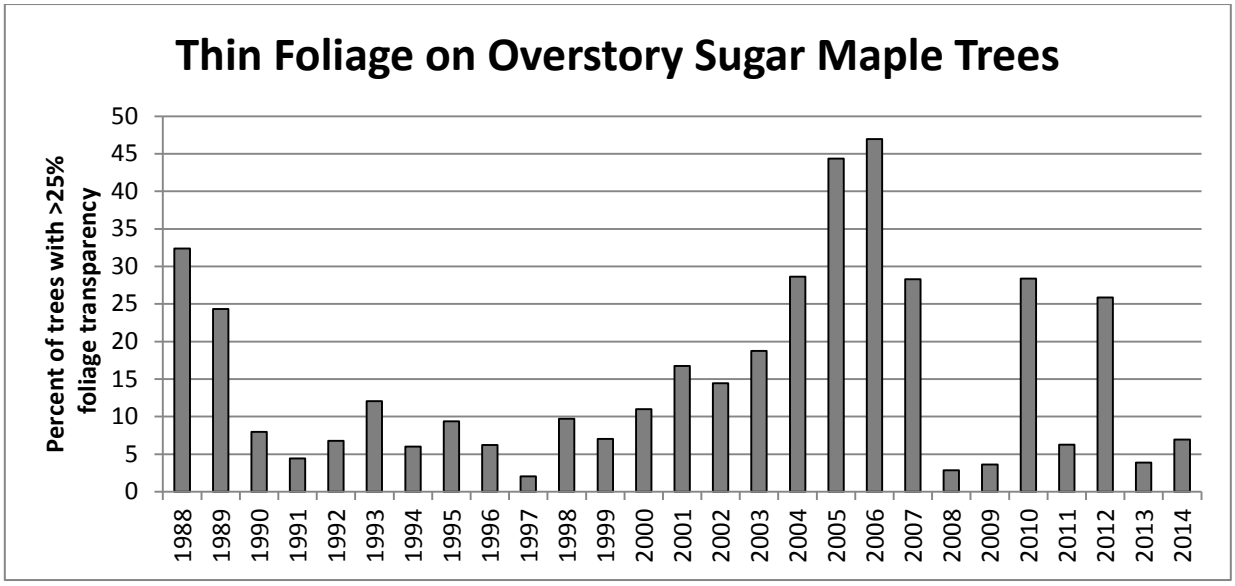


Figure 42. Trend in the percent of overstory sugar maple trees on NAMP plots with thin foliage, >25% foliage transparency. N=991 trees at 30 sites.

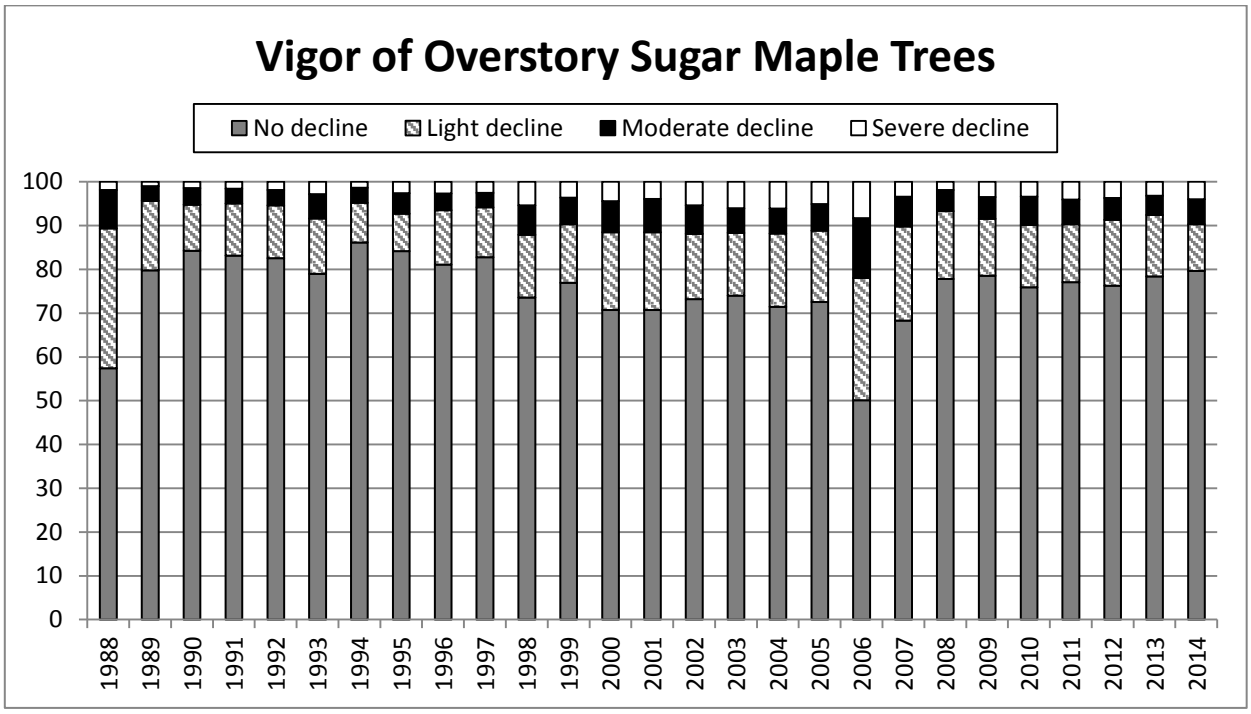


Figure 43. Trend in the percent of overstory sugar maple trees on NAMP plots with various vigor ratings. N=991 trees at 30 sites.

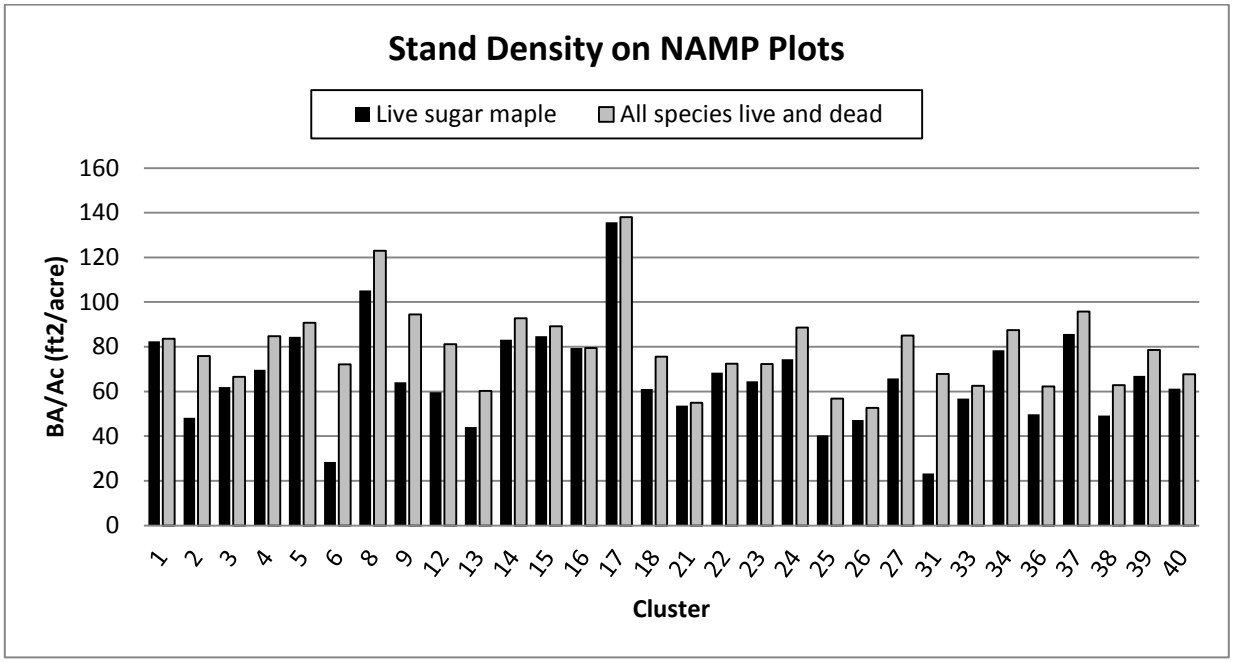


Figure 44. Stand density on NAMP plots calculated as basal area per acre showing differences between density of live sugar maples compared to all live trees.

Regeneration data collected periodically from 1988 through 2013 have now been analyzed. Both seedlings and saplings have decreased over the monitoring period (Figures 45 and 46). Reasons for these decreases is unknown and may vary between sites. Possible explanations include: competition from invasive plants, deer browse, soil moisture deficits, poor nutrient availability due to acid deposition, past land use practices or other reasons.

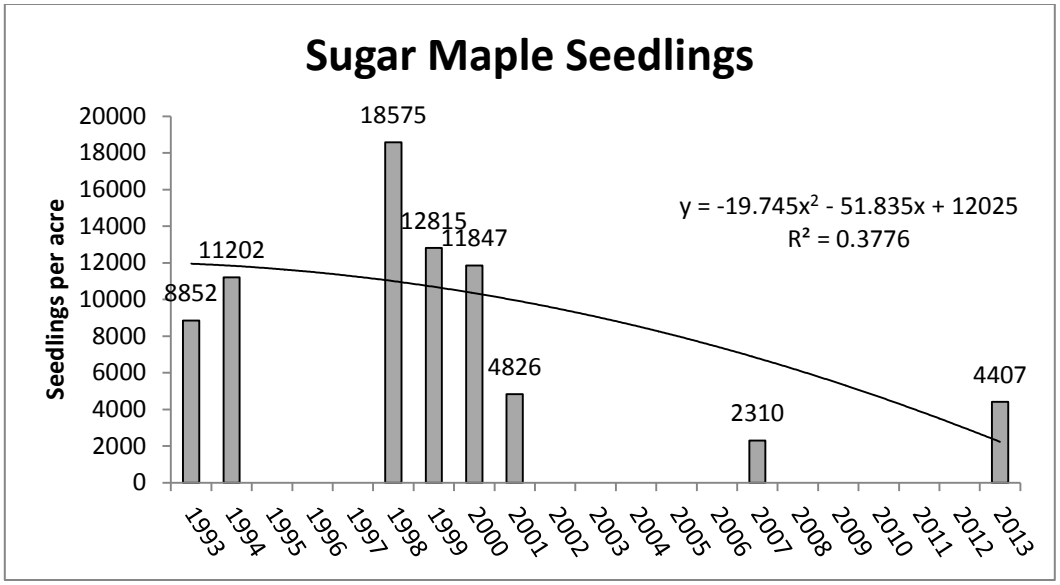


Figure 45. Periodic counts of sugar maple seedlings on NAMP plots average over 30 sites.

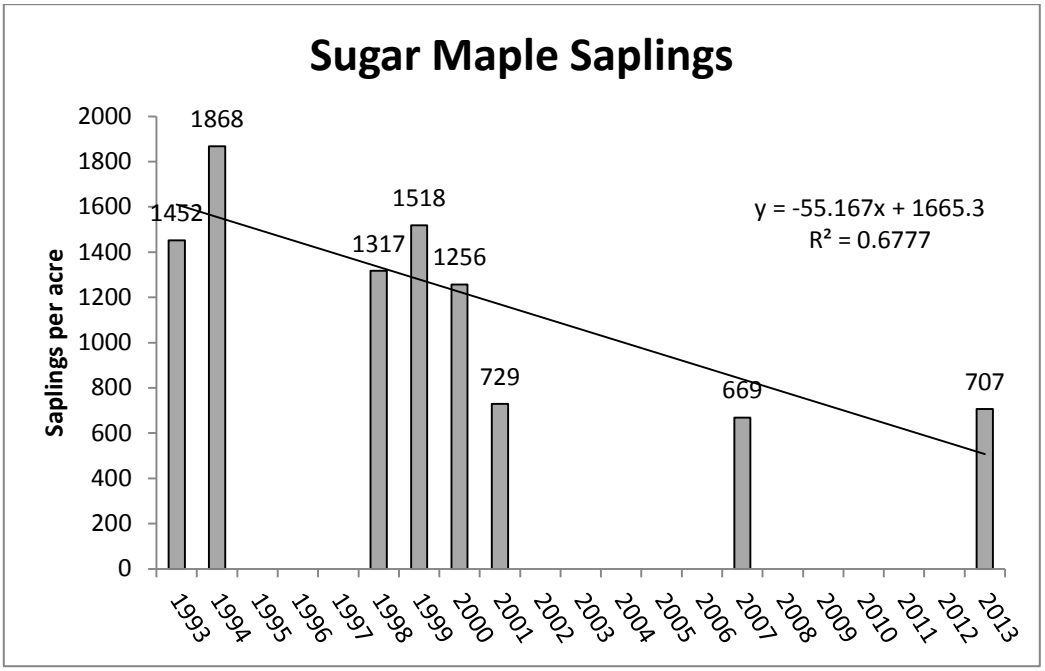


Figure 46. Periodic counts of sugar maple saplings on NAMP plots average over the 30 sites.

Vermont Monitoring Cooperative

Trends in Forest Health at Mount Mansfield and Lye Brook in 2014

Fourteen plots on Mount Mansfield and 5 plots at the Lye Brook Wilderness Area were re-measured in 2014 using standard forest health metrics. Additional metrics were collected by University of Vermont field crews to better document tree growth and regeneration changes.

Crown health measurements at Mount Mansfield show a cycle of increases and decreases in average dieback over the past 23 years, but a trend towards increasing transparency (Figure 47a). Patterns at Lye Brook are not as defined. When low and high elevation plots at Mount Mansfield are analyzed separately for unthrifty crown ratings (trees with high dieback or thin foliage), the low elevation plots seem to be in a recovery mode from a high point in 2006 (Figure 48). High elevation plots consistently have more trees with high dieback, and the percent of trees with high foliage transparency remained high in 2014 with 15% of trees having thin foliage (Figure 49). Lye Brook monitoring plots show trees in a recovery mode following a peak in 2007 (Figure 50).

Additional analyses were conducted on data through 2013 as part of the VMC Annual Report (VMC Annual Monitoring Report For 2013), grouping species health for all the plots at both sites combined. While percent dieback showed no significant long-term trends, there was an upward trend in percent transparency. Relative to measurements taken in the early 1990's, current mean transparency is nearly double for all species and is particularly high for white ash and paper birch. While this could be the natural results of successional processes, the VMC will continue to monitor these species to determine if changing environmental conditions are altering competitive relationships among forest species.

A total of 18% of trees on all plots had damages affecting tree health. A third of the trees damaged were a result of weather damage (broken boles and other weather damage) (Table 27). Beech bark disease and other cankers both accounted for 14% of damaged trees.

Regeneration plots have been periodically re-measured over the monitoring period. Sapling counts on monitoring plots in the Lye Brook Wilderness Area have been in decline over the past 20 years (Figure 51). While beech sapling abundance has remained steady, red maple and other species have decreased. On low elevation plots at Mount Mansfield (1400-2200 feet), similar declines in sapling abundance have been measured for birch and sugar maple on both the east and west slopes of the mountain, while beech saplings appear to be increasing following a decline (Figures 52-53). On upper elevation plots, however, balsam fir saplings have been increasing in abundance over the monitoring period (Figures 54-55).

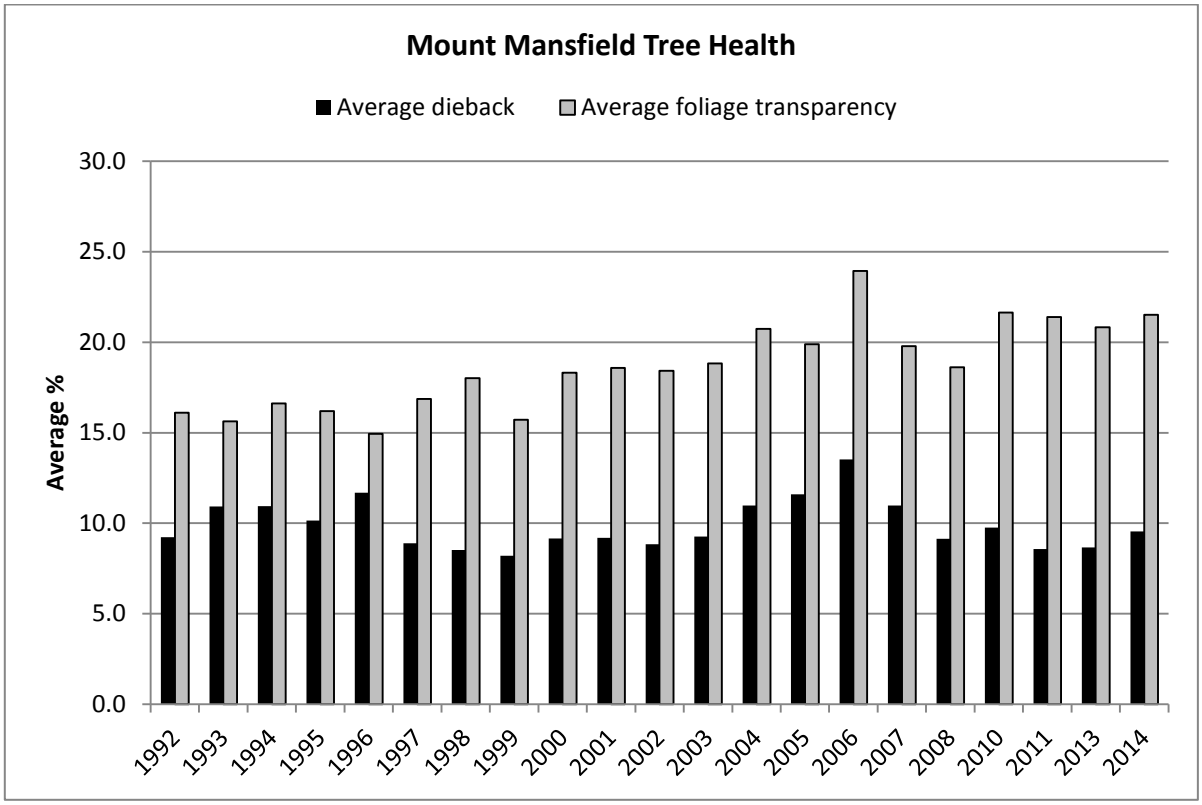


Figure 47 (a).

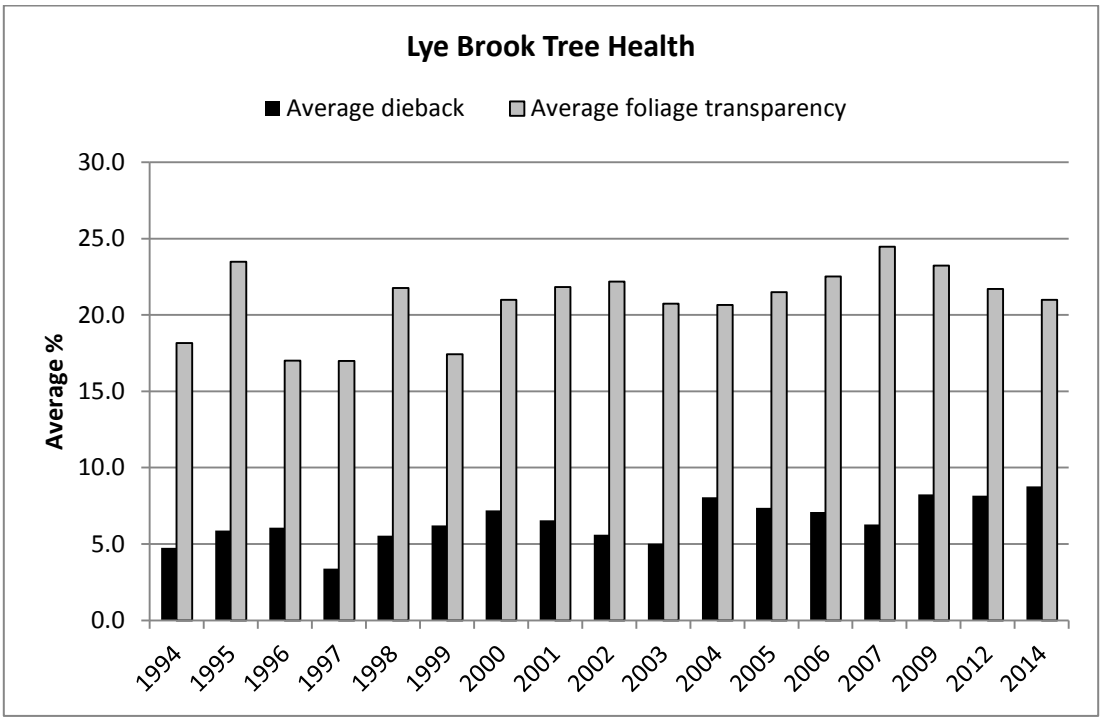


Figure 47 (b). Trend in overstory trees average dieback and foliage transparency at Mount Mansfield (a) and Lye Brook Wilderness Area (b). Note: Since 2007 plots have been on a 3 year measurement cycle.

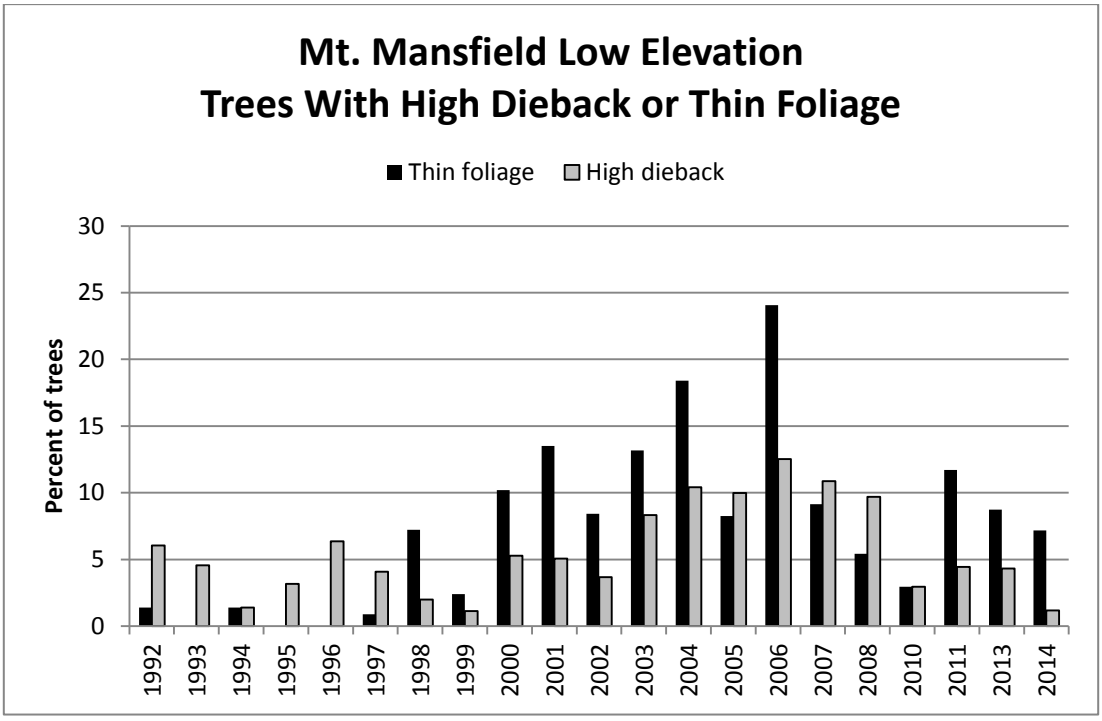


Figure 48. Trend in overstory trees with thin foliage (>25% foliage transparency) and high dieback (>15%) on plots at 1400 and 2200 feet on the east and west slope of Mount Mansfield. Note: Since 2007 plots have been on a 3 year measurement cycle.

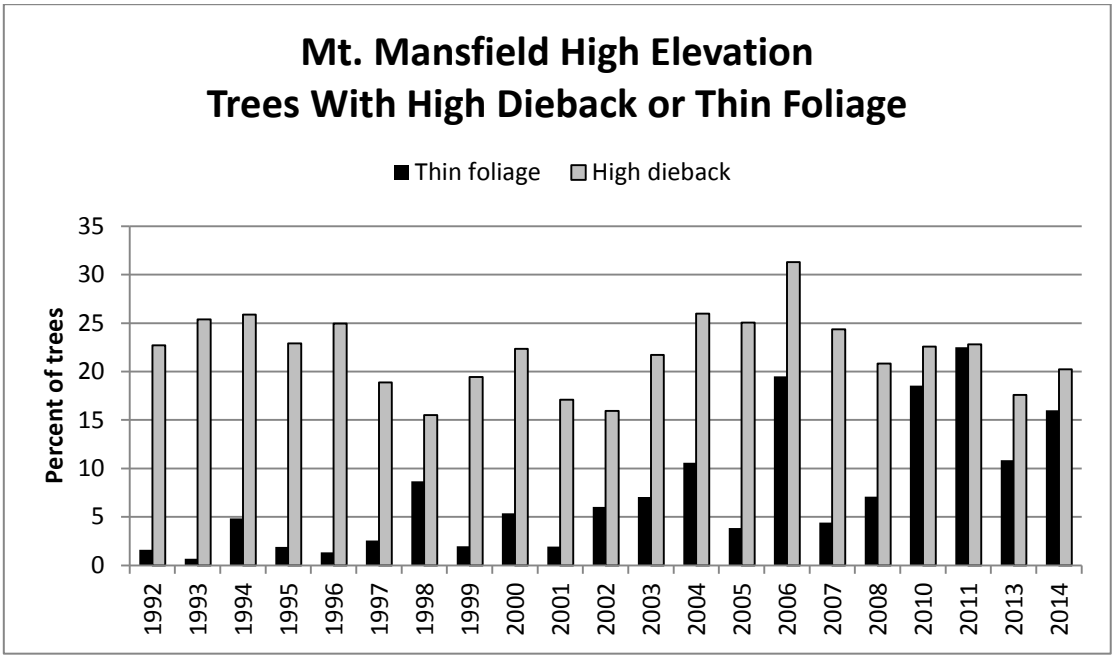


Figure 49. Trend in overstory trees with thin foliage (>25% foliage transparency) **and high dieback (>15%)** on plots at **3000 and 3800 feet on the east and west slope of** Mount Mansfield. Note: Since 2007 plots have been on a 3 year measurement cycle.

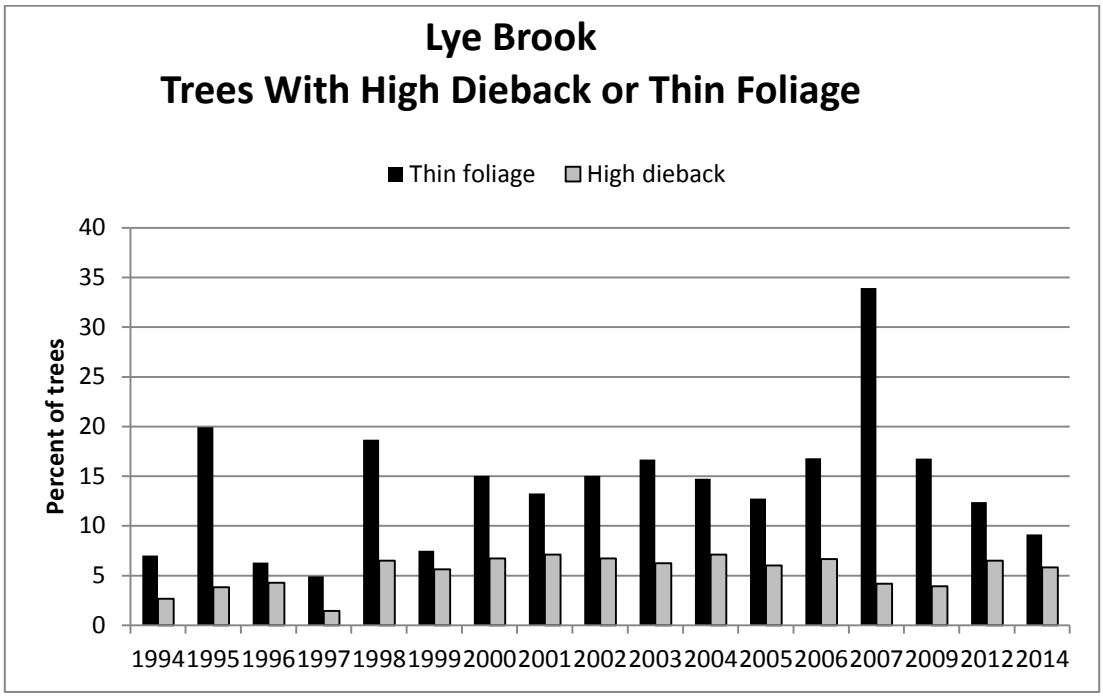


Figure 50. Trend in overstory trees with thin foliage (>25% foliage transparency) and high dieback (>15%) on plots at 1400 and 2300 feet in the Lye Brook Wilderness Area. Note: Since 2007 plots have been on a 3 year measurement cycle.

Table 27. Specific damage agents and frequency of occurrence for 2014.

Damage type	% of damaged trees
Broken boles	34
Cracks and seams	18
Beech bark disease	14
Cankers	14
Nectria canker	7
Conks	3
Sugar maple borer	4
Eutypella canker	3
Animal damage	1
Weather damage	1

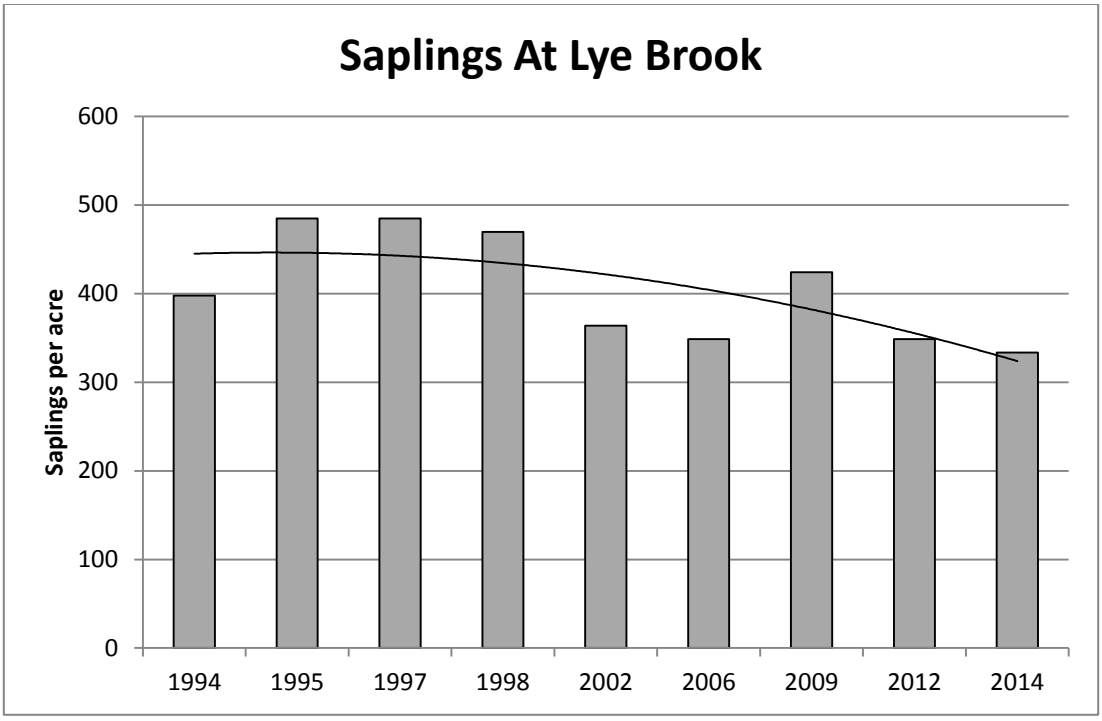


Figure 51. Trend in sapling abundance on 5 monitoring plots in the Lye Brook Wilderness Area.

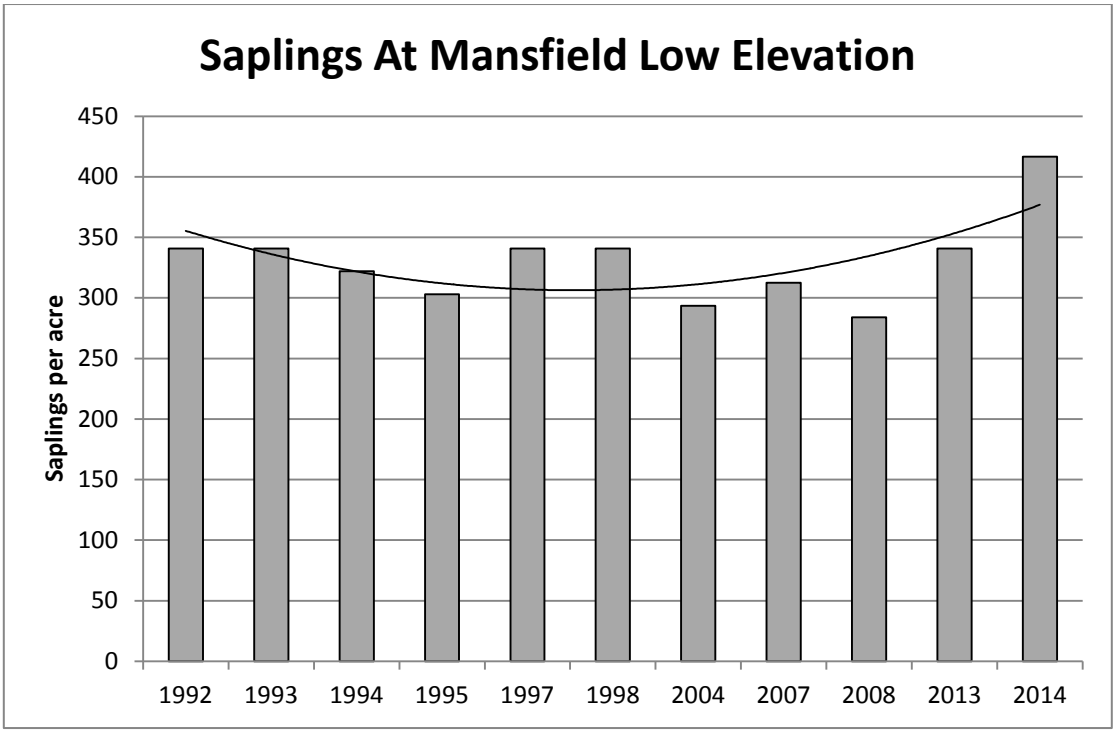


Figure 52. Trend in sapling abundance on 8 monitoring plots on Mount Mansfield at 1400 and 2200 foot elevations.

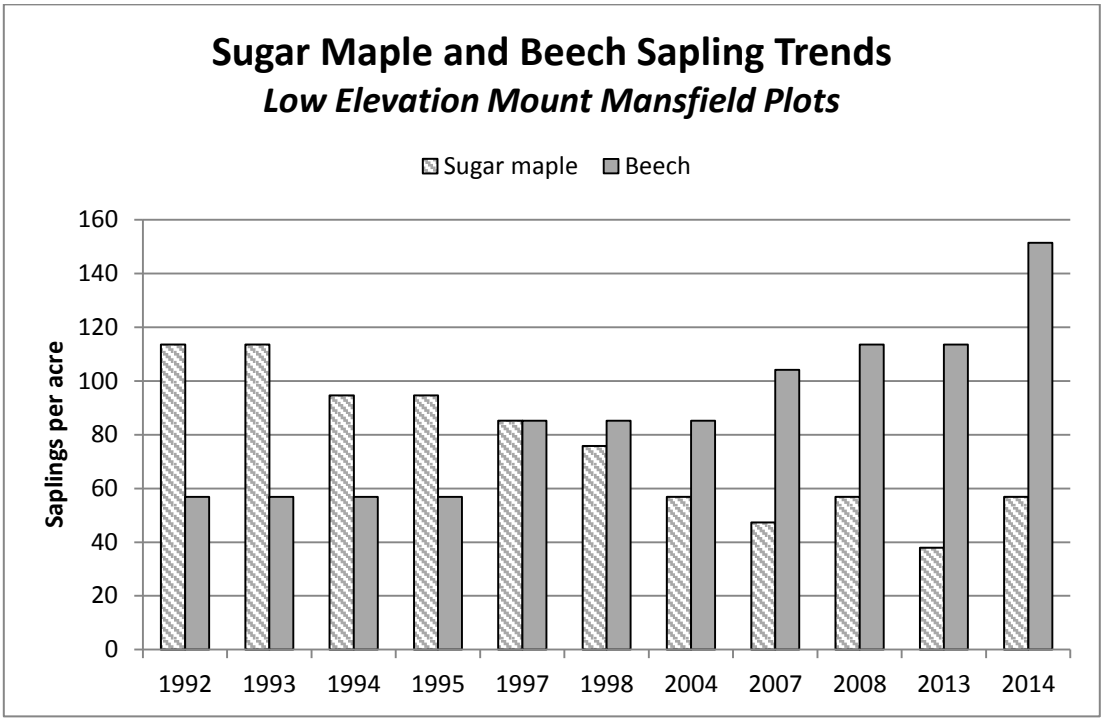


Figure 53. Trend in sugar maple and beech sapling abundance on 8 monitoring plots on Mount Mansfield at 1400 and 2200 foot elevations.

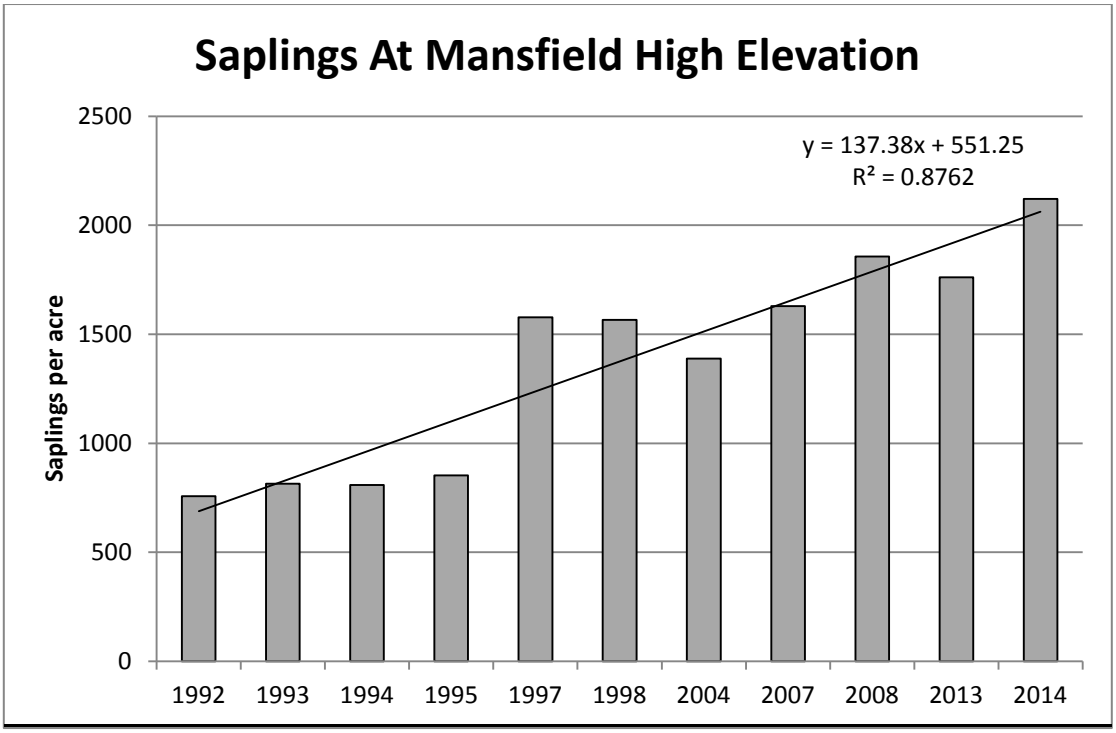


Figure 54. Trend in sapling abundance on 6 monitoring plots on Mount Mansfield at 3000 and 3800 foot elevations.

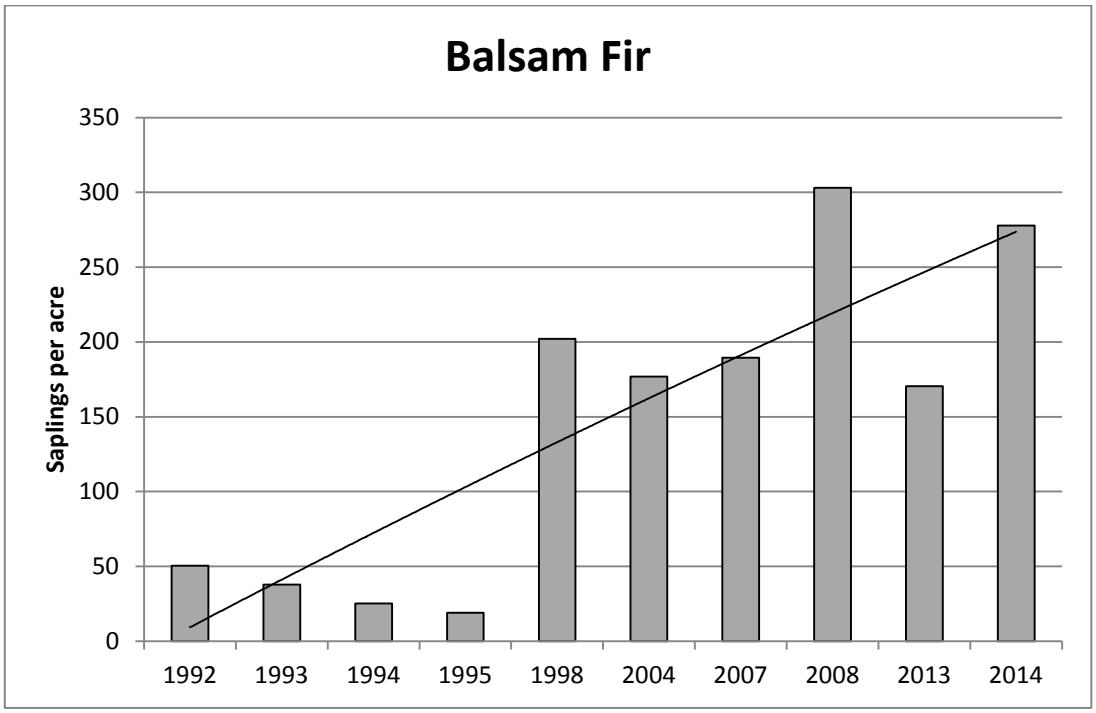


Figure 55. Balsam fir sapling abundance on 6 monitoring plots on Mount Mansfield at 3000 and 3800 foot elevations.

CHRISTMAS TREE CONDITIONS 2014

Information reported here was provided by FPR retiree Ron Kelley, who maintains his interest in Christmas tree health. Ron's notes summarize reports from members of the New Hampshire-Vermont Christmas Tree Association, combined with his observations during visits to Christmas tree farms.

Winter Injury was widespread and much more damaging than usual, actually killing some trees.

Fir-fern Rust was widespread and very noticeable early in the growing season but damage levels were not serious enough to be a big concern.

Balsam Twig Aphid was very light to non-existent in most plantations, the one exception being a plantation in Essex. This follows a year in which populations appeared to be rising dramatically. Perhaps the harsh seesaw winter affected the overwintering eggs in all but the warmest regions.

Balsam Gall Midge was also very light despite building populations in some plantations last year.

Yellow Broom Rust is very common now in many plantations. Cutting out the brooms early in the spring (they break bud before the rest of the tree) and controlling the chickweed alternate hosts should keep this problem under control.

Rhizosphaera Needle Blight is the most prevalent needle disease and is present in an ever increasing number of plantations.

Lirula Needlecast is more commonly seen than in the past but tends to affect only scattered individual trees so is noticed as much as Rhizosphaera.

Delphinella Shoot Blight is being seen in more plantations than in the past.

Phytophthora Root Rot continues to be a large and increasing problem for trees, especially Fraser Fir, on sites that are not well drained.

Armillaria Root Rot continues to be an increasing problem, especially interplanted trees and third or fourth generation of trees on the same site.

Conifer Root Aphid has been found affecting young Fraser and Canaan fir in a few new plantations. No aphids or symptoms have been found on nearby ash trees which are supposed to be the alternate host for the insect. This includes young ash trees planted between root aphid infested trees in Morristown in the spring of 2013. The winged stage was seen flying in October last year in a Bakersfield plantation, too late to affect ash.

RSK: 7-31-2014

Vermont Forest Health

Tree Condition in Maple Sugaring Sites on State Lands: Results for 2014

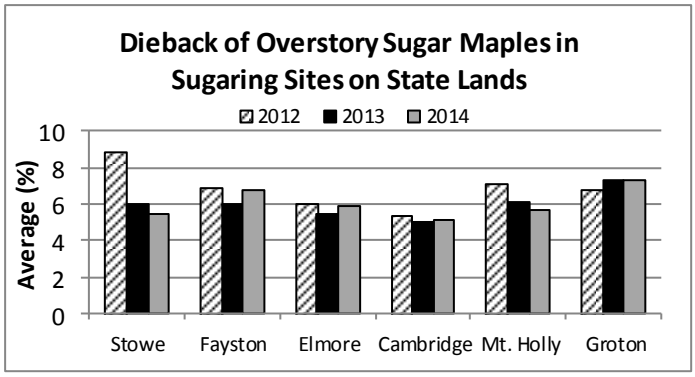
Department of Forests, Parks, & Recreation
February 2015 vtforest.com

Results For 2014

In 2012, forest health monitoring plots were established in seven sites on state lands under license agreement for maple sugaring. Plot design and measurements are the same as for the 30 other sugar maple health monitoring plots in Vermont previously established under the North American Maple Project (NAMP). One site, in Andover, has since been discontinued as a sugarbush.

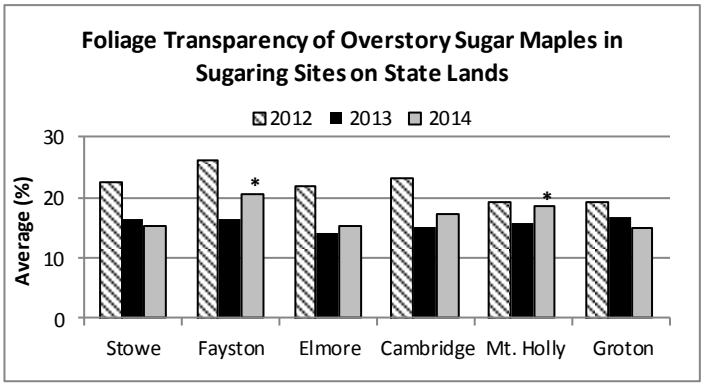
Substantial defoliation affected four of the sites in 2012 but none of the sites had significant defoliation in 2013. However in 2014, two sites, Fayston and Mt. Holly, had scattered moderate defoliation, most likely caused by saddled prominent. As a consequence, the foliage transparency rating, which indicates leaf density, showed significant increase at these two sites over 2013. There was no statistically significant difference in crown dieback between years at any of the sites.

The 2014 sugar maple condition ratings on the six sites were similar to average ratings for the 30 NAMP plots statewide, which include sugarbush and untapped maple stands scattered throughout the state. Dieback and transparency for overstory trees averaged 6.3% and 18.3%, compared to 7.1% and 16.9% for the NAMP plot maples.



Dieback evaluates new dead twigs. Higher ratings indicate current or past stress effects on tree health.

Foliage transparency evaluates the density of leaves. Higher ratings indicate thinner foliage, and reflect current year stress.



FORESTS, PARKS & RECREATION VERMONT AGENCY OF NATURAL RESOURCES

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