FOREST INSECT AND DISEASE CONDITIONS IN VERMONT 2011

FORESTS, PARKS & RECREATION
VERMONT
AGENCY OF NATURAL RESOURCES

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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 2011

Tropical Storm Irene toppled trees, exposed root systems and wounded stems from floating debris. Photo Credit: L. Carlson

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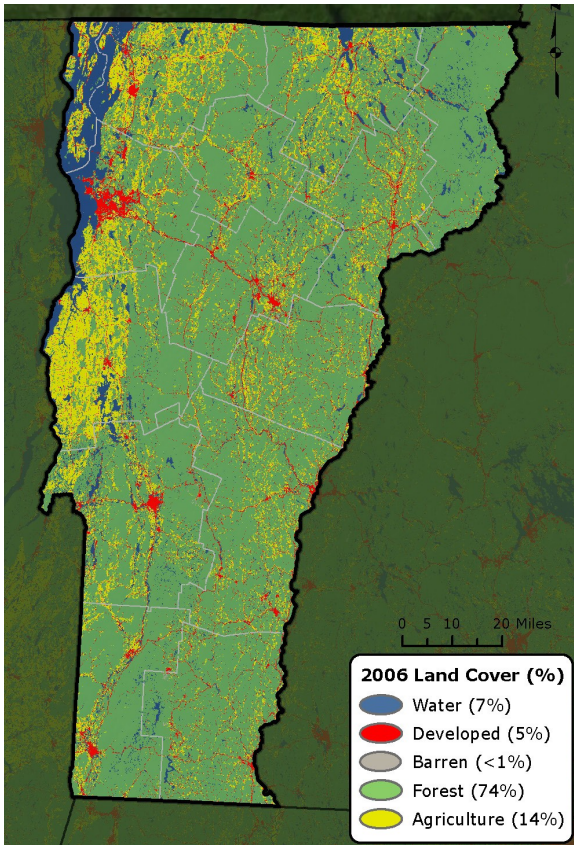
Forest Health VERMONT *highlights* 2011



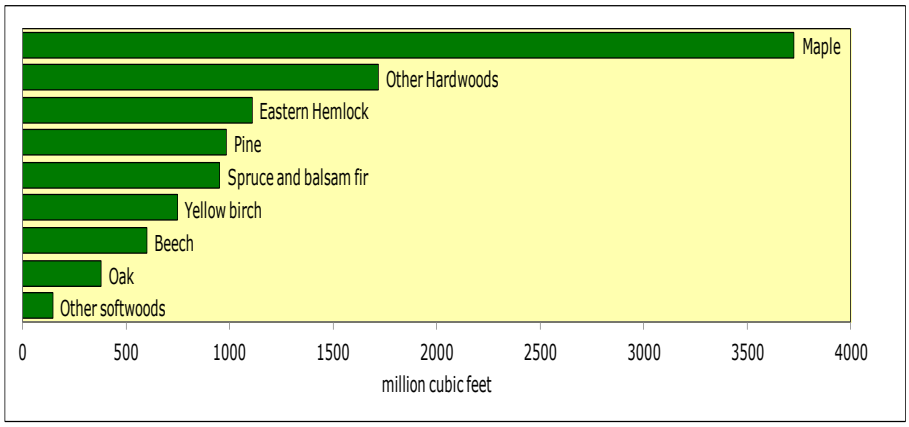
These highlights summarize information from the report on Forest Insect and Disease Conditions in Vermont 2011. The complete annual report, as well as other Vermont forest health information, is posted on-line at www.vtfpr.org/protection/idfrontpage.cfm.

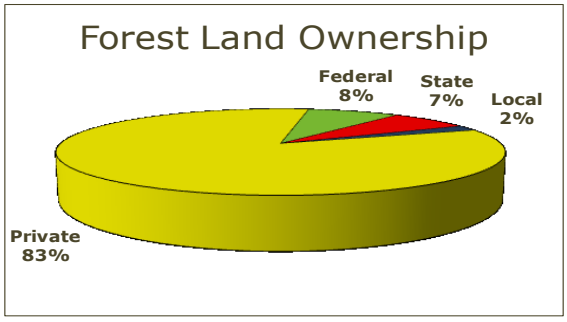
To receive a copy by mail, for assistance in identifying pests, diagnosing forest health problems, on-site evaluations, and insect population sampling, to obtain defoliation maps, management recommendations, and additional literature, or to participate in invasive pest monitoring, contact Forest Resource 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 eight percent under federal management in the Green Mountain National Forest. Sugar and red maple, eastern hemlock, and American beech account for over half of Vermont's trees. More information on Vermont's forest inventory is at Vermont's Forest Resources, 2010.



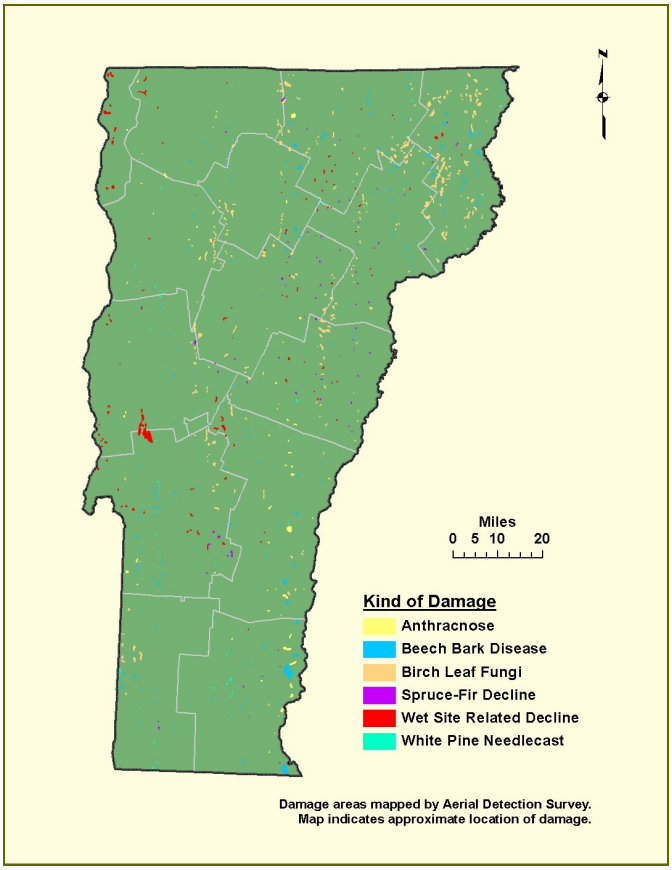


Forest Health Programs in the Northeast

Vermont Department of Forests, Parks and Recreation 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 2011, only 57,000 acres of forest damage were mapped statewide. This represents just 1% of Vermont's forestland, indicating that forest canopies were generally healthy. Half the acreage mapped was hardwood and softwood defoliation by leaf fungi due to wet growing season conditions. Twenty-percent of the damage was due to the non-native beech bark disease.



Damage areas mapped by Aerial Detection Survey.
Map indicates approximate location of damage.

Forest Health Program Highlights

Invasive Pests and Plants continue to be a major focus of the forest health program. 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. An interagency Invasive Forest Pest Action Plan is updated every year. A new 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 in volunteer efforts.

To support these efforts, a Forest Pest First Detectors program is being initiated, modeled on a similar program in Minnesota. Volunteers will be trained to assist their communities with early detection and rapid response. Online course materials are now available, and training sessions are being conducted. We continue to conduct numerous outreach activities to increase invasive pest awareness and improve early detection. In 2011, these reached thousands of people through fairs and festivals, and hundreds more through training sessions and hands-on workshops. In 2012, invasive pest preparedness activities will continue, including mini-grants that will be offered to communities to prepare invasive forest pest response plans.

Information about Forest Pest First Detectors is on the vtinvasives website.

Flooding of the state offices and the Forest Biology Lab destroyed historical forest pest records and ruined much of the insect collection.

The **Flooding of the State Office Complex** in downtown Waterbury had a major impact on forest health programs. Staff members were displaced and forestry records accumulated over the last century were destroyed, including historical reports and photos. The Forest Biology Lab was inundated with three feet of water and silt, ruining much of the insect collection. Collection data for the specimens that are beyond recovery are being entered into the Vermont Invertebrate Database Alliance (VIDA) records.

A Climate Cabinet was established by Vermont's governor to coordinate **Climate Change** efforts across state agencies and departments. An adaptation white paper, Climate Change and Vermont's Forests, provides an overview of the challenges facing forestry, what programs are already in place to address those challenges, and what steps need to be taken next to continue adapting to the impacts of climate change. To follow up, a project was initiated to develop Vermont-appropriate adaptation strategies for managing forests in a changing climate. Objectives are to identify vulnerable species and landscapes, develop decision-making tools, establish demonstration areas and develop a monitoring system.

Other Forest Health Initiatives which continued in 2011include the following:

- A campground invasive plant control project with the Green Mountain National Forest
- Efforts to discourage long-distance firewood movement
- A multi-state project to slow the spread of hemlock woolly adelgid
- An investigation into causes for tree mortality in Vermont and adjacent states
- An effort to build capacity for an invasive plant management program
- A project to conserve germplasm of disease resistant butternut
- A study of forest carbon at recently harvested sites with the University of Vermont

We also continue to provide diagnostic services, assist the Vermont Department of Health in monitoring tick populations, and participate in programs with the Vermont Invasive Exotic Plant Committee and Vermont's Endangered Species Committee.

Flood Damage started in the spring. Precipitation set a record high at Burlington, with nearly 20" from March through May. The shoreline of Lake Champlain remained under water from April through early June. Trees in flooded areas were submerged for weeks, and those species not well adapted to flood conditions succumbed. Coming on the heels of a wet season, the rain event on May 26-28th caused river flooding throughout northern Vermont.

On August 28th, tropical storm Irene tracked up the Connecticut River Valley. Rainfall totals ranged from 3.2"- 8.15", shattering records dating back to the summers of 1949, 1950 and 1971. The widespread heavy rainfall and river flooding were accompanied by wind, with gusts up to 85 mph reported on Mt Mansfield. Flash flooding was common across central and southern Vermont. For example, the Otter Creek in Rutland crested at nearly ten feet above flood stage. At least 260 roads and 18 state highway bridges were washed out or closed.

The force of flood waters from tropical storm Irene uprooted trees, undermined root systems, and wounded stems with floating debris.

2011 Forest Damage

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

Water was a particularly important driver of forest health in 2011. The growing season was bookended by record-breaking floods. Wet weather was also responsible for widespread foliage diseases. Where it did not cause damage, all the moisture had its upside. Tree health and growth were generally good, and dense tree crowns ensured that foliage season, once again, would not disappoint.

Thousands of acres of forestland along lakes and streams were inundated. The force of flood waters uprooted trees, undermined root systems, and wounded stems with floating debris. Many flooded areas were left with a thick layer of sediment, which buried roots. We expect substantial non-native plant invasions on disturbed sites, and some trees were swept away for good, but most were left standing and are expected to survive the short duration of standing water. More information is in the leaflet, How Does Late Summer Flooding Affect

Moist spring conditions set the stage for foliage diseases. Throughout the state, **White Pine Needlecast** led to premature casting of last year's needles. Fungi on diseased needles were identified by the US Forest Service as *Mycosphaerella dearnessii,* the causal agent of brown spot needle blight, and the needlecast fungi *Bifusella linearis* and *Canavirgella banfieldii*. Most current shoots developed normally and top branches were rarely affected, so we don't expect severe impacts. Because of wet spring conditions in 2011, and high fungus levels, white pine needle diseases are likely to be common again next year.

Hardwood foliage diseases were also common. **Septoria Leafspot on Birch** continued to be widespread at high elevations, with 24,976 acres mapped during aerial surveys. Mostly due to this disease, white birch dropped its leaves about ten days ahead of normal in monitoring plots on Mount Mansfield. **Anthracnose** became noticeable by late spring on sugar maple, ash, and red oak. Browning continued to show up through the growing season as leaves infected in the spring dried out. Many ash dropped leaves prematurely. More information is in the leaflet, Anthracnose Disease. Leaf and/or shoot diseases were also common on elms, poplars, willows, and sycamores.

Beech Bark Disease was the primary cause of dieback and mortality on 11,042 acres. The VT ANR Management Guidelines for Optimizing Mast Yields in Beech Mast Production Areas have been completed, incorporating beech bark disease considerations as well as wildlife needs.

Oak Defoliation by oak leaf tier and leaf rollers reappeared. This complex has been causing noticeable defoliation since 2008, with the same locations affected. Leaves are chewed, skeletonized and occasionally rolled, but rarely enough to cause refoliation. New Hampshire has reported scattered mortality from similar damage.

Very little **Pear Thrips** damage was observed, and spring counts of thrips on sticky traps were low. With this year's heavy sugar maple flower production, numbers in 2012 may be much higher. When they feed on flower buds, thrips produce more offspring.

Other Insect Defoliator populations remain low. Although there is a big increase in spruce budworm defoliation north of the Saint Lawrence River in Quebec, moth trap catches are down from 2010 in northern Vermont. Hickory tussock moth caterpillars were commonly observed, but no defoliation was reported. Saddled prominent, gypsy moth, and forest tent caterpillars were all observed in 2011, but the reports were isolated, and any defoliation was very light. Bruce spanworm was observed causing light defoliation in several stands. Moths were commonly observed in the fall, indicating that damage may increase in spring of 2012.

Defoliation from Septoria Leafspot on birch continued to be widespread at high elevations.

By late spring, Anthracnose became noticeable on sugar maple and other species. Browning continued through the growing season.

Wind Damage from several events resulted in 800 acres of mortality, mostly in northern Vermont. **Ice Damage** occurred following a March storm, breaking branches and scattering fir and hemlock shoots on the forest floor.

Seed Production was unusually heavy on a variety of species, including sugar and red maple, white ash, birch, red oak, willow, hickory, and apple. While it's normal to have occasional bumper seed crops, the widespread synchrony of flowering led to concern that stress might be involved. *Northern Woodlands* magazine, among others, addressed the question: Do Stressed Trees Produce More Seeds?

Seed production was unusually heavy on many species, including sugar maple.

Ash Decline was reported from several locations, including Addison, Rutland, and Windsor Counties. Symptomatic trees in Addison and Rutland Counties tested negative for the ash yellows disease. Research in New England has identified sensitivity to water table changes as another common cause of ash decline. This may occur on sites which are clearly wet or droughty, as well as mesic sites which are merely shallow. Since only the outer rings transport water in ash, it is particularly susceptible to fluctuations in water availability.

Workshops on managing terrestrial invasive plants in Vermont woodlands will be held again in spring, 2012.

Exotic Pest Update

A number of projects are taking place regarding **Non-Native Invasive Plants**. Collaborating with The Nature Conservancy, a field guide, *Best Management Practices for the Prevention and Treatment of Terrestrial Invasive Plants in Vermont Woodlands*, and a pocket guide, *Invasive Terrestrial Plants of Vermont*, were produced. Tools were developed to assist landowners and managers in assessing infestations, creating management plans, utilizing cost share programs and hiring contractors. These are available through the vtinvasives Tools and Resources page. This website also provides access to iMapInvasives, which tracks the spread of invasive plants. Workshops on managing invasive plants were held in the fall, and will be repeated in May, 2012.

Funded by the American Recovery and Reinvestment Act, crews were hired to conduct non-native invasive plant control work in campgrounds, dispersed camping, and roadside recreation sites in the Green Mountain National Forest, in State Parks and on the Long and Appalachian Trails. Work was completed at 62 sites. Targeted plants included Japanese knotweed, goutweed, garlic mustard, wild chervil, wild parsnip, burning bush, honeysuckle, multiflora rose, and buckthorn.

Don't Move Firewood efforts continued, including publicity aimed at winter tourists through the Winter Vacation Guide and mentoring a UVM class conducting a student-oriented campaign. Although Vermont does not have a statewide rule, State Parks and the Green Mountain National Forest continue to have firewood restrictions. Export of firewood from Vermont is limited by other quarantines. Under a new rule, New Hampshire will only accept untreated firewood if there is a compliance agreement. Untreated firewood cannot be exported to Maine, New York, or Canada. More information on firewood, including a downloadable Don't Move Firewood poster, is available on the website, firewood.vt.gov.

Don't Move Firewood outreach included an ad in the Winter Vacation Guide and collaboration with a UVM Forest Health class.

Emerald Ash Borer is not known to occur in Vermont and was not detected by public outreach or survey. However, it continues to be detected nearby. In 2011, an infestation was discovered on the island of Montreal, and a beetle was trapped in the Albany County town of Selkirk. To date, no beetles have been detected east of the Hudson River in New York.

Due to the increasing threat of emerald ash borer, survey efforts have intensified. Purple panel traps were deployed at 2200 sites on a 2x2 mile grid over most of the state, in an effort led by USDA-APHIS. Surveys of the predatory wasp, *Cerceris fumipennis*, were conducted in most Vermont counties, with volunteers making significant contributions. Several new nest locations were identified. We are also beginning to use girdled trap trees as a detection tool. For 2012, we will be looking for landowners interested in participating in a statewide trap tree network.

Current information is being assembled to assist landowners and managers in making decisions about ash management, including Emerald Ash Borer: Information for Vermont Landowners and more technical information for land managers. A Policy on Forest Management Plans and Amendments for Land Enrolled in Vermont's Use Value Appraisal Program (UVA) Related to Emerald Ash Borer has been developed. Plans to treat ash in response to emerald ash borer will be approved for UVA lands as long as they adhere to the program's minimum standards.

Ash seeds were contributed to the National Ash Seed Collection Initiative.

To prepare for the worst possible outcome, we participated in the National Ash Seed Collection Initiative. Seeds from fifty ash trees were collected for storage at the National Center for Genetic Resources Preservation in Colorado. A variety of other preparedness activities are planned for 2012 including preplanning for bio-control, pesticide use, and quarantine compliance agreements.

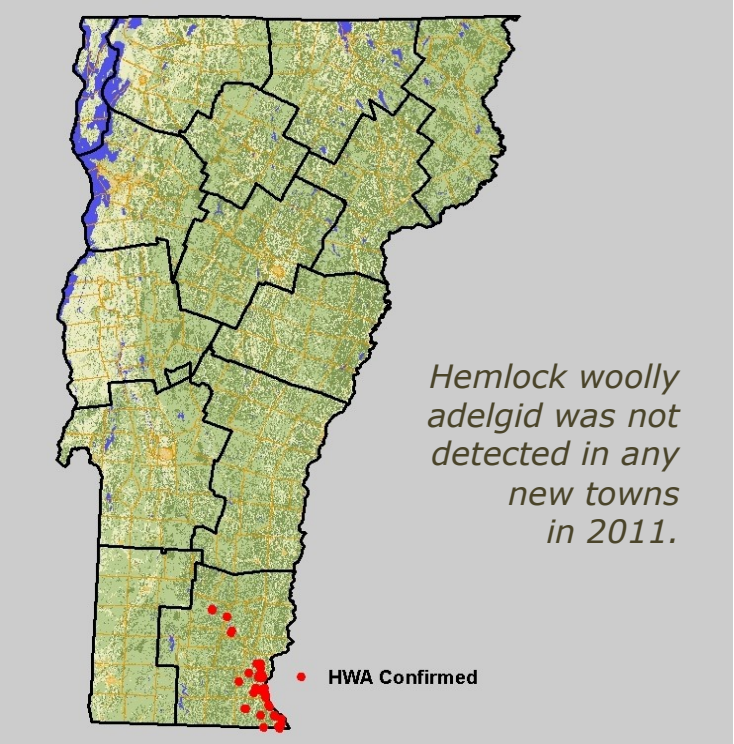
We will be looking for landowners interested in participating in a girdled trap tree network to detect emerald ash borer.

Asian Longhorned Beetle is not known to occur in Vermont. We don't recommend any management adjustments in anticipation of this insect. Its infestations expand gradually and mortality is not rapid. However, early detection is especially important for Asian longhorned beetle. Although several small infestations have been successfully eradicated, in Worcester County, MA, where the infestation is about twenty years old, the quarantine zone now covers over 100 square miles. Eradication efforts there are far from complete.

In 2009, 96 of the 198 Vermont property owners, whose primary residence is in the vicinity of the infestation in Worcester County, responded to a questionnaire to determine if firewood may have been moved into Vermont. In 2011, the non-respondents from that survey were contacted. Thirty-three were reached by telephone; letters were mailed to the others. Nineteen surveys were returned, for a total 2009-2011 response rate of 76%. Follow-up was conducted for the three 2011 responses indicating firewood or live plants had been transported.

Hemlock Woolly Adelgid was not observed in any new towns, and the infestation remains confined to Windham County. The drop in detections is attributed to colder temperatures in winter 2010-11 than the previous year. Average overwintering mortality in monitoring sites increased to 87% from 25% in 2009-10. This insect has now been detected in 38 locations in seven towns. Annual surveys are conducted, with assistance from citizen volunteers, at five sites in each town adjacent to infested towns.

Vermont is collaborating with the states of New Hampshire and Maine and the US Forest Service to manage hemlock woolly adelgid on a regional basis. Recommendations for Landowner Response are available for managing the insect in the forest and the home landscape.



Hemlock woolly adelgid was not detected in any new towns in 2011.

Hemlock products from Windham County are subject to quarantines. Vermont facilities may freely receive hemlock logs, pulpwood, or chips as long as the site has a compliance agreement. See Hemlock Wood Product Considerations for more information. The Vermont Agency of Agriculture, Food, and Markets monitors nurseries for possible introductions of hemlock woolly adelgid.

Vermont has hosted several biocontrol research projects. An adult of the predatory beetle, *Larcicobius nigrinus,* which was released by UMass in Brattleboro in 2009, was recovered in 2010, but none were found in 2011. A UVM report on the 2010 trial application of the fungal insecticide, Mycotal, with a whey based "forest fungus factory", indicates that adelgid population growth was suppressed in treated trees. A new UVM project Dynamics of a Naturally-Occurring Fungus-Caused Disease of Hemlock Woolly Adelgid has been initiated. Biotests of the native entomopathogen, *Myriangium sp*., are being conducted to determine its virulence and persistence.

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

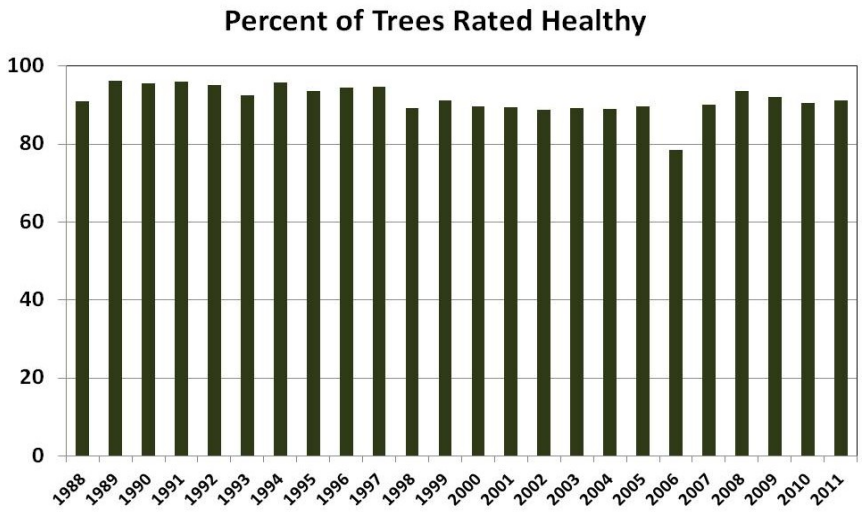
Butternut Canker levels remain stable, with most butternuts showing symptoms of the disease. We have been participating in a multi-state project, with Plant Technologies LLC, to conserve butternut germplasm. In winter 2010-2011, scions for grafting were also collected from 48 trees known to be pure butternut, which seemed to have some disease resistance. Trees grafted from 33 different Vermont butternuts are being maintained by the University of Missouri. Plans are to outplant these trees or their progeny in Vermont seed orchards.

Brown Spruce Longhorn Beetle has been established in Nova Scotia since at least 1990. In 2011, it was detected in New Brunswick. This insect has not been seen in Vermont, including in pheromone traps deployed in 2011 in two Caledonia County locations.

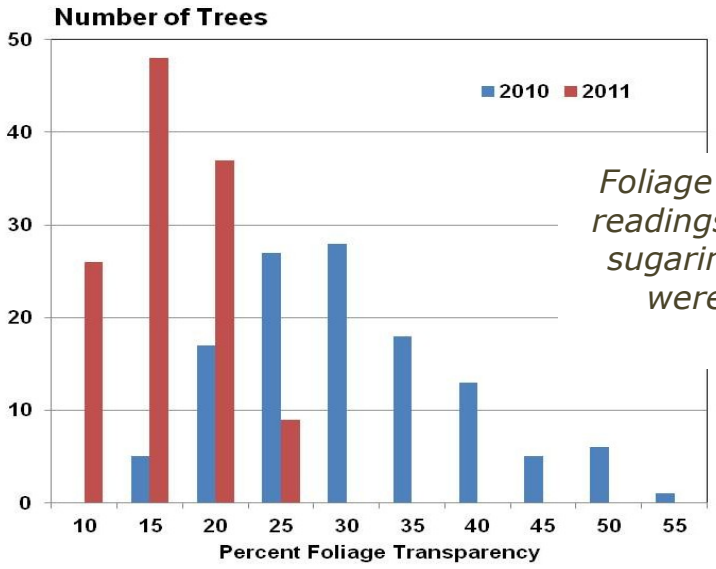
There were no new **European Wood Wasp** (*Sirex noctilio*) detections in 2011. A few other non-native species that have not been observed in Vermont include elongate hemlock scale, as well as the agents that cause oak wilt, thousand cankers disease, and sudden oak death.

Monitoring Forest Health

In Vermont's **North American Maple Project** plots, tree condition improved from 2010. Only 2% of sugar maples had thin foliage. Eight percent had symptoms of moderate or heavy decline, and dieback averaged less than 7% of fine twigs dead.



Only 8% of sugar maples in North American Maple Project (NAMP) plots had symptoms of moderate or heavy decline.



Foliage transparency readings improved at sugaring sites which were damaged by frost in 2010.

As a follow-up to the widespread **Foliage Injury from Frost in 2010**, evaluations were conducted of Tree Recovery from Frost Damage in Maple Sugaring Sites on State Lands. Transparency readings improved substantially at all six maple sugaring sites. Dieback and crown vigor generally improved as well, indicating that most trees have recovered from the frost event. Crown health also improved substantially in frost damaged NAMP plot trees.

Now in its 21st year, the **Vermont Monitoring Cooperative** continued to support forest ecosystem monitoring and research. Long-term study results and data are accessible at: sal.snr.uvm.edu/vmc. A new urban forest health initiative began in 2011. Trees in Burlington were evaluated by University of Vermont students to establish baseline health data. Nearly 200 plots will be used for long-term monitoring and to evaluate ecosystem services.

As part of a project to investigate potential causes for **Increased Mortality in Vermont's 2008 FIA Data**, 24 field visits and 15 sampling locations were evaluated. Tree cores and soil samples will be evaluated to establish time of mortality and stress factors involved. Additional projects conducted by local scientists have examined other species, including paper birch (*Halman et al: Potential role of soil calcium in recovery of paper birch following ice storm injury in Vermont, USA*) and red spruce (*Schaberg et al: Assessment of weather-associated causes of red spruce winter injury and consequences to aboveground carbon sequestration*).

References

Land Cover Map: U.S. Geological Survey. 2011. 2006 National land cover dataset. Sioux Falls, SD.

Forest Land Ownership, Forest Species Type: U.S. Department of Agriculture, Forest Service. 2009. Forest resources of the United States, 2007. Gen. Tech. Rep. WO–78. Washington, DC. 336 p.

For more information, contact the Forest Biology Laboratory at 802-879-5687 or:	Windsor & Windham Counties…….. Bennington & Rutland Counties…… Addison, Chittenden, Franklin & Grand Isle Counties…….. Lamoille, Orange & Washington Counties …… Caledonia, Orleans & Essex Counties……	Springfield (802) 885-8845 Rutland (802) 786-0040 Essex Junction 802) 879-6565 Barre (802) 476-0170 St. Johnsbury (802) 751-0110

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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,

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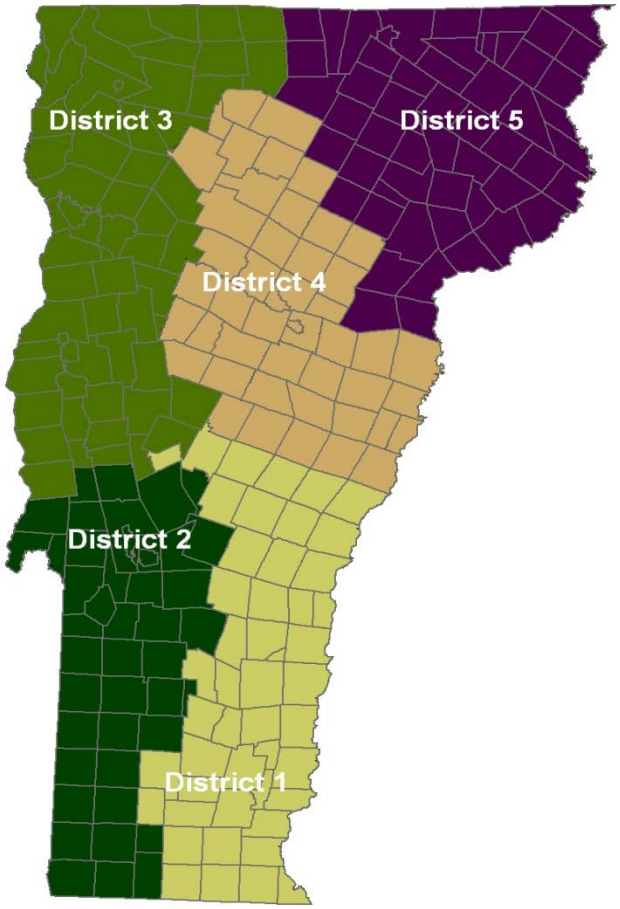

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INTRODUCTION

The information in this report is based on aerial surveys to detect forest damage, as well as ground surveys and observations by Vermont Forestry Division staff. A statewide aerial survey to map late season defoliators and general forest conditions was flown between July 27th and September 21st. All surveys were conducted using a digital sketch mapping system.

This report is dedicated to the memory of Johnny Barrows, who worked for the Department of Forests, Parks and Recreation between December 1959 and September 1997. His account of some of his activities over that time period is included in this report, and provides a taste of his knowledge of Vermont's forests, contributions to the Department, and sense of humor.

ACKNOWLEDGEMENTS

Thanks to the many individuals who contributed to this report, including Mary Burnham, Dan Dillner, Jim Esden, Jay Lackey, and Lars Lund from our Forest Resource Protection staff, as well as retired Forest Protection staff Ron Kelley, and intern Jonathan Decker. Wendy Richardson provided administrative support in many program areas. Lou Bushey, Aaron Hurst, Jeff Briggs, Neil Monteith, Eric Hansen, Chris Olson, Sam Schneski, Richard Greenwood, Jim Horton, Danielle Fitzko, Paul Frederick, Bob DeGeus, and Jason Nerenberg provided assistance in special programs.

Support in many program areas was provided by US Forest Service Forest Health Protection staff, including Michael Bohne, Margaret Miller-Weeks, Bill Frament, Ryan Hanavan, Isabel Munck and Nate Siegert; by the Vermont Agency of Agriculture, Food, and Markets, including Jon Turmel, Tim Schmalz, Emilie Inoue, and Rhonda Mace; UVM Extension staff, including Kate Forrer, Ann Hazelrigg, Caitlin Cusack, and Tim Wilmot, and by USDA APHIS, including Mark Michaelis and Steve Lavallee.

Gina Davis, University of Massachusetts, Scott Costa, University of Vermont, David Orwig, Harvard University, and Margaret Skinner, University of Vermont, contributed to our work in Vermont stands infested with hemlock woolly adelgid. Dale Bergdahl, Plant Technologies LLC, led efforts with butternut canker. Sharon Plumb, The Nature Conservancy, provided leadership for numerous invasive plant activities. Lindsay Watkins, University of Vermont Field Naturalist, provided field assistance for the mortality study.

Taxonomic assistance came from Cheryl Smith, University of New Hampshire, Wayne Sinclair, Cornell University, Ross and Joyce Bell, University of Vermont emeriti, Rod Crawford, University of Washington, Dan Jennings, Northeastern Forest Experiment Station, Maine (retired), Rick Hoebeke, now at the University of Georgia, Don Chandler, University of New Hampshire, Chuck Lubelczyk , Vector-borne Disease Lab, Maine Medical Center, Robert Acciavatti, US Forest Service (retired), Dale Schweitzer, The Nature Conservancy, New Jersey, Dave Wagner, University of Connecticut, Don Miller, Lyndon State College emeritus, and Vermont Entomological Society members Scott Griggs, Michael Sabourin, and Warren Kiel.

Volunteers have been key to weather and phenology monitoring, emerald ash borer biosurveillance, and hemlock woolly adelgid citizen monitoring. Special thanks go to Luke Curtis for assistance in many activities including helping to salvage the insect collection. Other volunteers include Ben, Sam and Jessica Dillner, MaryLou Webster, Bruce Jenson, Lisa Sheridan, Jody Lowes, Dan Ruddell, Pieter van Loon, Virginia Barlow, Joan Waltermire, Scott Diedrich, Doug Burnham, Mark Lemke, Michael Quinn, Mary Ellen Copeland, Jordan Fletcher, Mark Halverson, and Dina Kail.

SPECIAL ACKNOWLEDGEMENT

Johnny Barrows (1934-2011)

Presented by Johnny to Protection Staff, September 2007, Seyon Ranch

Johnny soil sampling.

Introduction

The intent of this article is to give the historical background of the old Forest Pest Division now called the Forest Resource Protection Division. This will describe the duties and obligations of the early years and laying the foundation of what the division is today.

All of the early people from Dick Fifield, Hollis Prior, Pete Reed, and all the rest made this all possible. I doubt if ever a finer more capable group could ever or ever will be assembled together again.

When I started work for the Forests & Parks in 1959 there were in the department:

Perry Merrill was Commissioner.
Ted Walker was Chief of Pest Control.
Albert Gottlieb was Assistant Commissioner.
Robert Farrington was State Forester.
Nathan Dauchy was Chief of Fire Control.
Robert Simon was Chief of State Parks.
Alden Eastman was in charge of Wood Utilization.
Esther March and Helen Weed's mother were the two secretaries.

I read about the job that was advertised in the Rutland Herald. I drove to Montpelier one day in October of 1959 and applied for the job then called "Porcupine Control Agent". The Forests & Parks Office at that time was up a long flight of stairs in a building in back of what's now the Pavilion Building. This had a wooden railing, and I got a two-inch sliver in my left hand. It was bleeding, and I wrapped my handkerchief around it and put my hand in my pocket.

Ted asked me if I only had one hand, and I showed him the sliver. He said Esther will take that out…she tried to get it out but she didn't. Later I went to the doctor and had Tetanus shot…what a way to start!

Esther made out my application. I couldn't write very well because I'm left handed. I thought later I should have sued the State then I wouldn't have had to do all this!

I was in Montpelier for an interview the last of November and was quizzed all morning on my knowledge of animal behavior, tracking, woods lure, animal identification and tree, marksmanship, knowledge of firearms, and general hunting skills…something I noticed immediately that none of the interviews possessed. Eight people were interviewed.

A few days later I received in the mail a notice that I had been hired and was to return to Montpelier to make out the few papers required of the position.

The first of December 1959 was my first day. I rode to Montpelier with Dick Fifield who had been hired the year before. There were four of us in all (myself, Dick, Carl Smith from Victory, and Edward Stearns from Ferrisburg). The pay was 90¢ per hour, 75¢ meal allowance, and 4¢ a mile for our own vehicles.

Johnny circa 1960's.

Let me give you a little history on the Porcupine Control Project…

Vermont had paid a bounty on the porcupine, black bear, bobcat, and timber rattle snake since the early 1900s with little or no control and a big expense. The bounty on porcupines was 50¢ for a set of ears. A person with a little skill and a sharp knife could make a dozen sets of ears out of a porcupine's belly. So the porcupine population was expanding at an alarming rate. Back then in Vermont timberlands association was very strong, and the members were complaining about the terrible damage being done to their young stand of northern hardwoods.

Many ski areas were starting up and they too were complaining of the porcupine damage done to the ski lifts especially the rubber bushings inside the shives that carried the lift cables. They were also having damage to the mountain ski buildings.

The State and Town Highway Departments were receiving a lot of damage to highway guard rail posts and signs which were soaked with road salt, and the porcupines were chewing them up. But most of the damage was on landowner's property pole size sugar maple and yellow birch along with plantations many planted during CCC days.

So Commissioner Perry Merrill and Ted Walker went seeking advice and found the State of Minnesota had had success in controlling porcupines using the poison bait apple method using sodium arsenate in red delicious apples placed well back in the dens. This was done during the winter months when other fruit-eating animals were in hibernation. This poison bait method had been perfected at the University of Massachusetts under Wildlife Professor Wendell Dodge.

So Wendell Dodge was contacted, and he made a few field trips into Vermont. He said, "Yes this will work in the short term but in the long term you have got to have natural control" and this animal was the fisher. The fisher was native to Vermont and a predator on porcupines and other. Vermont's fisher population was all trapped out in the early 1900s and its loss of habitat due to early forest fires and logging and farming practices.

So again, Commissioner Merrill had a meeting with the Commissioner of Fish & Game, George Davis, to see if it was possible to restock fisher in some of the remote areas of the state, and all were in agreement. The old Commissioners could do anything they wanted to do.

So armed with this information, Perry Merrill went to the legislature and said he needed men to start a Porcupine Control Project to give all relief from damage. This he got…

History on the fisher.

Like I said earlier, the fisher was native to Vermont although now for all practical purposes all but extinct. A questionnaire was sent to Game Wardens, loggers, and anyone who spent considerable time in the woods if they knew anything about a possible remaining population.

People responded. Ray Pratt, Newfane Game Warden, said he had picked up one as a roadkill and he had seen tracks of one near Townshend State Park. A man said there was evidence of fisher in the Lowell Mountains, and Joe Tuttle from Tunbridge sent a picture of one he caught in a trap. So yes there was a very limited surviving population with the few wildlife biologists that the State had at the time. Jim McMartin, Russell Lord, and Wildlife Professor Dr. Robert Fuller from UVM agreed that stocking a few fisher with the few we already had would help in the control process.

So an agreement with the Department of Inland Fisheries and Game Dept. in Maine was made, and a Mr. Myron Smart who was Maine's State Trapper to live trap fisher for Vermont and send them all by plane for us to release in different sites. Later Vermont paid Maine back somewhat by sending Maine 24 wild turkeys.

I remember it was a cold January night Dick Fifield called me and said Myron Smart had just called him and he had three fisher. He was sending them to West Lebanon, NH Airport, and they would be there in the morning. So we were at the airport I think they came in at 8:00 a.m. We were met at the airport by Ted Walker, Dr. Fuller, and several members of the press all wanting to take pictures.

Well I wished I could say this was a success but it wasn't. When Myron sent the traps which were wire cages he covered them with burlap bags of which of course the burlap was gone. The fisher there were two small females and one large male and were pretty much beat up in their cages. I'm sure the two females didn't make it, and I don't know about the male. They were released in the mountain of Appalachian Gap in Fayston.

After that, Dick had charge of the fisher release. He said we have got to build some wooden boxes to put the traps into and keep the fisher in the dark, and we have got to release them in the dark (no fanfare and no other people). So we built boxes and sent them by plane to Myron in Maine and after that the fisher came through in much better condition. Myron would send the fisher to us, and we would send back the empty traps and boxes. They either came into Lebanon or Burlington. Rutland's runway wasn't long enough.

The first release was in winter 1960. At Myron Smart's request, he said to Dick and me, "Why don't you come up to Dover-Foxcroft and go trapping with me for a week and then you can compare the areas these fisher were caught in to areas you have in Vermont? Then they can be released in familiar country." So Dick and I went to Maine for a week learning the ways of the fisher. For a week we just talked fisher. We learned their favored road crossings, their seasonal habitats, their favored type of forest cover, and their mating habits. And we came back with much better knowledge than we had before and were able to release them in their favored habitat. We also learned that most of the females were pregnant, most were caught in January and the young were born the last of February/first of March. This was a plus for us (126). I don't know how many were released in the state, but we started seeing results after a couple of years.

The state legislature at that time was made up of farmers, loggers, and landowners many of whom were having trouble with porcupines themselves. Porcupines were everywhere. We worked the first few years on requests first-come first-served. The numbers were staggering – 300 dens in the Bethel quarries alone, 175 dens on one side on Saltash Mountain in Shrewsbury.

Dick Fifield and I shot 57 in one day on Charles Handley's property in Braintree. Mr. Handley was a member of the legislature. I treated 50 dens and shot 30 on Royal Cutts' property in Townshend. Royal was in the legislative appropriations committee.

Wilbur Johnson, State Highway Foreman, said after we told him we would be hunting porcupines at night up on Route 73 Brandon Mountain, "I will bury with a spoon all the porcupines you can get." We left 40 in a pile along with a sign, "Wilbur take your spoon and bury these and we will get you some more." He said don't ever do that again!

The work season ran from December 1st to April 1st. That first year I treated over 500 dens and shot 259 porcupines more than double some of the others. April 1st I was asked to stay on and work on the BRC Program. This ended September 1st.

History of the BRC Program.

The Blister Rust is a disease on white pine trees carried by windblown spores which to live required the host plant of the Genus Ribes which are currant and gooseberry plants. The spores are carried by wind and moisture from the plant leaves to the needles of the white pine, going from the needles to the limbs, to the trunk causing a canker which girdles the tree killing the tree. The spores from the canker blow back to the Ribe leaves and the process starts all over again. By removing the Ribes bush, this breaks the cycle.

The BRC and the gypsy moth inspections were the duties of the Department of Agriculture Forest Service but these employees were all older people having been hired back in the CCC days.

There was on the BRC program:

Huntley Palmer – Montpelier
Moston Mullholland – Rutland
Frank Rose – Bellows Falls

The gypsy moth inspections were:

Robert Rambo lived in Bridgewater but worked out of Bennington
Ted May – Rutland

All these people were retired in the early 1960s and all the government programs were turned over to the states.

Blister Rust disease was first discovered on nursery stock sent from Germany and a plant on the Billings Farm in Woodstock after it showed up on other planting stock sent from Germany.

The Department of Agriculture Forest Service started the control program back in the 1930s as a cooperative effort using town, state, and federal funds. The catch was the Town had to come up with the money and if they did, the State and Federal would match it. *Example: Town appropriation $200, State and Federal $200 each for a total of $600 worth of work.*

Crews were hired to remove by pulling up Ribe bush in and around white pine stands. The first year I was involved with BRC was the first year Ribe bush were sprayed instead of being pulled.

We used different types of sprayers and we used – now get this – 245T mixed 6 oz. to a gallon of fuel oil. The same mixture as they used to spray the jungles of Vietnam. Over the years I have probably had as much Agent Orange on me as anybody.

I acted as Crew Chief. I hired my own people. A crew was no more than four.

Ribes were mostly found along stonewalls, roadsides, ledge areas around large trees, swamps, and we sprayed them all.

The crew chiefs carried sidearms because we shot every porcupine we found. This also included most snakes, especially around West Haven, Fair Haven, and Benson. Over the years I shot four timber rattlesnakes.

At that time every pasture was full of cows and young stock and bulls were the biggest threat. Hollis remember when the bull had us up trees in Danby?

So that was the Blister Rust Program.

I was then asked to stay and work on gypsy moth. I was called an inspector. Thousands of Christmas trees came out of the mountains of Rutland County. They were shipped on the trains and all had to be inspected for gypsy moth egg masses under the instructions of Ted.

Then I started over again on porcupines. My work status was called permanent part-time which I got paid for holidays and ½ day a month vacation. For this I got a pay raise of $1.25 per hour and our mileage went up to 8¢ per mile.

During the early years we were involved with search and rescue working with Fish & Game people. We also assisted them with dead deer surveys, wildlife counts, and some assisted in waterfowl counts on the game refuge. We even helped from time to time stocking fish in remote ponds. Duties we would never be asked to do today.

Another very interesting thing happened on October 10, 1963 because Vermont had already suffered major losses from forest fires and many towns didn't have the means to fight these fires. Then Governor Philip Hoff declared a proclamation suspended the hunting and fishing and other recreational activities including hiking and wood cutting and logging. The woods and waters were closed to all except for the landowner, his tenants, and servants or persons in the public employment engaged in abating such fire conditions.

Johnny and Churchill Scott, Killington fire tower, 1981.

During the thirty days the woods and waters were closed, those of us who worked for the Forest Service our job was to patrol the back roads and should we see anyone there were to tell them to leave. We carried cards signed by the Governor giving us authority to do this.

The woods and hunting and fishing seasons were reopened on November 10, 1963 due to all day rain on October 31, 1963. It will never happen again.

One time in the middle of the night I had a telephone call from Ed Kehoe, Commissioner of Fish & Game. He wanted me to see him in Montpelier the next time I came up. He said he had just come from a board meeting, and they were talking about me and he said I'll tell you when you get here. Well I didn't know of anything I had done but the next day I found an excuse to go to Montpelier because I wanted to find out. I met with Ed and he said, "We want you to come work with us." He said it would only entail a little paperwork. I told him I would let him know in a week. I almost did but now I am so glad I didn't.

Back at that time we were the envy of some of our other employees. We all knew what our duties were and when they should be done. We made our own schedules and did our own work plans. We had a lot of night meetings so if we didn't want to come in until noon the next day, we didn't.

We were the first to have our own state vehicles (with credit cards) which some people really resented. Some people called us "Perry's Pets" even though Perry had long since retired. If something special in the

department had to be done, they always asked the Protection people to do it, and we always accomplished anything we were asked to do. We could do no wrong.

We combined with Fire Control in the early 1970s and our duties greatly expanded, and we had supervisors other than the Chief in Montpelier.

Some of the boys and I (I say boys because there were no girls then) had problems with this. I never did. I worked under some great people who gave us a free reign to do our duties as we see fit – Elwin Leysath, Gene Keenan, and our own Barbara Burns.

The Porcupine Control Program came to a close in the early 1970s. During that time (21 years) I treated over 10,000 dens and have shot over 3,000 porcupines. I will never kill another! I would like to know how many hundreds of miles I have walked on snowshoes and how many boxes of ammunition I have shot up – it would be scary! And my knees feel it.

The BRC program closed out about 1980 except for a few chosen plantations and nursery inspections. Now the nursery is closed.

I retired September 1st 1997. I had what I always called a 38-year vacation. I enjoyed every day and almost made a living doing it!

After I retired I was appointed by then Governor Howard Dean to serve on the Fish & Wildlife Board. This was a six-year term I served from 1999-2005. If I had it all to do over I wouldn't change a thing. I enjoyed every day. I couldn't have had a better job.

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WEATHER HIGHLIGHTS – DECEMBER, 2010 TO DECEMBER, 2011

- **Boxing Day Blizzard, December 26-27, 2010.** A significant nor'easter affected the eastern U.S. from Florida to Maine. This storm brought between 12 and 32 inches of snow to the major northeast cities, Philadelphia, NYC, Boston, Hartford, Providence and the surrounding areas. Southern Vermont received between 12 and 21 inches in Bennington and Windham counties.

- **January 12, 2011.** Another **major nor'easter**, the second in 2 weeks affected mid-Atlantic and southern New England. This storm originated in the southern U.S. on January 8 leaving a track of snow and ice from Texas to the Carolinas before moving north. Connecticut was severely affected with many locations receiving up to 30″ of snow. Wilmington, Vermont had 36″ with 14 to 30 inches in other southern Vermont towns. Northern Vermont received snow as well with amounts from 3 to 15 inches, higher amounts in the mountains, lower amounts in the most northern counties.

  As a result of this storm, on January 11, 2011, 49 of the 50 states had snow on the ground. The only state without any snow was Florida. Hawaii had 7″ of snow on top of Mauna Loa.

- **Groundhog Day storm, February 2, 2011.** Blizzard conditions, sleet, ice and severe weather affected 1/3 of the U.S. starting on Feb 1 on a track from New Mexico and northern Texas to New England and Eastern Canada.

  Vermont's share of this massive 33 state event was rather unimpressive, just a good old fashioned Vermont snowstorm that dropped up to 17" of snow in Waterbury. More widespread snowfall amounts ranged from 8-12 inches statewide. Light winds and powdery snow caused few problems. Many schools, businesses and meetings were closed for the day, several closing the night before, keeping traffic light and roads clear for road crews.

- **Rare thundersnow event, February 5, 2011.** Reports from all over the state as well as New Hampshire, Maine and Mass of thunder and lightning accompanying snow, sleet and freezing rain. The thundersnow started about 10:00 p.m. in northeast Vermont with intense bright flashes of lightning and thunder and lasted 30 to 40 minutes.

  Thundersnow is rare east of the Rockies. For thundersnow storms to occur, temps near the surface need to be fairly warm (in this case near 30 degrees). More importantly, the overall storm needs to be very strong and rapidly getting stronger which means there is a particularly cold patch of air way high overhead. The U.S. generally records 6 thundersnow events annually. Prior to this event, thundersnow was reported in New York in January and in Chicago during the Groundhog day storm.

- **February 18, 2011**. **High temperature record** set in Montpelier with 56°. Daytime temps statewide in the 50's and even 60° in Bennington.

- **February 27, 2011**. Burlington set the **record for snowiest February** with 42.6″. The old record was 42.3″ set in 2008. This was the second snowiest climatological winter, December 1 to February 28 in Burlington with 97.4″ (the record is 103.4″ in 2007-2008).

- **March 7, 2011.** Another **major snowstorm** with 2+feet of snow in many locations and significant ice damage in southern Vermont. Thirty inches in Jericho and Cambridge, 29″ in Newport. Burlington set another record for largest snowstorm in March with 25.8″. Townshend received 2.63″ of rain and Sunderland, a ½ inch of ice. Over 550 schools closed for the day as did state government. High winds brought down powerlines, thousands were without power. An avalanche off Mt. Pisgah closed Route 5A near Willoughby Lake in Westmore and a barn collapsed in Shelburne trapping 10 milking goats under heavy snow. All were dug out unhurt.

- **March 14, 2011.** Melting from warmer temps and rain over the weekend caused several small **ice jam floods** that closed some state and local roads mostly in northern Vermont. Basement flooding from the Moose River in St. Johnsbury continued for several days.

- **April 12, 2011. Moderate flooding** from rain and snow melt along these rivers at these locations: Missisquoi – North Troy, Berkshire; Lamoille – Johnson, Jeffersonville; Winooski – Waterbury, Essex Junction; Otter Creek – Center Rutland.

- **April 26, 2011.** Heavy rains caused **flash flooding** and road closures for several routes in northern Vermont.

- **April 28, 2011.** Lake Champlain set a **new high water record** – 102.16 feet (old record 101.9). Major flood state is 101.5 feet. Flooding of state highways, local roads, streets continue. Burlington set another record for wettest April.

- **May 6, 2011.** Lake Champlain set a **new all-time high water record** of 103.27 feet. In addition to the flooding, wave action caused extensive damage to property along the lakefront. Wind caused waves to "pile up" on shoreline facing the wind and so varied depending on wind direction.

- **May 8 – 13, 2011.** First **extended stretch of dry weather** since November, 2010…followed by extended rainy spell.

- **May 26, 2011. Severe weather event** caused extensive damage in central and northern Vermont. Supercells produced large diameter hail (baseball sized reported in Duxbury), winds up to 70 mph with the highest damage from downed trees and powerlines occurring from Johnson to Island Pond and from Duxbury to Plainfield to Lunenburg. Flash flooding occurred from Barre to St. Johnsbury with rainfall amounts of 3 to 5 inches and localized amounts up to 7 inches.

- **May 31, 2011.** Burlington **wettest month records** set for (1) the month of April with 7.88" (Previous record was 6.55" in 1983); (2) the month of May with 8.67" (Previous record was 7.10" in 2006); and (3) wettest meteorological spring (March, April, May) with 19.94" (Previous record was 15.46" in 1983.)

- **June 9, 2011. Severe weather event** brought down trees and powerlines mostly in southern four counties of Vermont**.** Lightning caused structure fire occurred in Ludlow.

- **June 19, 2011**. Lake Champlain drops below flood stage.

- **July 6, 2011**. **Severe storm event.** Lightning caused structure fires in Burlington, Barnet, Westford and two in Essex. In 2011 to date, structure fires caused by lightning have also occurred in Addison, Bradford, Danville, Stowe and St. Johnsbury.

- **July 21 – 24, 2011. Official heat wave.** Multiple locations in Vermont recorded temperatures over 90° for at least 3 straight days. Multiple locations across the state broke records for the highest high and the highest low temperatures over this period. With high humidities as well, the heat felt more like a summer day in Virginia.

- **August 23, 2011. 5.8 magnitude earthquake** 40 miles northwest of Richmond, Virginia felt from South Carolina to Maine. Reports of quaking felt in Vermont but no damage reported.

- **August 28, 2011. Tropical Storm Irene.** Widespread devastation especially to southern Vermont. Affects from damage will be felt for years to come.

- **September, 2011. Temperatures well above normal.** Records set across the state for highest high and highest low.

- **October 30, 2011. Nor'easter** brought heavy snow to southern Vermont**.** Brattleboro received 15.1 inches of snow, the most in a single day in October since 2002 with 4". Northern Vermont received only a trace to 4".

- **December 31, 2011. 2011 the wettest year on record.** Records set in Burlington with 50.92" (Previous record 50.42" set in 1998); Montpelier with 53.81" (Previous record 48.65" set in 2006), and St. Johnsbury with 51.21" (Previous record 49.42" set in 1983).

WEATHER AND PHENOLOGY

Unless otherwise noted, all temperature and precipitation reports in the narrative below are from our Essex fire weather station.

WEATHER SUMMARY 2011

Fall and Winter, 2010-2011. November of 2010 lived up to the month's gloomy reputation with mostly cloudy skies. It was relatively mild, temperature-wise, however, with quite a few days in the 50s and even a 63^0F on the 14th. On the Saturday after Thanksgiving, a blast of cold winter air allowed the ski areas to make snow and provided a boost for the first weekend of the ski season. It was short-lived, though, with temperatures back into the 50s and heavy rain on November 30th. On the very next day, December 1st, the first of several freakish weather events rocked the state. Strong downslope winds from the southeast gained in strength all day. Mount Mansfield recorded a 103 mph gust! All along the western slopes of the Green Mountains and the lesser hills in the Champlain valley winds reached the 60-80 mph range. Entire stands of trees were broken and/or uprooted. Damage was extensive to everything in the path of the falling trees…powerlines, homes, etc. Especially hard hit were the white pines and hemlocks and any hardwoods with defects. Trees that grew in clumps with shared root systems tipped over as a single unit.

The first widespread snow of the season started falling on December 6th. A low pressure in retrograde (i.e. moving from east to west) drifted back from the Atlantic and stalled just north of Maine. Several days of continuous, light snow added up to 30" in some mountain locations. The Essex Junction weather station recorded only 8", but the storm provided an early snow cover for the new season. Like many December snowfalls, this snow did not last even a week when another storm carrying considerable moisture brought an all day/all night rain to Vermont. The snow disappeared in the valleys and turned to mush in the mountains. After it passed by, cold temperatures turned the precipitation back to snow. This would be the last time the bare ground would be visible until early April. Throughout the rest of the month, many small snowfalls (almost every day) accompanied by the cold temperatures needed to keep them from melting made for a classic white Christmas. On the day after Christmas, a strong, fast-moving storm hit the east coast cities. Blizzard conditions stranded many travelers trying to head home from their holiday visits.

A temperature of 52^0F on New Year's Day in the Champlain valley settled the snow considerably, but once again in January, frequent light snows kept accumulating. Daytime temperatures stayed in the 20s. Eighteen of the first nineteen days in January had at least some measurable snow…twenty four of the thirty one days of December had snow! The western slopes of the Green Mountains and the higher elevations everywhere in the state began piling up a significant light and fluffy snowpack. On January 12th, a strong nor'easter developed near Cape Hatteras. It moved up the eastern seaboard and brought heavy snow to southern and eastern Vermont. By 7:00 AM in the morning, schools as far north as Vergennes closed in anticipation of the storm. Not even a flake was in the air in Burlington!

The mercury only reached 3^0F above zero on the 23rd of January. That night (the coldest night in years) recorded a temperature of -25^0F at Essex. Another snow storm tracking up the east coast barely grazed southern Vermont on the 27th of January. The big cities of DC, Philly, Boston and NY were right in its path. 18" of snow fell in Manhattan! Yet another storm, a few days later, formed along the eastern seaboard. This storm, dubbed the Groundhog Day storm, stretched for 900 miles and affected nearly 100 million people living in its path. Snow continued to pile up in Vermont…barn roofs began

to collapse and homeowners were scrambling to buy roof rakes. February set a record for snowfall at the Burlington weather station.

Spring, 2011. A slow warm-up began on Friday, March 4th. Light rain began falling that Saturday night. By Sunday morning it had changed to heavy rain. At around 10:00 AM on Sunday, the precipitation changed to snow and continued to fall all day, all that night and most of Monday. This was the biggest snowstorm of the season in northern Vermont. Nearly 30" fell in Burlington, making it the third largest snow storm in that city's history. Three months of accumulating snows produced an exceptional snowpack throughout the state. Snowshoes were required to go anywhere that wasn't plowed. More barn roofs collapsed and some farmers were unable to ship their milk because the haulers couldn't get to the farms. The snow was so deep in people's back yards that the squirrels were able to jump past the baffles on the bird feeders and raid the seeds.

The sugaring season was off and running by mid-March. The deep snowpack made getting around in the woods difficult, and the early March snowstorm caused some damage to the tubing. Most sap runs in March were short and light because the overnight low temperatures often sank below 20^0F. In spite of these less than ideal weather conditions, the majority of sugarmakers ranked 2011 as their best year in regards to quantity of syrup made. Vermont led all states in maple syrup production with 1.14 million gallons!

Ski areas were operating into April with nearly mid-winter conditions. A technician from NOAA measured the water content of the snow in Duxbury. There was more than 7" of water in that core! All this water was just waiting for some warm temperatures to start pouring down from the mountains towards the rivers and lakes. That warm-up arrived on April 11th accompanied by heavy rain and thunderstorms (1.13" of rain in Essex and 73^0F). This marked the end of the good skiing and the end of the sugaring season for most producers. Local flooding from the runoff closed roads in Essex, Williston and Cambridge (to name but a few). For the next several months, the phrases "flooding" and "road closures" would become all too familiar to Vermonters.

Overnight heavy rain on April 26th caused flooding everywhere on the next morning. Many schools were closed, and the rainfall set a record for both the 24 hour and the April monthly totals in Burlington. Lake Champlain was on a steady rise since early March. It reached the official flood stage of 100' on April 13th…rose above the previous historical level from 1993 of 101.8' on April 28th…and kept rising to set a new all-time record of 103.27' on May 6th. The Charlotte ferry closed because the loading dock was under water. Isle LaMotte schools closed because the island was "cut off" by the high water on Route 129. Lakeshore camp and homeowners fought back the water with everything they could in a desperate attempt to protect their property.

Some of the numbers from the spring flooding were truly amazing. The Winooski river gauge at Essex measured the river delivering close to 30,000 cubic feet of water per second after the late April rain and melt. Flood waters increased the surface area of Lake Champlain by 66 square miles. The volume of water in the lake increased by 867 billion gallons. It would be impossible to capture the frustration and helplessness that this flooding caused to the residents along Lake Champlain. While the water was high and the winds came from the north, those with property facing that direction watched as the relentless waves pounded away at the shore…when the wind was from the south, the people facing that direction got their turn to witness the assault. From March 5th to May 6th, the lake rose 7.5', and it stayed above flood stage for more than two months! Trees along the shoreline had the soil around their roots washed away…many fell over and many more will die from the exposed roots in the next few years. The eroding waves also caused sloughing of the lakeshore banks and sent the trees on

those slopes sliding down to the water level. Tree species that were not tolerant of the prolonged flooding died all around the lake perimeter.

The spring of 2011 had one repeating theme; a series of low pressure systems would move up the east coast and stall over the mid-Atlantic region sending moisture from the ocean northward into Vermont. At the Burlington weather station, April recorded 274% of normal precipitation…May, 261%...and for the meteorological spring of March, April and May, 234% of normal to set a new all time record. One rain-free spell lasting 8 days from May 6th to May 13th was the only opportunity to dry out. The spring fire season was minimal. It was difficult to find the conditions that would allow for prescribed burns to be conducted. The amount and frequency of the spring rains made the leaf disease, anthracnose, widespread in Vermont. The primary host species were maple and ash. It was a heavy flowering year for many tree species…notably, sugar maple, red maple, silver maple, ashes, birches, hickories, apples, white cedars, and more. Pollen counts taken on May 24th in Burlington were higher than any time in the last 20 years.

A line of severe thunder storms passed through north and central Vermont on May 26th. That evening a tornado touched down in Roxbury, and heavy rain (nearly 5" in St. Johnsbury) turned the brooks and rivers into raging torrents. Flash floods in Washington County hit the towns along the Winooski River especially hard. Many local and state roads were washed away by the rushing water. Twenty four homes were destroyed in Barre and Cabot. Damage to roads and other public infrastructure was estimated to be in the millions of dollars. Unlike the slow and relentless rise of Lake Champlain's waters, this type of flooding came fast and furious and quickly departed leaving a path of destruction behind. For the second month in a row this spring, May also set a record for rainfall in Burlington.

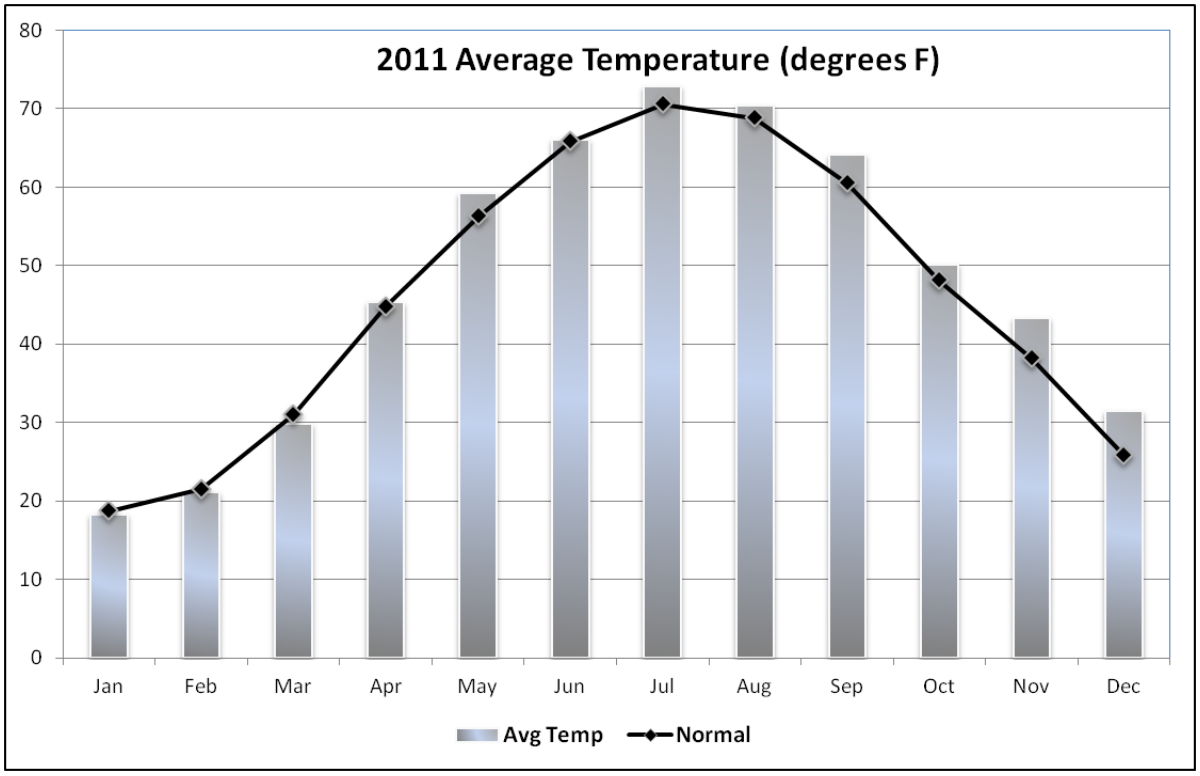
Summer and Fall, 2011. The rest of the summer was fairly normal for temperatures and somewhat above normal for precipitation. There were never more than four or five days between rains. One notable hot spell in late July set a record of 97^0F on the 21st. During this spell, Burlington also set a record high overnight "low" that made sleeping unbearable for those without air conditioning. The meteorological summer of June, July and August in Burlington recorded a 1.3^0F rise in high temperatures, a 1.5^0F rise in low temperatures, and a 1.55" increase in precipitation.

One more weather extreme was waiting to hit Vermont last summer. On August 28th, tropical storm Irene blasted the state with copious moisture and strong sustained winds. In Essex, 3.65" of rain fell, but the central and southern mountain towns got a lot more…11.23" in Mendon! Some areas still recovering from the May flooding were hit again—and harder! Over 400 local and state roads were closed from the destructive flash flooding; 30 bridges were damaged or destroyed; more than 700 homes were either flooded or destroyed. Eleven towns remained isolated for days with all of the roads into town impassible. The state office complex in Waterbury had water to the top of the desks in the ground floor offices. This flooding ruined thousands of acres of agricultural crops and made the produce from many truck gardens unfit for sale. In many ways the flooding from Irene surpassed the damage from the 1927 devastating flood. It will be many years before Vermonters will recover either financially or emotionally from this storm.

Vermont was reeling from the blow from Irene just as the fall foliage season was about to begin. Speculation ran high that tourists would be reluctant to chance a visit to our state. These doubters had underestimated the indomitable spirit of Vermonters. Volunteers by the thousands pitched in and helped the flood victims. Free concerts raised money and people gave generously to the flood victim fund. The road crews and construction companies repaired the roads in record time. Help poured in from the surrounding states and from the nation to help Vermont get back up on its feet in an impressive show of community spirit. The foliage season even cooperated by being a little later than

normal and buying some time to get the roads and bridges fixed. Late summer and early fall weather was mild, cloudy and wet…not conducive to early color. There were few hard freezes, even in the mountains. By Columbus Day weekend, however, the stars were aligned just right —beautiful, sunny fall weather at the peak of the foliage season and on a long holiday weekend. Tourism ended up about normal throughout the state and the leaf peepers once again enjoyed Vermont's fall show.

Figures 1-19 and Tables 1-2 provide details on 2011 temperatures, precipitation (including very dry conditions in November), and phenological observations.



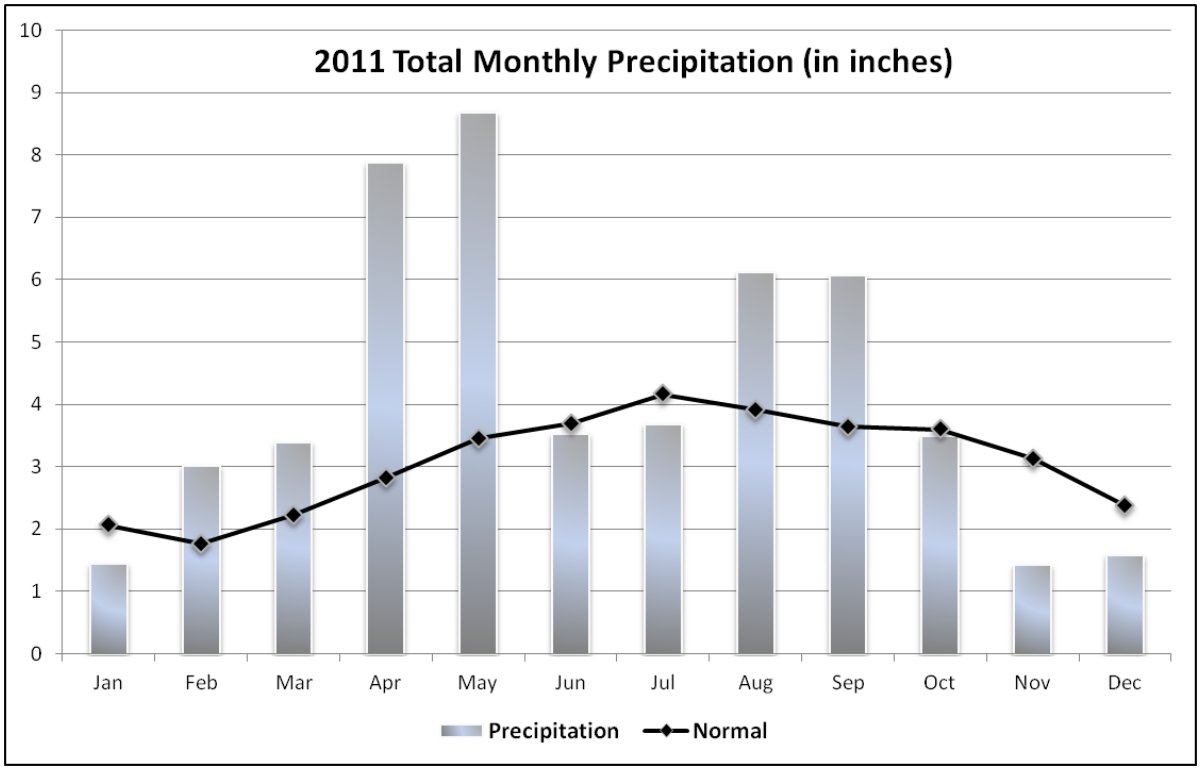


Figure 1. Monthly average temperature and monthly total precipitation in 2011, compared to normal for Burlington, Vermont. (Normals are for years 1981-2010.) *Source: National Weather Service, Burlington.*

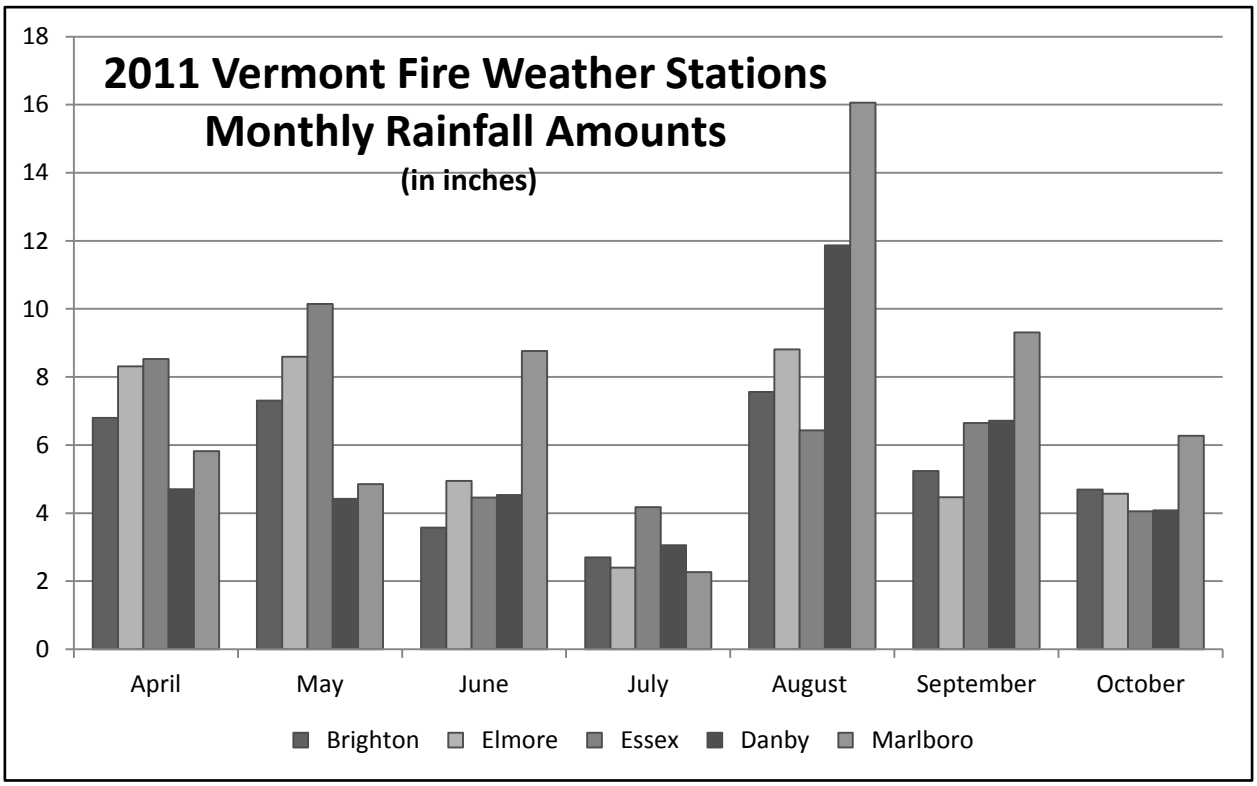


Figure 2. Monthly rainfall amounts (in inches) at Vermont fire weather observation stations through fire season, April-October, 2011.

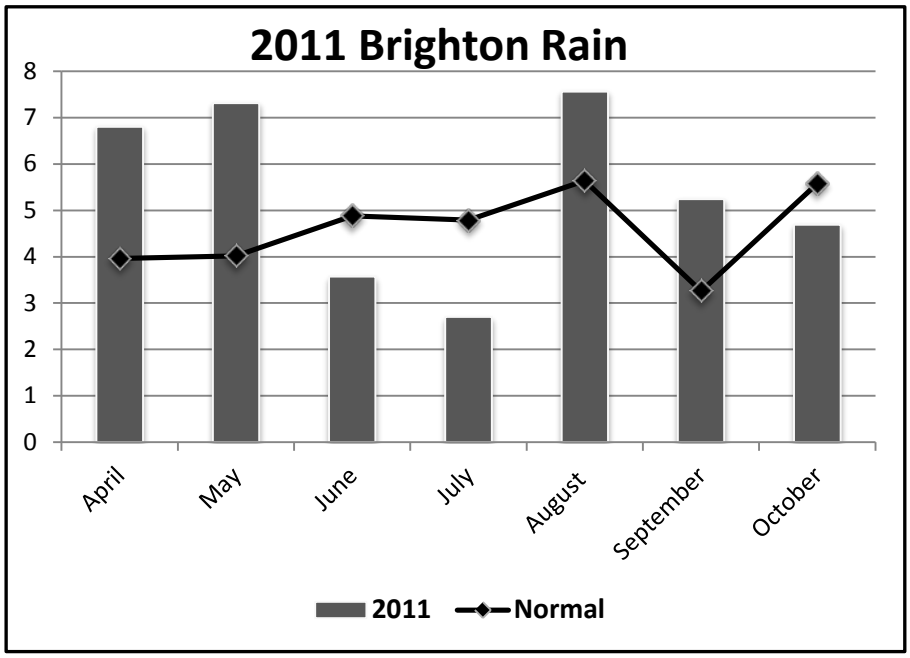


Figure 3. Monthly rainfall amounts (in inches) at the Nulhegan fire weather observation station in Brighton, Vermont compared to normal through fire season, April-October, 2011. Normal is based on 9 years of data.

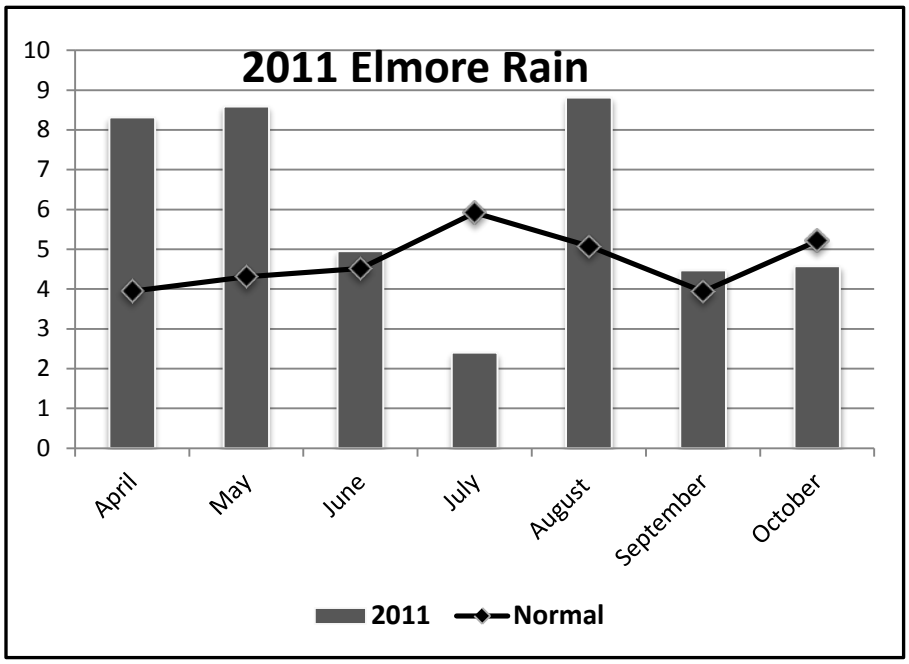


Figure 4. Monthly rainfall amounts (in inches) at the fire weather observation station in Elmore, Vermont compared to normal through fire season, April-October, 2011. Normal is based on 17 years of data.

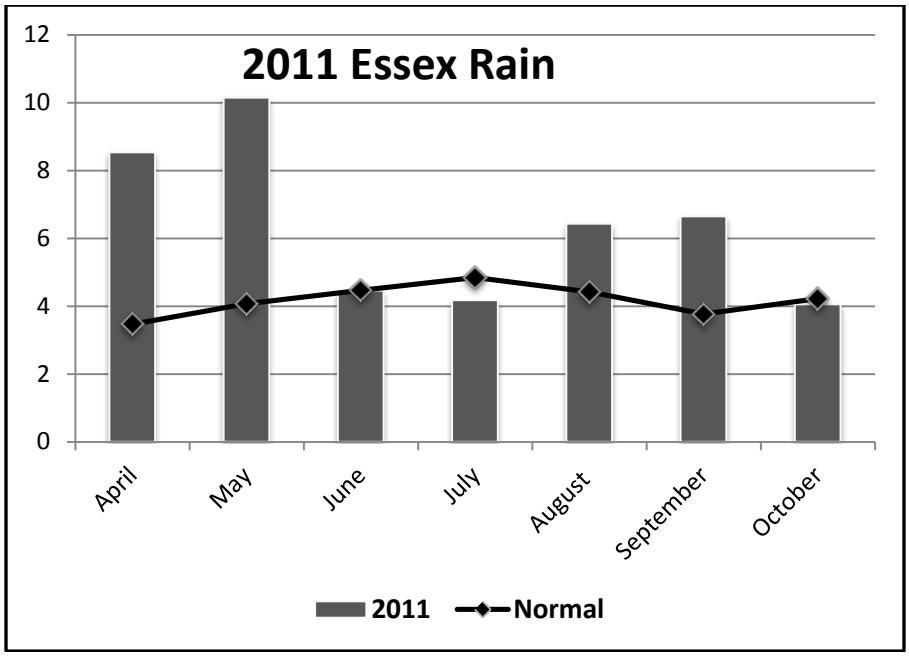


Figure 5. Monthly rainfall amounts (in inches) at the fire weather observation station in Essex, Vermont compared to normal through fire season, April-October, 2011. Normal is based on 18 years of data.

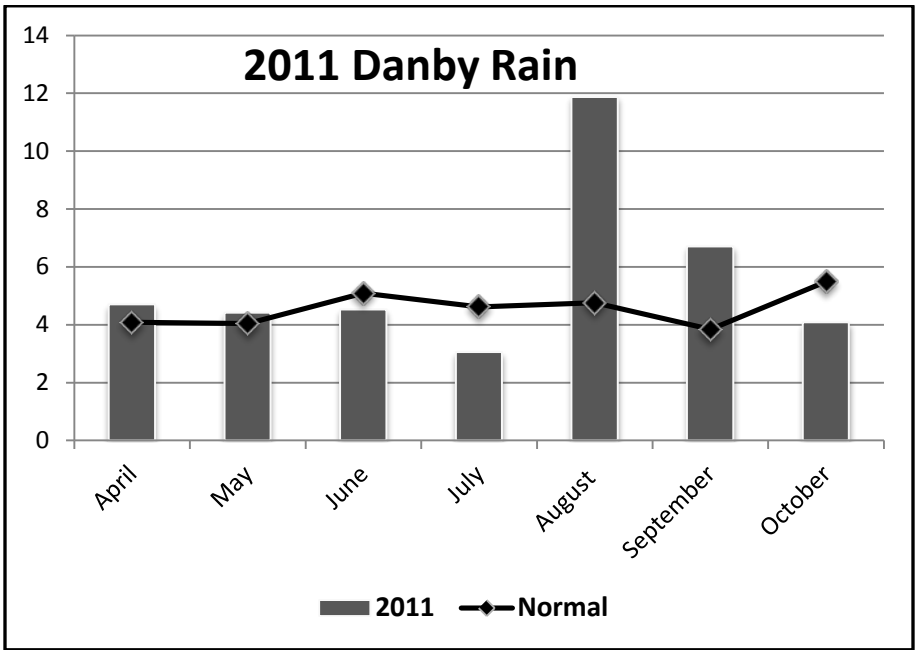


Figure 6. Monthly rainfall amounts (in inches) at the fire weather observation station in Danby, Vermont compared to normal through fire season, April-October, 2011. Normal is based on 14 years of data.

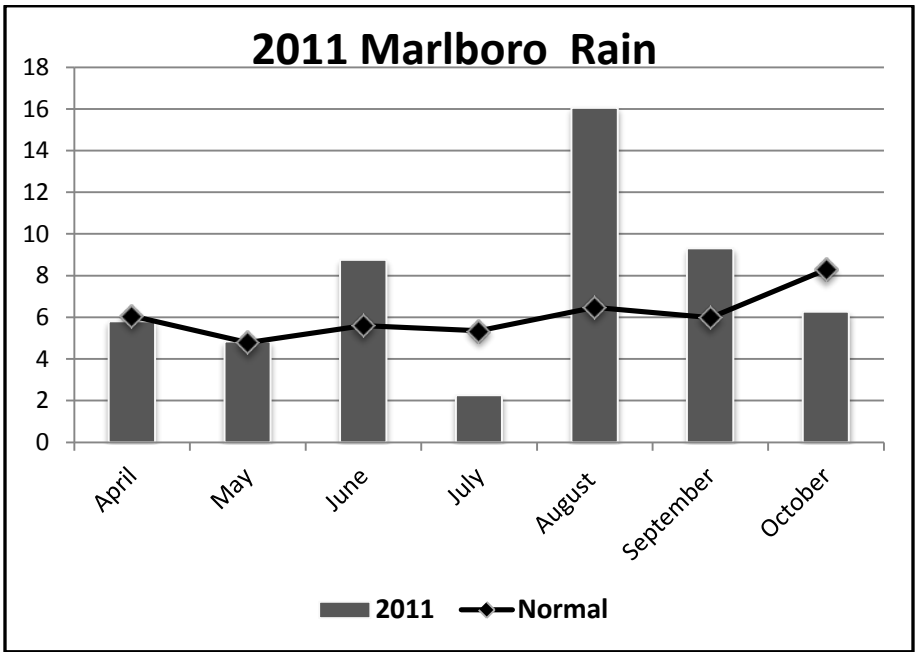


Figure 7. Monthly rainfall amounts (in inches) at the fire weather observation station in Marlboro, Vermont compared to normal through fire season, April-October, 2011. Normal is based on 9 years of data.

Spring Bud Break and Leaf Out At Mount Mansfield

Sugar maple trees are monitored for the timing of bud break and leaf out in the spring at the Proctor Maple Research Center as part of the Vermont Monitoring Cooperative. Sugar maple bud expansion got off to a slow start this spring, and budbreak was significantly later than the 21 year average by 6 days. Rapid bud expansion allowed full leaf-out timing to be on the early side of normal (Figure 8).

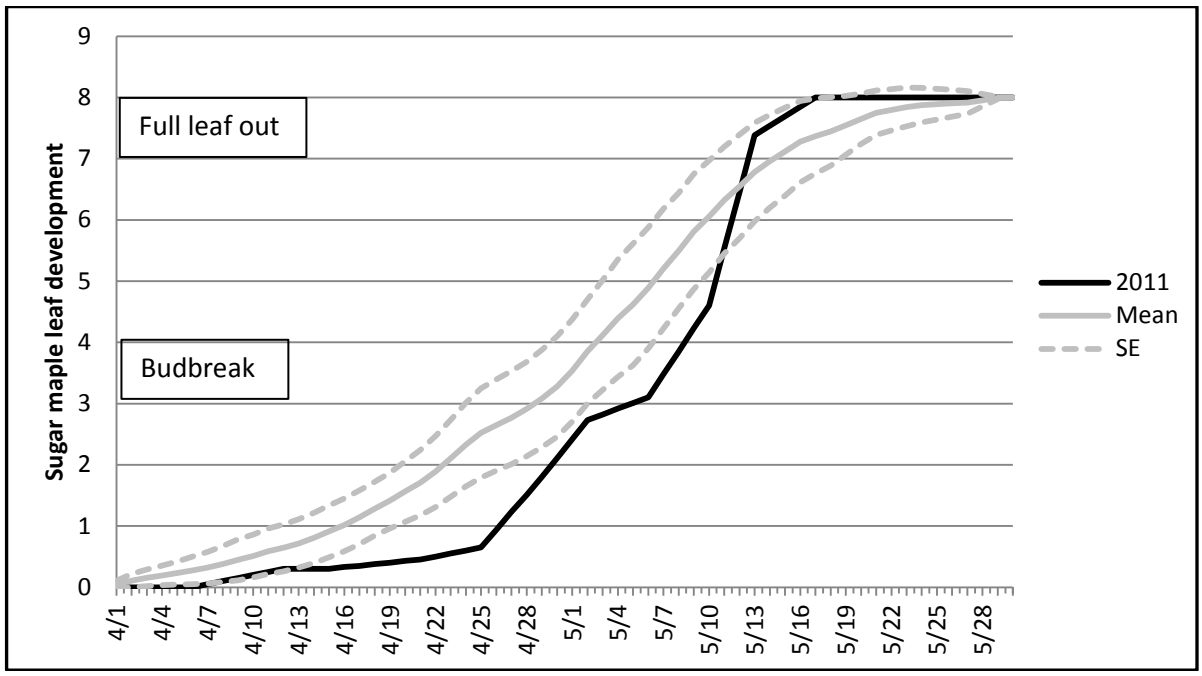


Figure 8. Timing of sugar maple bud break (bud stage 4) and full leaf development (bud stage 8) at the Proctor Maple Research Center compared to the 21-year average.

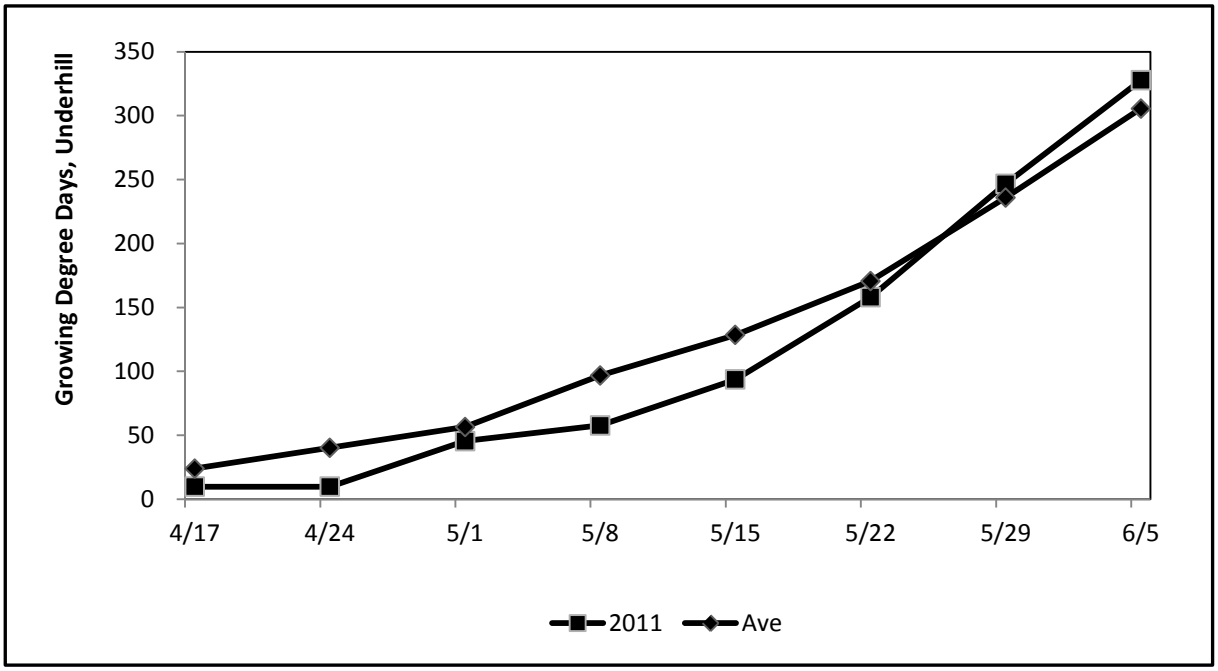


Figure 9. Weekly spring cumulative growing degree days for Underhill, Vermont, in 2011 compared to mean 1993-2011 accumulations. 50°F was used as the threshold of development.

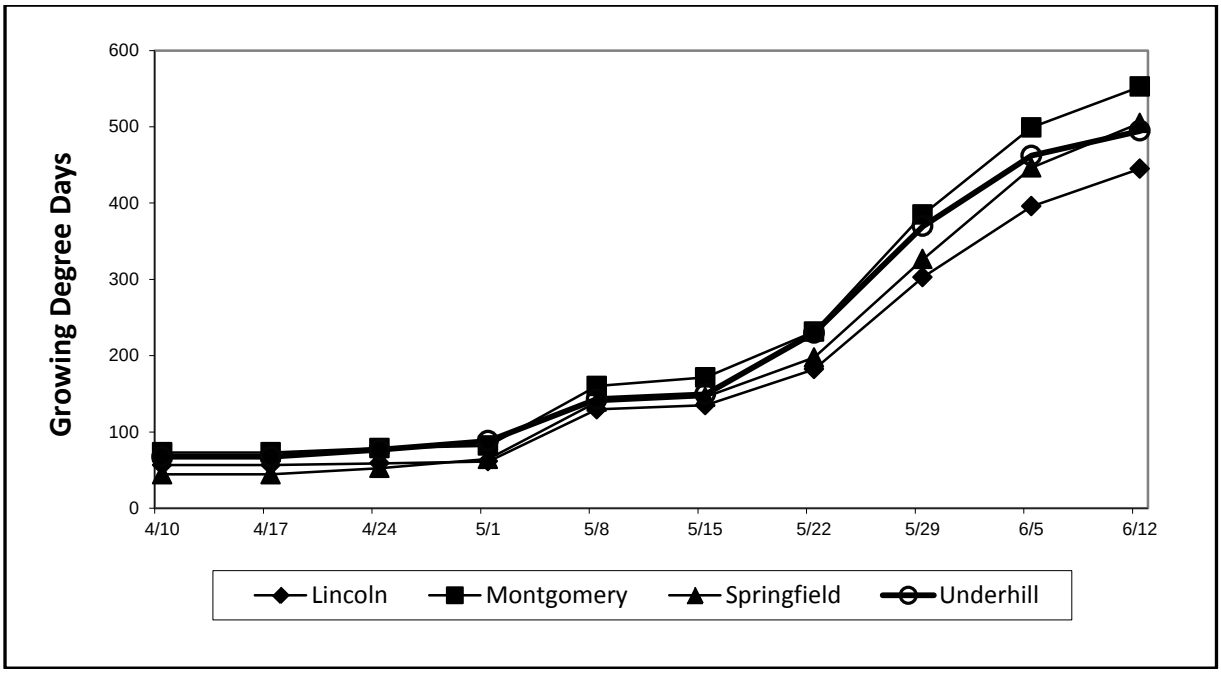


Figure 10. 2011 weekly spring cumulative growing degree days for Springfield, Underhill, Montgomery, and Lincoln, Vermont. 50°F was used as the threshold of development.

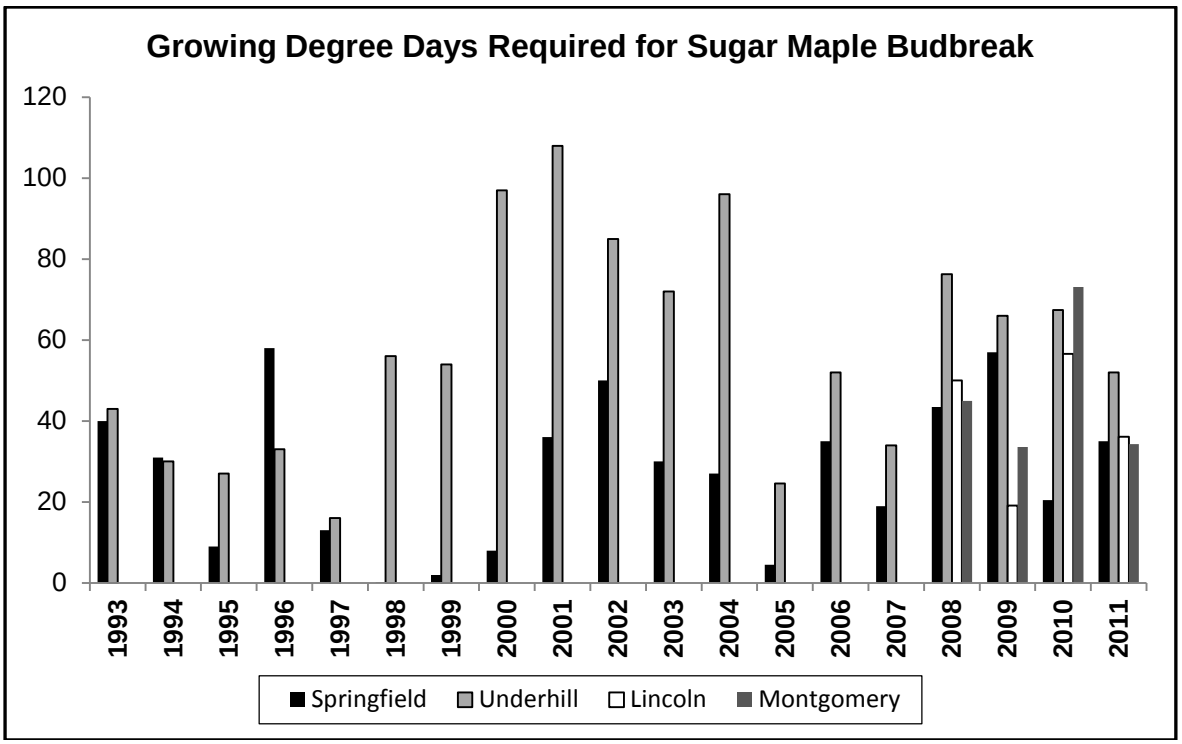


Figure 11. Growing degree days for sugar maple budbreak in Springfield and Underhill 1993-2011, and for Lincoln and Montgomery 2008-2011.

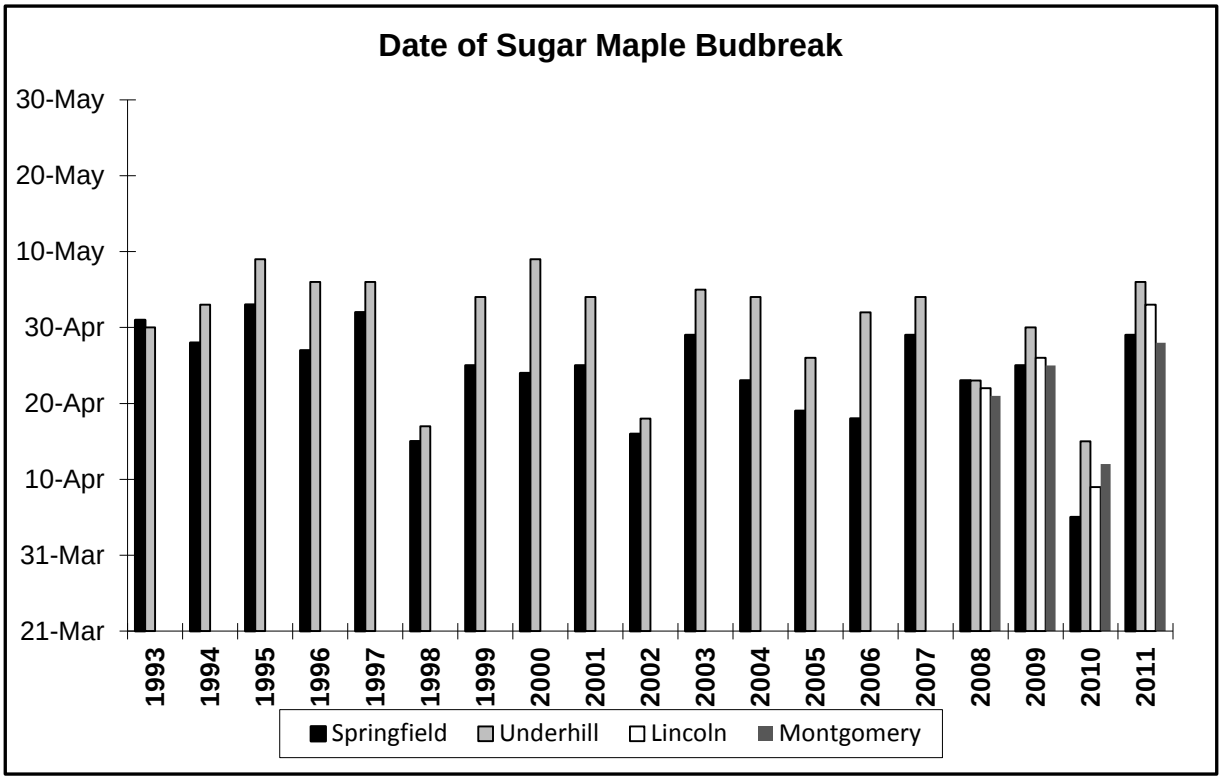


Figure 12. Dates of sugar maple budbreak in Springfield and Underhill 1993-2011 and for Lincoln and Montgomery 2008-2011.

Table 1. First observation dates of phenological development and growing degree day accumulations from 4 sites in Vermont for 2011. 50^0F is used as the threshold of development.

Biological Indicator	Lincoln	Montgomery	Springfield	Underhill
PLANT DEVELOPMENT				
Showing Green				
Fir, Balsam	5/24 (115.7)	5/12 (91.6)		5/13 (85)
Hemlock		5/21 (180.6)		5/13 (85)
Spruce, Red		5/23 (211.7)		
Budbreak				
Ash, White	5/10 (37.5)	5/12 (91.6)	5/6 (58)	
Aspen, Quaking		5/10 (77.3)		
Cherry, Black	4/28 (24.9)	4/28 (34.3)	4/24 (9)	
Cherry, Choke	4/28 (24.9)	4/25 (3.6)		
Elm, American		5/5 (70.2)		
Fir, Balsam		5/17 (125.4)		5/17 (98)
Hemlock		5/23 (211.7)		5/26 (206)
Lilac	4/28 (24.9)	4/28 (34.3)		
Maple, Red	5/3 (36.1)	5/6 (70.2)		5/6 (52)
Maple, Silver				
Maple, Sugar	5/3 (36.1)	4/28 (34.3)	4/29 (35)	5/6 (52)
Oak, Red		5/11 (84.7)	5/6 (58)	
Shadbush	5/3 (36.1)			
Spruce, Red		5/31 (342)		
Flowers of Deciduous Trees and Shrubs				
Ash, White		5/6 (70.2)		
Aspen, Quaking		4/24 (3.6)	4/10 (0)	
Cherry, Black				
Cherry, Choke		5/23 (211.7)		
Elm, American			4/8 (0)	
Lilac (first flowers)		5/18 (133.5)		5/24 (180)
Maple, Red	4/28 (24.9)	4/27 (16.7)	4/8 (0)	4/29 (40)
Maple, Silver				
Maple, Sugar	5/9 (37.5)	5/1 (47.4)	4/27 (15)	5/6 (52)
Oak, Red		5/17 (125.4)		
Shadbush	5/10 (37.5)			5/8 (57)
Wildflowers				
Dandelion				
Marsh Marigold	5/10 (37.5)			
Virginia Spring Beauty	5/3 (36.1)	4/27 (16.7)		4/29 (40)
Wild Strawberry		5/21 (180.6)		
INSECT DEVELOPMENT				
Eastern tent caterpillar (first tent)		5/14 (119.7)		5/17 (98)
Pear thrips (first adults)				4/21 (10)
OTHER OBSERVATIONS				
Spring peepers calling		4/25 (3.6)		
Full green up	5/31 (221.9)	5/21 (342)		

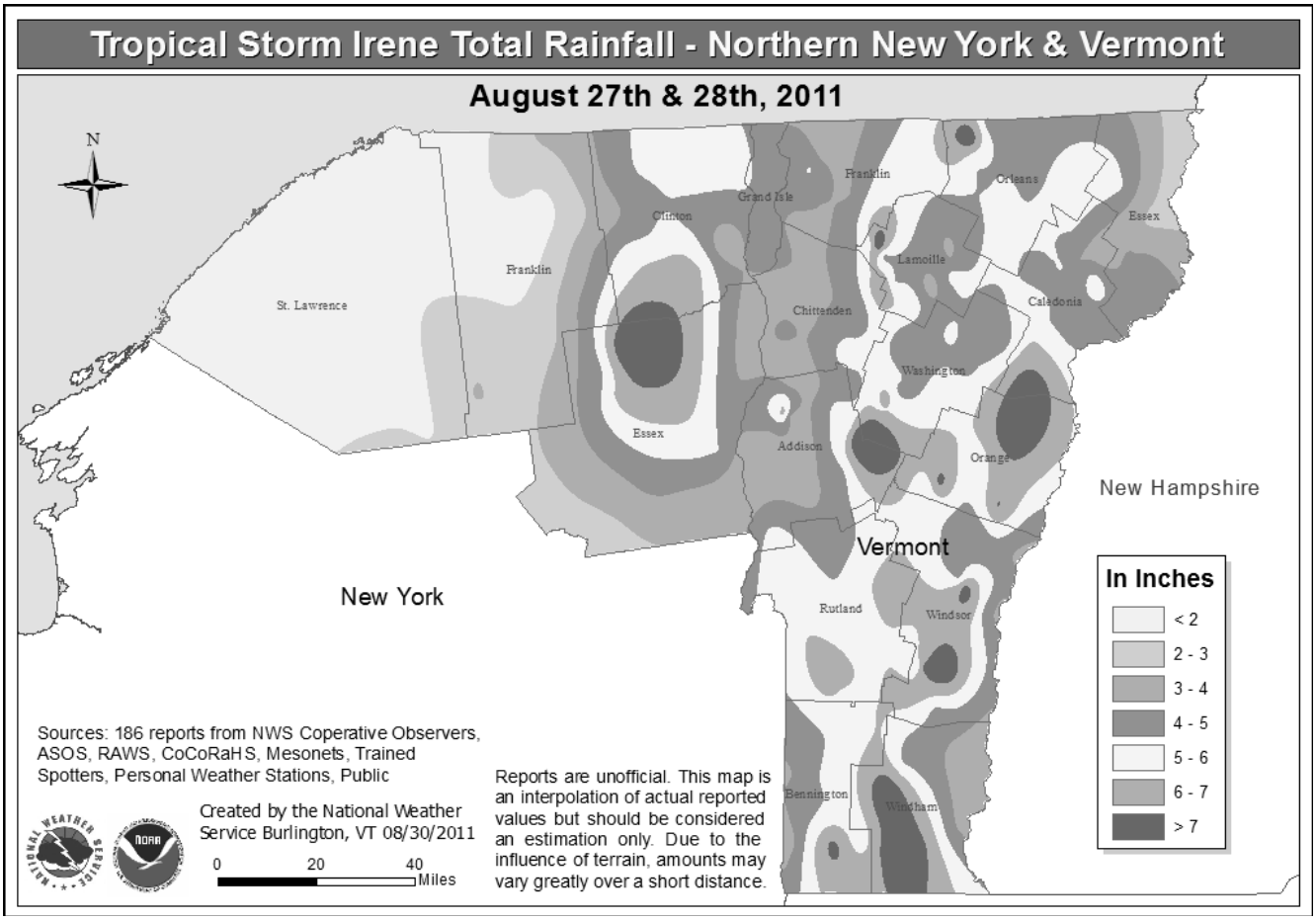


Figure 13. Tropical Storm Irene Total Rainfall – Northern New York and Vermont. Created by the National Weather Service, Burlington, VT August 30, 2011.

Fall Color Monitoring at Mount Mansfield

Sugar maple trees and 4 other hardwood species at Mount Mansfield are monitored for the timing of fall leaf color and leaf drop (end of growing season). In 2011, fall color was 5 days later and leaf drop was 9 days later than the 21 year record for sugar maple at the 1400 foot elevation site (Figures 14-15). With the exception of white birch, the other species monitored at 1400, 2200, and 2600 foot elevations were similar or slightly later than the long-term average. White birch color and leaf drop were exceptionally early this year, 15 and 10 days respectively, due to heavy leaf disease (Septoria) that caused leaves to brown or drop (Figure 16).

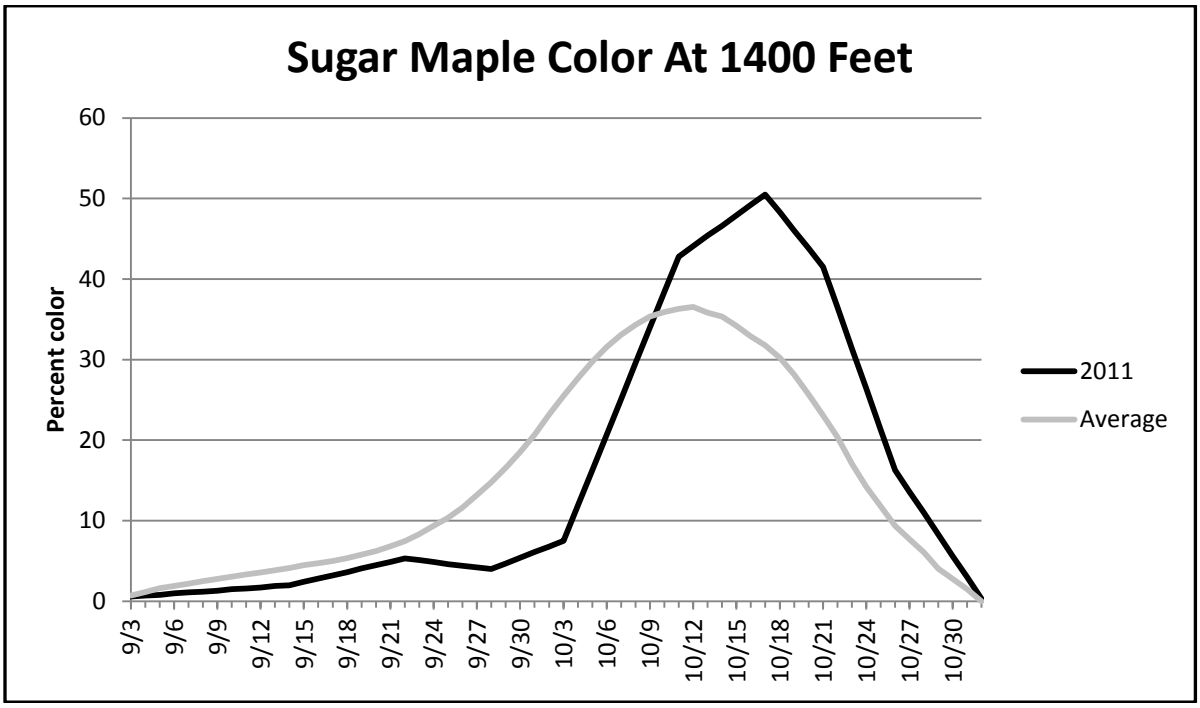


Figure 14. Timing of fall color on sugar maple trees monitored at the Proctor Maple Research Center, Underhill. The 21-year average is compared to 2011.

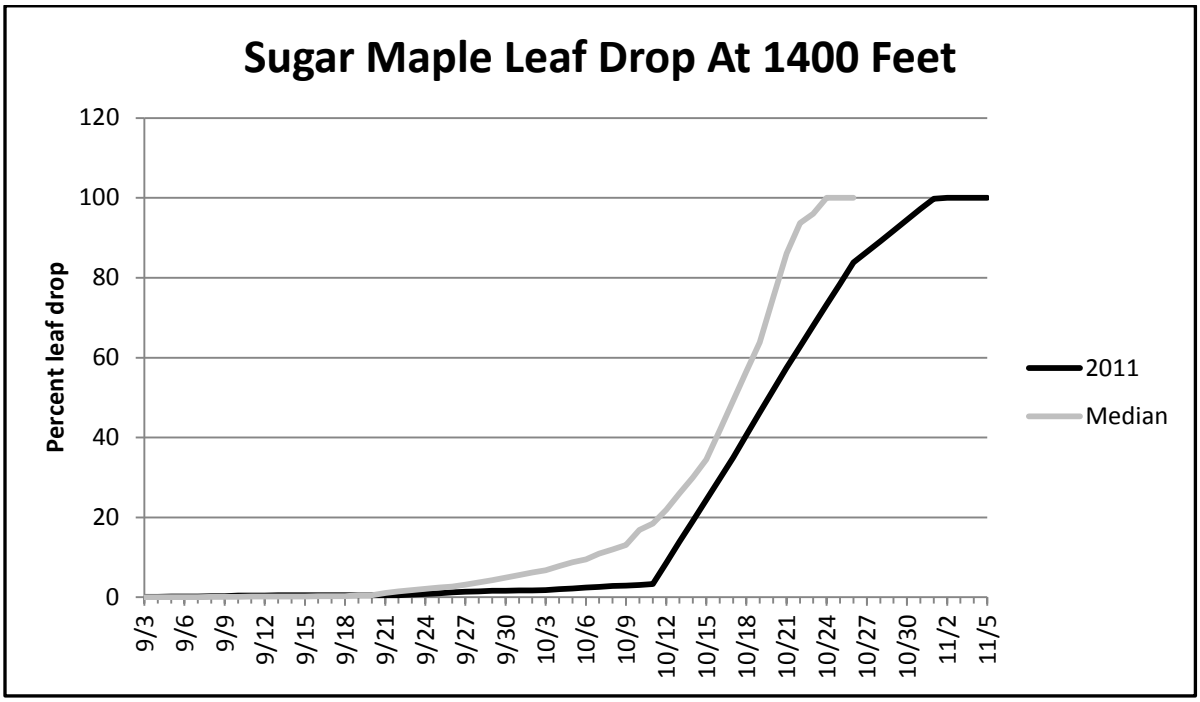


Figure 15. Timing of fall color on sugar maple trees monitored in the Underhill State Park. The 21-year median is compared to 2011.

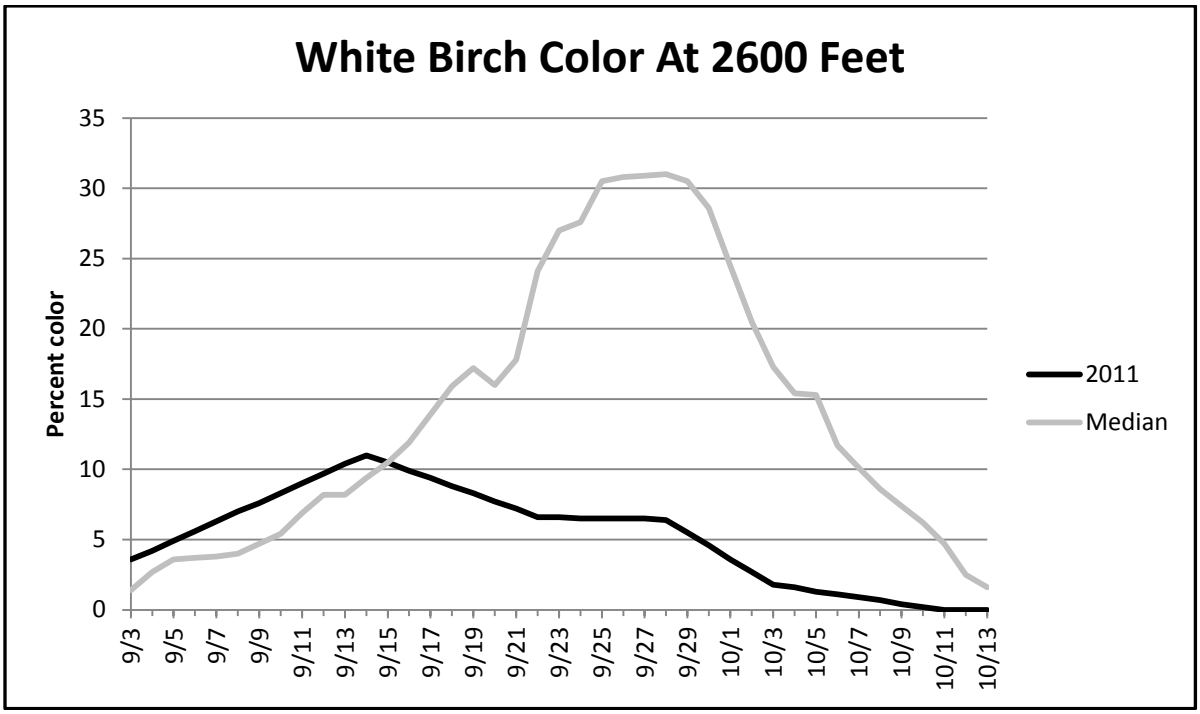


Figure 16. Timing of fall color on white birch trees monitored above Underhill State Park, at 2600 feet. The 13-year median is compared to 2011.

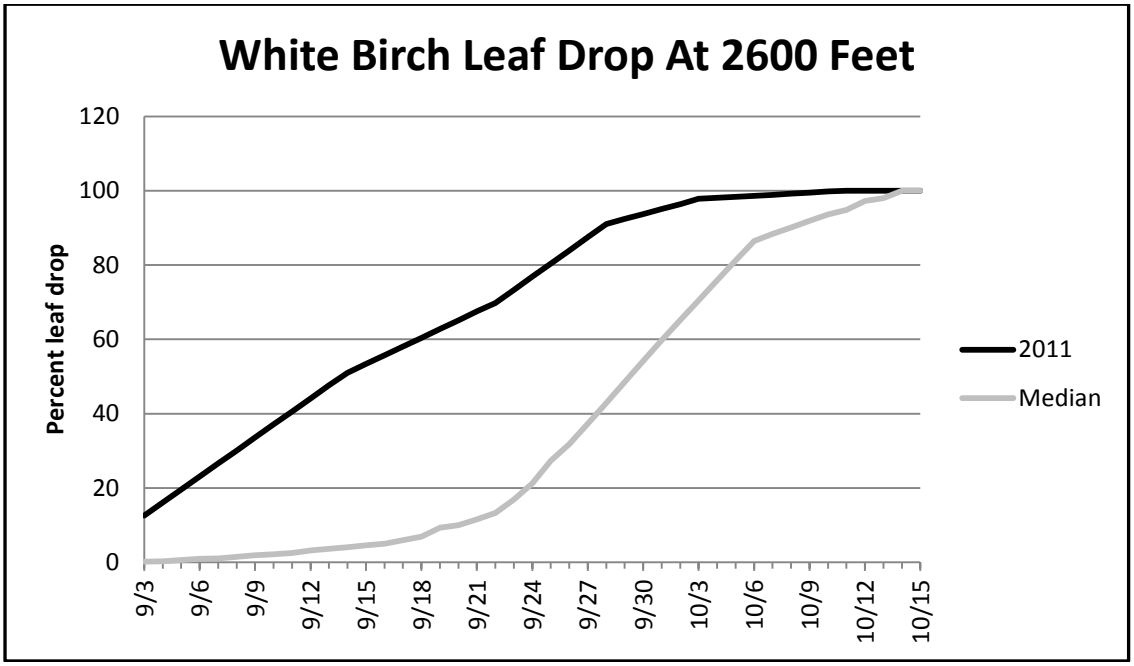


Figure 17. Timing of leaf drop on white birch trees monitored above Underhill State Park, at 2600 feet. The 13-year median is compared to 2011.

Table 2. Average dates of sugar maple budbreak, end of growing season and length of the growing season at the 1400 foot elevation monitoring site at the Proctor Maple Research Center in Underhill.

Year	Date of Budbreak	Day of Year Budbreak	Date of End of Growing Season	Day of year End of Growing Season	Length of Growing Season (Days)
1991	4/28	118	10/15	289	171
1992	5/7	128	10/13	287	159
1993	5/4	124	10/18	291	167
1994	5/6	126	10/14	287	161
1995	5/13	133	10/19	292	159
1996	5/14	135	10/22	296	161
1997	5/16	136	10/14	287	151
1998	4/17	107	10/15	288	181
1999	5/5	125	10/19	292	167
2000	5/9	130	10/17	291	161
2001	5/4	124	10/15	288	164
2002	4/18	108	11/5	309	201
2003	5/9	129	10/28	301	172
2004	5/4	125	10/27	300	175
2005	5/2	122	10/27	300	178
2006	5/2	122	10/16	289	167
2007	5/7	127	10/22	295	168
2008	4/22	113	10/15	288	175
2009	4/30	120	10/29	302	182
2010	4/22	112	10/26	299	187
2011	5/7	128	10/19	291	163
Average	5/3	123	10/20	292	170

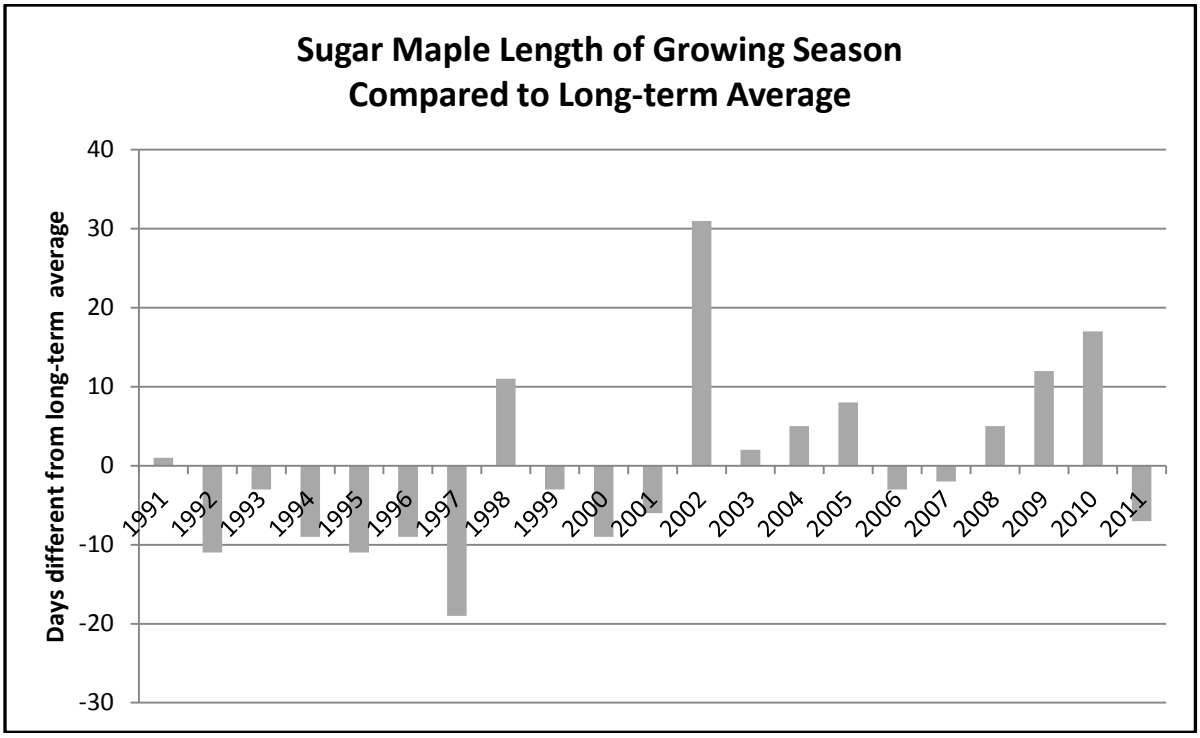


Figure 18. Length of sugar maple growing season at the monitoring site at the Proctor Maple Research Center in Underhill, compared to the 21-year long-term average. Negative numbers mean shorter than normal and positive numbers mean longer than normal growing season.

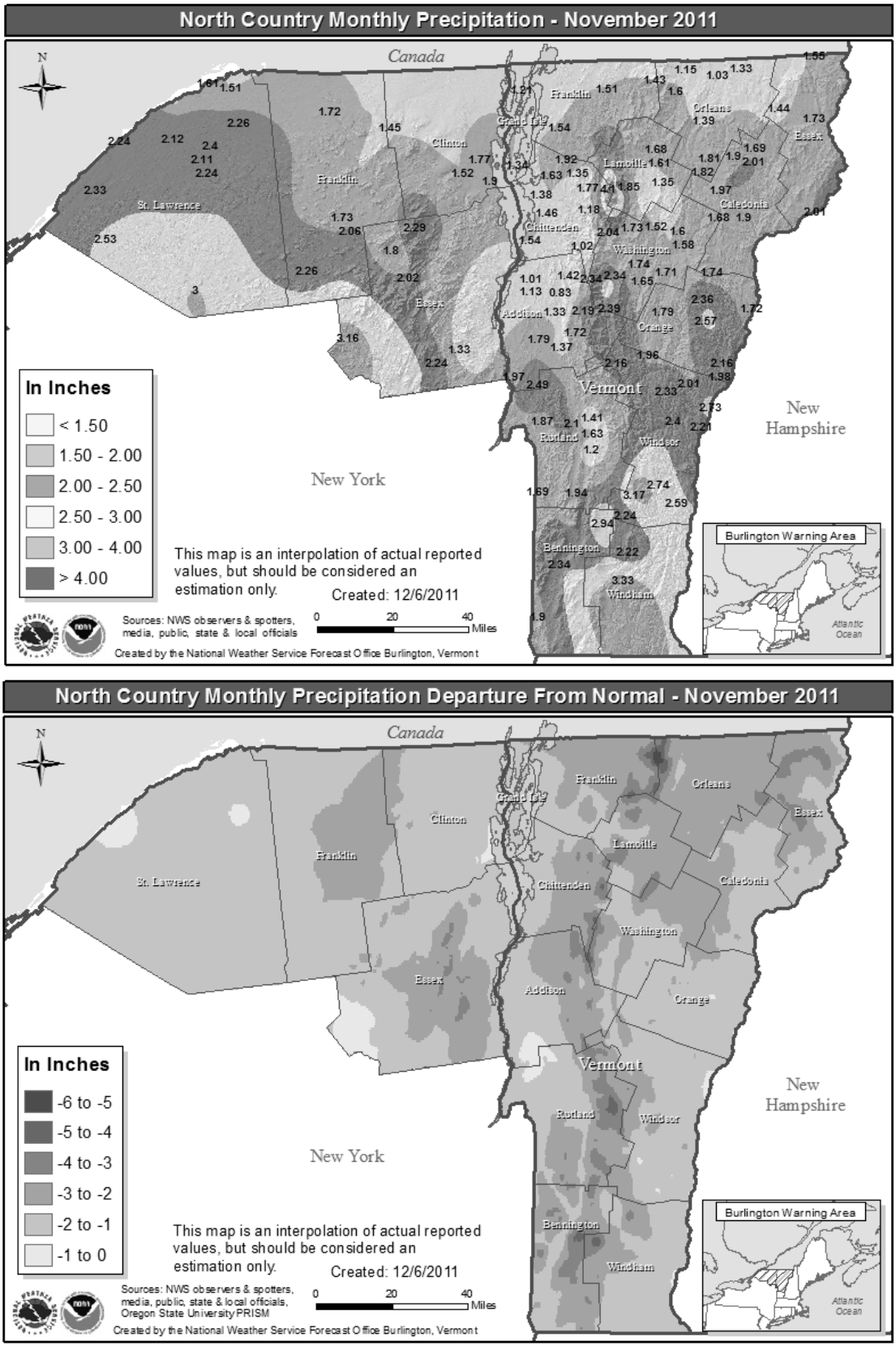


Figure 19. November 2011 precipitation data for Vermont and Northern New York. Created by the National Weather Service Forecast Office, Burlington, VT.

FOREST INSECTS

HARDWOOD DEFOLIATORS

Birch Defoliation was observed on 24,975 acres in 2011. Most of the damage was from Septoria leaf spot (*Septoria betulae*), with minimal feeding by leafmining sawflies such as *Fenusa pusilla* and *Messa nana*. White birch leaf drop was significantly affected by Septoria and anthracnose at 2,600 feet. (See Weather and Phenology, and Disease sections of this report.)

Bruce Spanworm, *Operophtera bruceata,* moth flight was the largest seen in many years. Only light feeding by caterpillars was noted statewide, including in NAMP plots in Orleans County (Newport and Derby), Bennington County (Arlington and Rupert), Lamoille County (Elmore and Stowe) and Orange County (Vershire). Bruce spanworm was also cited as cause for light defoliation in Danby (Rutland County), but on very few trees. Defoliation may be more noticeable in 2012 if the adult population is any indication.

Forest Tent Caterpillar, *Malacosoma disstria*, populations remained low, and no defoliation or larvae were observed. Average moth catch in pheromone traps was up slightly in nine of 13 survey locations (Table 3 and Figure 20).

Table 3. Average number of forest tent caterpillar moths caught in pheromone traps, 2002-2011. There were 3 traps per location in 2011.

Site	Year									
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Castleton	----	----	----	17	17.3	8	1	4.7	1	1.7
Fairfield (NAMP 29)	----	1.3	1.7	----	4.3	4.7	4	10.3	2.0	6
Huntington (NAMP 027)	9.2	6.7	10	15.7	16	6.3	4.3	4.3	2.7	6.3
Killington/Sherburne (Gifford Woods)	6.8	9.7	20	15.3	21	17.3	7.3	8	2.7	0
Manchester (new site in 2008)							0	5.7	3	1
Rochester (Rochester Mountain)	5.9	4.7	9	4.7	29	10.3	0.7	----	0.3	0
Roxbury (Roxbury State Forest)	16	14.7	13	7.3	22	22.7	8.0	2.7	7.0	2
SB 2200 (Stevensville Brook)	3.8	11.7	18.3	23.3	35.3	6.3	5.7	10	2.7	6.3
Underhill (VMC 1400)	3.6	3	0.3	7.3	9.3	2.7	1.3	8.3	5.7	8.3
Underhill (VMC 2200)	3	7	6.3	11.7	6.3	4.7	1.3	4.3	2	2.7
Stowe (VMC 3800)	1	2.7	10.3	26	5.7	5	1.3	1.7	0.7	2
Waterbury (Cotton Brook)	2	0.7	2	41	22.3	0.3	1	5	3.3	4.3
Waterville (Codding Hollow)	0	1.3	1.3	17.7	24.7	2.7	2.3	1.3	3.0	4.3
Average	**5.2**	**6.9**	**10**	**17**	**17.8**	**7.6**	**2.9**	**5.5**	**2.8**	**3.5**

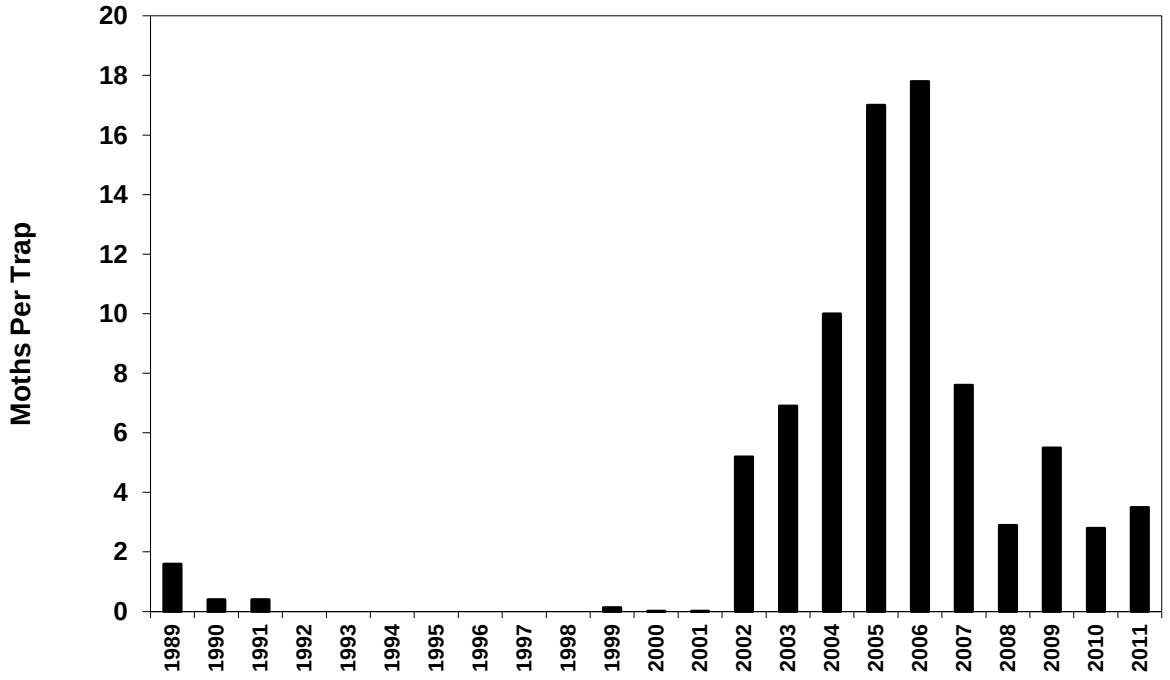


Figure 20. Average number of forest tent caterpillar moths caught in pheromone traps 1989-2011. Three traps per site, with PheroTech lures, were used in 2011.

Gypsy Moth, *Lymantria dispar*, remained low. There was no noticeable defoliation and egg masses were uncommon. Egg mass counts at focal area monitoring plots remained low, with only 2 masses found (Table 5 and Figure 22). Male moths continue to show up in pheromone traps deployed for forest tent caterpillar moths.

Table 4. Number of gypsy moth egg masses per 1/25th acre from focal area monitoring plots, 2003-2011. Average of two 15-meter diameter burlap-banded plots per location in 2011.

Site	Town	Year								
		2003	2004	2005	2006	2007	2008	2009	2010	2011
Arrowhead	Milton	1.5	2.5	0	0	0	2.5	0	0	0.5
Brigham Hill	Essex	2.5	2	1.5	0	0	0	0	0	0
Ft. Dummer	Guilford	0	-----	0	0	0	0	0	0	0.5
Middlesex	Middlesex	0	2	0	0.5	2	2.5	2.5	-----	-----
Minard's Pond	Rockingham	0.5	2	0	0	0	0	0.5	0	0
Mount Anthony	Bennington	1.5	0	0	0	0	0	0	0	0
Perch Pond	Benson	0	0	0.5	1	0	0.5	0	0.5	0
Rocky Pond	Rutland	0	0	0.5	3	3	0.5	0	0	0
Sandbar	Colchester	3	1.5	0	0	0	2.5	0.5	0	0
Tate Hill	Sandgate	0	30	18	3	0	1.5	0.5	0	0
Average		**1**	**4.4**	**2.1**	**0.8**	**0.5**	**1.0**	**0.4**	**0.06**	**0.11**

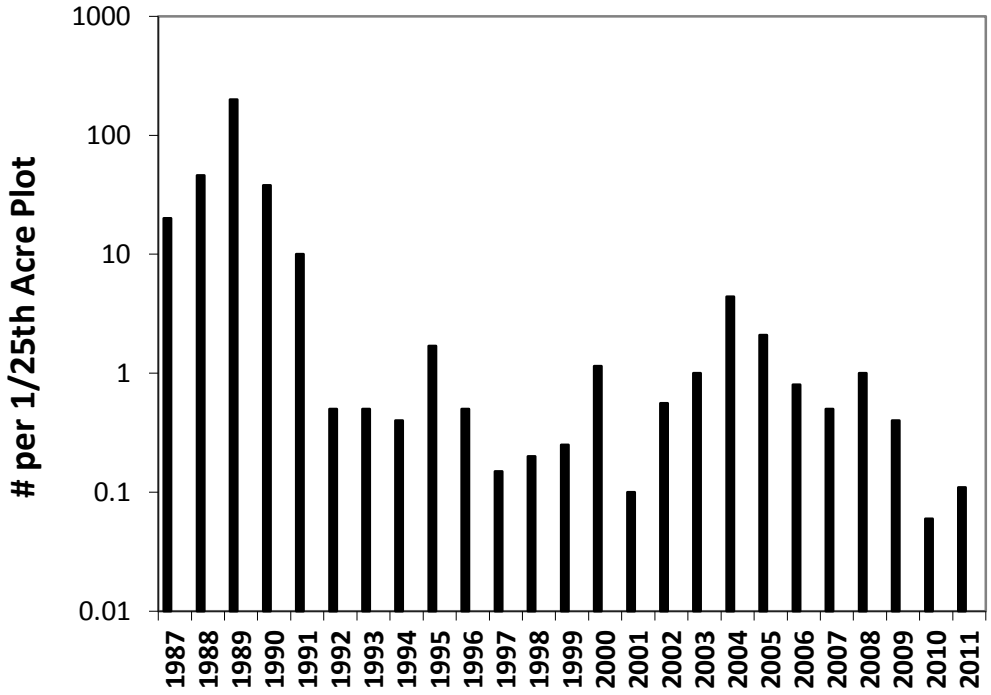


Figure 21. Number of gypsy moth egg masses per 1/25th acre from focal area monitoring plots, 1987-2011. Average of ten locations, two 15-meter diameter burlap-banded plots per location, in 2011.

OTHER HARDWOOD DEFOLIATORS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Birch Leaf Mining Sawflies	*Fenusa pusilla, Messa nana*	Birch		See Birch Defoliation narrative.
Bruce Spanworm	*Operophtera bruceata*	Sugar maple, aspen, beech and other hardwoods		See narrative.
Cherry Scallop Shell Moth	*Hydria prunivorata*	Black cherry	Hyde Park, Lincoln	Damage observed on black cherry saplings.
Eastern Tent Caterpillar	*Malacosoma americanum*	Hardwoods and *Rosacea* sp.	Throughout	Widespread occurrence at generally low levels.
Elm Sawfly	*Cimbex americana*	Elm, maple, birch, willow and basswood	Starksboro	Not considered a problem in forest situations; very occasionally a minor defoliator of shade/ornamental elm and willow trees. The large, fleshy larva and formidable adult sawfly look more worrisome than they are.
Euonymus Caterpillar	*Yponomeuta cagnagella*	Euonymus	Chittenden	Ornamentals; Euonymus/burning bushes with heavy webbing.
European Snout Beetle	*Phyllobius oblongus*	Maples, elm and many other hardwoods	Widely scattered	Beetles numerous at observation sites for short period.
Fall Webworm	*Hyphantria cunea*	Hardwoods	Throughout	Webs noticeable throughout, but populations variable. Damage generally low, rarely moderate, though occasional shrubs completely defoliated. Noticeable decline in number of webs in roadside trees in southwestern Vermont.
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*	Hardwoods	Scattered throughout	Larvae very numerous in many areas in 2011. Many inquiries received because of observations of caterpillars in Champlain Valley and elsewhere. Noticeable basswood defolation observed in Springfield.
Japanese Beetle	*Popillia japonica*	Many	Northern Vermont	Fewer reports from the Champlain Valley; more reports outside the Valley. Noticed on many plants, including Japanese knotweed.
Lilac Leafminer	*Caloptilia syringella*	Lilac	Morrisville	Moderate damage.
Locust Leafminer	*Odontata dorsalis*	Black locust	Chittenden County	40 acres mapped during aerial survey. Not observed in central and northeast Vermont.
Maple Leaf Cutter	*Paraclemensia acerifoliella*	Maples	Caledonia and Essex Counties	Observed on NAMP plots and various other locations, but only light damage observed.
Maple Trumpet Skeletonizer	*Epinotia aceriella*	Sugar maple	Wilmington	Minor damage observed.
Mimosa Webworm	*Homadaula anisocentra*	Honeylocust	Springfield	Moderate damage observed on young planting.
Oak Leaf Tier Complex	*Croesia semipurpurana* and others	Red oak	Scattered observations	Decrease from 2010. Oak leaftier, along with its cohorts, continue to cause light to moderate damage in the same locations as previous years. NH reports mortality in some locations with repeated defoliations.
Oak Slug Sawflies	*Caliroa* and *Periclista*	White oak	Vernon, Albany	Generally light feeding observed. Natural agents generally keep these slimy insects in check.
Orange-humped Mapleworm	*Symmerista leucitys*	Sugar maple	Scattered observations	Individual larvae observed over the summer in several locations.

OTHER HARDWOOD DEFOLIATORS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Rose Chafer	*Macrodactylus subspinosus*	Many	Throughout	Increased numbers observed in 2011.
Saddled Prominent	*Heterocampa guttivata*	Hardwoods	Sutton	Aside from Sutton report, where light to moderate damage was observed in 2 stands, no other saddled prominent caterpillars were reported.
Speckled Green Fruitworm	*Orthosia hibisci*	Apple	Burlington	Individual larvae observed.
Spotted Tussock Moth	*Lophocampa maculata*	Found on lilac, but feeds on many hosts	Morrisville	Showy larvae seen from July to September.
Tortricid Caterpillars	Family Tortricidae	Butternut	Sutton	Had completely defoliated a butternut and were beginning to feed on a second tree.
Viburnum Leaf Beetle	*Pyrrhalta viburni*	Viburnum	Townshend	Some branch dieback observed at Townshend State Park; compared to previous years, populations are down throughout.
White Marked Tussock Moth	*Orgyia leucostigma*	Many	Scattered observations	Caterpillars observed in late summer.
Winter Moth	*Operophtera brumata*	Hardwoods		Not known to occur in Vermont, but has spread in Massachusetts to the Fitchburg area.
Yellownecked Caterpillar	*Datana ministra*	Apple, elm	Barre City, Middlebury	Caterpillars observed feeding in colonies, defoliating one branch before moving to another.

Hardwood defoliators not reported in 2011 included Birch Leaf Folder, *Ancylis discigerana* ; Birch Skeletonizer, *Bucculatrix canadensisella* ; Maple Basswood Leaf Roller, *Sparganothis pettitana* ; Maple Webworm, *Tetralopha asperatella* ; Mountain Ash Sawfly, *Pristiphora geniculata* ; Oak Skeletonizer, *Bucculatrix ainsliella* ; Satin Moth, *Leucoma salici* ; Spring Cankerworm, *Paleacrita vernata* ; Striped Alder Sawfly, *Hemichroa crocea* ; Uglynest Caterpillar, *Archips cerasivoranus.*

SOFTWOOD DEFOLIATORS

Spruce Budworm, *Choristoneura fumiferana*, defoliation and larvae were not observed in 2011. Populations are building up in the region, with increased defoliation in Quebec north of the St Lawrence River. Because overmature fir is currently less abundant than prior to the outbreak in the 1970s-1980s, we don't expect this buildup to result in the same level of damage. We used pheromone traps for spruce budworm for 20 years (1983-2003), then discontinued the survey for 2004-2009. We reinstated our pheromone trap efforts in 2010. In 2010 and 2011, traps were deployed in Orleans, Caledonia, Essex and Chittenden Counties. With the exception of the trap site in Holland (Orleans County), counts were lower than in 2010 (Table 5 and Figures 22-23). We do not anticipate defoliation by the spruce budworm in 2012.

Table 5. Average number of spruce budworm moths caught in pheromone traps, 1991-2011. Trapping had been discontinued 2004-2009. There were 3 traps per location, one location per town 2011.

County	Town	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2010	2011
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
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
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
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
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
Caledonia	Burke	3.5	2.3	6	3	0	2	3.7	7.3	6	30	15	3	1.7	4	1.7

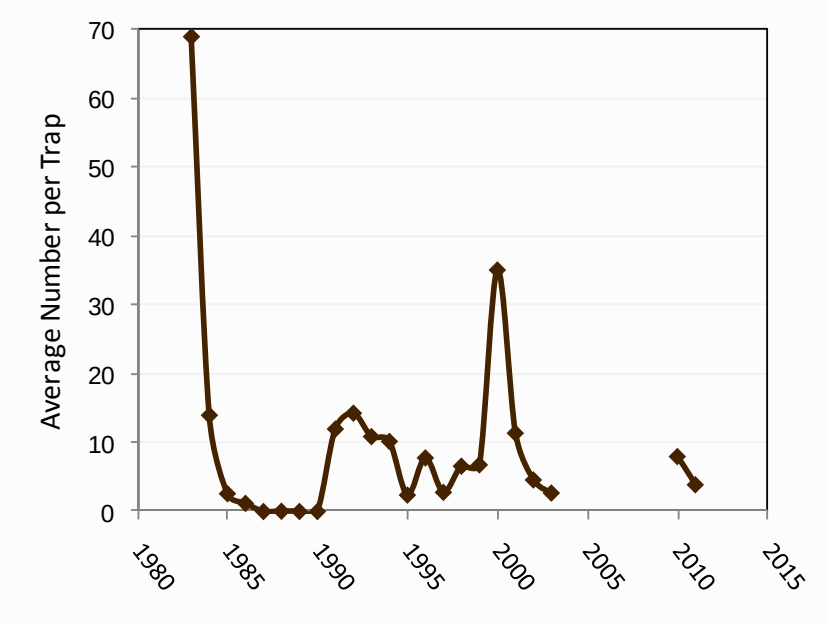
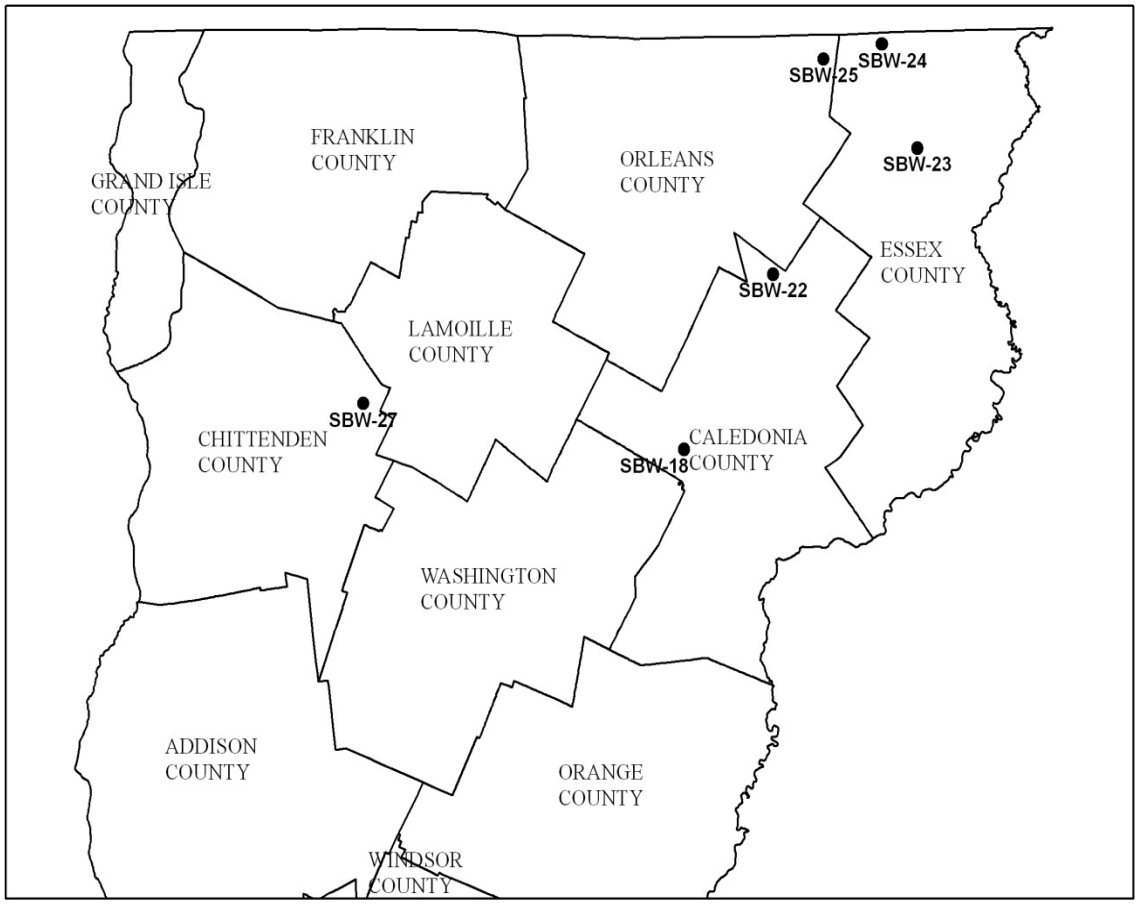


Figure 22. Average number of spruce budworm moths caught in pheromone traps 1983-2011. Trapping was discontinued, 2004-2009. Average of six locations in 2011.

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 23. Locations of spruce budworm pheromone traps in 2011. Coordinates are NAD83.

OTHER SOFTWOOD DEFOLIATORS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Arborvitae Leaf Miner	*Argyresthia thuiella*	Cedar	Rutland City	Homeowner call in Rutland County; not reported elsewhere in the state.
Eastern Spruce Budworm	*Choristoneura fumiferana*			See narrative.
Fall Hemlock Looper	*Lambdina fiscellaria*	Hemlock	Vernon	Very light feeding reported.
Larch Casebearer	*Coleophora laricella*	Larch	Southern Vermont	Only light damage observed.
Webspinning Sawflies	Family Pamphiliidae	Blue spruce	Swanton	On ornamental.
Yellow-Headed Spruce Sawfly	*Pikonema alaskensis*	Blue spruce	Randolph	On ornamental.

Softwood defoliators not reported in 2011 included European Pine Sawfly, *Neodiprion sertifer* ; Introduced Pine Sawfly, *Diprion similis* .

Hemlock Woolly Adelgid, *Adelges tsugae*, remains confined to Windham County, with no new towns reported as infested in 2011. Infestations have now been detected in 38 locations in six towns (Figure 25). Infested trees were destroyed at the single site in Rockingham (2007), but infestations are active in Brattleboro, Vernon, Guilford, Dummerston, Townshend and Jamaica.

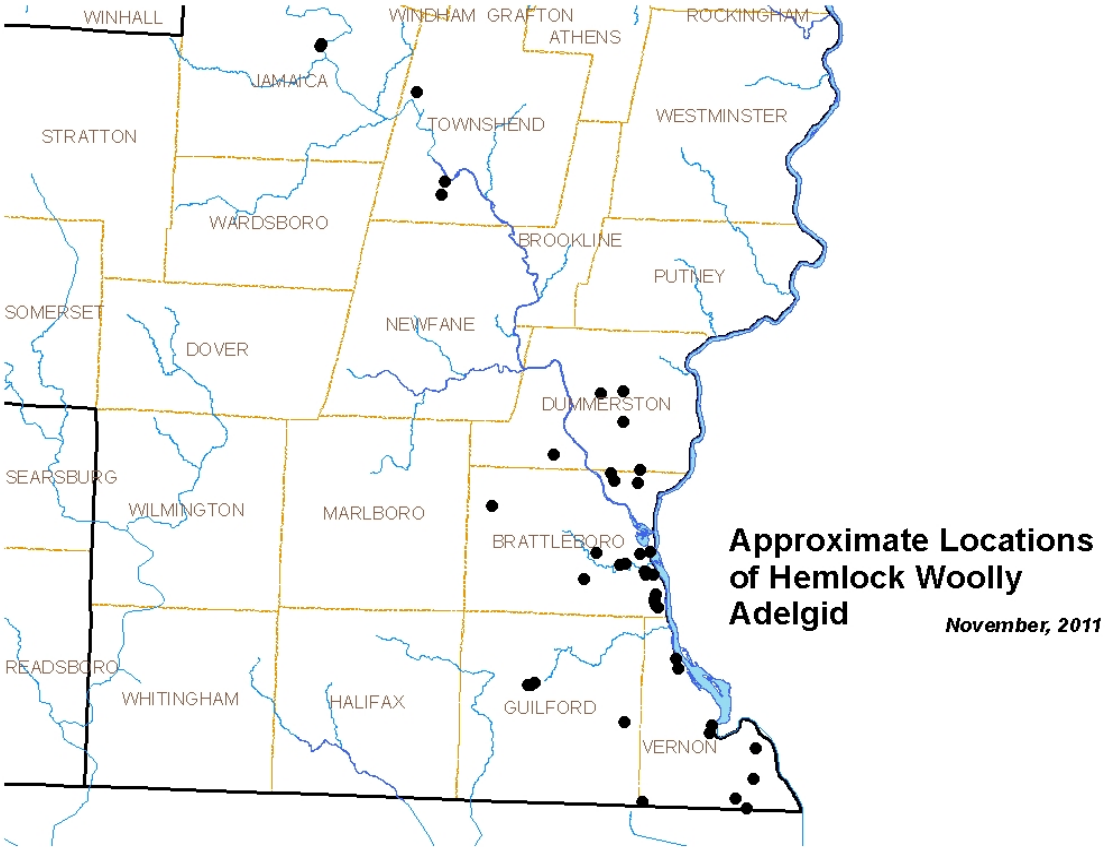


Figure 24. Known locations of hemlock woolly adelgid infested trees in 2011.

All bordering towns with known infestations of hemlock woolly adelgid were surveyed. In each town, five high risk sites were visited. High risk sites included locations near water, travel corridors, and infestations in neighboring towns. A minimum of 200 branches per site was examined for hemlock woolly adelgid. Research suggests that, at this sampling intensity, the likelihood of missing a detectable population is low.

Fourteen towns had survey work done, including the 12 'adjacent' towns that had a minimum of five sites. A total of 73 sites were surveyed (Table 6). Trained volunteers assist in detection surveys. The Maine Forest Service's "Take a Stand for Hemlock" training materials have been adapted for use in Vermont. Four sessions were held for training in hemlock woolly adelgid monitoring surveys. Twenty-seven citizen monitors did 30 of the survey sites.

We also received reports of suspect infestations from informed citizens. All reported suspects were followed up in the lab or by field visit.

Table 6. Hemlock woolly adelgid detection surveys conducted in 2011.

	# Surveyed in 2011	# of New Detections in 2011	# Known to be Infested
Towns	14	0	6
Sites	73	3	38

Vermont continues to collaborate with the states of New Hampshire and Maine and with the US Forest Service to develop a regional approach to managing this insect.

Outreach supports early detection, appropriate management, and quarantine compliance. Outreach is a first step in engaging volunteers and invites public involvement in government decision-making. In 2011, 18 informational sessions were offered with 528 in attendance. Informational materials were made available to hundreds of individuals at the Vermont State Fair, the Vermont Welcome Center, the Quechee Balloon Festival, the Strolling of the Heifers, and the Vermont Wildlife Festival. Hemlock woolly adelgid materials were made available on the Vermont Forestry Division website, **vtforest.com**, including an annual revision of "Vermont Invasive Forest Pest Update: Hemlock Woolly Adelgid." Hemlock woolly adelgid information has also been prepared for the Vermont Invasives website, **vtinvasives.org**.

Overwintering mortality was assessed at five locations with iButton data loggers (manufactured by Dallas Semiconductor Corp.). These were installed at the sites on 12/13/10 and removed on 4/6/11. Hemlock branch tips with new growth were sampled on April 6. At least 100 new sistens per site were examined under a dissecting microscope to determine the numbers of live and dead adelgids.

Winter of 2010-2011 was colder than the previous year, and overwintering mortality of the adelgids was higher. Mortality at the five sites averaged 87%, compared to 25% in 2009-2010 (Table 7 and Figure 25).

Table 7. Percent of hemlock woolly adelgid sistens that were dead in April 2011 at five Windham County sites, compared to minimum ambient temperature in winter 2010-2011.

Town	Site	Winter 2009-2010			Winter 2010-2011		
		Minimum Temperature ^{0}C	% Dead	# of Sistens Examined	Minimum Temperature ^{0}C	% Dead	# of Sistens Examined
Brattleboro	Vernon Street	-17	14%	100	-26	96%	787
Vernon	Fort Bridgman Rd	-17	13%	100	-24	56%	1022
Guilford	Wilkens Hill	-20	74%	148	-26	94%	676
Townshend	Townshend SP	-18	9%	4483	NA	89%	414
Jamaica	Jamaica SP	-19	13%	14,023	-24	98%	528
Average		**-18**	**25%**		**-25**	**87%**	

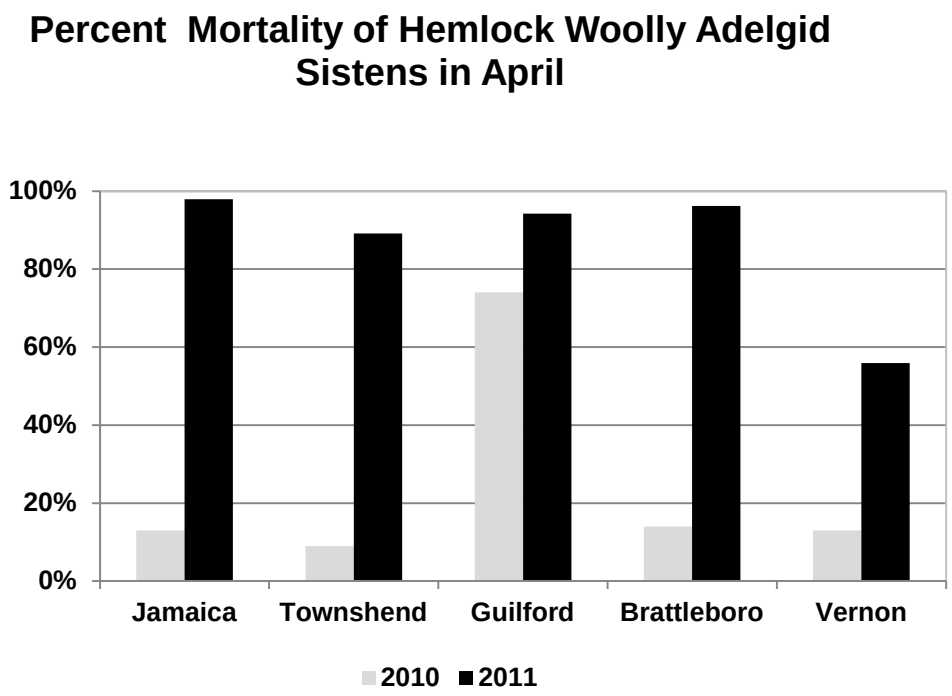


Figure 25. Comparison of mortality of hemlock woolly adelgid sistens at five Windham County sites 2010-2011.

The "State of Vermont Joint Quarantine #2: Hemlock Woolly Adelgid" remains in effect to slow the spread of hemlock woolly adelgid. Hemlock materials from infested counties cannot move into Vermont or to other counties within Vermont unless the destination has a compliance agreement. Currently seven facilities have hemlock woolly adelgid compliance agreements.

The two sites where the predatory beetle, *Larcicobius nigrinus*, was released in fall, 2009 were sampled for beetles on October 28th with Dr. Geena Davis from the University of Massachusetts. No *L. nigrinus* beetles were recovered.

A final report, "Experimental Hemlock Woolly Adelgid Suppression Townshend State Park," was completed by Costa Enterprises, LTD. The report summarizes the results of the 2010 application of the biopesticide Mycotal to ten hemlock trees in Townshend State Park. Mycotal contains the insect-killing fungus *Lecanicillium muscarium,* and was applied in a whey microfactory formulation (MycoMax). Field post-treatment evaluations showed a significant decrease in adelgid population growth on treated trees. There was a significant interaction ($P \leq 0.05$) between initial population levels and post-treatment counts (Figure 26). Post-treatment differences were not significant in similar lab counts, which may reflect the small sample size and variability in initial populations.

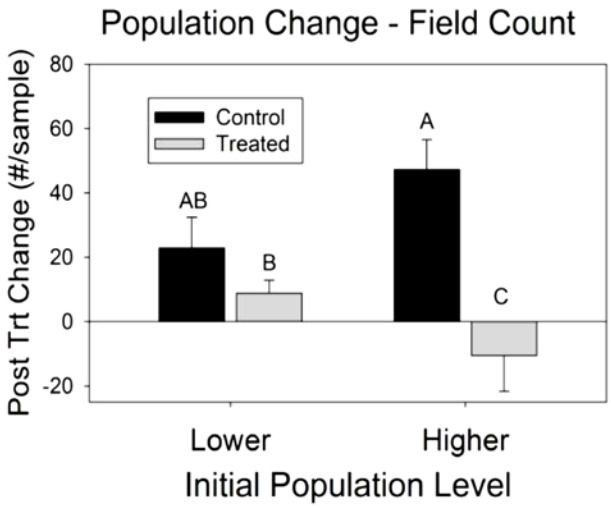


Figure 26. Change in hemlock woolly adelgid populations from pre-treatment levels on untreated trees and trees treated with the biopesticide Mycotal combined with MycoMax fungal enhancer in a study conducted in Townshend State Park in 2010. Different letters above bars indicate significant differences between averages. (Data from Costa, S. 2011. "Experimental Hemlock Woolly Adelgid Suppression Townshend State Park," Interim Final Report. 13 pp.)

A cooperative investigation into the potential use of native insect-killing fungi for the biocontrol of hemlock woolly adelgid is being conducted by the University of Vermont Entomology Research Laboratory and the VT Department of Forests, Parks and Recreation. Two isolates of *Myriangium* sp. were applied to infested hemlock trees in Vernon, VT on August 24. Hemlock woolly adelgid mortality on the treated trees had increased five weeks after treatment. Evaluation of the samples is ongoing to isolate the causal agent from the cadavers. In addition, samples will be taken in the spring of 2012 to assess carryover effects of the treatments. This work is funded by the US Forest Service and the Northeastern States Research Cooperative.

In June, a workshop for professional arborists, foresters and horticulturalists on treating trees infested with hemlock woolly adelgid was co-sponsored with New Hampshire Department of Resources and Economic Development and University of New Hampshire Extension. Approximately 30 practitioners attended the daylong event. In August 2011, a workshop for Vermont landowners and homeowners was held in Brattleboro, covering treatment methods appropriate for homeowners.

Pear Thrips, *Taeniothrips inconsequens*, damage ranged from none to light in 2011, even on regeneration. One exception was moderate distortion of ornamental maple foliage attributed to thrips in West Windsor.

Thrips populations decreased at the monitoring location in Underhill, with only 248 caught on sticky cards, compared to 1,021 in 2010. Populations at this site were comparable to 2008 and 2009, when 350 and 296 were collected, respectively (Table 8). In NAMP plots, thrips were noted on just a few trees in Starksboro, Huntington, Rupert and Duxbury.

Thrips numbers may increase in 2012 due to the heavy pollen production in 2011. A diet that includes pollen significantly increases adult longevity, total oviposition, and oviposition rate of thrips.

Table 8. Total number of pear thrips caught on four yellow sticky cards at a monitoring site in Underhill, Vermont by date of sampling 2008-2011.

2008		2009		2010		2011	
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				
4/3 – 4/10	0	4/3 – 4/9	0	4/2 – 4/7	408	4/6 – 4/12	0
4/10 – 4/16	13	4/9 – 4/16	25	4/7 – 4/15	100	4/12 – 4/21	2
4/16 – 4/25	261	4/16 – 4/23	111	4/15 – 4/23	102	4/21 – 4/29	191
4/25 – 5/2	12	4/23 – 4/30	39	4/23 – 5/3	175	4/29 – 5/6	10
5/2 – 5/9	36	4/30 – 5/7	19	5/3 – 5/11	151	5/6 – 5/13	9
5/9 – 5/23	19	5/7 – 5/14	55	5/11 – 5/18	43	5/13 – 5/20	16
5/23 – 6/10	9	5/14 – 5/21	33	5/18 – 5/24	36	5/20 – 5/27	15
		5/21 – 5/28	11	5/24 – 6/1	4	5/27 – 6/2	5
		5/28 – 6/4	2	6/1 – 6/7	2		
Total	350		296		1,021		248

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Balsam Gall Midge	*Paradiplosis tumifex*	Balsam fir	Northern Vermont	Increasing numbers observed in a few Christmas tree plantations where the insect wasn't noticeable in the past. Populations remain down at very light levels for most growers.
Balsam Twig Aphid	*Mindarus abietinus*	Balsam fir	Throughout	Damage was generally minimal this year, with scattered trees affected. Heavy on occasional trees.
Balsam Woolly Adelgid	*Adelges picea*	Balsam fir	Statewide	No current balsam woolly adelgid activity observed. New mortality is rare in previously infested areas.
Beech Blight Aphid	*Grylloprociphilus imbricator*	Beech	Manchester	Scattered branches heavily infested, with large amount of black sooty mold.
Beech Scale	*Cryptococcus fagisuga*	Beech	Statewide	See Beech Bark Disease narrative.
Boxelder Bug	*Leptocoris trivittatus*	Boxelder	Throughout	Fewer observations than last year.
Cinara Aphids	*Cinara spp.*	Balsam fir	Craftsbury	Observed on scattered trees.
Cooley Spruce Gall Aphid	*Adelges cooley*	Spruce	Widely scattered	Fewer reports than usual.
Elongate Hemlock Scale	*Fiorinia externa*			Not known to occur in Vermont, but targeted during surveys for hemlock woolly adelgid.
Hackberry Nipplegall Maker	*Pachypsylla celtidismamma*	Hackberry	Burlington	Submitted as a novelty.
Hemlock Woolly Adelgid	*Adelges tsugae*	Hemlock	Windham County	See narrative.
Lacebugs	*Corythucha* sp.	Red oak	Vernon	Moderate population on ornamental oaks in front yard.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Lecanium Scale	*Lecanium* sp.	Hardwoods	Lewis	Observed on understory beech in decline study plots. Reported to be increasing in eastern Massachusetts.
Pear Thrips	*Taeniothrips inconsequens*	Hardwoods	Statewide	See narrative.
Pine Bark Adelgid	*Pineus strobi*	White pine	Southern Vermont	Light populations.
Pine Needle Scale	*Chionapsis pinifoliae*	Pines and sometimes other conifers	Grafton	Found on hemlock, generally a less common host than pine.
Pine Spittlebug	*Aphrophora parallela*	Conifers	Throughout	Seen occasionally, no significant damage.
Spiny Witch Hazel Budgall Aphid	*Hamamelistes spinosus*	Birch	Wilmington	Heavy on single tree.
Spruce Spider Mite	*Oligonychus ununguis*	Conifers	Southern Vermont	Only light damage observed, mostly ornamentals.

Sapsucking Insects, Midges and Mites that were not reported in 2011 included, Aphids, *Periphyllus sp.* ; Ash Flowergall Mite, *Aceria fraxiniflora* ; Cottony Maple Scale, *Pulvinaria innumerabilis* ; Eastern Spruce Gall Adelgid, *Adelges abietis* ; Erineum Gall Mite, *Aceria elonagtus* ; Honeylocust Plant Bug, *Diaphnocoris chlorionis* ; Oystershell Scale, *Lepidospaphes ulmi* ; Birch Lacebug, *Corythuca palipes* ; Boxelder Erineum, *Aceria negundi;* Butternut Blister Mite, *Aceria cinereae;* Hemlock Scale, *Abgrallaspis ithacae;* Maple Bladder Gall Mite, *Vasates quadripedes;* Maple Spindle Gall Mite, *Vasates aceris-crummena;* Pine Fascicle Mite, *Trisetacus alborum* ; Pine Leaf Adelgid, *Pineus pinifoliae* ; Ragged Spruce Gall Aphid, *Pineus similis* ; Red Pouch Gall, *Pemphigus rhois* ; Vagabond Aphid, *Mordwilkoja vagabunda* ; Woolly Alder Aphid, *Paraprociphilus tessellatus* ; Woolly Elm Aphid, *Eriosoma americana* .

BUD AND SHOOT INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Balsam Shootboring Sawfly	*Pleroneura brunneicornis*	Balsam fir	Northern Vermont Christmas tree plantations	Damage to balsam and Fraser fir was heavier than usual for an odd-numbered year. The cool wet spring may have prolonged the egg-laying season, resulting in more damage.
Common Pine Shoot Beetle	*Tomicus piniperda*	Pines	Throughout	Surveys between 1999-2005 confirmed the presence of this insect in 8 Vermont counties. Not observed and no damage reported in 2011. A federal quarantine is in place to limit the spread of this exotic insect into non-affected states.
Oak Twig Pruner	*Elaphidionoides parallelus*	Red oak	Scattered reports	Significant twig drop occasionally reported.
Pine Gall Weevil	*Podapion gallicola*	Red pine	Scattered reports	Commonly observed in many red pine stands throughout. Not thought to be at a level that affects tree health substantially.
White Pine Weevil	*Pissodes strobi*	White pine	Throughout	Damage commonly observed; more noticeable than usual in some areas in southern Vermont.

Bud and Shoot Insects not reported in 2011 included European Pine Shoot Borer, *Eucosma gloriola* ; Maple Petiole Borer, *Caulocampus acericaulis* .

ROOT INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Japanese Beetle	*Popillia japonica*	Many	Throughout	Populations low throughout the state.
June Beetle	*Phyllophaga* spp.	Many	Throughout	Few reports received in 2011.

Root Insects not reported in 2011 included Conifer Swift Moth, *Korsheltellus gracillis* .

BARK AND WOOD INSECTS

Asian Longhorned Beetle, *Anoplophora glabripennis*, is not known to occur in Vermont. We don't recommend any management adjustments in anticipation of this insect. Its infestations expand gradually and mortality is not rapid. The Vermont Agency of Agriculture, Food and Markets continues to lead a statewide awareness program to increase the likelihood of early detection.

In 2009, mailings went out to the 198 Vermont property owners with a primary residence zip code from Asian Longhorned Beetle regulated areas in Massachusetts. By spring 2010, 98 had responded. In October 2011 the 100 non-respondents were contacted. Thirty-three were reached by telephone. Letters were mailed to the 67 who could not be reached by phone. Twenty-two surveys have been returned by mail for a combined (2009 and 2011) 77% response rate (Figure 27). Following the 2011 mailing, only two property owners responded that they had transported firewood and one had planted live trees from Massachusetts on their property in Vermont in the last 12 years. These Vermont properties were inspected, and no evidence of Asian longhorned beetle was found.

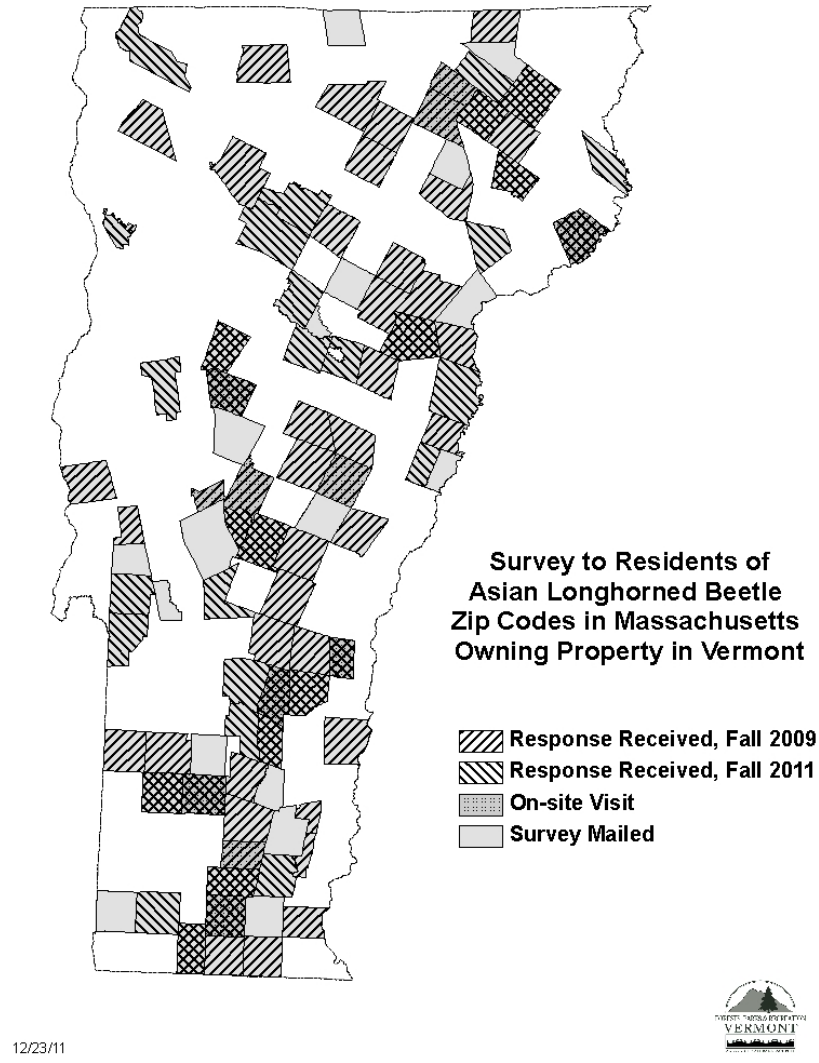


Figure 27. Response to survey mailed to 198 Vermont property owners with a primary residence zip code from Asian Longhorned Beetle regulated areas in Massachusetts.

Brown Spruce Longhorn Beetle, *Tetropium fuscum*, and **Black Spruce Beetle**, T. *castaneum*, two nationally-targeted longhorned beetles, were part of a Cooperative Agriculture Pest Survey (CAPS) pheromone-baited trap survey in Vermont in 2011. *T. fuscum* is an invasive wood boring beetle from Europe. It has been established in Halifax, Nova Scotia since at least 1990, and was recently detected in New Brunswick. *T. castaneum* is not known to be established in North America, but it has been intercepted in Canada (British Columbia) and the US (Portland, Oregon), and has been captured in traps in The Dalles, Oregon. *T. castaneum* is widely distributed in forests in Asia and Europe, and can be transported in logs, wood crating and lumber. If introduced, prospects of the insect reproducing are considered high.

Traps were deployed in two locations in Caledonia County, VT. Each site was visited six times between May 19 and August 10, 2011. No target *Tetropium* beetles were found at either of the two trap sites. However, a total of 106 specimens of the indigenous *Picea*-feeding species, *Tetropium cinnamopterum*, were collected. The non-target by-catch included 72 cerambycids and 650 scolytids.

Emerald Ash Borer, *Agrilus planipennis*, is not known to occur in Vermont and was not detected by public outreach or survey. However, it continues to be detected nearby. In 2011, an infestation was discovered on the island of Montreal, and a beetle was trapped in the Albany County town of Selkirk. To date, no beetles have been detected east of the Hudson River in New York.

Due to the increasing threat of emerald ash borer, survey efforts have intensified. Purple panel traps were deployed at 2200 sites on a 2x2 mile grid over most of the state, in an effort led by USDA-APHIS (Figure 28). In addition to their value as a detection survey tool, the purple traps greatly increased public awareness of emerald ash borer.

We are beginning to use girdled trap trees as a detection tool. In 2011, girdled trap trees were installed in the towns of Alburgh, Derby, Grand Isle, Rockingham, Shaftsbury, Wallingford and Weathersfield in early June (Table 9). Ash trees 4 - 10" in diameter, and 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. Trap trees were harvested in early December. One three foot section per 1" DBH was collected from each tree and peeled to look for signs of emerald ash borer. No signs were found.

Table 9. Locations where girdled trap trees were used to survey for emerald ash borer in 2011. Data include tree number, county, town, and coordinates.

Tree #	County	Town	Latitude	Longitude
I-1	Windham	Rockingham	N43.20286	W-72.51028
I-2	Windsor	Weathersfield	N43.43402	W-72.40448
II-1	Bennington	Shaftsbury	N42.97612	W-73.25272
II-2	Bennington	Shaftsbury	N42.97079	W-73.24872
II-3	Rutland	Wallingford	N43.40688	W-73.00859
II-4	Rutland	Wallingford	N43.40490	W-73.00874
III-1	Grand Isle	Alburgh	N44.96599	W-73.27115
III-2	Grand Isle	Grand Isle	N44.68911	W-73.29349
V-1	Orleans	Derby	N45.00506	W-72.08790
V-2	Orleans	Derby	N45.00456	W-72.10790

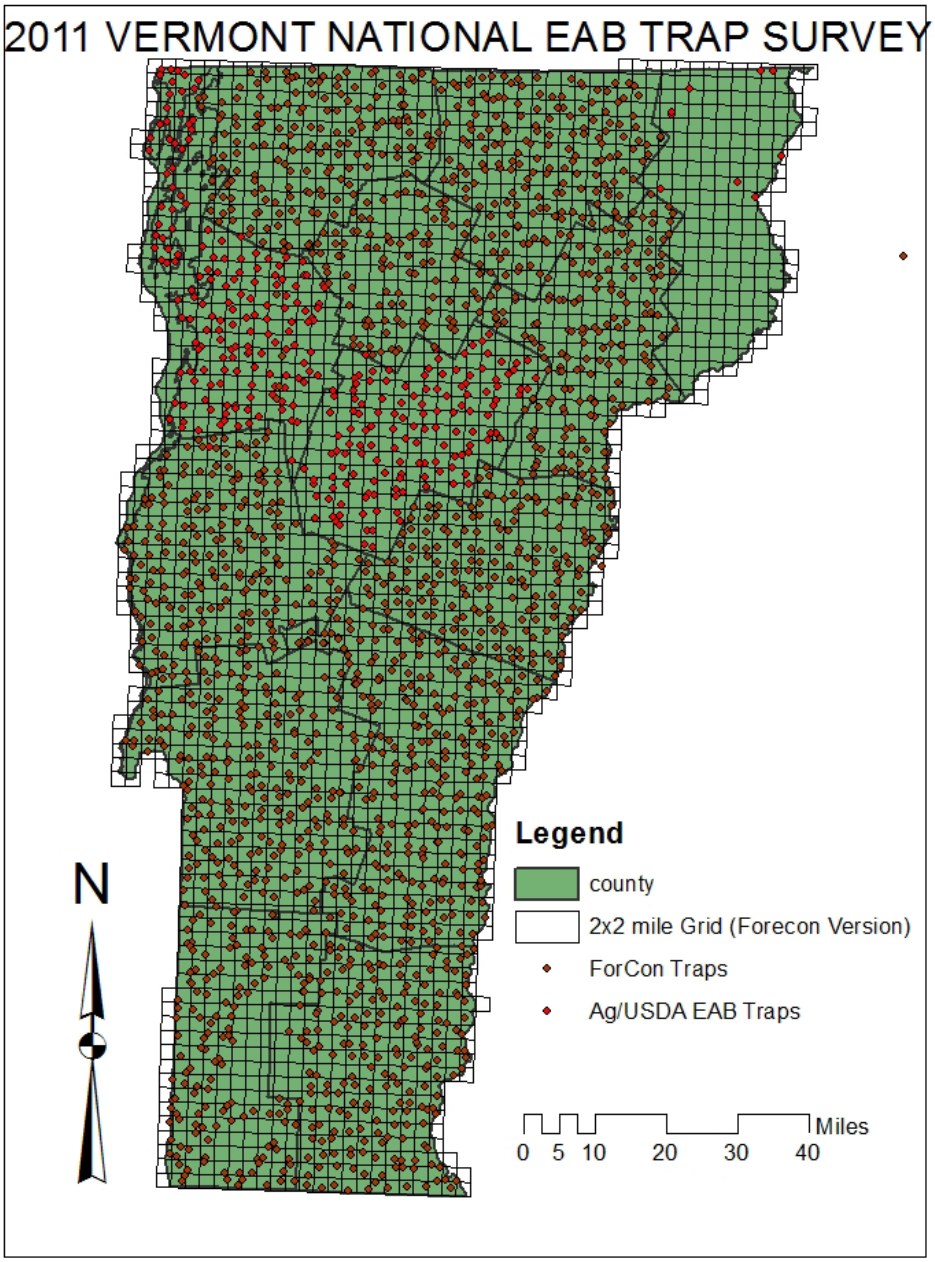


Figure 28. Location of Cooperative Agricultural Pest Survey Program emerald ash borer purple panel traps in 2011. One trap per site. *Credit: Vermont Agency of Agriculture, Food and Markets.*

Surveys of the predatory wasp, *Cerceris fumipennis*, were conducted in most Vermont counties, with volunteers making significant contributions. Several new nest locations were identified, and some sites previously low in number of nests showed marked increases. Beetles in the family Buprestidae, as well as one Chrysomelidae, were collected from 17 sites, representing six counties. (Tables 10 and 11 and Figure 29). Taxonomic assistance for this work was provided by E. Richard Hoebeke, now at the University of Georgia.

Table 10. Vermont sites where *Cerceris fumipennis* nests were found in 2011. Data include site name, town, county, coordinates, and numbers of buprestid beetles collected at each site.

Site	Town	County	Lat	Long	Number of Buprestids
Bakersfield Elementary School	Bakersfield	Franklin	44.78405	-72.80314	2
Blue Mountain UHSD	Wells River	Orange	44.155746	-72.083988	51
Castleton-Hubbardton Elementary School	Castleton	Rutland	43.619623	-73.211399	21
Dewey Field	Rutland Town	Rutland	43.60718	-73.013244	77
Estabrook Field	Brandon	Rutland	43.81077	-72.80164	62
John J. Flynn School	Burlington	Chittenden	44.517195	-73.259865	7
Lothrop School	Pittsford	Rutland	43.705447	-73.01867	1
Newbury Common	Newbury	Orange	44.078824	-72.05922	7
Poultney Elementary School	Poultney	Rutland	43.524364	-73.23738	23
Richford Playground	Richford	Franklin	44.991422	-72.682488	20
Sabotkas	West Rutland	Rutland	43.585506	-73.040778	59
Sand Hill Road	Putney	Windham	42.98179	-72.52043	3
Sharon Elementary School	Sharon	Windsor	43.785744	-72.453571	30
Stephen Ballantine Memorial Ballfield	Jamaica	Windham	43.099943	-72.779283	45
Tunbridge Town Rec Field	Tunbridge	Orange	43.895342	-72.484171	18
Union Village Dam	Thetford	Orange	43.793231	-72.259997	2
Windsor Town Recreation Field	Windsor	Windsor	43.46924	-72.40329	10
Grand Total					**438**

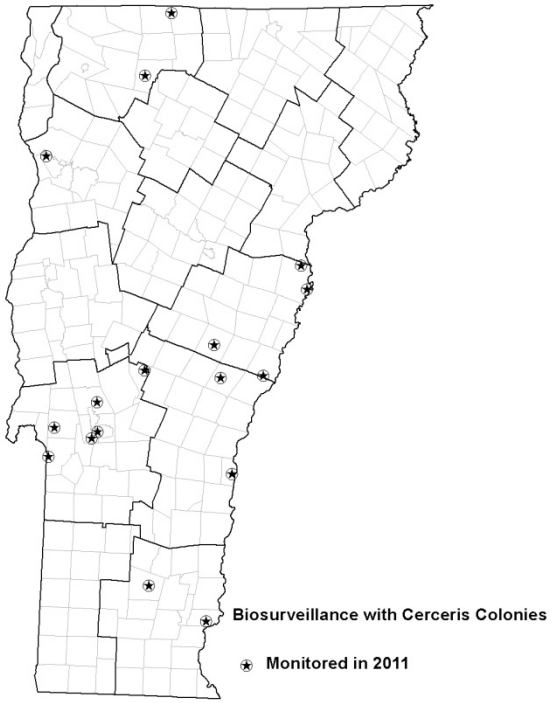


Figure 29. Locations of *Cerceris fumipennis* colonies monitored in Vermont 2011.

Table 11. Beetles collected in Vermont in 2011 during *Cerceris fumipennis* biosurveillance.

Species	Number
Family Buprestidae	
Agrilus anxius Gory	16
Agrilus arcuatus (Say)	13
Agrilus bilineatus (Weber)	2[1]
Agrilus granulatus (Say)	6
Agrilus politus (Say)	1
Agrilus spp.	8
Brachys ovatus (Weber)	3[2]
Buprestis maculativentris Say	9
Buprestis striata F.	14
Chrysobothris azurea LeConte	4[2]
Chrysobothris femorata (Olivier)	10
Chrysobothris harrisi (Hentz)	2[2]
Chrysobothris sexsignata (Say)	7
Chrysobothris spp.	6
Dicerca caudata LeConte	16
Dicerca divaricata (Say)	203
Dicerca lurida (F.)	33
Dicerca tenebrica (Kirby)	11
Dicerca tenebrosa (Kirby)	18
Dicerca tuberculata (G. &L.)	5
Eupristocerus cognitans (Weber)	1
Phaenops fulvoguttata (Harris)	13
Poecilonota cyanipes (Say)	34
Spectralia gracilipes (Melsheimer)	2
Family Chrysomelidae	
Neochlamisus sp., pb. *bebbianae*	1[2]
Total	438

[1] Found on purple traps in Vermont in the past but not collected from *Cerceris fumipennis* nest sites.
[2] Found at *Cerceris fumipennis* nests in Vermont for the first time this year.

Current information is being assembled to assist landowners and managers in making decisions about ash management, including **Emerald Ash Borer: Information for Vermont Landowners**. More technical information for land managers should be available in early 2012. A **Policy on Forest Management Plans and Amendments for Land Enrolled in Vermont's Use Value Appraisal Program (UVA) Related to Emerald Ash Borer** has been developed. Plans to treat ash in response to emerald ash borer will be approved for UVA lands as long as they adhere to the program's minimum standards.

To prepare for the worst possible outcome, we participated in the National Ash Seed Collection Initiative. Seeds from fifty ash trees were collected between 9/17 and 10/6 (Figure 30). These were sent to the USFS Wright Forestry Center in West Lafayette, IN. Selected seeds may be stored at the National Center for Genetic Resources Preservation in Colorado.

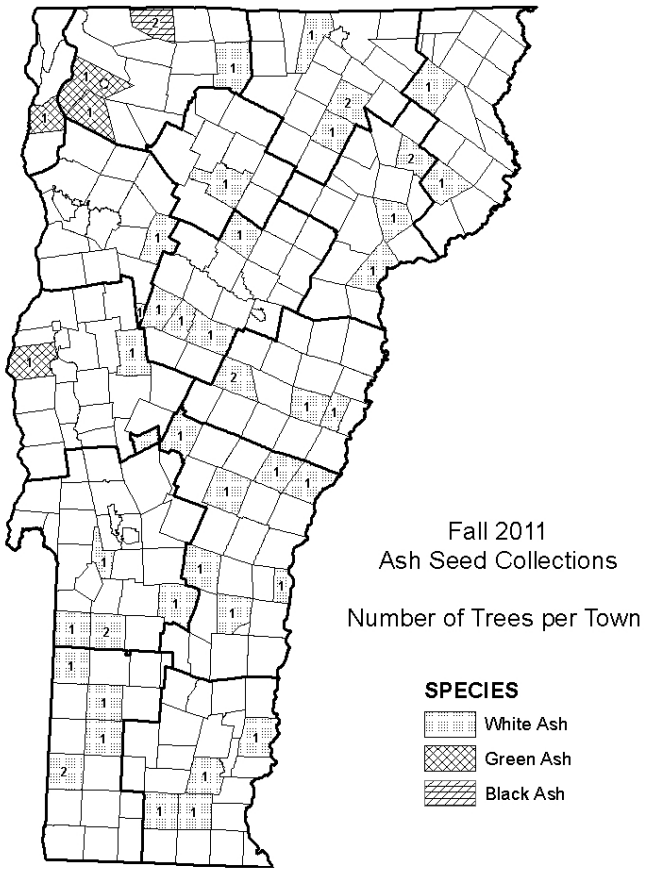


Figure 30. Towns in Vermont where ash seed were collected as part of the National Ash Seed Collection Initiative in 2011.

A variety of other preparedness activities are planned for 2012 including working with communities to develop invasive pest action plans, an EAB detection response drill, and pre-planning for bio-control, pesticide use, and quarantine compliance agreements.

Firewood

Don't Move Firewood activities are conducted to slow the spread of non-native bark and wood insects and pathogens. 2011 was the third year of the firewood exchange program in Vermont State Parks. As in previous years, if campers bring wood from over 50 miles away, it is exchanged for local wood if it can't be burned within 24 hours. The exchanged wood is bagged, stored, and burned over the winter. Parks personnel collected 212 bags of wood in 2009, and 379 bags in 2010. In 2011, 158 bags were collected. Hopefully this is the start of a downward trend! Public education and regulation of firewood in the northeast has been intense over the last few years and it appears to be making a difference. This year exchanged firewood came from Vermont, New Hampshire, New York, Massachusetts, Connecticut, Maine, New Jersey, Quebec and Ontario. Firewood continues to make it across the Canadian border despite regulation both ways. Parks collecting the most firewood this year were Grand Isle, Stillwater, Molly Stark and Gifford Woods.

Working with the Vermont State Marketing office, Vermont's Don't Move Firewood website, **www.firewood.vt.gov**, was updated, including articles and a poster for downloading. Other don't-move-firewood outreach activities included ads in the VT Campground Guide, the VT Fish & Wildlife Digest, and the VT Winter Vacation Guide. Information was provided at exhibits at the VT Campground Association, the Barre Rotary Sports, Recreation and Home Expo, the Quechee Balloon Festival, and the Strolling of the Heifers.

Trypodendron Bark Beetle Surveys

In 2011, we continued our cooperation in a taxonomic study to help ascertain the status and distribution of members of the ambrosia beetle genus *Trypodendron* in North America. Three Uni-Traps were deployed in Lincoln, VT, one in a mixed spruce stand and two in separate hardwood stands which included birch. In the spruce stand, we used lineatin pheromone, alpha-pinene and ethanol. In the stands with birch, we used a combination of lineatin, ethanol and the "natural lure" of small, cut branches of yellow birch that were bruised and draped with a wire over the traps. We used dry cups with vapona killing strips for collecting insects lured to the traps. Beetles were identified by Robert Acciavatti, US Forest Service (retired).

A total of 81 bark beetles was collected in the traps. *Trypodendron* beetles (a total of 76 specimens) were collected at the three sites, and included four species, *T. lineatum*, *T. retusum*, *T. rufitarsis* and *T. borealis*. The most numerous species of bark beetle collected during the survey (63 specimens) was *Trypodendron borealis*. Other species of Scolytinae collected during the survey included *Anisandrus sayi* (3), *Dryocetes affaber* (1), and *Hypothenemus* sp. (1).

Table 12. Trap sites and collection dates for *Trypodendron* taxonomic survey conducted in Vermont in 2011. Data include county, town, coordinates, trap and lure types, host trees, collection dates, and species and numbers collected.

Location	Coordinates (NAD 83)	Monitoring System	Pheromone Type	Tree Species	Placement Date	Collection Date	*Trypodendron betulae*	*Trypodendron borealis*	*Trypodendron lineatum*	*Trypodendron retusum*	*Trypodendron rufitarsis*
Addison Co., Lincoln	N44.05973 W-73.00206	Uni-trap	Lineatin, alpha-pinene and ethanol	Spruce, Red	17-Mar-11	14-Apr-11	0	0	0	0	5
					22-Apr-11	29-Apr-11	0	0	1	0	2
					29-Apr-11	04-May-11	0	14	0	0	0
					06-May-11	13-May-11	0	0	0	0	0
					13-May-11	25-May-11	0	6	0	0	0
					04-Jun-11	10-Jun-11	0	1	0	0	0
					10-Jun-11	21-Jun-11	0	2	0	0	0
					21-Jun-11	04-Jul-11	0	7	0	0	0
					04-Jul-11	15-Jul-11	0	16	0	0	0
					15-Jul-11	27-Jul-11	0	12	0	0	0
					27-Jul-11	08-Aug-11	0	5	0	0	0
				TOTALS			0	63	1	0	7
Addison Co., Lincoln	N44.06102 W-73.00340	Uni-trap	Lineatin, ethanol and birch branch	Birch, Paper	17-Mar-11	14-Apr-11	0	0	0	0	1
					29-Apr-11	06-May-11	0	0	0	1	0
					06-May-11	13-May-11	0	0	0	1	0
					13-May-11	25-May-11	0	0	0	1	0
					25-May-11	04-Jun-11	0	0	0	0	0
				TOTALS			0	0	0	3	1
Addison Co., Lincoln	N44.06160 W-73.00541	Uni-trap	Lineatin + birch branch	Birch, gray, paper and yellow	29-Apr-11	06-May-11	0	0	0	0	0
					13-May-11	25-May-11	0	0	0	0	0
					25-May-11	04-Jun-11	0	0	0	0	0
					10-Jun-11	21-Jun-11	0	0	0	0	0
				TOTALS			0	0	0	0	0
				GRAND TOTALS			0	63	1	3	9

OTHER BARK AND WOOD INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Ash Bark Beetle	*Hylesinus aculeatus*	Ash	Scattered reports	Beetles encountered as they emerged from firewood and logs; galleries observed in downed ash.
Asian Longhorned Beetle	*Anoplophora glabripennis*	Various hardwoods		See narrative.
Bronze Birch Borer	*Argrilus anxius*	Birch	Burlington, Rutland Town	Collected by *Cerceris fumipennis* wasps during biosurveillance surveys. (See Emerald Ash Borer.)
Black Spruce Beetle	*Tetropium castaneum*	Spruce, pine, fir and larch		See narrative.
Brown Spruce Longhorned beetle	*Tetropium fuscum*	Spruce, pine and fir		See narrative.
Brown Wood Borer	*Parandra brunnea*	Ash	Grafton	Reared from ash.
Carpenter Ant	*Camponotus* spp.	Conifers	Widespread observations	Reports of light to moderate populations.
Eastern Larch Beetle	*Dendroctonus simplex*	Larch	Throughout	See Larch Decline.
Emerald Ash Borer	*Agrilus planipennis*	Ash		See narrative.
European Woodwasp	*Sirex noctilio*	Pines		None observed in 2011. Single specimens found in pheromone-baited traps in 2007 and 2010.
Hemlock Borer	*Phaenops fulvoguttata*	Hemlock and occasionally other conifers	Bakersfield, Jamaica, Poultney, Sharon and West Rutland	Collected by *Cerceris fumipennis* wasps during biosurveillance surveys. (See Emerald Ash Borer.)
Japanese Cedar Longhorned Beetle	*Callidiellum rufipenne*	Arborvitae, eastern redcedar, juniper and others		Not known to occur in Vermont.
Northeastern Sawyer	*Monochamus notatus*	Conifers	Scattered observations	Adults observed during flight period.
Pigeon Tremex	*Tremex columba*	Sugar maple	Scattered throughout	Occasionally observed in declining trees.

OTHER BARK AND WOOD INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Pine Engraver	*Ips pini*	Pines	Hinesburg	Populations built up in trees damaged from December 2010 windstorm.
Red Oak Borer	*Enaphalodes rufulus*	Red oak	Enosburg	Borer can cause defects and seriously degrade timber.
Red-shouldered Pine Borer	*Stictoleptura canadensis*	Pines	Scattered observations	One of our more common colorful longhorn beetles.
Round-headed Apple Tree Borer	*Saperda candida*	Apple, mountain ash	Scattered observations	Observed in ornamental and orchard settings.
Round-necked Longhorn	*Clytus ruricola*	Sugar maple	Woodbury	Larvae feed on decaying hardwoods, especially maple.
Sugar Maple Borer	*Glycobius speciosus*	Sugar maple	Throughout	Commonly observed throughout the state.
Two-lined Chestnut Borer	*Agrilus bilineatus*	Oak	Halifax	Adults primarily attack suppressed or declining trees that are . Collected by *Cerceris fumipennis* wasps during biosurveillance surveys. (See Emerald Ash Borer.)
White-horned Horntail	*Urocerus albicornis*	Fir, larch, spruce, pine, hemlock, and other conifers	Guilford	Native horntail that was not associated with host at the time it was observed; collected "at large".
Whitespotted Sawyer	*Monochamus scutellatus*	White pine and other conifers	Common throughout	In some areas, more adults than usual observed this year; continued to receive numerous inquiries from people who mistook them for Asian longhorned beetle.

Other Bark and Wood Insects not reported in 2011 included Allegheny Mound Ant, *Formica exsectoides*; Brown Prionid, *Orthosoma brunneum*; Elm Bark Beetle, *Hylurgopinus rufipes & Scolytus multistriatus;* Locust Borer, *Megacyllene robinae*; Pitted Ambrosia Beetle, *Corthylus punctatissimus*; Redheaded Ash Borer, *Neoclytus acuminatus;* Ribbed Pine Borer, *Rhagium inquisitor;* Tanbark Borer, *Phymatodes testaceus.*

FRUIT, NUT AND FLOWER INSECTS

INSECT	LATIN NAME	HOST	LOCALITY	REMARKS
Asiatic Garden Beetle	*Autoserica castanea*	Many	Champlain Valley; Walden, Cabot, Hardwick	Observed more commonly than in recent past.
Rose Chafer	*Macrodactylus subspinosus*	Many	Statewide	Reported more often in association with ornamental flowers than as a tree pest.
Western Conifer Seed Bug	*Leptoglossus occidentalis*	Conifers	Statewide	Commonly observed (often in households); no damage to Vermont conifers has been recorded.

Fruit, Nut and Flower Insects not reported in 2011 included Ash Flowergall Mite, *Aceria fraxiniflora* ; Butternut Curculio, *Conotrachelus juglandis* ; Mossy Rose Gall, *Diplolepis rosae* ; Plum Curculio, *Conotrachelus nenuphar*.

STEM DISEASES

Symptoms of **Ash Yellows**, caused by *Candidatus* Phytoplasma fraxini, are commonly observed in southeastern and southwestern Vermont. Because of recent reports of ash decline from locations where witches' brooms were not observed, samples from five locations were sent to Agdia Testing Services. One inch square samples of bark and outer sapwood were collected from the exposed roots or root collar. Ash trees with dieback symptoms were selected for sampling, if present. Samples from five to ten trees per site were pooled for testing. The only site that tested positive for the presence of phytoplasmas, according to the Phytoplasma Nested PCR test, was one in Springfield, where witches' brooms were common (Table 13).

Table 13. Results of phytoplasma nested PCR tests from ash root phloem samples from five sites.

	Witches Brooms Present?	Ash Decline and Mortality	Number of Trees in Pooled Sample	Date Sampled	Phytoplasma Nested PCR Test
Mendon	No	Present	10	7/27	Negative
Ripton	No	Present	10	10/25	Negative
Springfield	Yes	Present	5	8/17	Positive
Starksboro	No	Present	5	10/25	Negative
Starksboro	No	Absent	10	10/25	Negative

Table 14. Mapped acres of beech bark disease in 2011.

County	Acres
Addison	132
Bennington	511
Caledonia	755
Chittenden	72
Essex	2,046
Franklin	77
Grand Isle	0
Lamoille	676
Orange	147
Orleans	971
Rutland	675
Washington	121
Windham	3,928
Windsor	921
Total	**11,033**

Beech Bark Disease, caused by *Cryptococcus fagisuga* and *Nectria coccinea var. faginata*, was the primary cause of dieback and mortality on 11,033 acres, a level similar to 2010 (Table 14, Figure 31). This non-native pest complex was the second most common cause of tree mortality mapped in Vermont, after wet site conditions.

The **VT ANR Management Guidelines for Optimizing Mast Yields in Beech Mast Production Areas** have been completed, incorporating beech bark disease considerations as well as wildlife needs.

Butternut Canker, caused by *Sirococcus clavigignenta-juglandacearum*, levels remain stable, with most butternuts showing symptoms of the disease.

We continue to participate in a multi-state project, with Plant Technologies LLC, to conserve butternut germplasm. Over 70 trees are in a database of potentially resistant trees. In winter 2009-2010, samples for DNA were collected from 73 trees, of which 71 were pure butternut. Scions were collected from 34 trees for grafting. In winter 2010-2011, samples for DNA were collected from 49 trees, of which 43 were pure butternut. Scions from 48 were collected for grafting. Trees grafted from 33 different Vermont butternuts are being maintained by the University of Missouri. Plans are to outplant these trees or their progeny in Vermont seed orchards. A similar project is being conducted by the Green Mountain National Forest, with scions collected on national forest land.

White Pine Blister Rust, caused by *Cronartium ribicola*, continues to cause noticeable scattered mortality following a recent increase in incidence. Concerns about this disease have increased, as cultivated varieties of black currant, thought to be immune, have turned out to be susceptible.

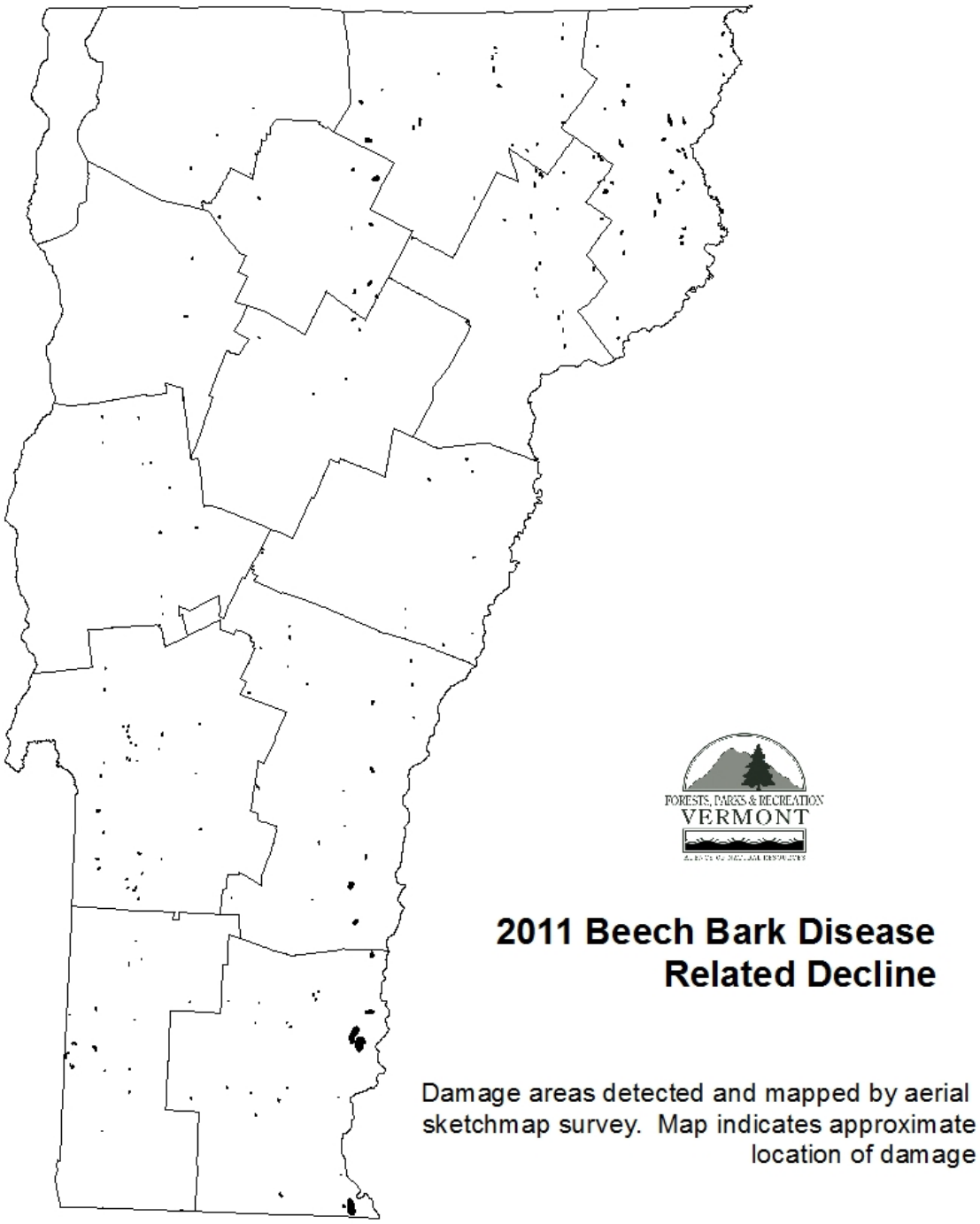


Figure 31. Beech bark disease related decline mapped in 2011. Mapped area includes 11,033 acres.

OTHER STEM DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Annual Canker	*Fusarium sp.*	Red maple	Central Vermont	Light damage.
Ash Yellows	*Candidatus Phytoplasma fraxini*	White ash	Southern Vermont	See narrative.
Beech Bark Disease	*Cryptococcus fagisuga and Nectria coccinea var. faginata*	Beech	Statewide	See narrative.
Black Knot	*Dibotryon morbosum*	Cherry	Throughout	Occasionally associated with heavy dieback.
Botryospaeria Canker on Blueberry	*Botryosphaeria dothidea*	Blueberry	Fairfax	
Brown Rot	*Monilinia fructicola*	Plum	Springfield	Ornamental.
Butternut Canker	*Sirococcus clavigignenta-juglandacearum*	Butternut	Statewide	See narrative.
Chestnut Blight	*Cryphonectria parasitica*	American chestnut	Southern Vermont, Champlain Valley	Observed occasionally on chestnut sprouts. The American Chestnut Foundation remains active in establishing seed orchards in Vermont.
Cytospora Canker	*Leucostoma kunzei*	Blue spruce	Widely scattered	More commonly observed in central Vermont.
Diplodia Shoot Blight	*Sphaeropsis sapinea*	Austrian pine	Essex	
Dutch Elm Disease	*Ophiostoma novo-ulmi*	Elm	Throughout	Levels remain higher than normal.
Eastern Dwarf Mistletoe	*Arceuthobium pusillum*	Black spruce	Franklin	
Fireblight	*Erwinia amylovora*	Apple, pear	Champlain Valley	

OTHER STEM DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Nectria Canker	*Nectria galligena*	Hardwoods	Scattered throughout	
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	Guilford	Dieback on 25% of crown.
Sirococcus Blight	*Sirococcus conigenus*	Red pine	Williamstown, Chelsea	Tip blight on overstory and understory trees.
White Pine Blister Rust	*Cronartium ribicola*			See narrative.
Willow Black Canker	*Glomerella miyabeana*	Willow	Charlotte	Heavy defoliation in early summer.
Yellow Witches Broom Rust	*Melampsorella caryophyllacearum*	Balsam fir	Widely scattered	Light damage.

Other Stem Diseases not reported in 2011 included Caliciopsis Canker, *Caliciopsis pinea* ; Delphinella Tip Blight of Fir, *Delphinella balsamae* ; Oak Wilt, *Ceratocystis fagacearum* ; Scleroderris Canker, *Ascocalyx abietina;* Sirococcus, *Sirococcus strobilinius* ; Verticillium Wilt, *Verticillium albo-atrum* ; Woodgate Gall Rust, *Endocronartium harknessii* .

FOLIAGE DISEASES

County	Acres
Addison	61
Bennington	12
Caledonia	0
Chittenden	192
Essex	0
Franklin	144
Grand Isle	16
Lamoille	140
Orange	259
Orleans	518
Rutland	225
Washington	68
Windham	1,478
Windsor	1,448
Total	**4,562**

Anthracnose, caused by fungi in the genera *Gloeosporium spp*., *Discula spp*., *Apiognomonia spp*., and others, became noticeable by late spring on a variety of hardwoods. Damage was widespread on sugar maple and white ash, common on red oak and red maple, and reported on redbud and lilac. Browning continued to show up through the growing season as leaves infected in the spring dried out. Many ash dropped leaves prematurely. Refoliation was observed on some trees including ash in Underhill. Damage was mapped on 4,562 acres, with the heaviest damage in southeastern Vermont (Table 15). More information is in the leaflet, **Anthracnose Disease.**

Table 15. Mapped acres of anthracnose in 2011.

County	Acres
Addison	549
Bennington	962
Caledonia	2,469
Chittenden	1,025
Essex	9,362
Franklin	576
Grand Isle	0
Lamoille	1,053
Orange	1,416
Orleans	3,124
Rutland	1,301
Washington	2,333
Windham	27
Windsor	776
Total	**24,975**

Septoria Leafspot on Birch continued to be widespread at high elevations, with 24,975 acres mapped during aerial surveys, compared to 13,280 acres mapped in 2010 (Table 16, Figure 32). Damage was particularly heavy at elevations above 1000'. Feeding by leafmining sawflies such as *Fenusa pusilla* and *Messa nana* was minimal, but contributed to the defoliation where present. Mostly due to this disease, white birch dropped its leaves about ten days ahead of normal in monitoring plots on Mount Mansfield.

Table 16. Mapped acres of birch defoliation in 2011.

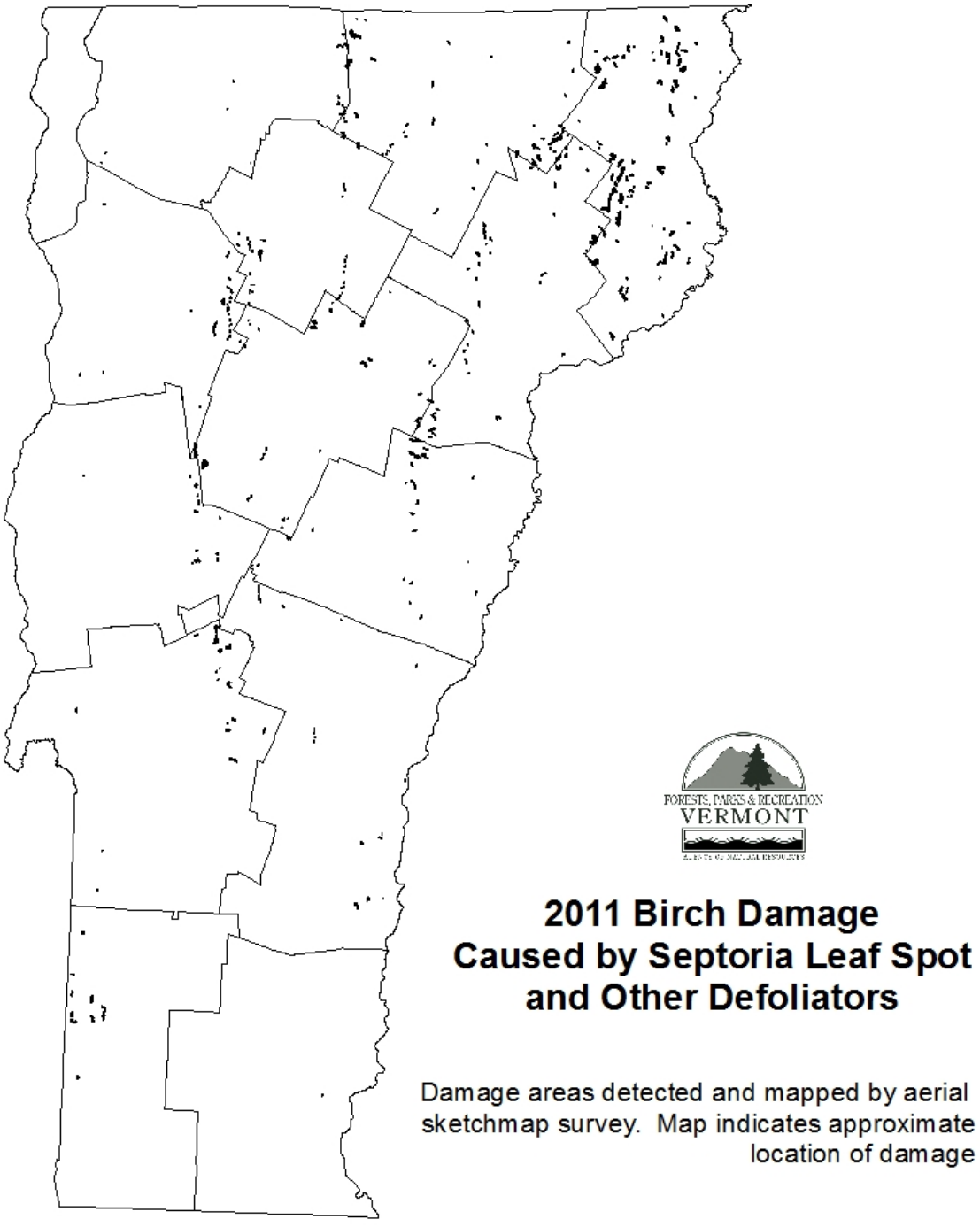


Figure 32. Birch defoliation mapped in 2011. Mapped area includes 24,975 acres.

Throughout the state, **White Pine Needlecast** led to premature casting of last year's needles. By early July, chlorosis and premature needle drop were common on mature white pines, with lower foliage more severely affected. Although symptoms were less noticeable during late summer aerial surveys, damage was mapped on 1092 acres (Table 17).

Fungi on diseased needles from multiple sites in northern New England have been identified by the US Forest Service as *Mycosphaerella dearnessi (*syn. *Scirrhia acicola)*, the causal agent of brown spot needle blight, and the needlecast fungi *Bifusella linearis* and *Canavirgella banfieldii*. Mycosphaerella (Brown Spot) is more commonly found in June collected white pine needles, while Bifusella and Canavirgella are more commonly found in April collected needles. It appears that Brown Spot is the primary pathogen involved.

County	Acres
Addison	67
Bennington	214
Caledonia	0
Chittenden	98
Essex	0
Franklin	25
Grand Isle	0
Lamoille	0
Orange	140
Orleans	36
Rutland	188
Washington	12
Windham	273
Windsor	40
Total	**1,092**

Most current shoots developed normally and top branches were rarely affected, so we don't expect severe impacts. However, because of wet spring conditions in 2011, and high fungus levels, white pine needle diseases are likely to be common again next year.

Table 17. Mapped acres of white pine needlecast in 2011.

Table 18. Fungi associated with white pine needlecast by month of sampling. Identifications made by the US Forest Service/Forest Health Protection and/or the Connecticut Agricultural Experiment Station.

Location	County	Month Sampled	Bifusella linearis	Brown spot
Lyndon	Caledonia	May	yes	yes
Waterbury	Washington	May		
Springfield	Windsor	May		
Brookfield	Orange	July		yes
Bethel	Windsor	July	yes	yes

OTHER FOLIAGE DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Actinopelte Leaf Spot	*Actinopelte dryina*	Red oak	Putney, Newfane	Present, along with anthracnose, on diseased foliage.
Anthracnose	*Glomerella spp. Apiognomonia spp.*			See narrative.
Ash Anthracnose	*Gloeosporium aridum*			See narrative.
Balsam Fir Needle Blight	*Rhizosphaera pini*	Balsam fir, Fraser fir	Scattered statewide	Continues to be a problem on Christmas trees, with occasional heavy damage observed.
Balsam Fir Needlecast	*Lirula nervata*	Balsam fir	Scattered statewide	Christmas trees.
Brown Spot Needle Blight	*Scirrhia acicola*			See White Pine Needlecast damage.
Canavirgella Needlecast	*Canavirgella banfieldii*			See White Pine Needlecast damage.
Cedar-Apple Rust	*Gymnosporangium juniperi-virginianae*	Apple	Champlain Valley	Also observed on red cedar.
Fir-Fern Rust	*Uredinopsis mirabilis*	Balsam fir	Widespread	Most Christmas tree plantations had less than 10% needle damage.
Giant Tar Spot	*Rhytisma acerinum*	Norway maple	Statewide	Common, but scattered occurrence. Minor damage to trees.
Maple Anthracnose	*Gloeosporium sp.*			See narrative.
Phyllosticta Leaf Spot	*Phyllosticta spp.*	Red maple	Wilmington	
Poplar Leaf Fungus	*Marssonina spp.*	Balsam poplar	Widely scattered.	Noticeable, but little damage mapped.
Rhizosphaera Needlecast	*Rhizosphaera kalkhoffi*	Blue spruce	Scattered statewide	Remains common at above-average levels.
Septoria Leaf Spot on Birch	*Septoria betulae*			See narrative.

OTHER FOLIAGE DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Septoria Leaf Spot on Maple	*Septoria aceris*	Sugar maple	Guilford	Light damage.
Sirococcus Tip Blight	*Sirococcus tsugae*	Hemlock	Southeastern Vermont	Light and scattered.

Foliage Diseases not reported in 2011 included Cyclaneusma Needlecast, *Cyclaneusma minus*; Dogwood Anthracnose, *Discula destructiva*; Larch Needlecast, *Mycosphaerella sp.*; Lophodermium Needlecast, *Lophodermium seditiosum*; Rhabdocline Needlecast, *Rhabdocline pseudotsugae*; and Swiss Needlecast, *Phaeocryptopus gaeumannii*.

ROOT DISEASES

DISEASE	LATIN NAME	HOST	LOCALITY	REMARKS
Annosus Root Rot	*Heterobasidion annosum*	Red Pine	Ripton	Pocket of mortality on the Green Mountain National Forest. Confirmed by the US Forest Service Forest Products Lab.
Armillaria Root Rot	*Armillaria spp.*	Balsam Fir Hardwoods	Dover, Ferdinand, Plymouth Statewide	On decline study plots. Commonly found on declining trees.
Phytophthora Root Rot	*Phytophthora cinamomi*	Balsam Fir	Weston	Pockets of mortality among 2011 transplants from single nursery source. Damage was noticeable by June. Confirmed by UNH Plant Disease Clinic.

Birch Decline and Mortality increased from 1,017 acres in 2010 to 2,395 acres in 2011 (Table 19). Most of this damage is old mortality that remains evident, especially on paper birch at upper elevations, but includes additional areas, especially in Lamoille County (Figure 34).

Table 19. Mapped acres of birch decline and mortality in 2011.

County	Acres
Bennington	34
Chittenden	269
Franklin	103
Lamoille	1,017
Orleans	652
Washington	322
Total	**2,395**

Frost Damage and Recovery was monitored in 2010 and 2011**.** A late spring frost in 2010 in mid-to upper elevation sugar maple forests resulted in foliage injury to 414,901 acres. Maples in 6 locations on State Forest Land were monitored between 2010 and 2011, and most trees recovered to a healthy condition. Foliage transparency improved at all 6 sites (Figure 33). Rapid taphole closure is an indicator of robust growth. In both 2010 and 2011, half the trees grew rapidly enough to completely close tapholes (using health spouts) between the time they were tapped in late winter, and the summer evaluations in July or August. The other half did not close indicating less than optimum tree health.

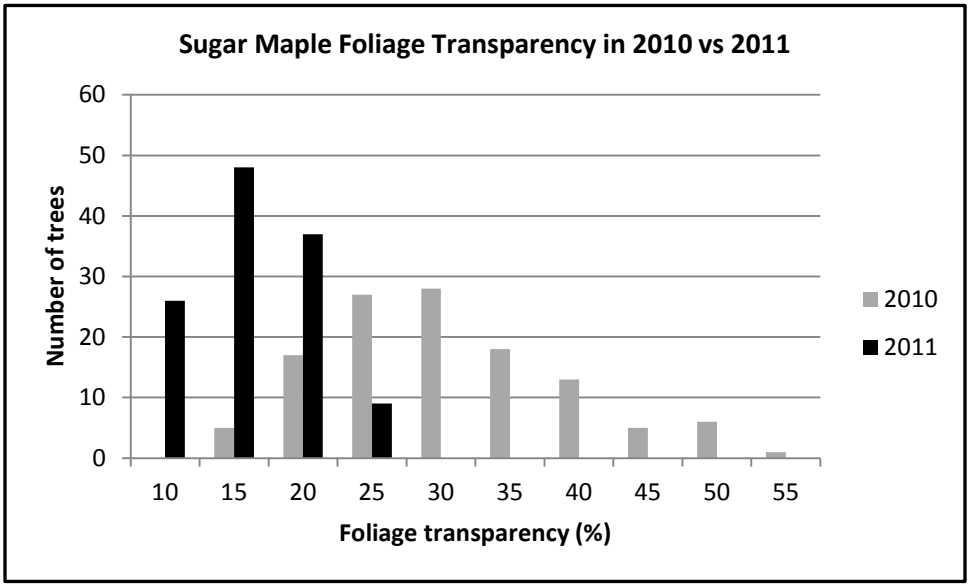


Figure 33. Foliage transparency improvement in 2011 at 6 sugar maple sites on state lands following the 2010 frost injury event.

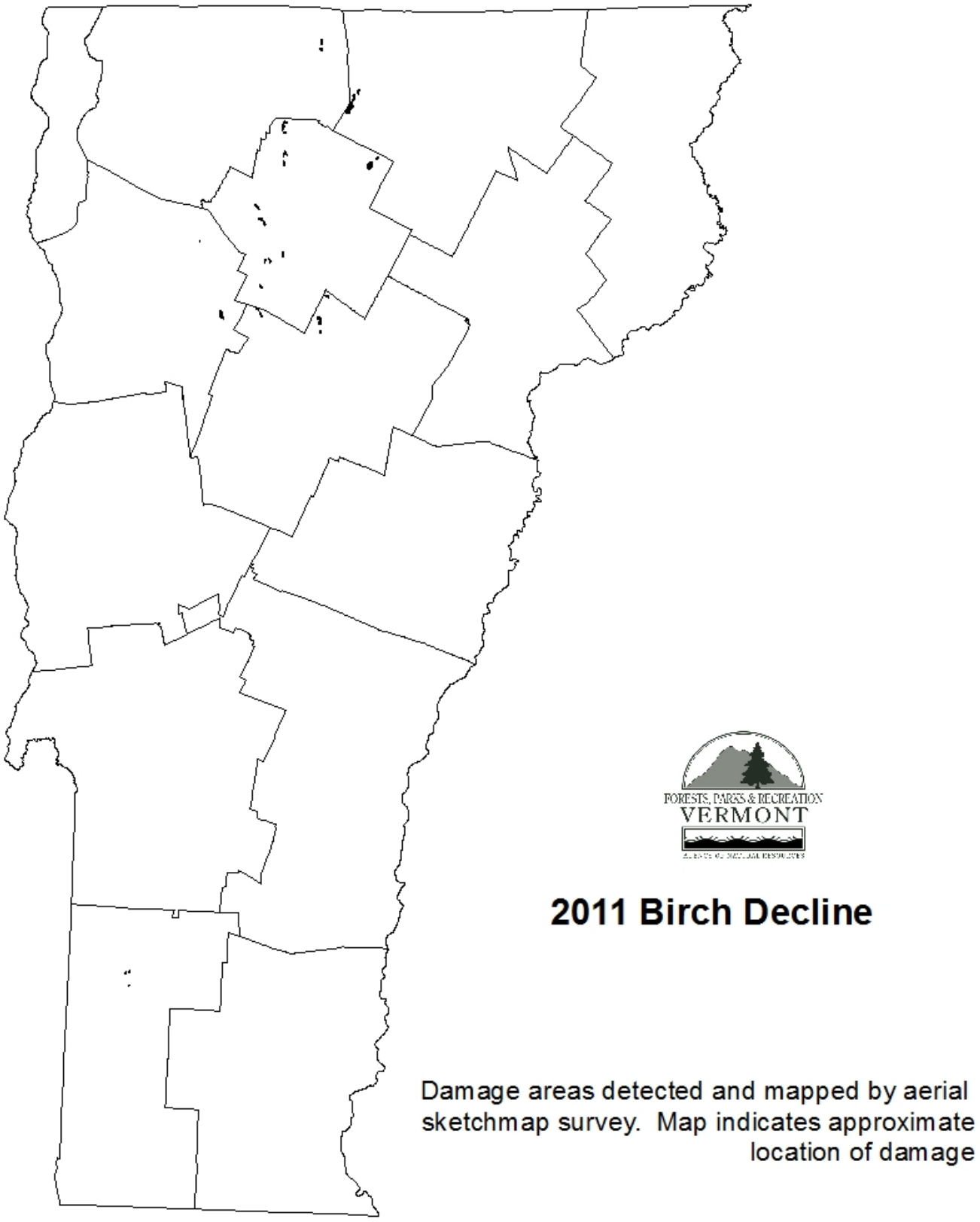


Figure 34. Birch decline and mortality mapped in 2011. Mapped area includes 2,395 acres.

At 20 additional sugar maple monitoring sites (North American Maple Project plots), crown health was also evaluated to assess recovery from frost injury. All trees showed improved health, and trees that experienced moderate-to-heavy frost injury in 2010 improved in crown health by around 10% (Figure 35).

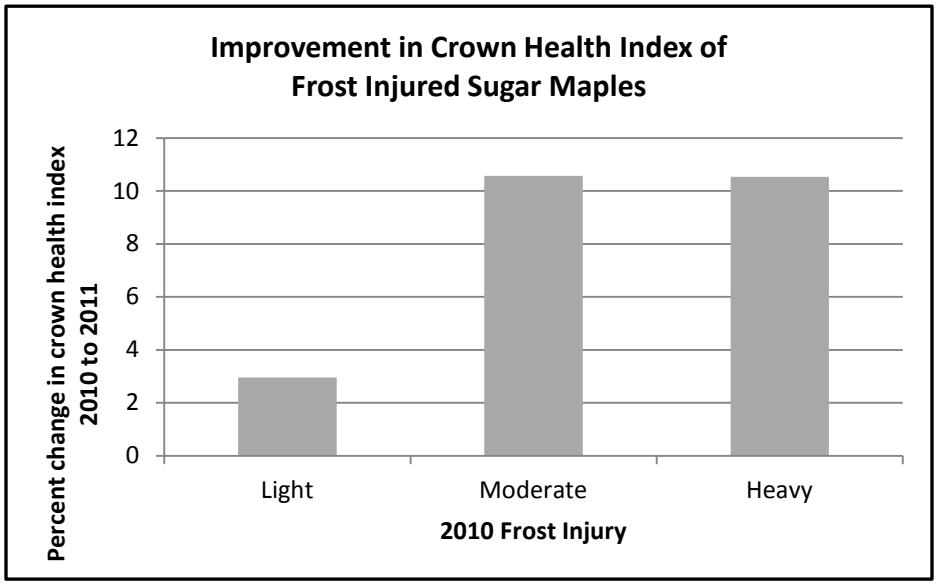


Figure 35. Improvement in crown health index of sugar maple trees on North American Maple Project plots in 2011 that had been affected by the 2010 frost injury event.

Spruce-Fir Decline increased in 2011, especially in Addison County. Last year only 558 acres of decline were mapped, compared to 1,847 acres in 2011. Some of this acreage is related to past balsam woolly adelgid damage, and new acreage may be related to water table fluctuations from flooding.

Table 20. Mapped acres of spruce-fir decline and mortality in 2011.

County	Acres
Addison	2,022
Bennington	383
Caledonia	147
Essex	139
Franklin	91
Lamoille	14
Orange	366
Orleans	116
Rutland	460
Washington	249
Windham	25
Total	**1,847**

Decline and mortality on **Wet Sites** increased substantially in 2011 resulting from above average rainfall, **Flooding**, and tropical storm Irene. Total acres of decline and mortality due to wet sites were 9,214 acres compared to 1,708 acres in 2010 (Table 21).

Table 21. Mapped acres of decline and mortality associated with wet sites in 2011.

County	Acres
Addison	1,860
Bennington	0
Caledonia	235
Chittenden	68
Essex	291
Franklin	351
Grand Isle	1,366
Lamoille	122
Orange	330
Orleans	300
Rutland	3,306
Washington	290
Windham	29
Windsor	665
Total	**9,214**

Spring Flooding followed a heavy snow pack and abundant precipitation. Spring precipitation (March, April and May) set a new high record at Burlington, with a total of 19.94 inches. The April snow pack was dense with water, and an April 11 thaw (temperatures 73^{o}F in Essex) accompanied by heavy rains caused local flooding. Additional heavy rains on April 26th further drenched landscapes. Lake Champlain water levels remained flooded from April through early June, with a maximum height of 103.27 feet on May 6th. The lake increased in surface area by 66 square miles. Trees in flooded areas were submerged for weeks, and those species not well adapted to flood conditions succumbed.

Fall Flooding followed extreme precipitation from **Tropical Storm Irene.** Rainfall amounts during the August 28th storm ranged from 3.2"- 11.23", shattering records dating back to the summers of 1949, 1950 and 1971. This widespread, intense rainfall resulted in soils quickly becoming saturated. The widespread heavy rainfall and river flooding were accompanied by wind gusts between 30 and 60 mph. The highest wind gust of 85 mph was reported on the summit of Mt Mansfield. This combination of winds with the loose saturated soil resulted in uprooted trees which took down power lines. Flash flooding was common across central and southern Vermont. For example, in west-central Vermont, the Otter Creek in Rutland crested at a new record flood stage of 17.21 feet. Flood stage at this gauge is 8 feet. Further north, the Winooski River flooded the State Office Complex in downtown Waterbury, leading to the evacuation of the Vermont Emergency Management headquarters. The Agency of Natural Resources headquarters were damaged in the flood and staff displaced to other locations for the near future. Historical forestry records,

reports and photos from the last century were destroyed. The first floor of the Environmental/Agriculture Laboratory Building, which houses the Forest Biology Lab was inundated with three feet of water and silt. A large portion of the insect collection and reference materials were destroyed. Data from remaining specimens are being entered into the Vermont Invertebrate Database Alliance (VIDA) before disposal.

Initial estimates of road washouts or closures across the state included 400 state and local roads with at least 30 state highway bridges being washed out or extensively damaged. In addition substantial infrastructure damage occurred within State Forests and State Parks. Thousands of acres of forest land along streams were inundated. The force of flood waters affected trees by undermining root systems and wounding stems from floating debris. The short duration of standing water at most locations prevented further tree health problems. Aerial mapping of forests exhibiting flood-damage symptoms, from the spring and fall flooding, totaled 9,214 acres (see Table 21, and Figure 36). Additional long-term impacts from the flooding are expected from movement and broader distribution of invasive plant materials to new locations downstream.

Wind Damage/ Ice Damage/ Snow Damage resulting in broken and down trees resulted from several events in December 2010 and May 2011. A total of 802 acres of mortality, mostly in northern Vermont were mapped (Figure 37).

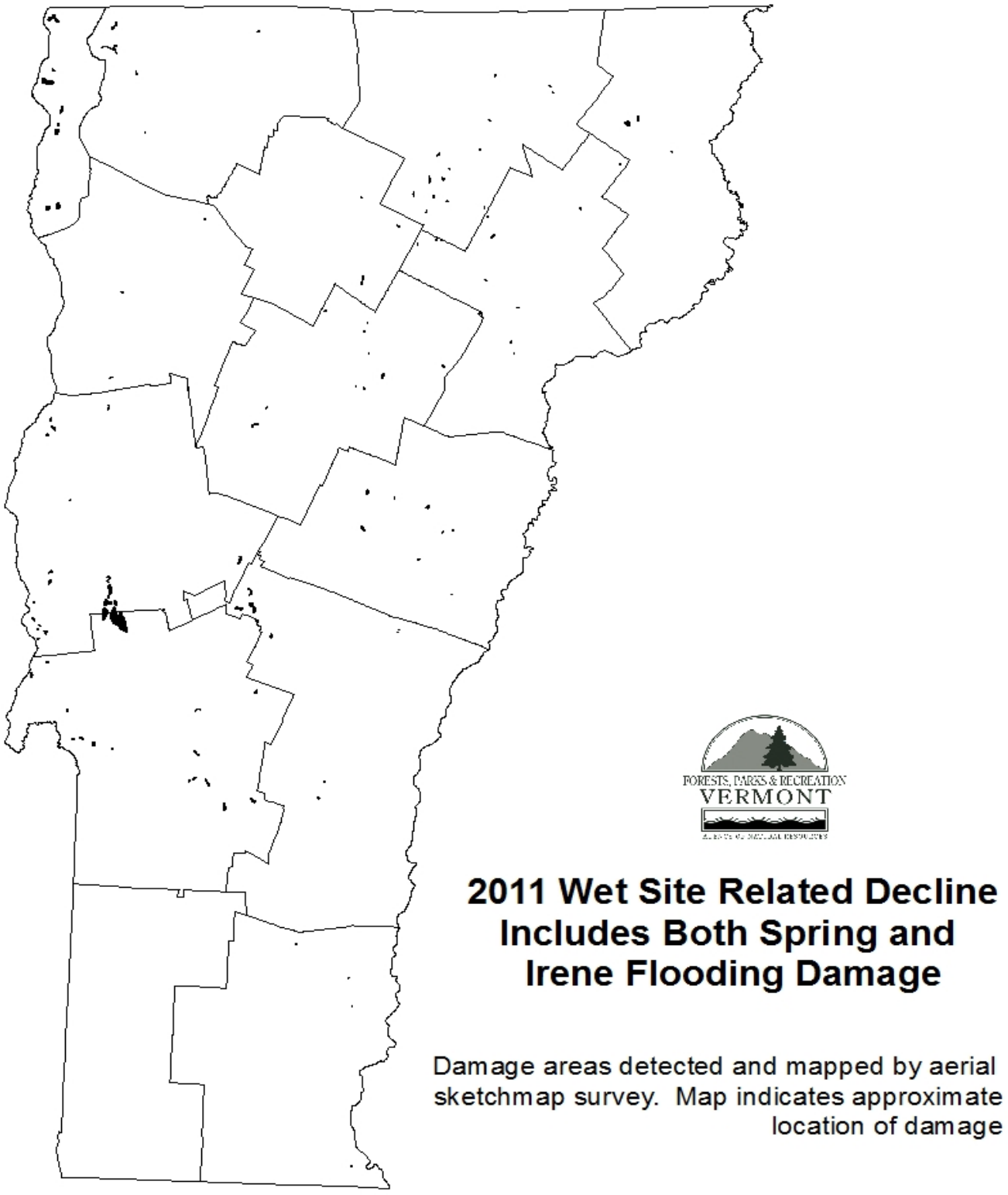


Figure 36. Wet-site related decline and mortality mapped in 2011. Mapped area includes 9,214 acres.

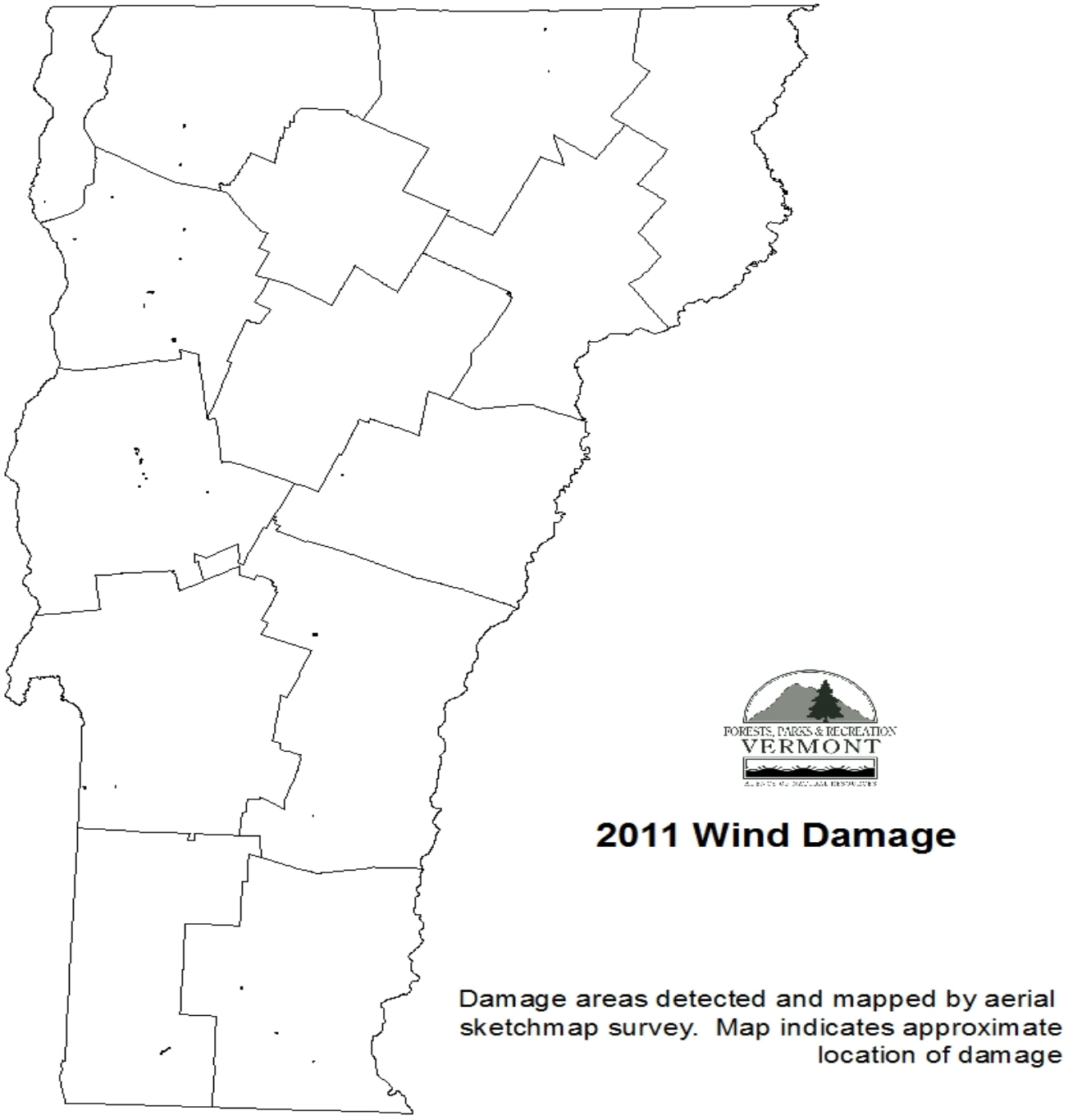


Figure 37. Wind damage mapped in 2011. Mapped area includes 802 acres.

Mortality Study

Higher than normal mortality from statewide inventory data prompted an evaluation, beginning in 2010, of species affected, timing of stress events, and probable causes, culminating in field surveys in 2011. Five species were largely responsible for the mortality: birch, red spruce, balsam fir, red maple, and American beech. Evaluations by the US Forest Service found that birch decline was initiated by the 1998 ice storm. Mortality was related to low soil calcium levels (Halman et al 2011). Red spruce winter injury was serious in 2003 and was shown to be responsible for decline (Schaberg et al 2011). Our study focused on potential causes for red maple, balsam fir and beech mortality from 1998-2007. While soil and tree core samples are still being processed, it is likely that balsam fir was affected largely by balsam woolly adelgid or fluctuating water tables; and beech mortality increased due to beech bark disease.

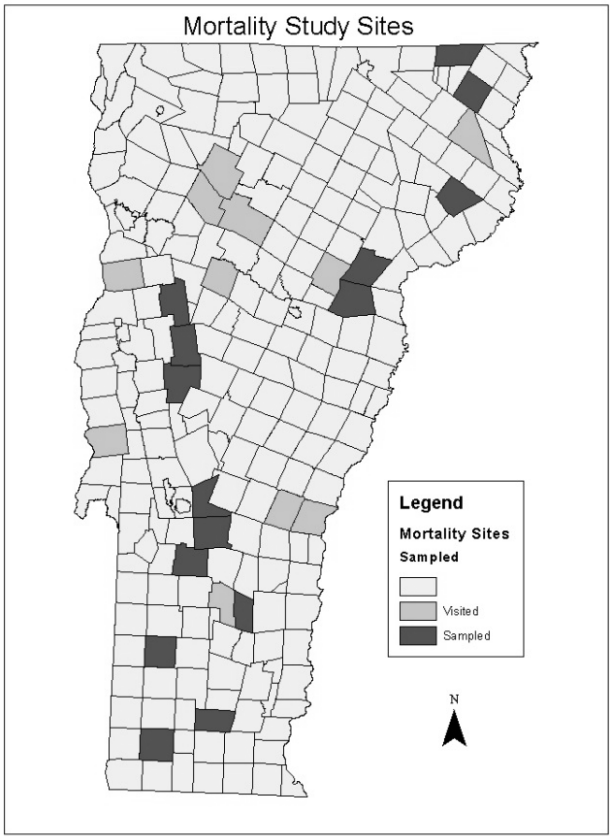


Figure 38. Field evaluations of mortality made in 2011.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

CONDITION	HOST(S)	LOCALITY	REMARKS
Birch Decline	Birch	Statewide	See narrative.
Drought	Hardwoods, elm and blueberry	Northeastern Vermont and Whitingham	Higher elevations and shallow soils along Lake Champlain.
Flooding/Wet Site	Many	Statewide	See narrative.
Frost	Many	Southern Vermont	Only light damage observed.
Hardwood Decline and Mortality	Hardwoods	Statewide	Decline continues on highly stressed sites, but no extensive hardwood decline was mapped in 2011.
Heavy Seed	Many	Statewide	Exceptionally abundant seed crop led to thin crowns on ash, maple, and other species.
Herbicide Injury	Red oak and sugar maple	Dummerston	
Ice Damage	Many	Statewide	See narrative.
Improper Planting	Christmas trees	Windsor and Windham Counties	Some trees not merchantable.
Larch Decline	Larch	Statewide	Unusually low. Only 41 acres mapped, a decrease from only 352 in 2010.
Lightning	Hardwoods and Norway maple	Champlain Valley and Brattleboro	Increase over last year.
Logging-related Decline	Mixed hardwoods	Winhall and Windham	Decline observed at high elevations, where heavy thinning was followed by snow, ice and wind damage.
Red Pine Decline	Red pine	Central Vermont, especially Williamstown and Chelsea	Moderate to severe decline in some stands.
Root Problem	Sugar Maple	Burlington	Ongoing.
Salt Injury	Conifers	Statewide	Increase over last year.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

CONDITION	HOST(S)	LOCALITY	REMARKS
Snow Injury	Many	Statewide	See narrative.
Spruce-Fir Decline	Spruce and fir	Northern Vermont	Same.
Wind	Many	Statewide	See narrative.
Winter Injury	Spruce	Statewide	Not common.

Diebacks, Declines and Environmental Diseases not reported in 2011 included fire damage, hail, and hardwood chlorosis.

ANIMAL DAMAGE

ANIMAL	SPECIES DAMAGED	LOCALITY	REMARKS
Beaver	Many	Scattered throughout	Damage levels stable.
Deer	Regeneration	Statewide	Uncommon in the northeastern counties, and common in southern Vermont.
Moose	Many	Northern Vermont	Balsam fir damage in decline study plots.
Porcupine	Many	Statewide	Uncommon.
Sapsucker	Many	Statewide	Increasingly noticeable.
Squirrel	Red oak, sugar maple, Norway spruce	Widely scattered, including Burlington, Stannard, and Brandon	Only light damage observed.

INVASIVE PLANTS

A number of projects regarding **Non-Native Invasive Plants** took place in 2011.

Vermont Invasives Website: http://vtinvasives.org

This website provides a wide range of information to a variety of user groups from citizen scientist to professional foresters. Topics that are related to invasive plants include:

- Educational Resources - information on assessing an infestation, writing a management plan, hiring a contractor and best management practices.

- iMapInvasives – a mapping tool for reporting infestations or mapping infestations on a property. Maps can be downloaded and printed for use in management plans.

- Best Management Practices – A spiral bound manual for land managers, forestry professionals and landowners for the prevention and treatment of terrestrial invasive plants in Vermont woodlands.

- Project-specific/Group-specific Web Pages – groups can develop their own web page and provide information about ongoing projects.

- Events – a section is provided for posting events ranging from educational workshops to on the ground control projects.

- CISMAs – information about forming a Cooperative Invasive Species Management Area (CISMA) or finding one in your area. This will allow limited resources to be used more effectively.

Invasive Plant Control Projects

Funding through the American Recovery and Reinvestment Act allowed for management of invasive plant populations in State Parks and the Green Mountain National Forest. Crews conducted invasive plant management activities in 15 state parks. Species treated included honeysuckle, buckthorn, barberry, bittersweet, autumn olive and goutweed.

Workshops

Two workshops which targeted land managers, “Best Management Practices for the Prevention and Treatment of Terrestrial Invasive Plants in Vermont Woodlands”, took place in the fall of 2011. These workshops consisted of an indoor session in the morning and an outdoor session in the afternoon. Participants learned to utilize a number of tools to inventory, map and create invasive plant management plans for properties. Approximately 50 people participated in each session. Two more workshops are scheduled for the spring of 2012.

Sugar Maple Health in 2011

Abundant growing season precipitation improved sugar maple crown health over the previous year on the 30 monitoring plots (North American Maple Project) (Figure 39). More than 96% of trees were rated as healthy. Less than 4% of trees had thin foliage or high dieback (Figure 40). Likewise, mortality of overstory sugar maples was very low; 0.2% died within the past year, tying 1997 for the lowest mortality over this 23 year record. Moderate and heavy seed production was seen at 60% of the sites, reflecting observations that hillsides were brown with ripened seeds.

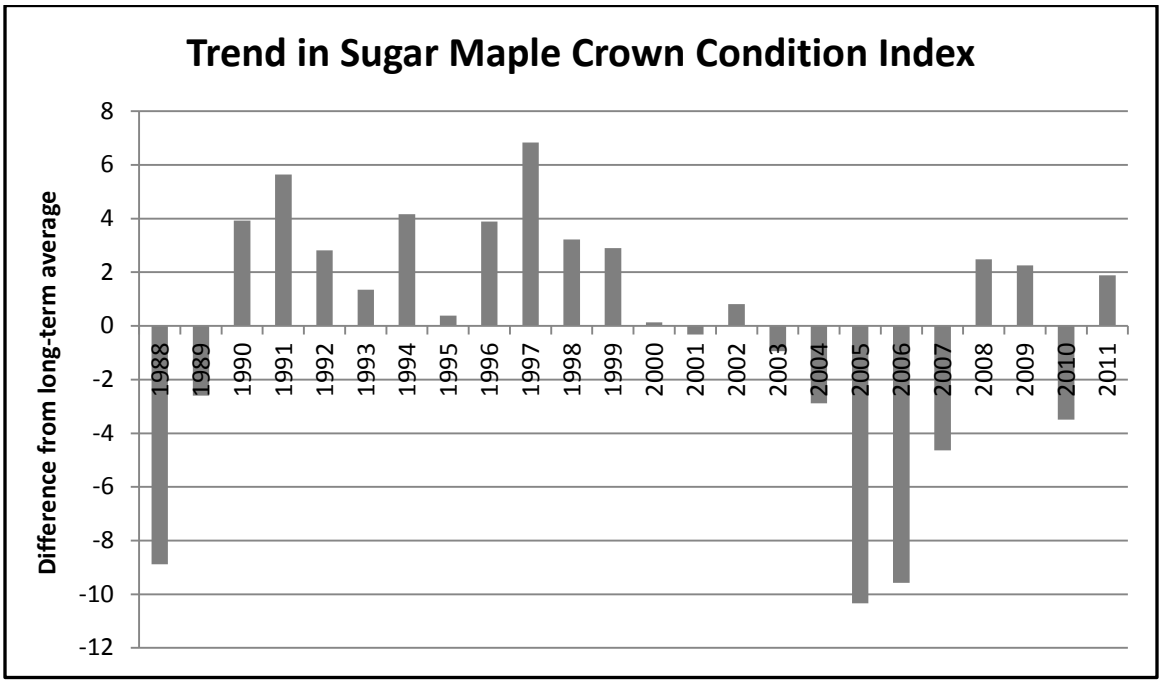


Figure 39. Trend in sugar maple Crown Condition Index from 30 Vermont NAMP monitoring sites. Positive values indicate crown condition was better than the long-term average.

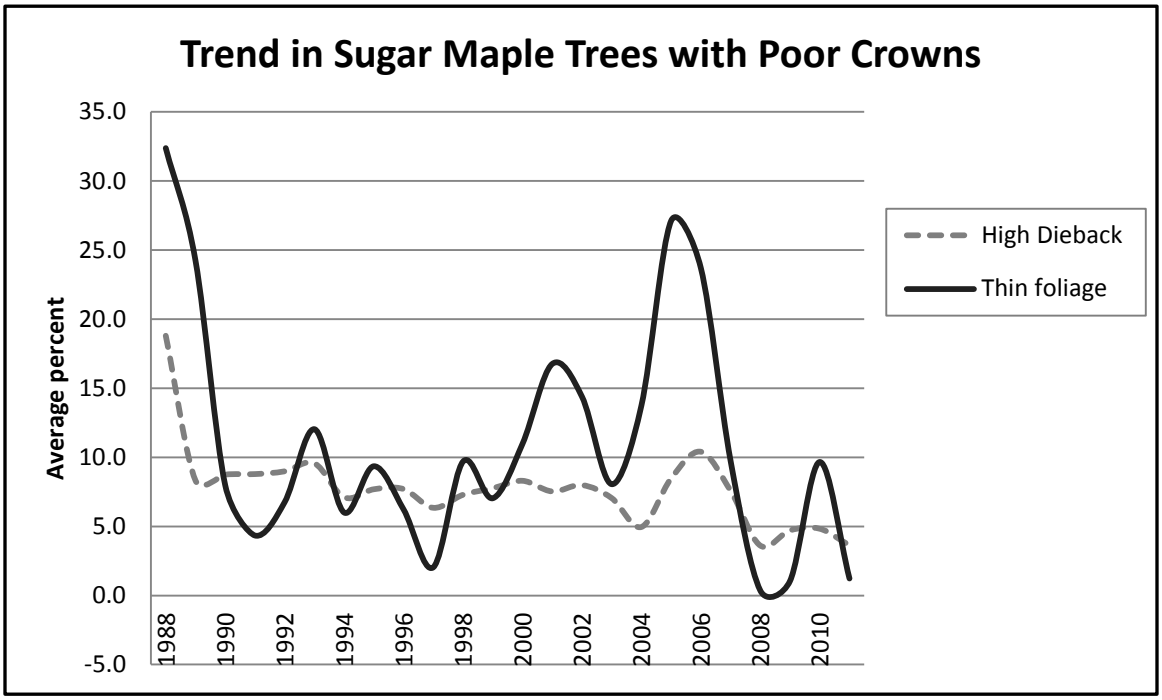


Figure 40. Trend in overstory sugar maple trees with high dieback (>15%) or thin foliage (>25%) from 30 NAMP plots.

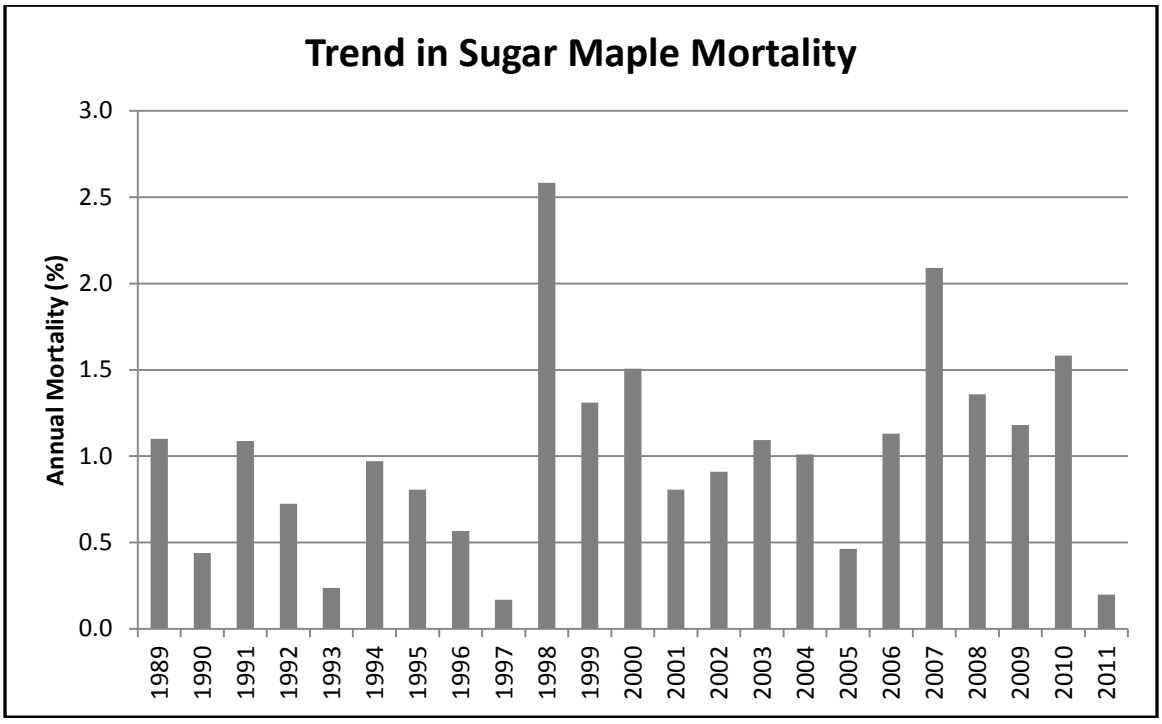


Figure 41. Trend in sugar maple annual mortality from 30 Vermont NAMP sites.

Trends in Forest Health at Mount Mansfield

Forest health monitoring plot trees on the east slope of Mount Mansfield continued to have a better-than-average-crown condition index (Figure 42). As part of the Vermont Monitoring Cooperative's Intensive Study Site, six plots with 4-subplots each, located in pairs at 3 elevations (1400, 2200 and 3000 feet), were measured for crown dieback, density, live crown ratio, and foliage transparency. The crown condition index combines these indicators to show annual differences in overall crown health as compared to the long-term average (1997-2011). Percent of trees with high dieback (12%) or thin foliage (15%) has improved since the high in 2006. (Figure 43). Mortality over the past 3 years was 1.6% annually, with one plot at 1400 feet elevation having 4.3% annual mortality. This plot was especially affected by wind damage.

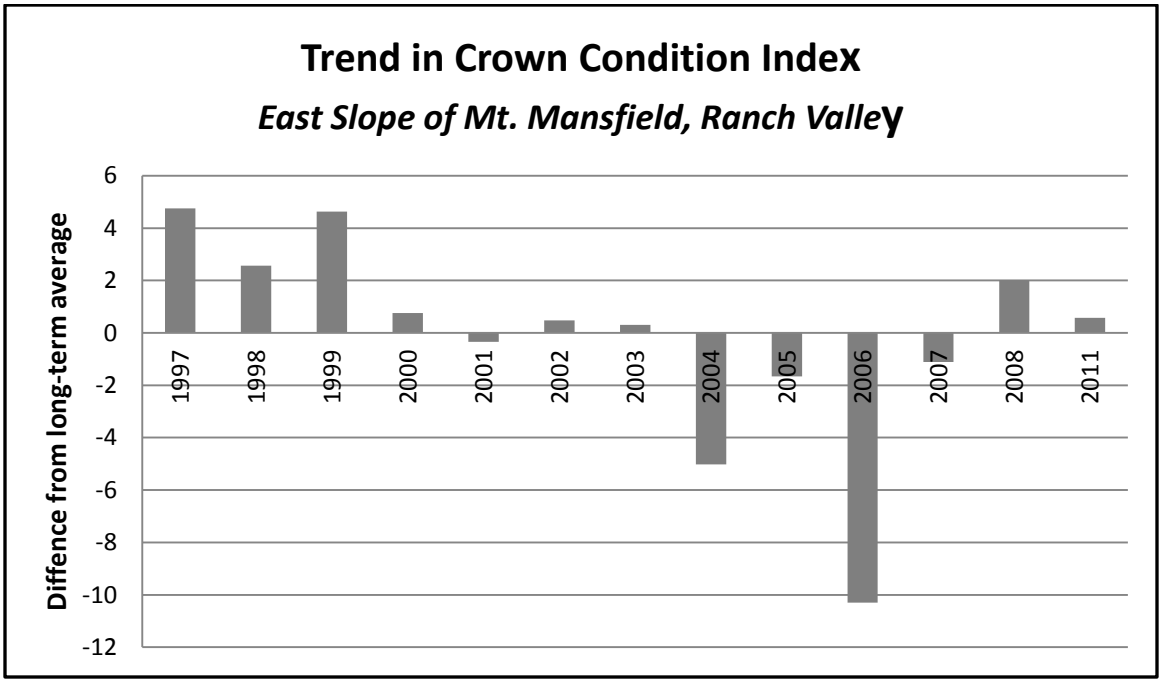


Figure 42. Trend in the crown condition index compared to the long-term average (1997-2011) for all 6 plots on the east slope of Mount Mansfield. Positive numbers indicate crown condition better than the long-term average.

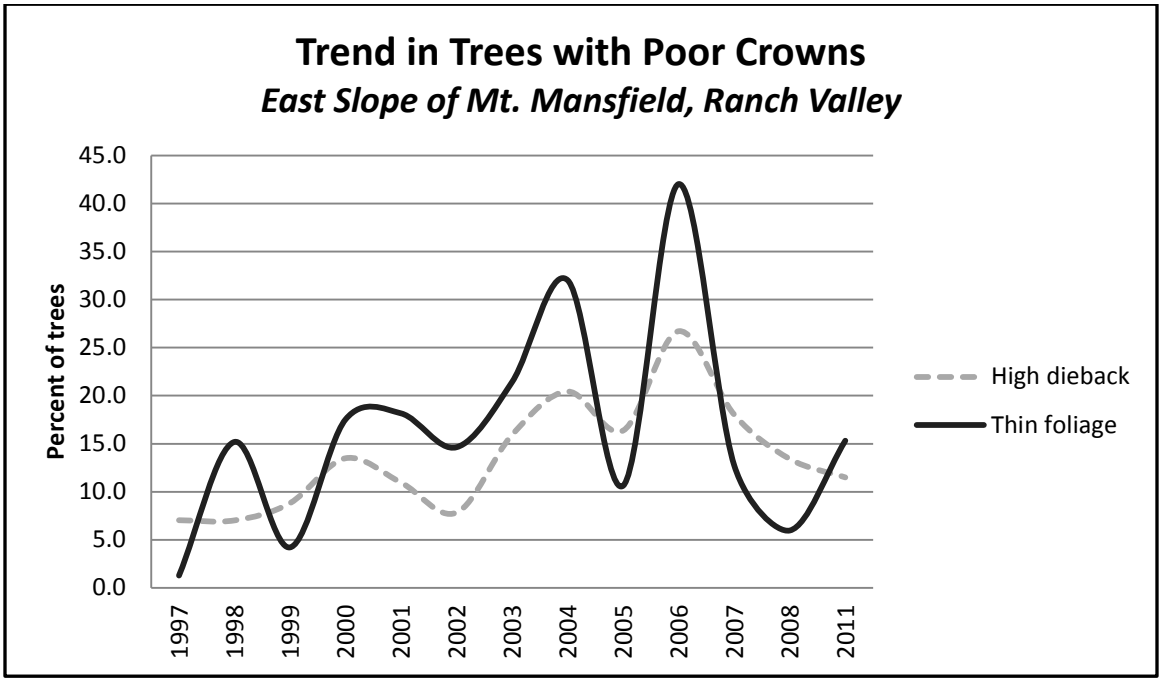


Figure 43. Trend in the percent of trees with high dieback (>15%) or thin foliage (>25%) for 6 plots on the east slope of Mount Mansfield in Ranch Valley.

Table 22. Types of special tree damages as a percent of damages observed on forest health monitoring plots on the east slope of Mount Mansfield in Ranch Valley.

Special damage	% of total damages
Beech scale and Nectria	26
Defoliation >20%	17
Weather related crack or seam	17
Beech scale, only	9
Conk	9
Eutypella canker	6
Sapsucker damage	6
Beech Nectria, only	3
Sugar maple borer damage	3
Canker	3
Weather damage	3

Other Forest Health Related Updates for 2011

Climate Change

- A Climate Cabinet was established to create collaboration between all state government agencies working towards climate change mitigation and adaptation goals. Greenhouse gas reduction targets were woven throughout the new VT Comprehensive Energy Plan.
- A climate change adaptation fact sheet for foresters summarizes climate changes already occurring, and strategies for forest adaptation. **http://www.vtfpr.org/htm/for_climatechange.cfm**
- A forest adaptation white paper summarizes our current understanding of climate change and forests **http://www.anr.state.vt.us/anr/climatechange/Adaptation.html**
- Several grant awards will result in comprehensive vulnerability assessment and adaptation strategies for all of the Agency of Natural Resources, as well as specific demonstration areas for forest adaptation strategies.

Vermont Monitoring Cooperative

The Vermont Monitoring Cooperative continued forest ecosystem monitoring and research for the 21st year. Long-term study results and data are accessible at: **http://sal.snr.uvm.edu/vmc/**. A new urban forest health initiative began in 2011. Trees in Burlington were evaluated by 70 students from the University of Vermont's Natural History and Field Ecology course to establish an urban forest health baseline. Nearly 200 survey plots across the city will be used for long-term monitoring, and for evaluation of ecosystem services using the "iTree Eco" software. In addition, students were trained to identify EAB and ALB signs for early detection. This permanent plot network is a collaboration between the UVM, the State, the U.S. Forest Service and the City of Burlington.