FOREST INSECT AND DISEASE CONDITIONS IN VERMONT 2010

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 2010

Frost Damage

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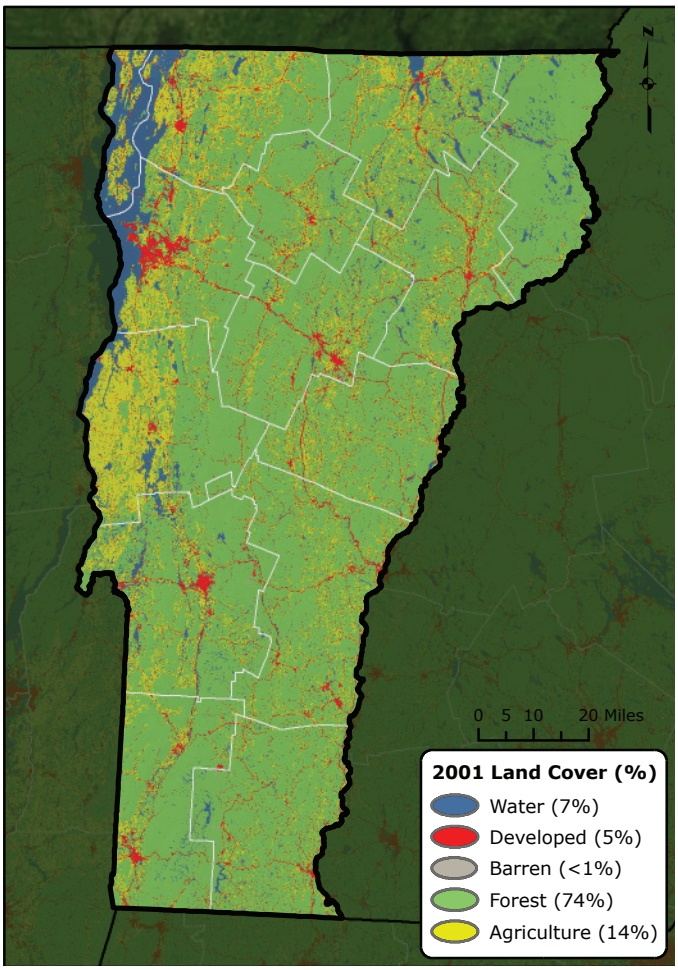
2010 Forest Health highlights

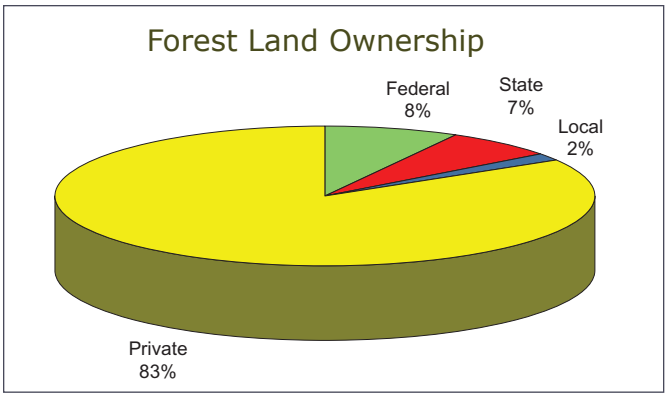
VERMONT

These highlights summarize information from the Forest Insect and Disease Conditions in Vermont 2010 report. The complete annual report, as well as other Vermont forest health information, is posted online at http://www.vtfpr.org/protection/idfrontpage.cfm. Contact Forest Resource Protection personnel or your County Forester to receive a copy by mail. This report provides information about identifying pests, diagnosing forest health problems, making on-site evaluations, sampling insect populations, and obtaining defoliation maps. It also includes management recommendations and additional literature as well as options for citizens to participate in invasive pest monitoring.



Forest Resource Summary

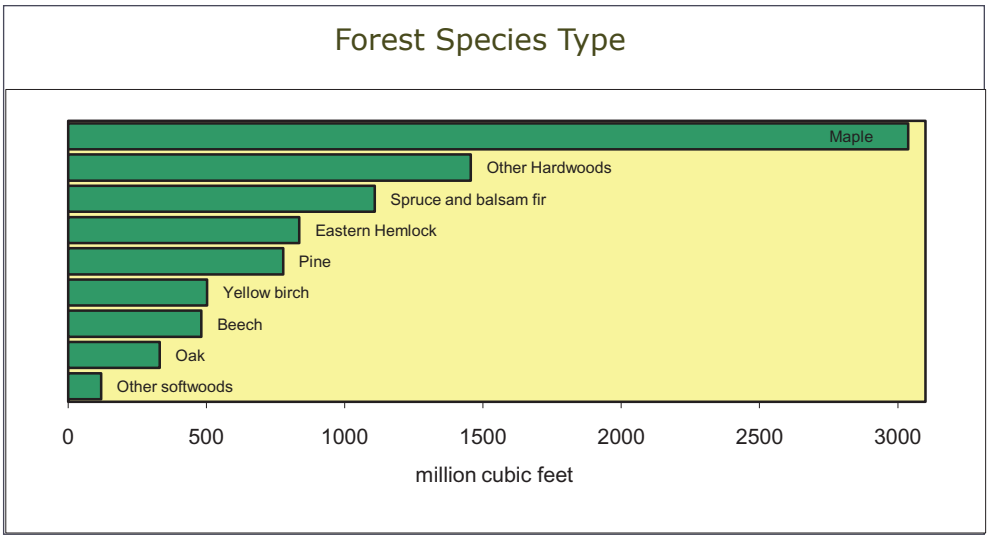
Forests cover 76 percent of Vermont. Over 83 percent of the State's forest land is privately owned with 8 percent under Federal



Forest Health Programs in the Northeast

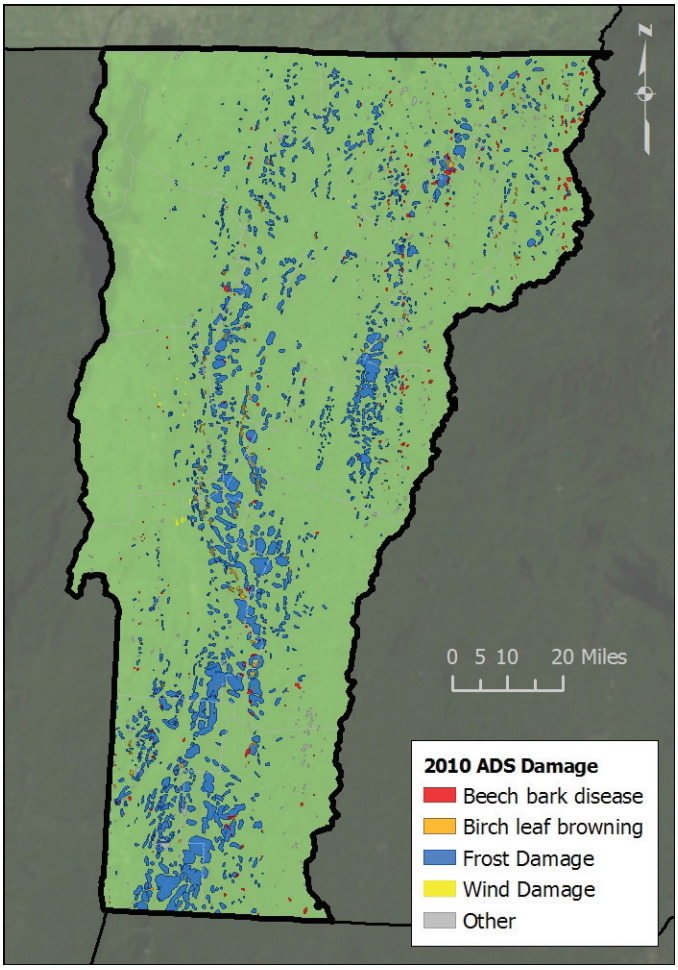
Vermont Department of Forests, Parks, and Recreation works in partnership with the U.S. Forest Service to monitor forest conditions and trends in Vermont and respond to pest outbreaks to protect the forest resource.

management in the Green Mountain National Forest. The major forest types contain maples and other hardwoods, along with spruce, balsam fir, pine, and hemlock.



Aerial Surveys

In Vermont, more than 480,000 acres of damage were mapped. Most of the damage was defoliation from the widespread frost that occurred in May, including areas on the Green Mountain National Forest. There were also about 65,000 acres of dieback, discoloration, and mortality due to a variety of forest damage factors, including beech bark disease and birch leaf spot.



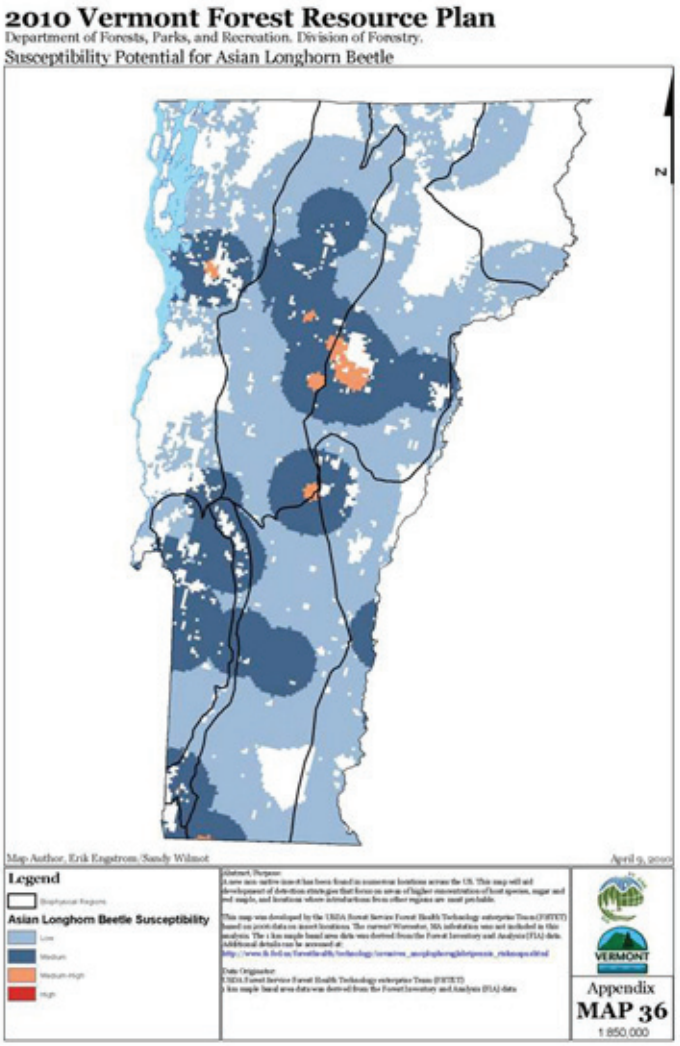
This map delineates aerial detection survey (ADS) results for Vermont in 2010.

Forest Health Program Highlights

The Forestry Division has published the 2010 **Vermont Forest Resources Plan – State Assessment and Resource Strategies** to guide work over the next 5 years. The plan recognizes that sustainable forests begin with healthy forests. It identifies priority issues and landscapes to focus resources, guided by the vision that "*the forests of Vermont will consist of healthy and sustainable ecosystems; a prosperous and sustainable forest products industry; abundant recreational opportunities; and a combination of ownership patterns supporting a working forest landscape and large, unbroken forest tracts. Citizens, government, and businesses understand their proper roles, responsibilities, and rights, and work together to support the values of forests for this and future generations.*" The plan can be accessed at http://www.vtfpr.org/htm/for_resourcesplan.cfm.

Vermont State government, academic institutions, businesses, and nongovernment organizations are working together on **climate change** issues through the Vermont Climate Collaborative. In 2010, the State greenhouse gas inventory was updated by the Agency of Natural Resources. Forest sequestration of carbon dioxide continues to increase although the rate has slowed. The agency also formed a team to plan for climate change impacts on infrastructure and natural resources. An initial assessment of potential impacts will be available in January 2011. This and other forest-related information can be found at http://www.vtfpr.org/htm/for_climatechange.cfm.

The **Vermont Monitoring Cooperative** (VMC) continued forest ecosystem monitoring and research for the twentieth year. Long-term study results and data are accessible through the new Web site (http://sal.snr.uvm.edu/vmc/). An annotated bibliography of forest health indicators and benchmarks has been developed that will be available in 2011. A new VMC-sponsored project will use research findings to develop recommendations for managing forest soil carbon and nutrition.



The State Assessment includes maps of susceptibility to exotic pests and acid deposition, occurrence of invasive plants and stored carbon, and decline history.

Other 2010 Forest Health Initiatives include:

- A new project to build capacity for an on-the-ground invasive plant management program
- Projects to detect emerald ash borer and Asian longhorned beetle through public awareness, biosurveillance, trapping, and targeting high-risk sites

- A public campground invasive species survey, control, and outreach project in collaboration with the Green Mountain National Forest
- An ongoing effort to discourage long-distance firewood movement
- Development of a model citizen monitoring program for forest invasives
- A multistate project to slow the spread of hemlock woolly adelgid
- An investigation into causes of tree mortality in Vermont and adjacent States
- A project to conserve germplasm of disease-resistant butternut
- A survey for new exotic pests of oak

Hemlock woolly adelgid

We continue to provide diagnostic services at the Forest Biology Lab; help the Vermont Department of Health monitor tick populations; and participate in programs with the Vermont Invasive Exotic Plant Committee, the Climate Change Collaborative, and the Endangered Species Subcommittee.

2010 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.

Weather was a particularly important driver of forest health in 2010. Heavy wind, spring frost, and several abnormally dry periods resulted in substantial areas of forest damage.

The most significant event of the year was **spring frost damage** due to below-freezing temperatures that occurred statewide during the week of May 9. With an early spring that included sugar maples leafing out several weeks earlier than normal, many trees were vulnerable. As a result, 414,901 acres of damage were recorded. Sugar maple was widely affected; there was substantial damage to birch, poplar, red maple, beech, and oak as well. Although most trees refoliated

Frost injury to sugar maple and other species occurred in late May.

shortly after the freeze event, new growth did not fully expand. Some trees did not refoliate at all, and retained damaged leaves all summer. Intermittent dry periods may have been responsible for the incomplete refoliation. Tree health is at risk when foliage is compromised for an entire growing season. Additional stress in 2011 could easily initiate decline and mortality. Recommendations for sugarbush evaluation are at http://www.vtfpr.org/protection/documents/VTFPR_EvaluatingSugarbushRecoveryfromFrost_Sept2010.pdf.

Hardwood **drought** symptoms were mapped on 5,970 acres in southern Vermont. Because drought conditions developed late in the growing season, the impact on tree health should be minimal. The weather was also abnormally dry throughout the State in May.

Widespread **white pine needle damage** developed suddenly in late May. One-year-old needles changed color, especially on lower branches. The symptoms were attributed to a combination of spring weather and disease fungi. Brown spot needle blight and Canavirgella needlecast were both commonly associated with the damage. Because topmost branches were rarely affected, most trees are expected to recover. However, the damage may accelerate white pine decline in marginal, wet sites because the damage was often severe in these low-lying areas.

Birch defoliation decreased with only 13,280 acres mapped during aerial surveys. While much of this was a result of Septoria leaf spot on paper birch at higher elevations, birch leafmining sawflies were more commonly seen than in recent years.

Beech bark disease was the primary cause of dieback and mortality on 14,738 acres. A spike in the disease continues due to dry fall conditions early in the decade, which allowed beech scale populations to increase. Smooth-barked healthy trees may be genetically resistant. Leaving these trees, while removing

Fungal diseases were associated with widespread white pine needle damage.

susceptible beech, will increase the proportion of seedlings resistant to beech bark disease. The Agency of Natural Resources is finalizing management guidelines to optimize yields in beech mast production areas. These guidelines will incorporate beech bark disease symptoms as well as wildlife needs.

Oak defoliation by leaf rollers was also less noticeable than in 2008-2009, and gypsy moth egg mass counts indicate continued low populations for 2011. Forest tent caterpillar populations continued to decline, and no defoliation was observed. Average moth catch in pheromone traps dropped in 11 of 13 survey locations. However, areas of red oak and sugar maple mortality, caused by forest tent caterpillar, are still noticeable in the Taconic range. Don't forget to consider **hardwood defoliators** if you encounter dieback or mortality. You can request defoliation records to determine whether damage was recently mapped in the area.

For the past several years, **spruce budworm** populations have been increasing in Eastern Canada. Nova Scotia reported its highest moth counts since 1994. In Quebec, the acres defoliated doubled between 2009 and 2010, to approximately 1.7 million acres. To date, all of the mapped damage is north of

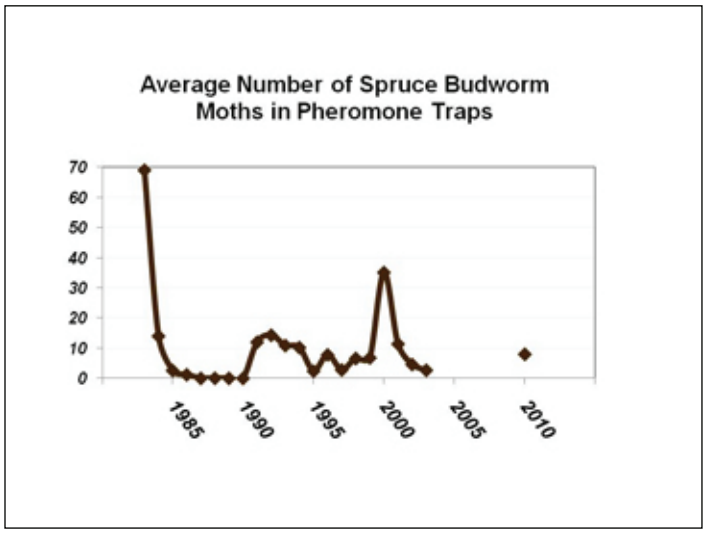
the St. Lawrence River. In Vermont, we had discontinued our pheromone trap program after 20 years (1983-2003). However, with recent regional increases, we decided to deploy traps in Orleans, Caledonia, Essex, and Chittenden Counties. Counts for 2010 were generally low.

Lacebugs were commonly observed on basswood, elm, and other hardwoods. These delicate, highly ornamented insects feed on a variety of species, usually on the undersides of leaves.

Ozone damage to foliage was light. A small amount of injury was observed on 3 of the 10 monitoring sites.

Norway spruce shoot drop was reported late in the season from scattered locations. Although squirrels clipped their share to feed on buds, drought conditions may also have played a role.

Scattered locations of **red pine decline** continue to be reported. No single causal agent has been identified, and site conditions don't appear to play a primary role. We are interested in hearing of stands where recent mortality has occurred.



With a spruce budworm outbreak building in Eastern Canada, trapping was resumed. Counts in 2010 were low.

Scattered locations of red pine decline continue to be reported.

Exotic Pest Update

The Vermont 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. We participated in the Forest Pest Outreach and Survey Project to help detect Asian longhorned beetle and emerald ash borer through public awareness and surveys. Targeted surveys for both insects were conducted in large areas of Rutland and St Albans.

We welcome volunteers to participate in our surveys. Volunteers do much of the hemlock woolly adelgid monitoring, survey for emerald ash borer and Asian longhorned beetle, and assist in our don't-move-firewood efforts. With University of Vermont Extension and the Nature Conservancy, we are participating in a project to develop best practices and tools for a Citizen Monitoring Program for invasives in urban forests. We expect to launch a citizen monitoring Web site in late spring.

State Park **firewood** restrictions to prevent introductions of non-native pests continued for the second year. About 400 bags of firewood (five cords) were exchanged, up from 200 in 2009. The increase may be due to higher camper visitation. We have developed a

firewood marketing program, including an updated Web site and an increased effort to partner with other natural resource organizations. We continued to work with the Vermont Campground Association and reached out to private campgrounds through handout materials, a newsletter article, and the Vermont Campground Guide. Details are available at http://www.firewood.vt.gov.

Invasive insect campground surveys were conducted at over 100 camping areas as part of our regional outreach and survey project, University of Vermont student efforts, and an ARRA (American Recovery and Reinvestment Act)-funded survey. No target insects were found. Invasive species were highlighted by State Park interpretive programs in 22 parks and several Green Mountain National Forest campgrounds that reached more than 14,000 people.

A number of projects are taking place regarding **non-native invasive plants**. A Web site dedicated to invasive plant and pest issues will be launched in the coming year. This will be accessible to a variety of user groups from citizen scientists to professional foresters. The Web site will also allow users to report invasive plant occurrences, which allows a landscape approach to management, and will include information on training, volunteer opportunities, demonstration sites, and Best Management Practices. Several Cooperative Invasive Species Management Areas (CISMAs) are unfolding. This will allow limited resources to be used more effectively.

ARRA crews conducted invasive plant surveys in 37 State Parks, 41 Green Mountain National Forest (GMNF) recreation sites, and along 160 miles of hiking trail. Fourteen State Parks and only one of the GMNF sites were highly infested. This may be due to higher elevation

In an effort to prevent introductions of non-native pests, 400 bags of firewood were exchanged in State Parks.

ARRA crews surveyed public campgrounds and hiking trails for exotic insects and plants.

and less intensive human use on the National Forest. Honeysuckle and common buckthorn were the most pervasive plants. Honeysuckle, buckthorn, multiflora rose, and dame's rocket were found along the Appalachian and Long Trails.

Emerald ash borer is not known to occur in Vermont and was not detected by public outreach or survey. Purple traps were deployed at 480 high-risk sites in an effort led by the Vermont Agency of Agriculture Food and Markets. As part of our monitoring effort, we searched for nests of the predatory wasp, *Cerceris fumipennis*, with the assistance of 20 volunteers. Of the 177 sites visited, 38 had at least one *Cerceris* nest, and 6 had 50 or more. Approximately 200 buprestids were collected.

Elsewhere in North America, emerald ash borer continues to show up in new locations, including an infestation in the Hudson Valley of New York about 50 miles from Vermont. It is currently known to occur in 15 States and 2 Canadian Provinces. The leaflet, "Preparing for Emerald Ash Borer: Recommendations to Reduce the Impact in Vermont," has been updated. In stands with a high percentage of ash, particularly if it exceeds 20 percent of the basal area, consider treatments to enhance other species. The Vermont Department of Forests, Parks, and Recreation is not recommending that all ash be harvested in anticipation of an outbreak.

Asian longhorned beetle is not known to occur in Vermont and was not detected by public outreach or survey. In 2009, 96 of the 198 Massachusetts residents from Asian longhorned beetle-infested areas who own property in Vermont responded to a questionnaire to determine if firewood may have been moved into Vermont. In 2010, we are following up with those who have not yet responded.

We don't recommend any management adjustments in anticipation of this insect. Its infestations expand gradually, and mortality

Volunteer assistance with emerald ash borer surveys included searching for nests of the wasp, Cerceris fumipennis.

is not rapid. However, early detection is especially important for the Asian longhorned beetle. If an infestation is found when it's still small, there's a realistic chance it can be eradicated. This has already happened in Chicago and New Jersey, and looks promising for New York and Boston.

Hemlock woolly adelgid detections increased in Windham County. Winter mortality of hemlock woolly adelgid was low, with over 85 percent survival in four of the five monitoring sites. This insect has now been detected in 38 locations in seven towns. In all, 74 sites were surveyed, including a minimum of 5 sites in each of the 12 towns adjoining infested towns. Volunteers continue to assist with detection surveys.

Recommendations for landowner response to hemlock woolly adelgid in Vermont are available at http://www.vtfpr.org/protection/documents/VTFPR_August2010HWAinVermont.pdf. Vermont is collaborating with the States of New Hampshire and Maine as well as the U.S. Forest Service to develop a regional approach to managing this insect. Mycotal, the fungal insecticide, was applied to trees in Townshend in cooperation with Dr. Scott Costa. Dr. Dave Mausel from the University of Massachusetts continues to monitor the survival of the

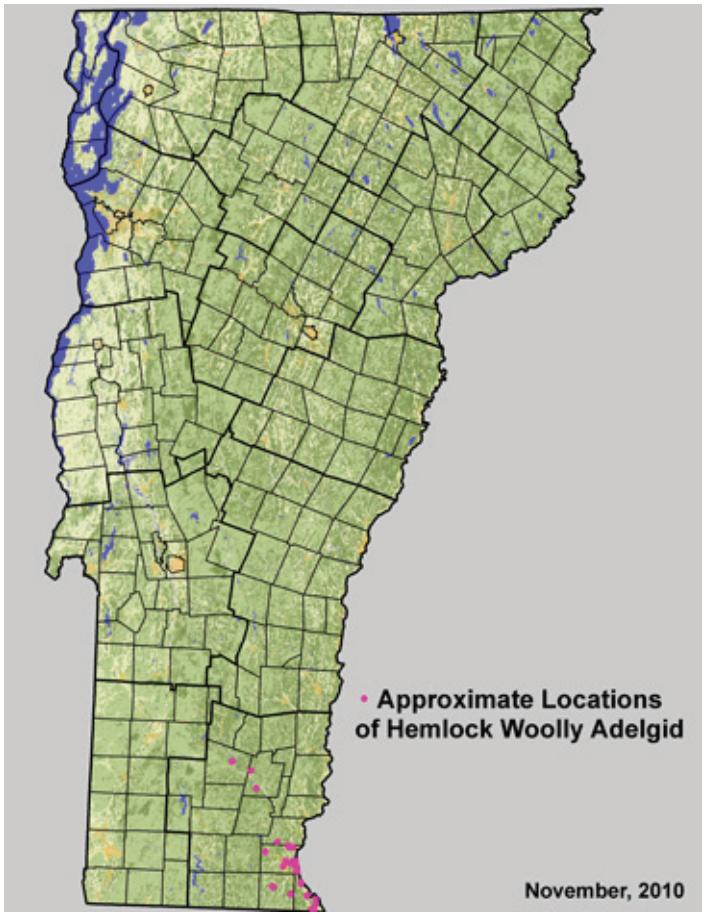
predatory beetle (*Laricobius nigrinus*) that was released in fall 2010.

Hemlock products from Windham County are subject to existing hemlock woolly adelgid quarantines. These vary from State to State. Vermont facilities may freely receive hemlock logs, pulpwood, or chips that may contain hemlock as long as the site has a compliance agreement with the Vermont Department of Forests, Parks, and Recreation. More information is available at http://www.vtfpr.org/protection/hwawoodproductconsiderations.cfm. The Vermont Agency of Agriculture Food and Markets continues to monitor nurseries for possible introductions of hemlock woolly adelgid on imported trees.

After 3 years of negative surveys, a single **European wood wasp** was collected in a bark beetle trap in Burlington. The wasp was likely transported to the site on logs slated for chipping. The only previous detection of this insect in Vermont was in 2007, in Lamoille County. No European wood wasps were caught in any of the 135 traps deployed statewide by USDA-PPQ. There are no Federal or State quarantines on this pest.

Butternut canker levels remain stable, with most butternuts showing symptoms of the disease. We have been participating in a multistate project, coordinated in Vermont by Dr. Dale Berghahl of Plant Technologies LLC, to conserve butternut germplasm. Collections were made from 43 butternuts that seemed to have some disease resistance. Scions from each tree were genetically checked to ensure that all trees sent for grafting were pure butternut. Scions from 33 trees were sent for grafting. Plans are to continue collections and to establish orchards for planting grafted trees.

The **common pine shoot beetle** has been found in many counties since it was first detected in Vermont in 1999. A Federal quarantine is in place to limit the spread



All known Vermont locations of hemlock woolly adelgid are in Windham County.

A fungal insecticide was applied experimentally to trees infested with hemlock woolly adelgid.

of this exotic insect, but pine material is free to move within Vermont and to most of the surrounding region. Details can be found at http://www.vtfpr.org/protection/PSBConsiderations.cfm.

To preserve butternut genes threatened by butternut canker, scions were collected from healthy trees for grafting.

Exotic oak pests, including summer fruit tortrix (*Adoxophyes orana*), variegated golden tortrix (*Archips xylosteanus*), light brown apple moth (*Epiphyas postvittana*), and Ramorum blight caused by *Phytophthora ramorum* were not detected in a Cooperative Agricultural Pest Survey of four sites. Surveys for European oak bark beetle (*Scolytus intricatus*) at three sites were also negative.

Efforts to eradicate the **oak wilt** detected near Albany, NY, appear to have been successful. Although this is not known to occur in Vermont, we have increased our vigilance in looking for this disease. Key symptoms include rapid leaf discoloration and wilting that start in the upper crown in early summer. Leaves turn brown and are rapidly cast. Affected trees occur in groups because the disease is spread through roots.

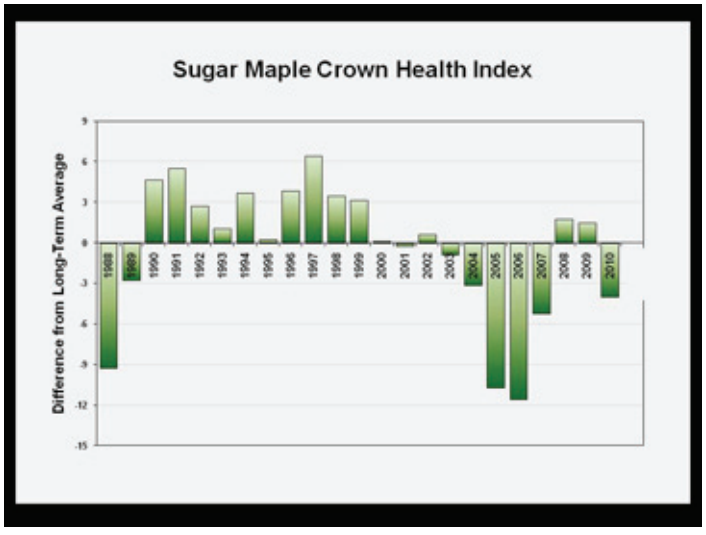
Mimosa webworm was detected for the first time in Vermont defoliating thornless honeylocusts in Springfield.

Monitoring Forest Health

In Vermont's **North American Maple Project** (NAMP) plots, only 5 percent of the sugar maples had more than 15 percent dieback in 2010. This is an improvement from recent years. However, the damage from late-spring frost, combined with pear thrips, resulted in lower than normal overall crown health. The crown health index was 4 percent below the long-term average.

NAMP data from 1988-2007 are being analyzed to assess long-term trends. Findings to date include:

- Sugar maple health was the same in both tapped and untapped stands.



Although dieback improved from recent years, sugar maple crowns were thinner than normal in North American Maple Project plots.

- Most trees with 20-35 percent dieback recover; most trees with more than 35 percent dieback do not.
- Annual mortality of canopy trees was 0.9 percent. This rose to 2.3 percent following the 1998 ice storm.
- Forest tent caterpillar defoliation in 2003-2006 increased tree mortality to 1.6 percent, and was more significant in stands with less tree diversity.
- Good soil nutrition improved recovery following defoliation. After pear thrips defoliation, no radial growth occurred for several years on sites with low soil calcium.
- Long-term health effects of the 1999 and 2001 droughts were evident through 2007.
- Non-native invasive plants have been found at 25 percent of the NAMP sites.

The crown condition of trees on the **Vermont Monitoring Cooperative's monitoring plots** on Mt. Mansfield (elevations of 1,400 to 3,800 feet) has recovered following a period of reduced health from 1997 to 2004. Trees on summit plots were less healthy than those at lower elevations.

We continue to pursue potential causes for **increased mortality** in our 2008 Vermont FIA data. Since the last inventory, the mortality of growing stock volume increased by 28 percent, which was distributed statewide. The increase is greatest for red maple, but increases were also identified for red oak, beech, sugar maple, white pine, and spruce. Smaller diameter trees may be affected to a greater degree. To date, no one cause explains the decline, including elevation, stocking, or ice damage.

Photos: Vermont Department of Forests, Parks, and Recreation

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January 2011

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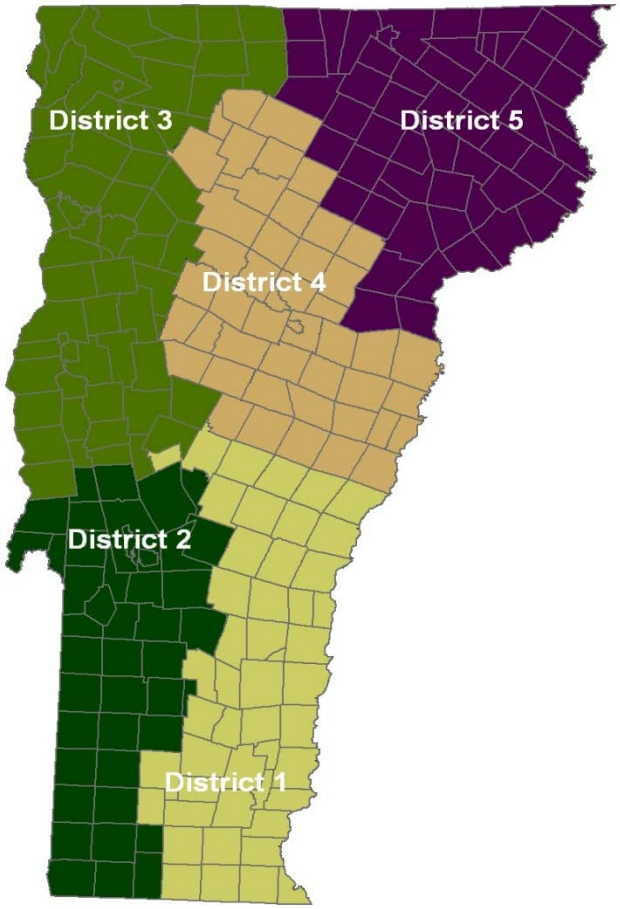

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INTRODUCTION

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 August 24th and September 28th. Special surveys were flown over southwestern Vermont on February 5th to map wind damage and over most of the state between May 27th and June 15th to assess frost damage. All surveys were conducted using a digital sketch mapping system.

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 retired Forest Protection staff Ron Kelley and John Barrows. Jeff Briggs coordinated ARRA campground surveys, and Wendy Richardson provided administrative support in many program areas. Jeremy Goetz, Lou Bushey, Eric Hansen, Aaron Hurst, and Matt Leonard assisted in conducting aerial detection surveys.

Support in many program areas was provided by US Forest Service Forest Health Protection staff, including Michael Bohne, Margaret Miller-Weeks, Bill Frament, Bob Cooke, Kevin Dodds, Tom Luther, Isabel Munck and Nathan Havill; by the Vermont Agency of Agriculture, Food, and Markets, including Jon Turmel, Tim Schmalz, Emilie Inoue, Rhonda Mace, Alan Graham and Lance Ebel, and by USDA APHIS, including Mark Michaelis and Steve Lavallee.

Taxonomic assistance came from Robert Acciavatti, US Forest Service (retired), Ross and Joyce Bell, University of Vermont emeriti, Don Chandler, University of New Hampshire, Rod Crawford, University of Washington, Eric Day, Virginia Tech., Ann Hazelrigg, University of Vermont, E. Richard Hoebeke, Cornell University, Chuck Lubelczyk, Vector-borne Disease Lab, Maine Medical Center Research Institute, Don Miller, Lyndon State College emeritus, Bill Ostrofsky, Maine Forest Service, Jessica Rykken and Stefan Cover, Museum of Comparative Zoology, Harvard University, Daniel Suomi, Washington State Dept of Agriculture, and David Wagner, University of Connecticut. Vermont Entomological Society members Leif Richardson, Michael Sabourin and Scott Griggs also provided assistance. David Mausel, University of Massachusetts and Scott Costa, 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. MaryBeth Deller, Green Mountain National Forest, and Sharon Plumb, The Nature Conservancy, assisted with invasive plant survey design and reporting. The contributions of Redstart Forestry and the UVM Lands crews are gratefully acknowledged.

Special thanks go to Ben and Jessica Dillner and Luke Curtis for their contributions to our phenology and weather databases. Lisa Sheridan, Ben and Sam Dillner, Pieter van Loon, Virginia Barlow, Joan Waltermire, Luke Curtis, Doug Burnham and others helped with the emerald ash borer biosurveillance work. Mary Ellen Copeland, Pieter van Loon, Jordan Fletcher, Mark Halverson, and Dina Kail were primary coordinators of the hemlock woolly adelgid citizen monitor effort. Students from Leyland and Gray High School (Bruce Whitman, supervisor) and the Compass School (under leadership of Eric Rhomberg) contributed to this effort as well. Ryan McGrath, from Leyland and Gray, inventoried the trees at the Townshend State Park fungus release site.

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WEATHER HIGHLIGHTS – DECEMBER, 2009 – DECEMBER, 2010

- **December 19-20, 2009** record snow in mid-Atlantic states – 12-25″ in many major cities and other locations.

- **January 2-4, 2010** snow storm. South Burlington received 33″, the most ever recorded in one storm at the Burlington National Weather Service office since records began in 1883. Other snowfall amounts by county:
  - Chittenden – 20+″
  - Addison, Franklin, northern Essex, western Caledonia – 12 -20″
  - Lamoille, Rutland, southern Essex, parts of Caledonia, Orleans, Addison, southern Windham – 6-12″
  - Washington, Orange, northern Windham – 2-6″

- **January 6, 2010** freezing drizzle leaves hoar frost in elevations above 1600 feet for the first 2 weeks of the year (also occurred Christmas 2009).

- **January 25, 2010** January thaw. Temperatures in the upper 40's and 50's (59° in Middlebury). Rainfall amounts from 0.19″ in St. Johnsbury to 2.2″ in Woodford, with an average amount across the state of 1″. The snow depth decreased 4-8″. Although the potential for serious ice jam flooding was high, only minor flooding occurred. Jams broke up before causing major problems.

- **February 5-6, 2010** another record snow in mid-Atlantic states dumps 12 to 30″.

- **February 10, 2010** "Snowmageddon" blankets mid-Atlantic in white. This blizzard was the 3rd of the winter for mid-Atlantic states. Washington DC, Philadelphia, and Baltimore all received over 70″ of snow this season. Only 13 times since 1870 has Washington, DC received a 12″ storm.

- **February, 2010** temperatures above normal and very little precipitation for the first 3 weeks.

- **February 23-24, 2010** precipitation impacts the state. Rain and snow mix in valley elevations totaling 10 to 14″ of snow. In higher elevations, most of the precipitation fell as a heavy, wet snow. Many of these locations received over 20″. The highest amounts fell in the central and southern Green Mountains (Warren - 32″, Waitsfield - 31″, Randolph - 26″, and Bethel - 25″). The heavy snow caused power failures, bad roads and poor visibility.

- **March, 2010** fifth warmest on record for Burlington. Temperatures statewide were 7-9° above normal. New record daily high temperatures set on March 19th in Burlington with 66° (old record 60° set in 1894) and Montpelier set a new record of 64° (old record 57° set in 1968).

- **March, 2010** most of the precipitation occurred in two rain events.

  - **March 23** - southern sections received 1.5 to 2″, with isolated higher amounts. St. Johnsbury and Montpelier set daily rainfall records on the 23rd, reporting 1.06″and 1.13″, respectively. Locations further north and west received barely a third of an inch.
  - **March 29-31** – rainfall totals from this second storm were generally 1 to 1.75″ across Vermont with more rain in southern Vermont. The Marlboro fire weather station received over 3.5″.

- **April, 2010** the mild conditions continued into the first part of April. New daily record high temperatures were set on April 3rd in Burlington with 82° (old record 73° set in 1981), Montpelier with 84° (old record 71°in 1981), St. Johnsbury with 83° (old record 75°in 1981), and Mount Mansfield with 69°.

- **April 27-28, 2010** rare, late season snowstorm. The most snow fell in northern Vermont in the higher elevations, the western slopes of the Green Mountains and the Northeast Kingdom.
  - An unusual storm that kept weather forecasters guessing as snow fell in some places, rain in others, and all sandwiched in between one weekend at 60°and an upcoming weekend at 70°.
  - Snowfall amounts - Jeffersonville - 24″, Underhill - 22″, Eden - 21″, Walden – 13″, Burlington – a record 5.5″, Barre/Montpelier - 3″.
  - Fairbanks Museum received 10.2″, the latest date to receive this much snow and the most snow of the year.
  - Heavy, wet snow buried spring blooms, forced leafed out trees to bend and some to break, and caused power outages with the most in Chittenden, Franklin, Grand Isle, Lamoille and Orleans counties and scattered outages in parts of Caledonia and Addison.
  - One happy recipient of the snow was the Jay Peak ski resort in northern Vermont, which was scheduled to be operating the upcoming weekend but decided to open the Thursday before to take advantage of the storm.

- **May, 2010** the warmer-than-normal spring continued into May, as monthly temperatures remained above seasonal averages. Many locations reached into the mid 80s on the 2nd. This was quickly followed by a cool stretch, right on Mother's Day weekend. Record low temperature set in Burlington on the 13th.

- **May 9 to May 13, 2010** killing frosts damage new foliage (see frost narrative). Observed minimum temperatures below 32° were recorded at all of Vermont's fire weather stations. Temperatures in the upper 20's and low 30's were observed at all the stations on May 11 and May 13.

- **May 26, 2010** a severe weather event in western Vermont known as the "Route 7 Runner" produced damaging winds and hail (see wind narrative).

- **May 31, 2010** Memorial Day morning much of central and eastern New England awoke to the unusual and acrid smell of smoke from multiple large wildfires across central Quebec. Visibilities between 1 and 3 miles were commonplace during the morning and afternoon hours, with air quality indices nearing the very unhealthy 200 level in a few spots around midday. Smoke began to slowly disperse by later in the day and into the evening hours as a warm front lifted northward through the area allowing winds to turn southerly. While quite rare in our region similar cases have been documented, the most notable recent event occurring on July 7, 2002.

- **Spring 2010** second warmest on record since 1885. March, April, and May averaged 49.1° slightly lower than the 49.3° average of the same period in 1903. The average spring temperature for Vermont is 43.5°.

- **July 21, 2010** strong winds, heavy rains, and golf ball sized hail take down trees and powerlines in Orange and Rutland counties (see wind narrative). One-half to 2″ of rain fell across much of the State with the heaviest amounts from Windsor County north and along the western slopes of the Greens. Golf-ball sized hail was observed at Bristol and nearly 2″ hail was reported in Brookfield.

- **January 1 to July 31, 2010** above normal temps for all of Northeast U.S. and February through July was the warmest on record as per NOAA. July much above normal for Vermont.

- **August 3-4, 2010** hazy, hot, and humid conditions result in heavy rain in northern Vermont. Rainfall amounts: Orleans county – 3-5″; Lamoille county – 2.5-3.75″; Franklin county – 2.5-5″; Essex county – 4-5″; Chittenden county – 1+″ in Burlington to 4.5+″ in Westford; Caledonia – county 1.5 to 4″; Addison – 1 to 1.5″; Washington – 0.5 to almost 3″; Windsor county – 0.01 to almost 1″.

- **August 10, 2010** U.S. Drought Monitor shows abnormally dry in Windham County.

- **September 1-3, 2010** heat wave. Essex, Danby, Marlboro and Elmore fire weather stations average 90° maximum temperature through the period.

- **September, 2010** moderate drought continues through most of the month in southern Vermont. Below normal precipitation the first 28 days of September was reflected at Ball Mountain Lake (Windham County) with only 1.84″ (normal 3.57″) and Pownal (Bennington county) 1.08″ (normal 3.90″).

- **September 29-October 1, 2010** remnants of tropical storm Nicole saturated all of Vermont.
  - Rain developed on the night of the 29th in southern Vermont and steady rain developed across the entire state during the 30th. The heaviest rain in northern Vermont occurred on October 1. Rainfall amounts observed at Vermont's fire weather stations during this 3-day period were 6.64″ in Marlboro; 4.97″ in Danby; 4.84″ in Elmore; 2.97″ in Essex and 4.13″ in Brighton.
  - Storm impacts from this event ranged from several house evacuations in Lyndonville and Bristol to many road closures from flooding in western and Northeast Vermont.

- **October 15, 2010** a powerful Nor'easter blew through Vermont toppling trees, packing heavy rain and even snow in higher elevations.
  - Mt. Mansfield set a new snowfall record on October 15 with 7″ of snow and again on October 16 with 18″ of snow. The old record on October 16 was 14″ set in 1982.
  - Rain storm totals ranged from 1.5-5″ across the state.

- **October, 2010** a new monthly precipitation record was set at the Mt. Mansfield summit with 14.71″ and in Brattleboro with 12.5″.

- **December 1, 2010** classic downslope wind event caused by the collision of warm and cold fronts brought hurricane force winds to western Vermont. 103 mph gust at the top of the nose on Mt. Mansfield, Cambridge 84 mph, Starksboro 74 mph, Burlington 48 mph (see wind narrative).

WEATHER AND PHENOLOGY

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

Fall and Winter, 2009-2010. November of 2009 was unusually sunny. The days were warm and the nights were cool. The average high temperature for the month was 52°F at the Essex weather station. Ski areas hoping to open for the Thanksgiving Holiday weekend were disappointed. As far as tourism was concerned, it was a typical NO-vember…no leaves, no snow, no anything. While the nights were cold enough to make snow, the days were mild enough to melt it all away. Early December continued the warm trend. On December 3rd, warm moist air from the south brought a record high temperature of 59°F in Burlington and dropped 0.67" of rain in a fast moving storm. The first snowfall in Burlington fell on December 7th--tying the all-time record for the latest first measurable snow. This storm had a lot of energy with it. High winds tracked all the way across the nation from the Pacific coast to New England. These damaging winds hit especially hard just north of Middlebury with many blowdowns, power outages and road closings. In its wake, lake effect snow stretched all the way from Lake Ontario. A steady snow machine cranked out the white stuff over central and eastern New York State.

Temperatures fell around the middle of the month. Daytime high temperatures were in the teens, and the overnight lows were near zero (-5°F on the 19th at Essex). There was only a meager snowpack in the valley to blanket the ground from this cold. A major snowstorm came up the east coast on December 18th and 19th. This storm dumped nearly two feet of snow on Washington, D.C. and other major east coast cities. It turned out to sea from Boston, however, mostly missing Vermont. It was the first of several winter storms to hit the east coast cities last winter. Although there was a white Christmas in the Champlain valley, it warmed up and rained the next day. Much of the snow disappeared heading into the New Year.

The big snowstorm of the winter for the Champlain valley began in earnest on the 2nd of January. Snow fell day and night adding up to the all-time record for Burlington of 33 inches. This total even topped the Christmas of 1969 storm. In many ways this was a very unusual storm. While Burlington recorded 33 inches of snow, the mountain village of Stowe only got 5″—turning the usual relationship between these two locations upside down. The water content of the snow was also very unusual. Normally one can estimate about 10″ of snow for every 1″ of water. The ratio for this storm was 25:1. This extremely light snow settled quickly, but provided a base for consistent snow cover into March.

February was cold and dry in Vermont. A second major snowstorm hit the cities of the Atlantic coast on February 6th, paralyzing Washington D.C. and Philadelphia again, and once again missing Vermont. A few days later (February 10th) yet another snow storm shut down the busy cities along the east coast. This one barely grazed southern Vermont. It was looking like you needed to go south if you wanted to experience a "real" winter. There was one final snow storm during the last week of February in Vermont. Heavy, wet snow (about 14″ in Essex) knocked down powerlines especially in the southern part of the state.

After this last winter storm, a stretch of warm days and cold nights marked the beginning of an early sugaring season. Right through mid-March, the sap ran steady and heavy. The producers that were tapped early enough to take advantage of these sap runs had a good year. Overall, sap sugar content was generally perceived to be less than normal, though. Sap sweetness started out normal, and then

became abnormally low. This may have been the result of the long period between freezes; sap sugar often rises after a freeze, but in 2010, the trees had little chance to "rest". The season came to an abrupt ending with the onset of very mild weather around the 16th of March.

Spring, 2010. The snow was gone from all valley locations by the 13th of March. March was so dry and warm that there was a grass fire in Vergennes on the 11th! The first 20 days of the month had only 0.15″ of precipitation at Essex…the last 11 days had 3.00″—putting an early end to the fire season and charging the soil with plenty of moisture for the spring awakening. April started off with record breaking warm weather (84°F at Essex on the 3rd). Over Easter weekend the buds jumped…daffodils were flowering and sugar maple flower buds were swelling half way up the mountains. On April 5th, the ice went out on Joe's Pond—the earliest ice out since the contest began…earliest by 11 days! All the phenological signs pointed to a nearly two week jump on spring development. Sugar maple bud break was 13 days ahead of the 19 year average; the cloned lilac phenology study was 11 days ahead of the 30 year average at the Essex weather site. Leaves were coming out on the trees and the fields were greening up. Around the middle of the month the days were still mild, but the nights were cool. Spring development was still progressing and still early, but the rate had slowed a bit. A big change was in store for the end of the month. On Monday April 26, the temperature hit 68°F and the day was sunny. Overnight a cold front approached bringing wet snow and high temperatures in the thirties. In Essex 7 ½ inches of snow fell, but the mountains got between 18-20″ of the white stuff. By the end of that week, most of the snow had melted. Saturday's high temperature was in the 80's and humid!

On May 4th, a line of severe thunderstorms passed through northern Vermont. Twin funnel clouds were spotted in Morrisville! This storm contained areas of damaging hail that peppered the leaves that had opened up so early. About a week later, another assault on the tender foliage came in the form of back-to-back killing frosts (see frost damage acreage maps in abiotic section). Damage was reported across the state, with the tree species that broke bud early suffering the worst effects. The mountains had brown bands of frost damage starting at about 1400´ elevation and ending at the upper elevations where the trees had not yet reached budbreak. Most of the trees in this damage zone lost all of those brown leaves, and refoliated with a second set of stunted, somewhat chlorotic leaves. After these freakish frosts, the weather returned to the unusual warmth. May recorded two 90°F days and six 80°F days with very little rainfall. Most of the precipitation fell in two thunderstorms occurring on either end of the month.

Summer and Fall, 2010. June was wet. Measurable precipitation fell on 20 of the 30 days. July was hot. The July 4th weekend was a heat spell up and down the east coast including Vermont. From the 4th through the 9th of July, the temperature averaged 94°F, with the highest being 98°F on the 8th at Essex. Lake Champlain water was unusually warm after this hot spell. Measured at six feet deep at the King Street dock in Burlington, it was 76°F. Shallow waters off the many beaches were considerably warmer. Overall, most of the growing season was warm with sufficient moisture. There were 16 days of 90°F or higher from May through September. The growing degree days (base 50°F) at the Essex weather station were 30% above average (2633 compared to 2025). May was the only month with a dry spell lasting more than four or five days. A second official "heat wave" (3 consecutive days with temperatures of 90°F or higher) came at the end of August and the first part of September…six days with an average temperature of 92°F at Essex.

That early start to the growing season tracked through the entire summer with many crops becoming ripe two weeks early. Apples, grapes, pumpkins, etc. were all ready for picking ahead of their traditional harvest time. Speculation that this trend would mean an early fall foliage season was supported by the sightings of color in mid-September. From data based on observations over the past twenty years, however, most of the tree species reached their peak color very close to average.

Perhaps the upper elevation birches were a few days early to reach peak color and a few days earlier to drop their leaves. Two species of trees seemed to have especially colorful leaves last fall. White ash leaves seemed to accent the reds and purples more than usual, and the American beech leaves showed a very coppery brown. The foliage season, once again, did not disappoint Vermont residents and visitors alike. In some places in the state (especially in the southern counties), the very hot beginning to the month of September and the subsequent lack of rainfall brought down some leaves prematurely. On September 24th, there were ankle-deep leaves on the sidewalks from the stressed street trees in Woodstock, Vermont.

A couple of rain storms accompanied by high winds did manage to knock down many of the colorful leaves before their time. The first fall storm started on September 30th and continued into the first day of October. At the Essex weather station, 2.87″ of rain fell in that twenty four hour period compared to only 2.91″ of precipitation for the whole rest of the month of September. Other locations throughout the state received even more rain from this storm—as much as 5-6″ in some locales. Two weeks later (October 15th) a major nor'easter hit Vermont again dropping 3″ or more rain accompanied by high winds. This storm ended with a switchover to snow in the higher elevations. Mt. Mansfield picked up nearly 20″ of snow. Many leaves and branches came down to spell the end of the foliage season in the mountains. The colorful leaves lingered on in the valleys throughout October. The month was wet (8.21″ of rain at Essex) but the nights were mild. The lowest overnight temperature was 27°F on the 23rd. Most nights only went down to the upper thirties or low forties.

Fall mast surveys conducted by the Vermont Department of Fish and Wildlife indicated that hard mast production in 2010 was exceptional for acorns and poor to absent for beech nuts. For soft mast, surveyors reported an abundance of apples, blackberries, and chokecherries statewide. (For more details, contact the Vermont Fish and Wildlife Department.)

Winter, 2010. A severe wind storm on December 1st brought hurricane-force winds to Chittenden County, causing damage to forests and ornamental trees, closing roads, and causing power outages. Wind gusts over 90 mph were reported at lower elevations on the west flank of the Green Mountains and over 100 mph on the summit of Mount Mansfield.

Figures 1-16 and Tables 1- 2 provide details on 2010 temperatures, precipitation, and phenological observations.

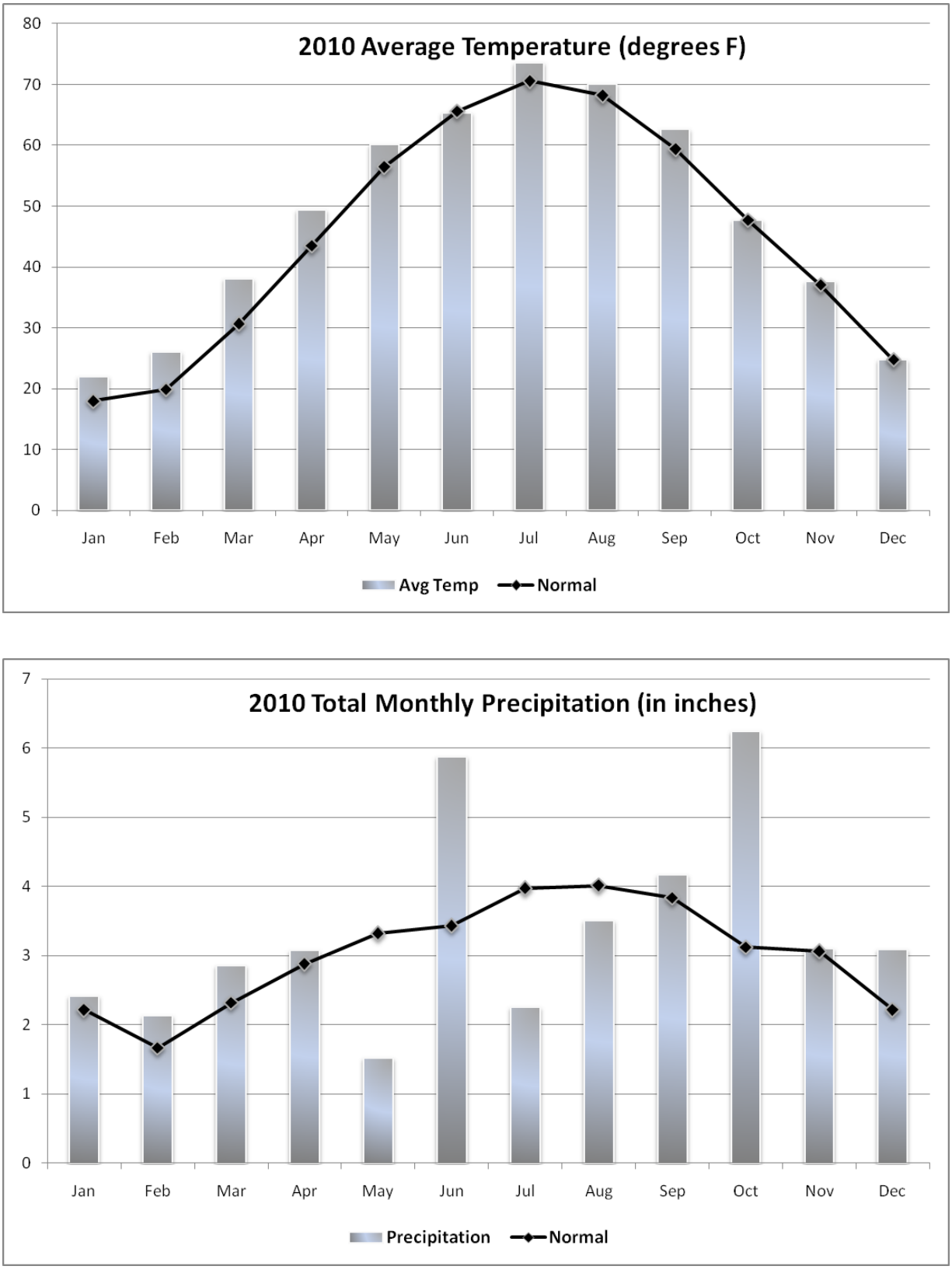


Figure 1. Monthly average temperature and monthly total precipitation in 2010, compared to normal for Burlington, Vermont. (Normals are for years 1971-2000.)

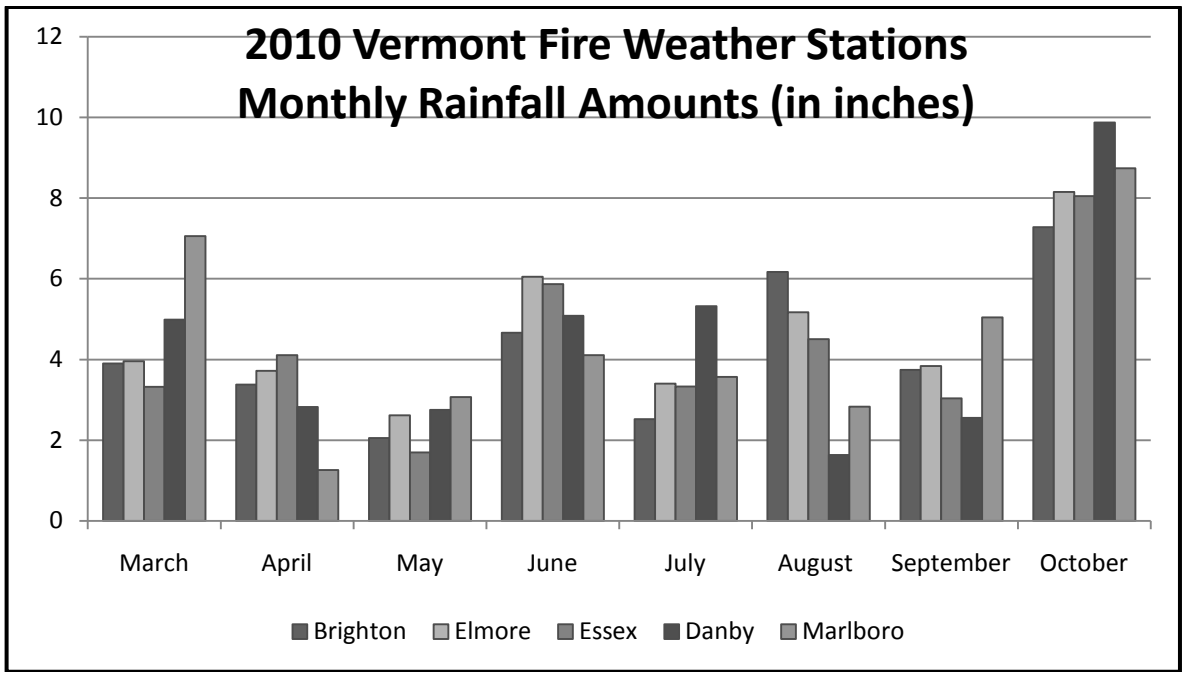


Figure 2. Monthly rainfall amounts (in inches) at Vermont fire weather observation stations through fire season, March-October, 2010.

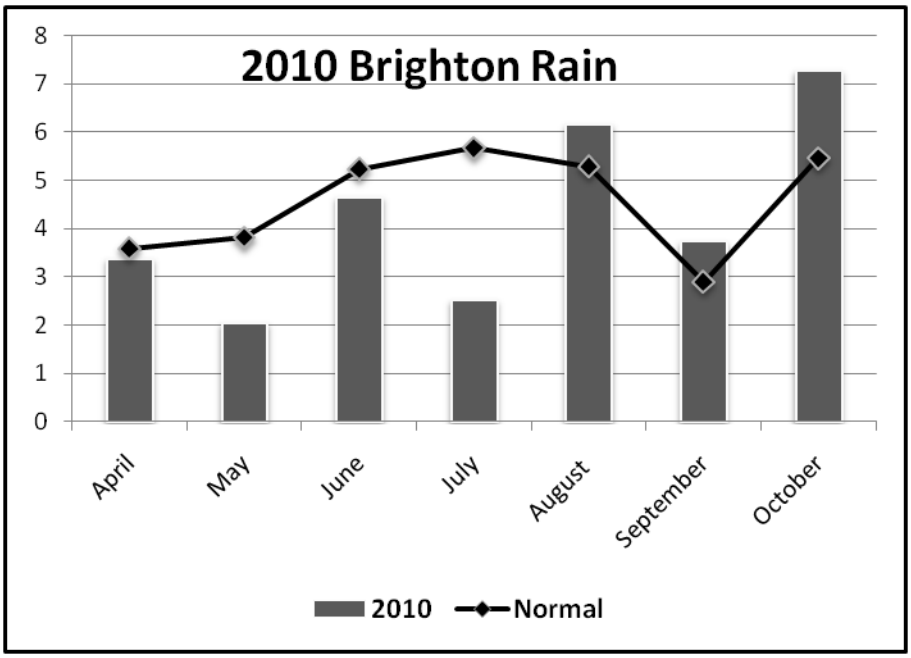


Figure 3. Monthly rainfall amounts (in inches) at the Nulhegan fire weather observation station in Brighton, Vermont compared to normal through fire season, April-October, 2010. Normal is based on 8 years of data.

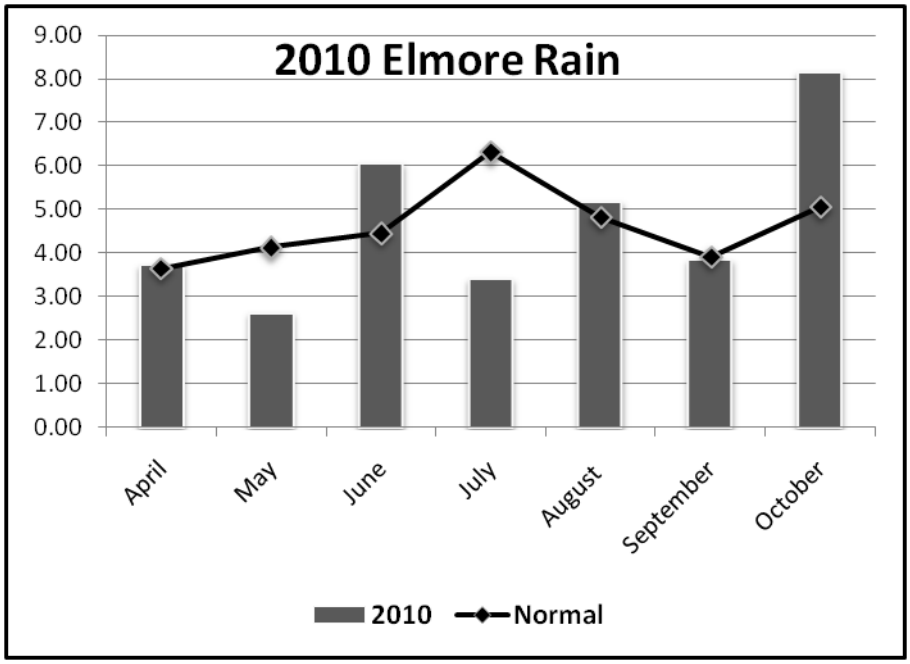


Figure 4. Monthly rainfall amounts (in inches) at the fire weather observation station in Elmore, Vermont compared to normal through fire season, April-October, 2010. Normal is based on 16 years of data.

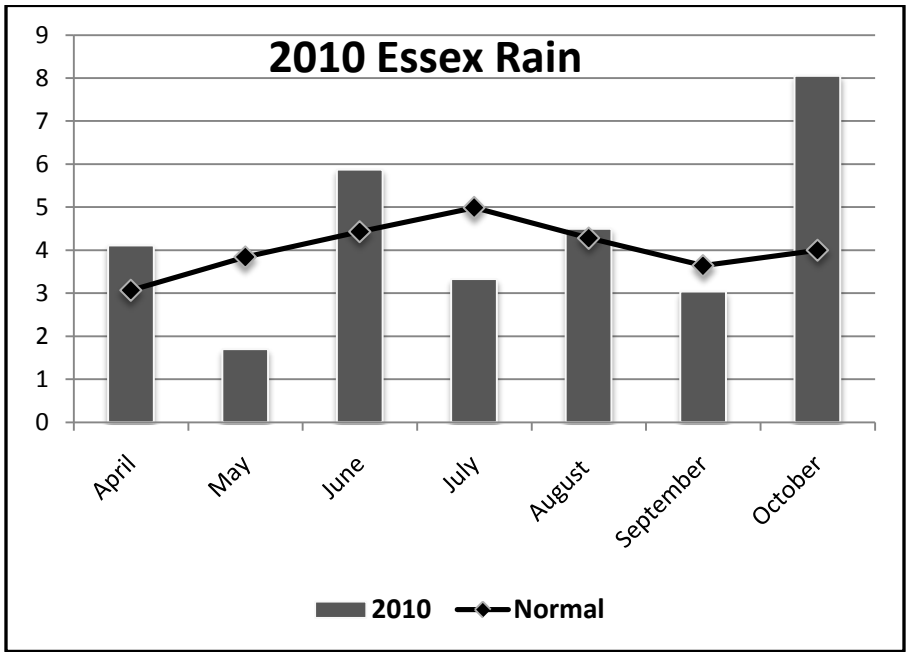


Figure 5. Monthly rainfall amounts (in inches) at the fire weather observation station in Essex, Vermont compared to normal through fire season, April-October, 2010. Normal is based on 17 years of data.

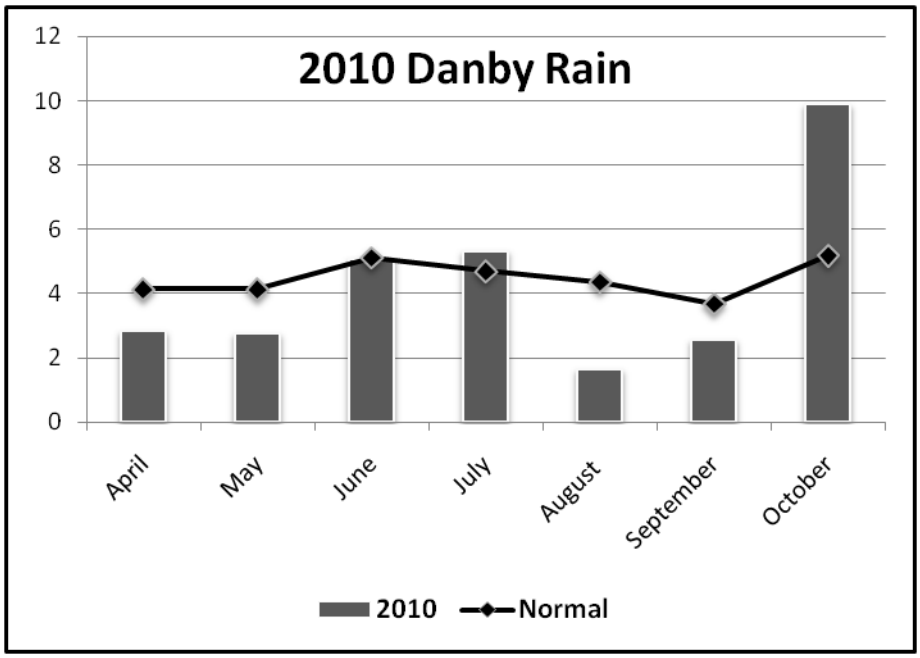


Figure 6. Monthly rainfall amounts (in inches) at the fire weather observation station in Danby, Vermont compared to normal through fire season, April-October, 2010. Normal is based on 13 years of data.

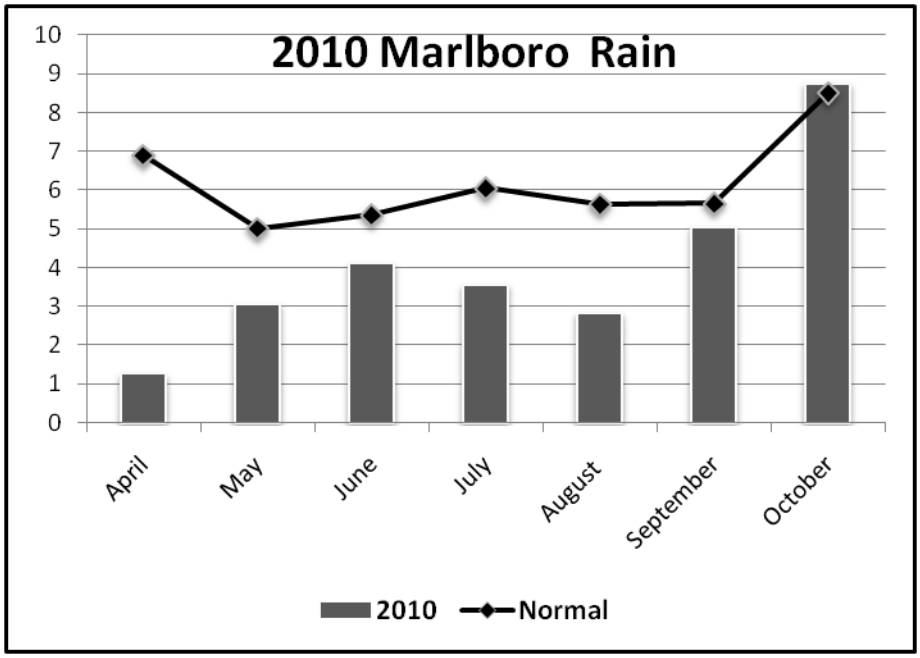


Figure 7. Monthly rainfall amounts (in inches) at the fire weather observation station in Marlboro, Vermont compared to normal through fire season, April-October, 2010. Normal is based on 8 years of data.

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. In 2010, bud break was 11 days earlier than the 20 year average (Figure 8) and full leaf out was around 16 days earlier.

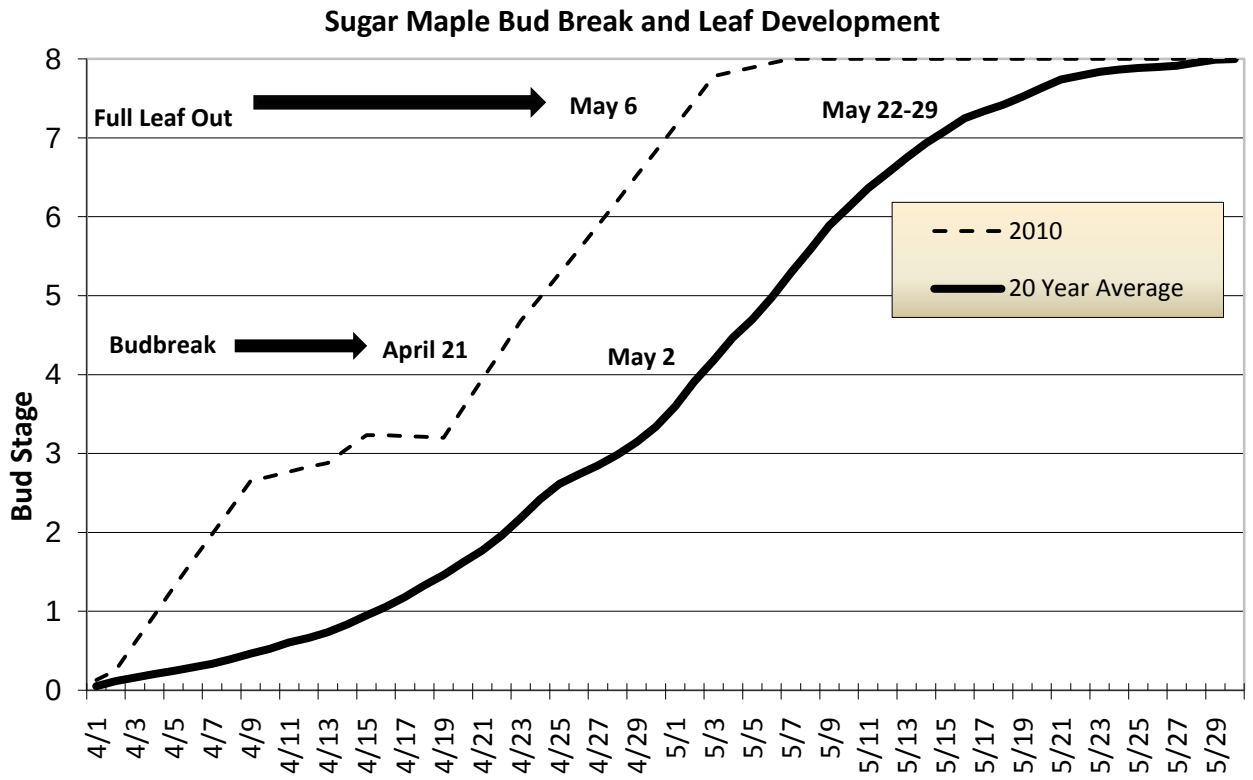


Figure 8. Timing of sugar maple bud break (bud stage 4) and full leaf development (bud stage 8) at the Proctor Maple Research Center compared to the 20-year average.

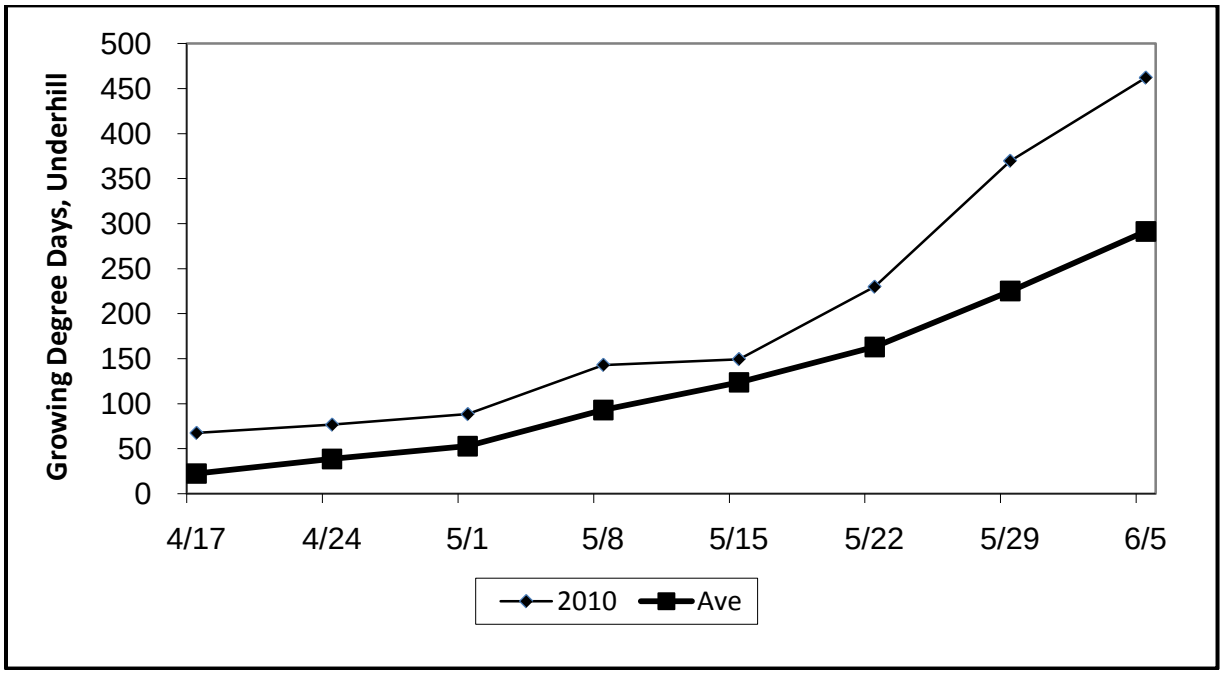


Figure 9. Weekly spring cumulative growing degree days for Underhill, Vermont, in 2010 compared to mean 1993-2010 accumulations. 50°F was used as the threshold of development.

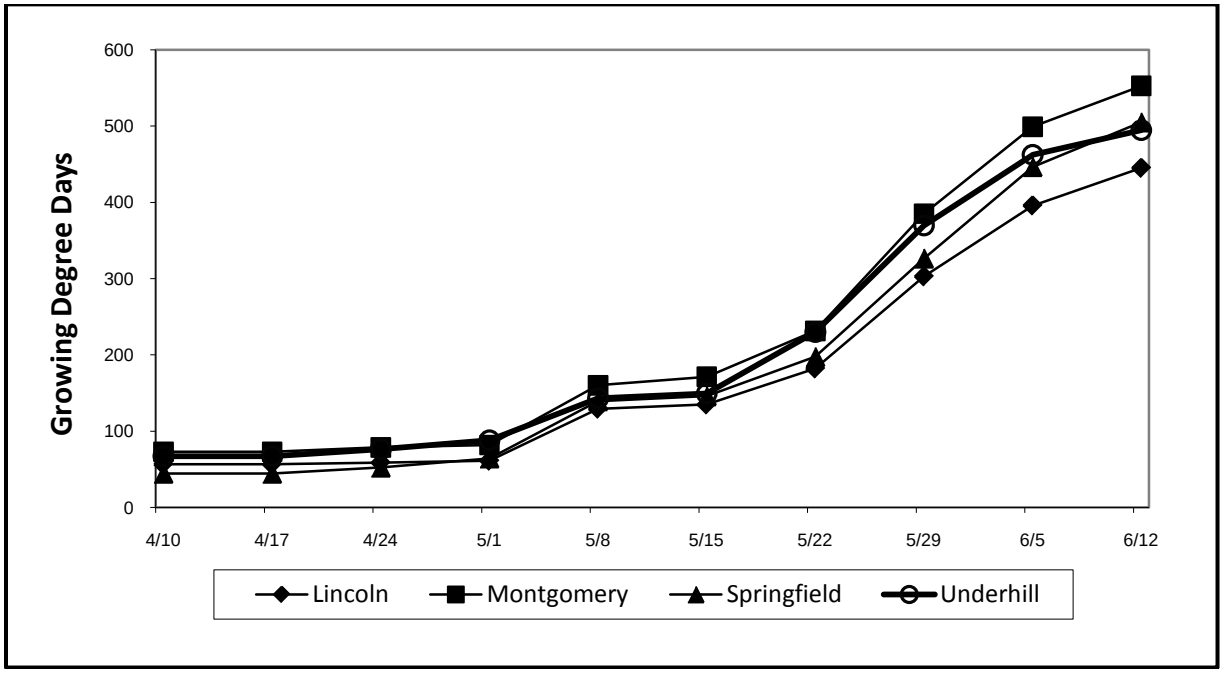


Figure 10. 2010 weekly spring cumulative growing degree days for Springfield, Underhill, Montgomery, and Lincoln, Vermont. 50°F was used as the threshold of development.

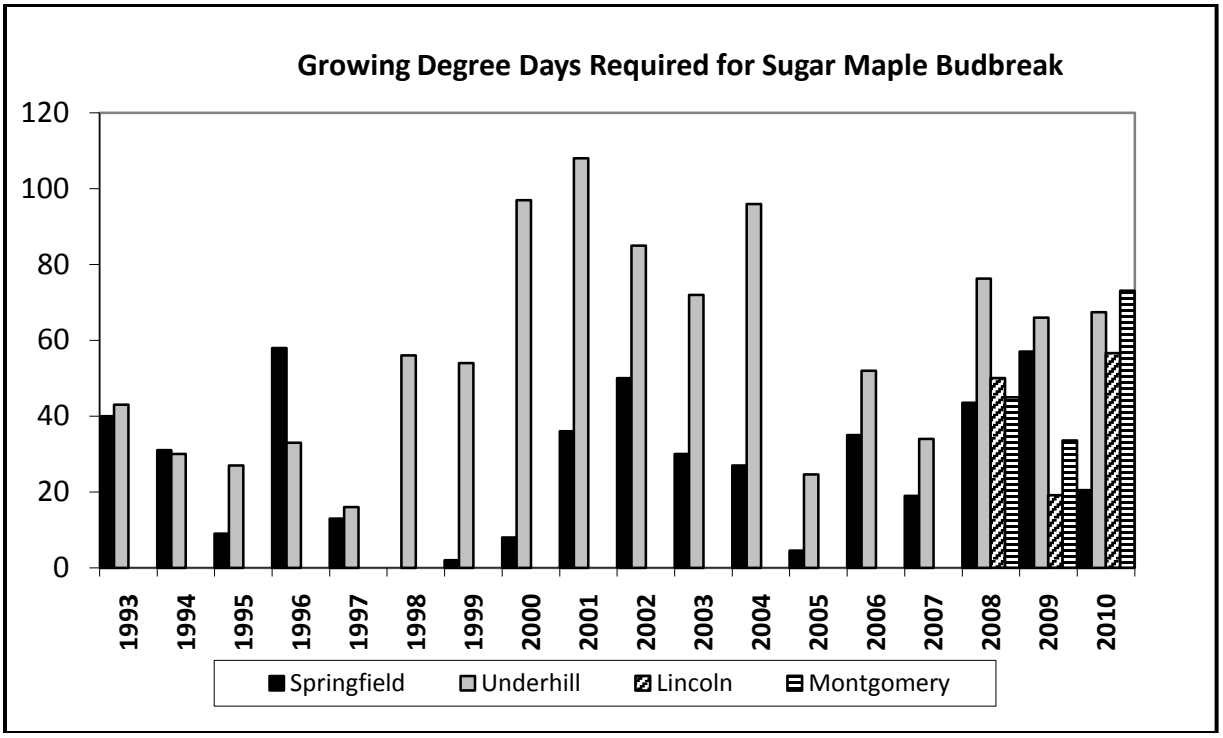


Figure 11. Growing degree days for sugar maple budbreak in Springfield and Underhill 1993-2010, and for Montgomery and Lincoln 2008-2010.

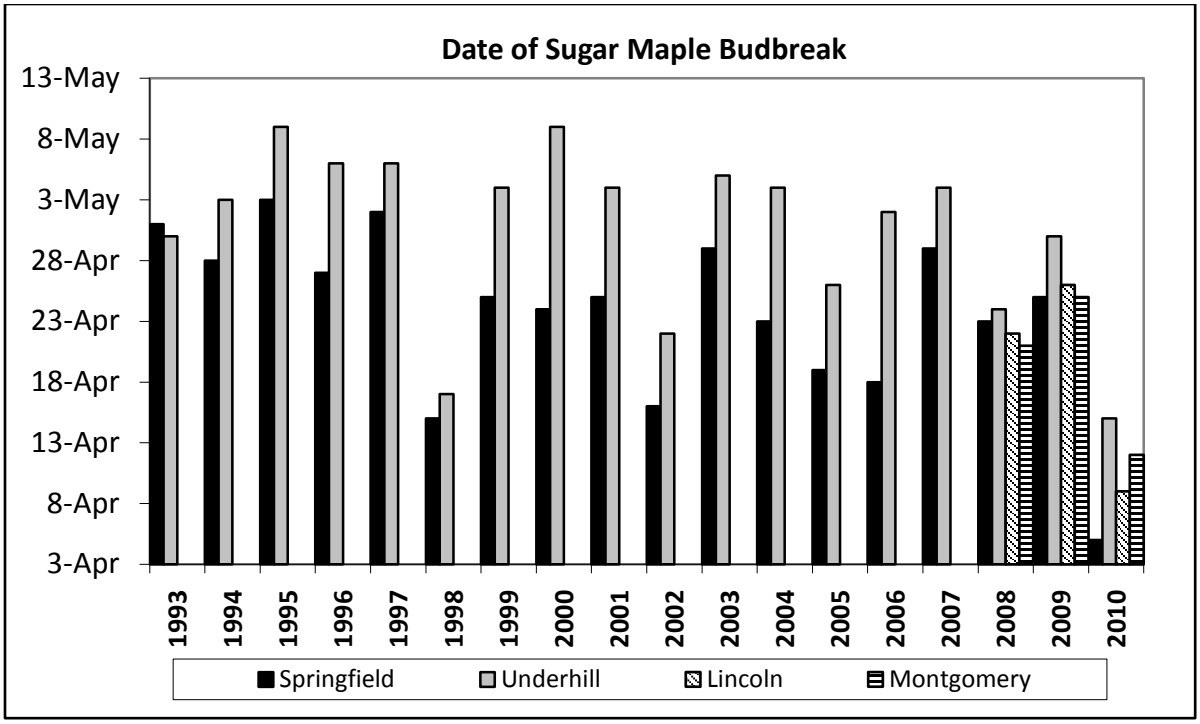


Figure 12. Dates of sugar maple budbreak in Springfield and Underhill 1993 and for Lincoln and Montgomery 2008-2010.

Table 1. First observation dates of phenological development and growing degree day accumulations from 4 sites in Vermont for 2010. 50°F is used as the threshold of development.

Biological Indicator	Lincoln	Montgomery	Springfield	Underhill
PLANT DEVELOPMENT				
Showing Green				
Fir, Balsam	4/26 (61.4)	5/4 (136.5)		4/30 (80.4)
Hemlock		5/13 (160.2)		5/3 (124.2)
Spruce, Red	5/14 (129.5)	5/12 (160.2)		
Budbreak				
Ash, White	4/26 (61.4)	5/6 (158.3)	4/25 (52.5)	4/26 (80.8)
Aspen, Quaking	4/7 (41.5)	4/9 (73.1)		
Cherry, Black	4/7 (41.5)	4/13 (73.1)	4/4 (19.0)	
Cherry, Choke	4/6 (37.8)	4/4 (41.0)		
Elm, American		4/22 (78.0)		
Fir, Balsam		5/13 (160.2)		5/3 (124.2)
Hemlock		5/22 (231.5)	5/4 (106.0)	5/12 (143.1)
Lilac	4/4 (28.5)	4/4 (41.0)		
Maple, Red	4/7 (42.1)	4/13 (73.1)		4/23 (76.3)
Maple, Silver				
Maple, Sugar	4/9 (56.6)	4/12 (73.1)	4/5 (20.5)	4/15 (67.4)
Oak, Red		5/5 (142.6)	4/18 (44.5)	
Shadbush	4/7 (41.5)	4/21 (74.7)		
Spruce, Red		5/17 (175.6)		
Flowers of Deciduous Trees and Shrubs				
Ash, White				
Aspen, Quaking	4/9 (56.6)	4/2 (5.2)	3/24 (0)	
Cherry, Black		5/18 (186.2)		
Cherry, Choke		5/15 (171.4)		
Elm, American			4/4 (19.)	
Lilac (first flowers)	5/16 (135.1)	5/10 (160.2)	5/3 (97.5)	5/18 (178.6)
Maple, Red	4/7 (41.5)	4/3 (23.3)	3/31 (0)	4/2 (20.7)
Maple, Silver			3/24 (0)	
Maple, Sugar		4/10 (73.1)		4/15 (67.4)
Shadbush	4/26 (61.4)	4/21 (74.7)		4/23 (76.3)
Wildflowers				
Dandelion			4/3 (9.0)	
Marsh Marigold	5/1 (61.4)			
Virginia Spring Beauty	4/7 (41.5)	4/8 (68.1)		4/5 (51.3)
Wild Strawberry		4/14 (73.1)		
INSECT DEVELOPMENT				
Eastern tent caterpillar (first tent)				4/30 (80.8)
Pear thrips (first adults)	4/14 (56.6)			4/5 (51.3)
OTHER OBSERVATIONS				
Spring peepers calling	4/9 (56.6)	4/3 (23.3)	4.3 (9.0)	
Full green up		5/24 (277.2)	5/23 (212.0)	

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 2010, fall color occurred earlier than the long term average for all species except for yellow birch trees at 1400 and 2200 feet where it was about normal (Figures 13-15). Rain and wind storms at the time when yellow birch leaves at 2200 feet were turning color (October 7) caused most colored leaves to drop, then when the remaining green leaves turned color, there was a second peak color spike. Sugar maple trees monitored at 1400 and 2200 feet colored earlier in 2010 than the long-term average - about 4 days earlier at 1400 and about a week earlier at upper elevations (2200 feet).

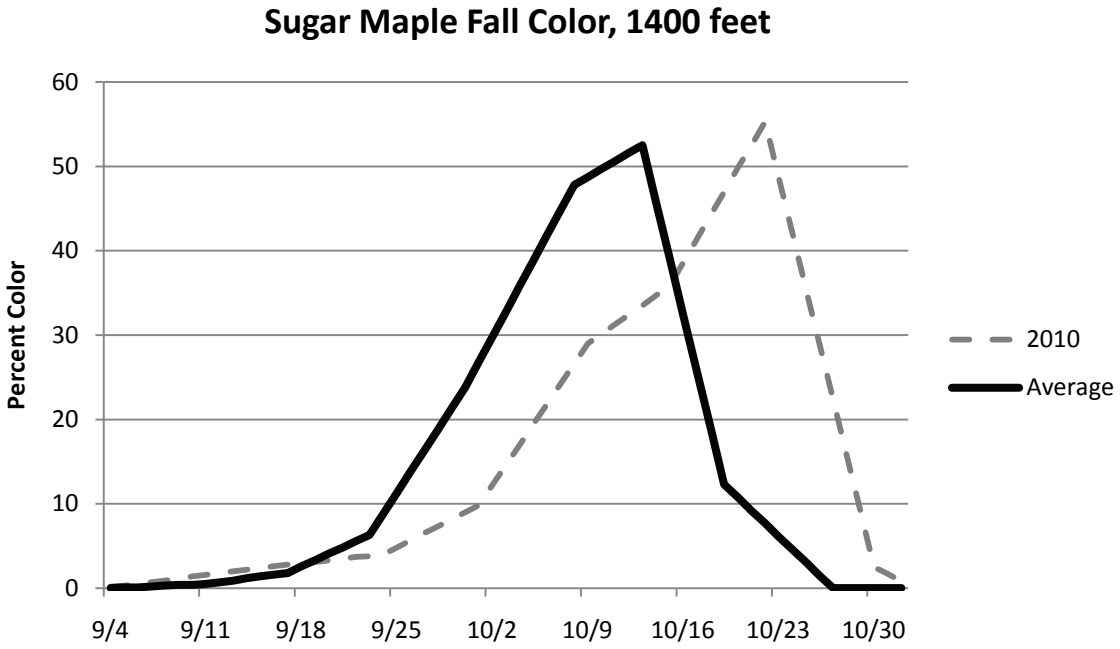


Figure 13. Timing of fall color on sugar maple trees monitored at the Proctor Maple Research Center, Underhill. The 20-year average is compared to 2010.

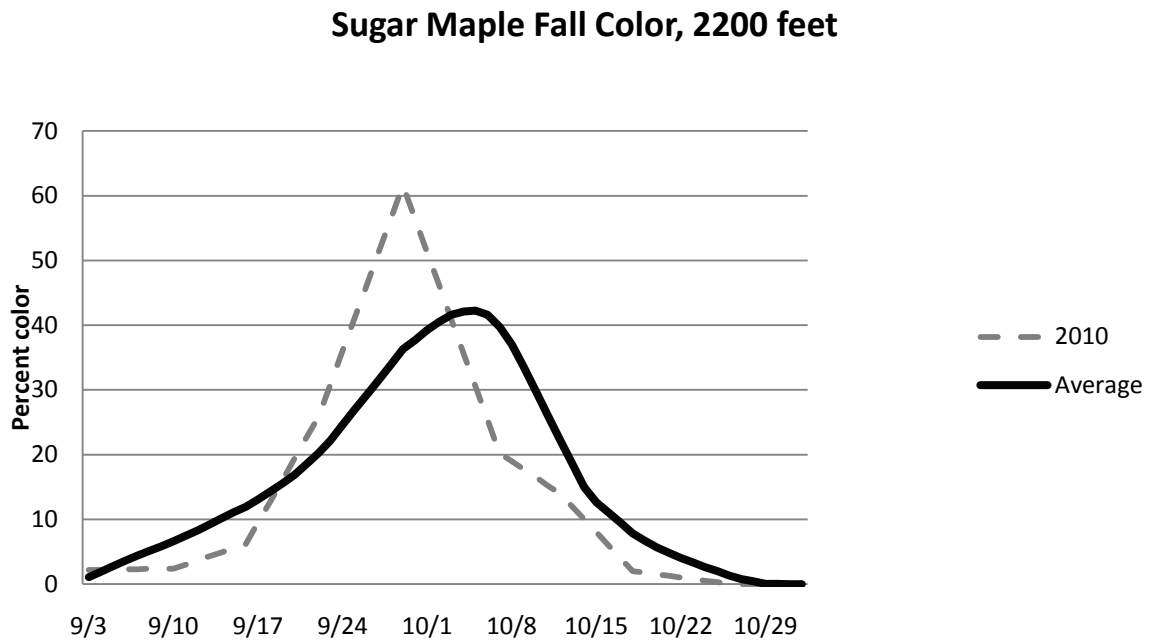


Figure 14. Timing of fall color on sugar maple trees monitored in the Underhill State Park. The 19-year average is compared to 2010.

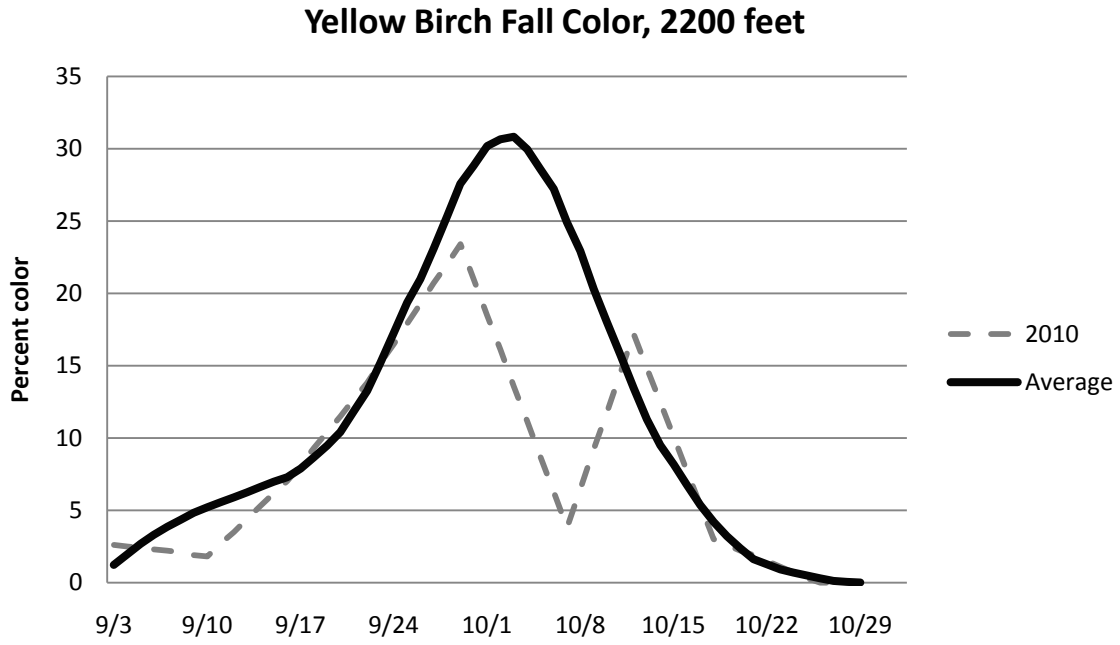


Figure 15. Timing of fall color on yellow birch trees monitored in the Underhill State Park. The 19-year average is compared to 2010.

Length of Sugar Maple Growing Season at Mount Mansfield

In 2010, the length of the growing season for sugar maple at our monitoring site was 17 days later than the long-term average (Figure 16). The length of growing season for individual sugar maple trees monitored at Proctor Maple Research Center (1400 feet) was 187 days (Table 2). The date for budbreak, May 3rd (11 days earlier than the long-term average), and the date for end of growing season (no more green leaves), was October 26th (5 days later than the long-term average).

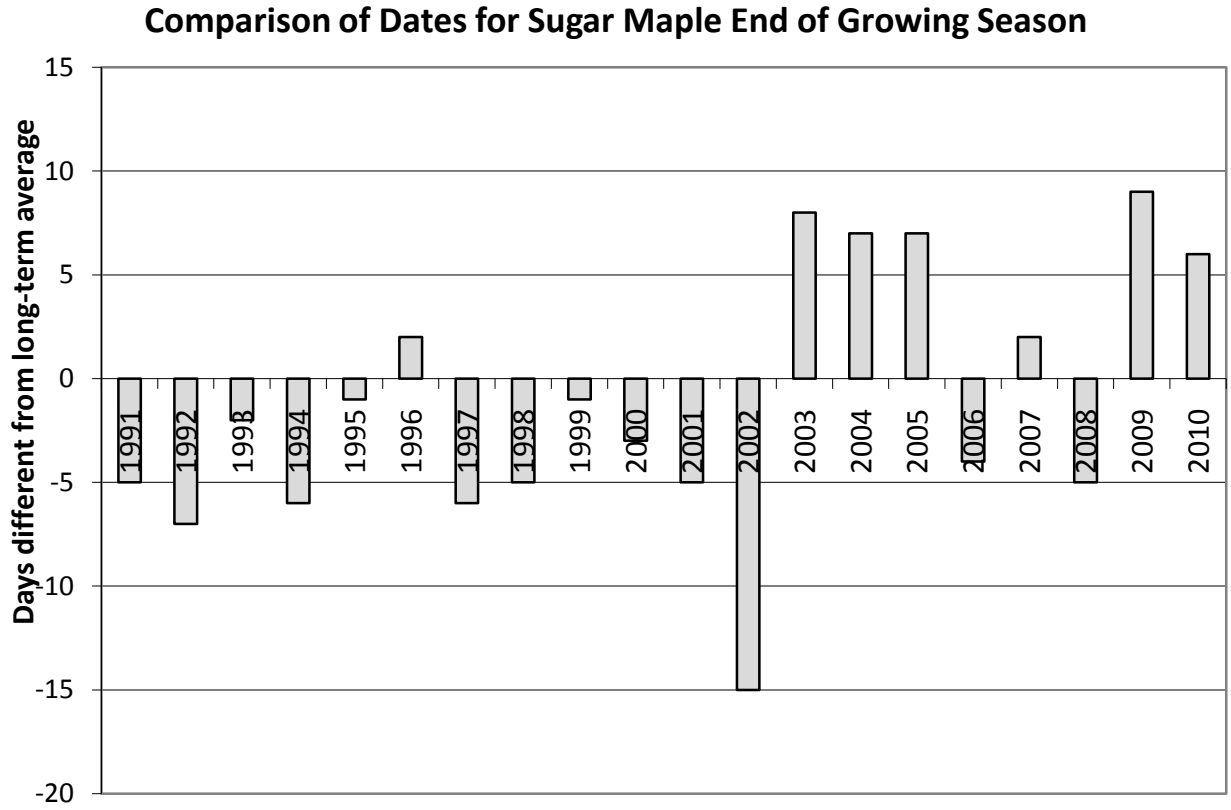


Figure 16. Annual date for sugar maple end of growing season (no more green leaves) at the monitoring site at the Proctor Maple Research Center in Underhill, compared to the 20-year long-term average. Negative numbers mean earlier than normal and positive numbers mean later than normal end of growing season.

Table 2. Dates of sugar maple budbreak, end of growing season and length of the growing season at the monitoring site at the Proctor Maple Research Center in Underhill.

Year	Date of Budbreak	Day of Year Budbreak	Date of End of Growing Season	Date of End of Growing Season (Day of Year)	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
Average	5/3	123	10/20	294	170

HARDWOOD DEFOLIATORS

Birch Defoliation, caused primarily by birch leafmining sawflies and Septoria leaf spot (*Septoria* betulae) decreased from 2009, and was mapped during aerial survey on a total of 13,280 acres (Table 3 and Figure 17). Most of the damage continues to be caused by *Septoria* leaf spot at upper elevations, although leaf mining by sawflies was more commonly observed than in 2009.

Table 3. Mapped acres of birch defoliation by birch defoliator complex in 2010.

County	Acres
Addison	1,234
Bennington	1,368
Caledonia	978
Chittenden	275
Essex	1,893
Franklin	0
Grand Isle	0
Lamoille	538
Orange	361
Orleans	299
Rutland	3,351
Washington	1,290
Windham	447
Windsor	1,246
Total	**13,280**

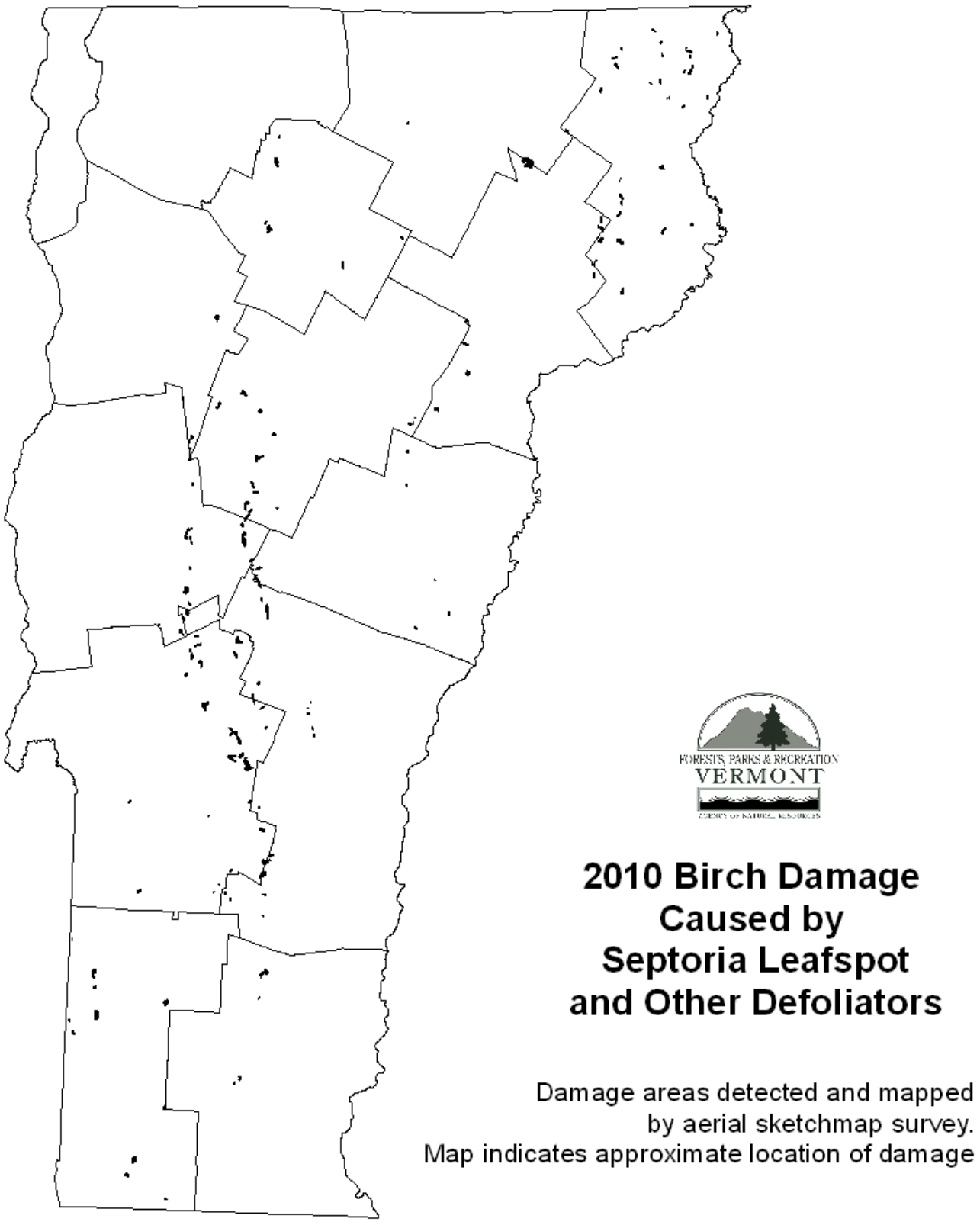


Figure 17. Late season defoliation of birch and other hardwoods in 2010. Mapped area includes 13,280 acres attributed to *Septoria* leaf spot and birch leafmining sawflies.

Forest Tent Caterpillar, *Malacosoma disstria*, populations continued to decline, and no defoliation or larvae were observed. Areas of mortality are still noticeable in the Taconic range. Average moth catch in pheromone traps dropped in 11 of 13 survey locations (Table 4 and Figure 18).

Table 4. Average number of forest tent caterpillar moths caught in pheromone traps, 2002-2010. There were 3 traps per location in 2010.

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

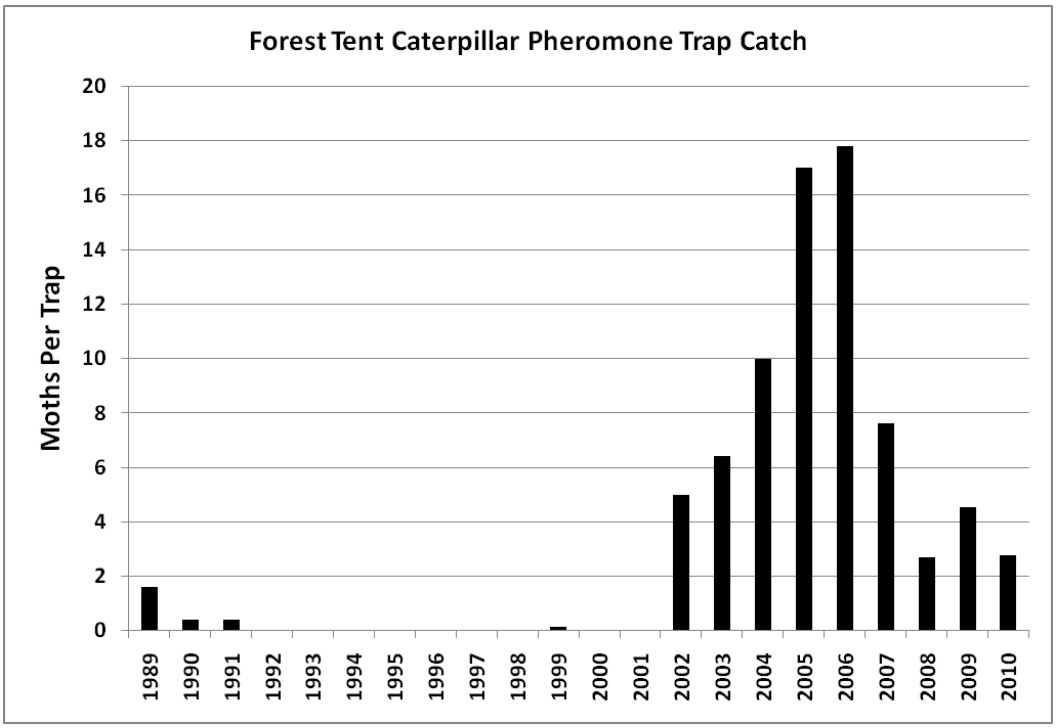


Figure 18. Average number of forest tent caterpillar moths caught in pheromone traps 1989-2010. Three traps per site, with PheroTech lures, were used in 2010.

Gypsy Moth, *Lymantria dispar*, remained low, but some light defoliation of suburban trees was observed in the Champlain Valley. Occasional egg masses were observed statewide. Egg mass counts at focal area monitoring plots remained low (Table 5 and Figure 19), predicting continued low populations for 2010.

Table 5. Number of gypsy moth egg masses per 1/25th acre from focal area monitoring plots, 2003-2010. Average of two 15-meter diameter burlap-banded plots per location in 2010.

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

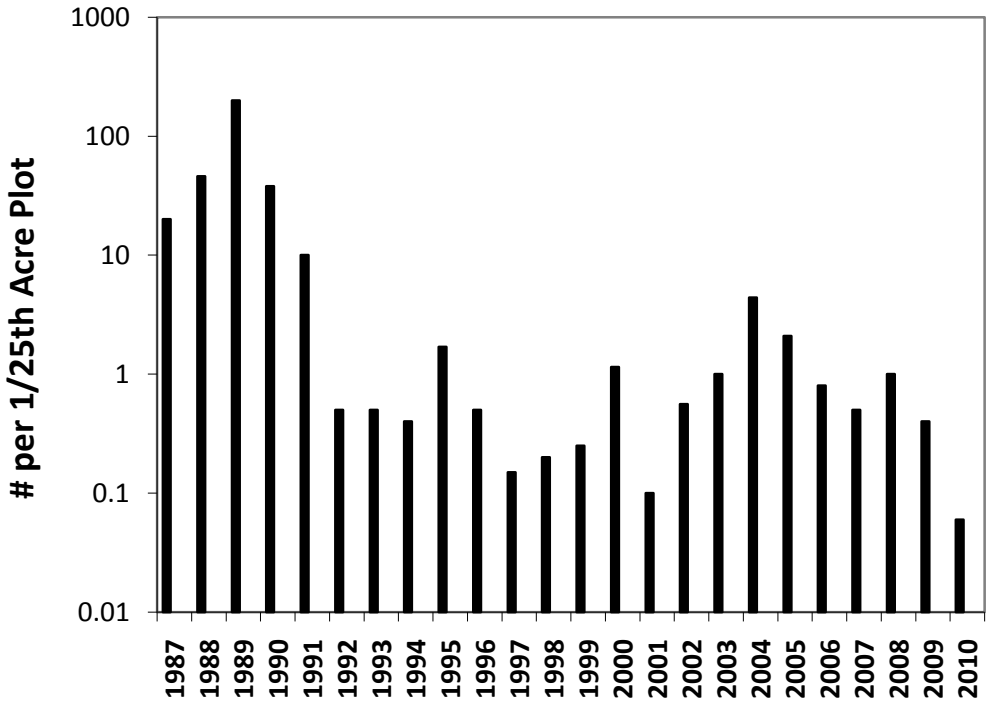


Figure 19. Number of gypsy moth egg masses per 1/25th acre from focal area monitoring plots, 2003-2010. Average of nine locations, two 15-meter diameter burlap-banded plots per location, in 2010.

Oak Commodity Survey

This Cooperative Agriculture Pest Survey (CAPS) was part of an effort initiated by the US Department of Agriculture to determine if a number of nationally-targeted oak pests were present in oak stands in Vermont. In the study, we used a combination of visual surveys, trap trees and baited traps. In May 2010, bolts were recovered from oak trees that were felled and left as trap trees, in 2009, at each of three oak survey sites (Bolton, Jamaica, and Arlington). These were placed in rearing tubes for collection of the European oak bark beetle (*Scolytus intricatus*) and other emerging insects. No target exotics emerged from the log bolts.

Pheromone traps were deployed at four new sites that contained declining oak (Sharon, Middlesex, Leicester, and West Haven) to survey for three defoliators: summer fruit tortrix (*Adoxophyes orana*), light brown apple moth (*Epiphyas postvittana*), and the variegated golden tortrix (*Archips xylosteanus*). Traps were deployed in early May and were visited every four weeks until late August- early September to replace lures and collect insects. Visual surveys were made at all sites for symptoms of oak decline caused by *Phytophthora ramorum*. None of the target species were found (Table 6).

The oak leaftier, *Croesia semipurpurana*, was attracted to traps that contained the lure for summer fruit tortrix, *A. orana*. (Table 7).

Table 6. Summary of site and collection data for 2010 oak commodity survey for the summer fruit tortrix (*Adoxophyes orana*), the light brown apple moth (*Epiphyas postvittana*) and the variegated golden tortrix (*Archips xylosteanus*). Data include counties, towns, GPS coordinates, dates of trapping survey, and numbers of target species found.

County	Town	Trap Location (NAD83)			Dates of trapping survey	# of site visits	# of target species found
		Adoxophyes orana (Summer Fruit Tortrix)	*Epiphyas postvittana* (Light Brown Apple Moth)	*Archips xylosteanus* (Variegated Golden Tortrix)			
Addison	Leicester	43.84874 -73.04766	43.84833 -73.04624	43.84775 -73.04581	5/1/10 – 8/26/10	4	0
Washington	Middlesex	44.32255 -72.68999	44.32210 -72.69032	44.32247 -72.69007	5/5/10 – 8/27/10	4	0
Windsor	Sharon	43.76557 -72.45281	43.76582 -72.45262	43.76601 -72.45295	5/10/10 – 9/15/10	4	0
Rutland	West Haven	43.58663 -73.41201	43.58629 -73.41203	43.58641 -73.41242	5/7/10 – 8/26/10	4	0

Table 7. Collection dates and numbers of oak leaftier, *Croesia semipurpurana*, attracted to traps that contained the lure for summer fruit tortrix, *Adoxophyes orana*, during CAPS survey for oak defoliators in Vermont in 2010.

County	**Town**	**Collection Period**	**Number of Oak Leaftier Moths/ Trap/ Collection Period**
Addison	Leicester	5/1/10 – 6/2/10	41
Washington	Middlesex	5/5/10 – 6/4/10	65
		6/4/10 – 7/8/10	176
Windsor	Sharon	5/10/10 – 6/18/10	109
Rutland	West Haven	5/7/10 – 5/29/10	59
		5/29/10 – 7/3/10	110

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Asiatic Garden Beetle *Autoserica castanea*	Various	Scattered	Adult beetles out early this year; population levels variable.
Azalea Sawfly *Amauronematus azaleae*	Northern Lights azalea	Jericho	Very numerous at this site; significant defoliation.
Birch Leafmining Sawflies *Messa nana* *Arge pectoralis* *Fenusa pusilla*			See birch defoliation.
Bruce Spanworm *Operophtera bruceata*	Various hardwoods	Rutland County Hyde Park	Only light feeding observed, but moths numerous in the fall.
Cherry Scallop Shell Moth *Hydria prunivorata*	Cherry	Hyde Park	Damaging black cherry saplings.
Eastern Tent Caterpillar *Malacosoma americanum*	Apple and cherry	Widely scattered	Populations remain low; occasionally observed along roadways.
European Snout Beetle *Phyllobius oblongus*	Sugar maple	Scattered	Observed in ornamentals and some nursery stock.
Fall Webworm *Hyphantria cunea*	Various hardwoods	Statewide	Decreasing in southern Vermont; scattered moderate to heavy damage in northern Vermont.
Forest Tent Caterpillar *Malacosoma disstria*			See narrative.
Gypsy Moth *Lymantria dispar*			See narrative.
Hickory Tussock Moth *Lophocampa caryae*	Various hardwoods	Scattered throughout	Individual larvae observed.
Japanese Beetle *Popillia japonica*	Various	Statewide	Adult beetles out early and observed for an extended period of time, but generally in fewer numbers.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Lesser Blotch Leafminer *Phyllonorycter* sp., prob. *P. lucidicostella*	Sugar maple	Statewide	Thought to be the cause of light levels of leaf blotch commonly seen on sugarbush regeneration. Not observed in 2009.
Locust Leafminer *Odontata dorsalis*	Black locust	Northwestern and central-western Vermont	Damage less visible than last year; considered medium to high in northwestern part of the state.
Maple Leafcutter *Paraclemensia acerifoliella*	Sugar maple	Statewide	Variable population levels reported. Increase in Bennington and Windham Counties. Elsewhere, notably light populations.
Maple Trumpet Skeletonizer *Epinotia aceriella*	Sugar maple	Statewide	Populations generally remain light.
Maple Webworm *Tetralopha asperatella*	Sugar maple	Weathersfield	Light damage to ornamentals.
Mimosa Webworm *Homadaula anisocentra*	Honeylocust	Springfield	Heavy defoliation of recent planting. Though no adults have been recovered, feeding injury with webbed foliage on honeylocust is consistent with mimosa webworm. Cocoons may be found under bark on the trunk of the host or in leaf litter under the tree. We are attempting to rear adults from material obtained at the site.
Oak Leaf Tier *Croesia semipurpurana*	Oak	West Haven, Middlesex, Leicester and Sharon	Though damage was not observed, numerous moths were collected in pheromone traps deployed for Summer Fruit Tortrix (*Adoxophyes orana*). See Oak Commodity Survey under Hardwood Defoliators.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Oak Skeletonizer *Bucculatrix ainsliella*	Oak	Champlain Valley and Southern Vermont	Common, with damage generally light to moderate. Pupae also seen on hemlock needles from Westminster.
Rose Chafer *Macrodactylus subspinosus*	Apple	Groton, St. Albans	More numerous at Groton site than last year. High populations and heavy feeding in St. Albans.
Spring Cankerworm *Paleacrita vernata*	Ash, basswood, white birch, and various fruit trees	Widely scattered	Individual larvae.
Striped Alder Sawfly *Hemichroa crocea*	Alder, birch, willow	Killington	Moderate feeding reported.
Viburnum Leaf Beetle *Pyrrhalta viburni*	Viburnum	Champlain Valley and elsewhere	Viburnum leaf beetle continues to destroy viburnums, but the number of calls is down.
White Marked Tussock Moth *Orgyia leucostigma*	Various	Widely scattered	Caterpillars observed in late summer; no damage noticed.
Winter Moth *Operophtera brumata*	Hardwoods		Not known to occur in Vermont, but research on spread in New England ongoing at UMass.

Hardwood Defoliators not reported in 2010 included Birch Leaf Folder, *Ancylis discigerana,* Birch Skeletonizer, *Bucculatrix canadensisella,* Maple Basswood Leaf Roller, *Sparganothis pettitana;* Mountain Ash Sawfly, *Pristiphora geniculata*; Orange-humped Mapleworm, *Symmerista leucitys*; Saddled Prominent, *Heterocampa guttivata*; Satin Moth, *Leucoma salicis*; Uglynest Caterpillar, *Archips cerasivoranus*.

SOFTWOOD DEFOLIATORS

Spruce Budworm, *Choristoneura fumiferana*, larvae or defoliation were not observed in 2010. However, for the past several years, populations have been increasing in eastern Canada. Nova Scotia reported its highest moth counts since 1994. In Quebec, the acres defoliated doubled between 2009 and 2010, to approximately 1.7 million acres, north of the St. Lawrence River. In Vermont, we had discontinued our pheromone trap program after 20 years (1983-2003). With recent regional increases, we decided to deploy traps in Orleans, Caledonia, Essex and Chittenden Counties. Counts for 2010 were generally low, and no defoliation is expected in 2011.

Table 8. Average number of spruce budworm moths caught in pheromone traps, 1991-2010. Trapping was discontinued, 2004-2009. There were 3 traps per location, one location per town 2010.

County	Town	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2010
Essex	Norton	3	10.7	5.7	2.3	1	1	1.3	26	34.7	29.7	17.7	1.3	2	5.33
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
Caledonia	Walden	17.7	17.7	13	14.3	3	6.3	2	4.3	5	85	16.7	9.7	3.7	6.67
Essex	Lewis	2.0	2.7	0.67	2	0	0.67	0	8	4.3	14	6.7	1.3	1.7	5.67
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
Caledonia	Burke	3.5	2.3	6	3	0	2	3.7	7.3	6	30	15	3	1.7	4

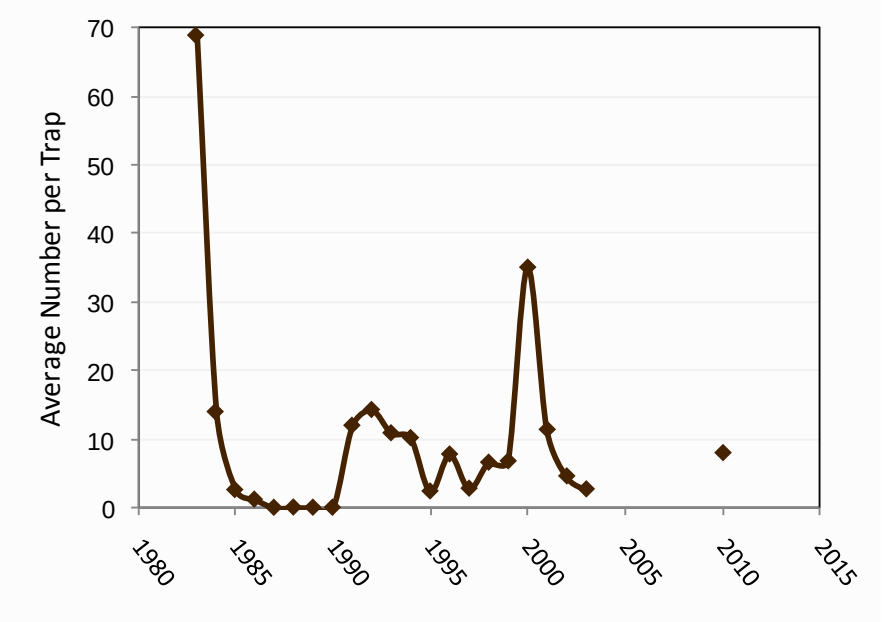


Figure 20. Average number of spruce budworm moths caught in pheromone traps 1983-2010. Trapping was discontinued, 2004-2009. Average of six locations in 2010.

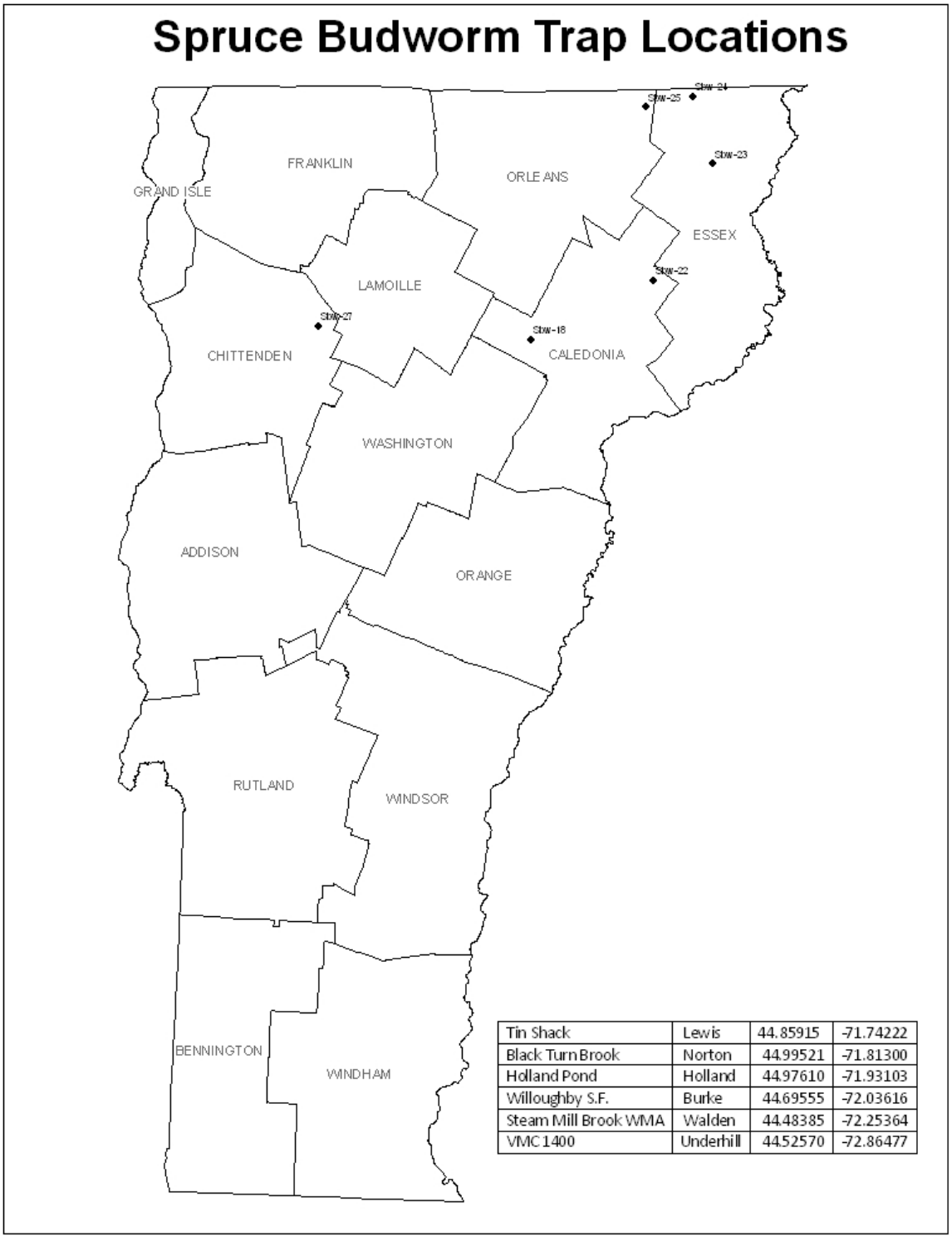


Figure 21. Locations of spruce budworm pheromone traps in 2010. Coordinates are NAD83.

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Arborvitae Leaf Miner *Argyresthia thuiella*	Arborvitae	Scattered throughout	Heavy in some ornamental settings, and noticeable in scattered forested stands.
Eastern Spruce Budworm *Choristoneura fumiferana*			See narrative.
Larch Casebearer *Coleophora laricella*	Larch	Scattered reports	Remains low.

Softwood Defoliators not reported in 2010 included European Pine Sawfly, *Neodiprion sertifer*; Introduced Pine Sawfly, *Diprion similis*; Yellow-Headed Spruce Sawfly, *Pikonema alaskensis.*

SAPSUCKING INSECTS, MIDGES, AND MITES

Balsam Woolly Adelgid, *Adelges piceae*, populations increased in southern Vermont, including on forest trees in Wilmington, ornamental balsam fir in Springfield, and Fraser fir Christmas trees in Bennington. The insect was not reported elsewhere. New mortality decreased in stands previously affected by the insect, although old mortality was readily visible. In all, 308 acres of recent balsam fir mortality, mostly attributed to balsam woolly adelgid, were mapped during aerial surveys, compared to 5,297 acres in 2009 (Table 9).

Table 9. Mapped acreage of recent balsam fir mortality, mostly attributed to balsam woolly adelgid, in 2010.

County	Acres
Addison	36
Caledonia	40
Essex	41
Orange	110
Orleans	34
Rutland	106
Washington	3
Windham	8
Total	**380**

Hemlock Woolly Adelgid, *Adelges tsugae*, detections increased in Windham County, but no new counties were reported as infested. Infestations have now been detected in 38 locations in seven towns (Figure 22). Infested trees were destroyed at the single site in Rockingham (2007), but infestations are active in Brattleboro, Vernon, Guilford, Dummerston, Townshend and Jamaica.

Vermont is collaborating with the states of New Hampshire and Maine and with the US Forest Service to develop a regional approach to managing this insect. Recommendations for landowner response to hemlock woolly adelgid in Vermont were developed for landscape and forest trees. These are available online.

In all, detection surveys were conducted at 74 sites, including a minimum of five sites in each of the twelve towns adjoining infested towns (Figure 23). Volunteers continue to participate in detection surveys. Twenty-one training sessions were conducted in 2010 with 415 people attending; approximately 80 volunteers assisted with surveys at 48 locations.

Winter mortality of the adelgids during the winter of 2009-2010 was noticeably less than the previous winter, and the consequent upswing in population was expected. Overwintering mortality was assessed at five locations with iButton data loggers (manufactured by Dallas Semiconductor Corp.). These were installed at the sites by December 4, 2009, and removed on April 6, 2010 (Figure 24). Hemlock branch tips with new growth were sampled between April 13 and April 28, 2010. At least 100 new sistens were examined under a dissecting microscope to determine the numbers of live and dead adelgids (Table 10). Mortality was 74% at the site, in Guilford, with the coldest recorded temperature. Mortality averaged 12% at the other four sites.

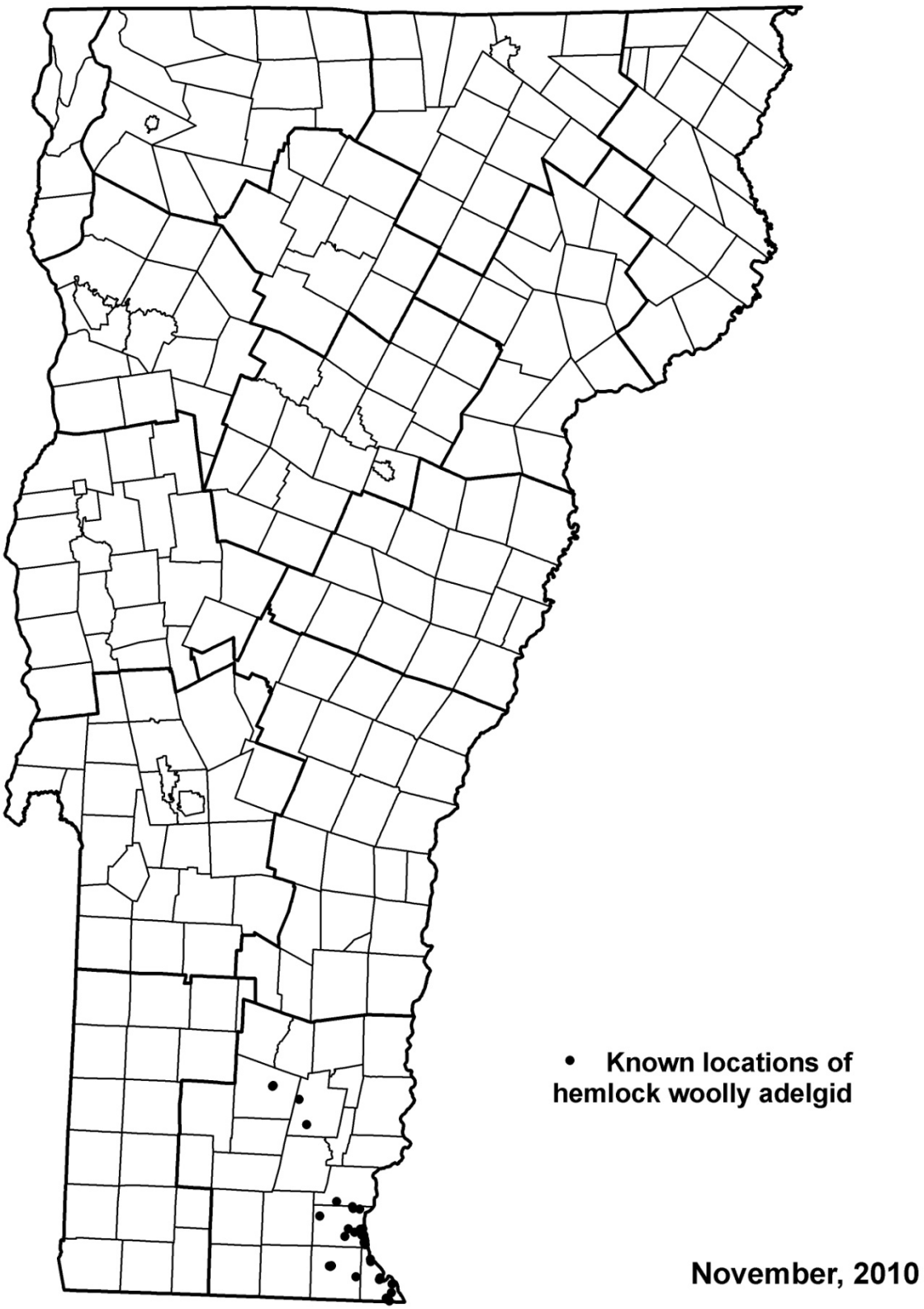


Figure 22. Known locations of hemlock woolly adelgid infested trees in 2010.

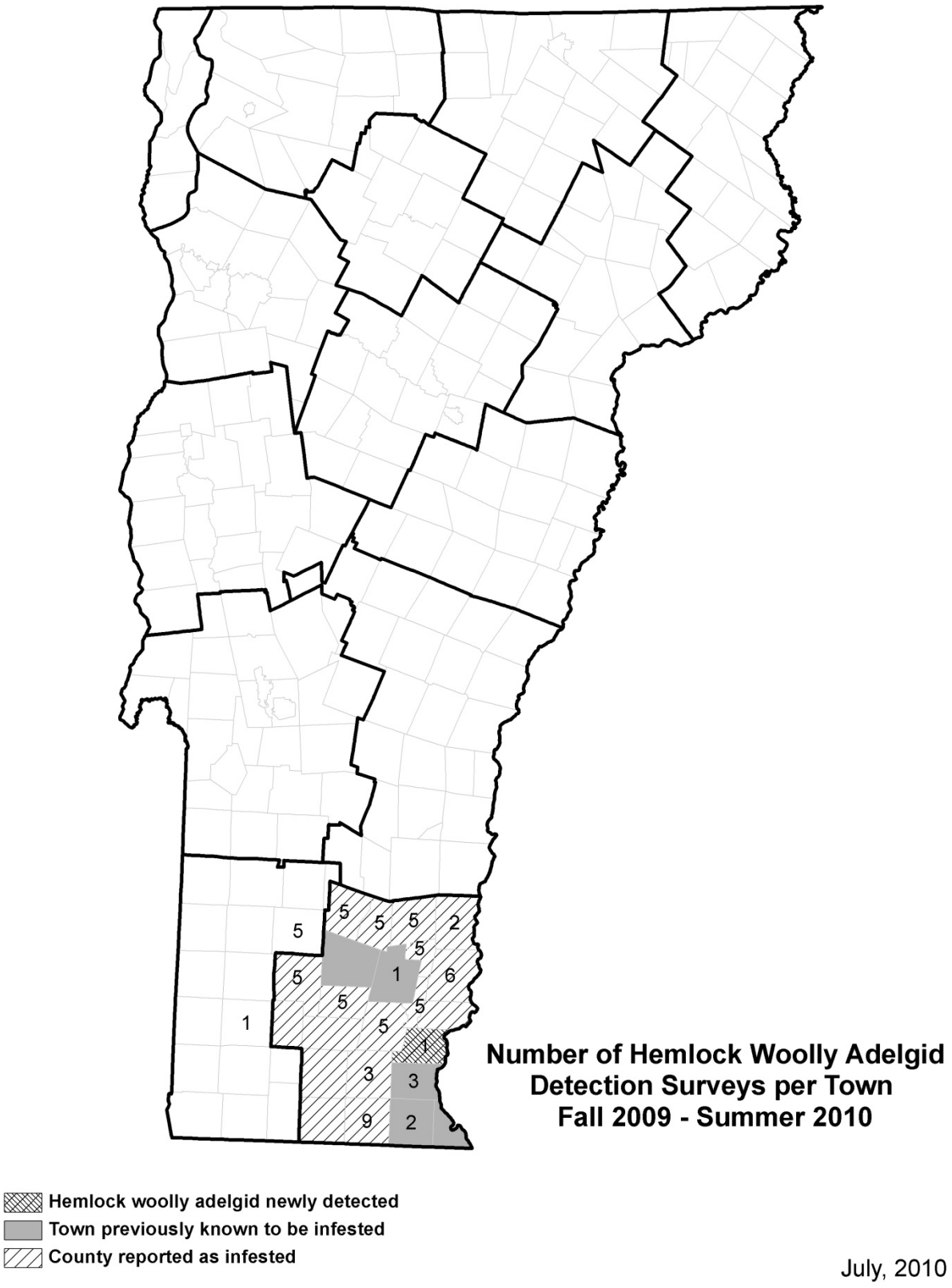


Figure 23. Locations of hemlock woolly adelgid surveys, October 2009 – July 2010.

Table 10. Percent of hemlock woolly adelgid sistens that were dead in April 2010 at five Windham county sites, compared to minimum ambient temperature in winter 2009-10.

Town	Site	Minimum Temperature °C	% Dead	# of Sistens Examined
Brattleboro	Vernon Street	-17	14%	100
Vernon	Fort Bridgman Road	-17	13%	100
Guilford	Wilkens Hill	-20	74%	148
Townshend	Townshend SP	-18	9%	4483
Jamaica	Jamaica SP	-19	13%	14,023
Average		**-18.2**	**24.6%**	

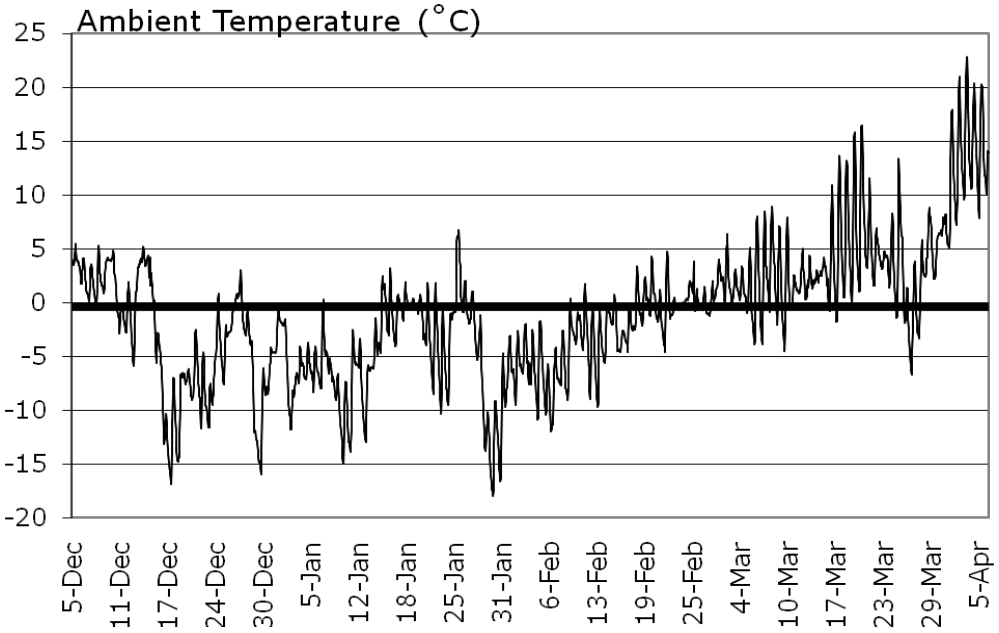


Figure 24. Ambient temperature (°C) measured by iButton data loggers December 2009 – April 2010. Average of five Windham County sites.

In cooperation with Dr. Scott Costa, the biopesticide Mycotal was experimentally applied, using hydraulic sprayer equipment, 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). Ten additional trees served as controls. Results from the monitoring of aestivating sistens four weeks after application indicate the hemlock woolly adelgid populations were significantly impacted. In the experimental group with low pre-treatment populations, fungus treated trees had counts of live hemlock woolly adelgid 1/16 of the controls. For trees with initially high populations, the fungal treatment reduced the number of insects to nearly ½ of controls. The data also indicated the percentage mortality of crawlers that had successfully settled on hemlock branches was significantly greater on trees treated with fungi. A substantial amount of fungus had persisted four weeks post-treatment.

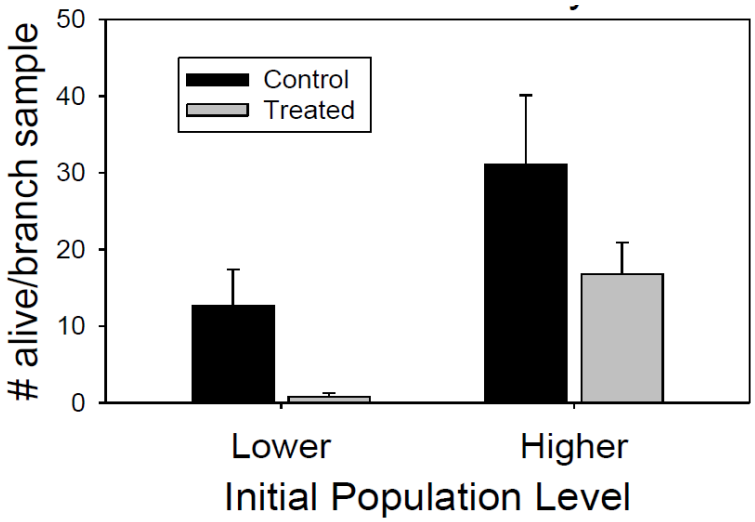


Figure 25. Average number of live hemlock woolly adelgid sistens on ten Mycotal-treated and ten control trees four weeks after treatment, by initial population level. Data from Costa, S. 2010. Experimental Hemlock Woolly Adelgid Suppression Townshend State Park, Interim Progress Report. 12 pp.

The two sites where the predatory beetle, *Larcicobius nigrinus*, was released in fall, 2009 were sampled for beetles in November 2010 by Dr. Dave Mausel from the University of Massachusetts. One *L. nigrinus* beetle was recovered from the site where beetles originating from Idaho had been released.

Seven new hemlock woolly adelgid compliance agreements were completed, after 196 wood-product processing facilities were contacted regarding the existing quarantine. All seven sites with compliance agreements have been inspected for the presence of hemlock woolly adelgid on any nearby hemlocks.

The State of New Hampshire's Division of Forests and Lands sent a mailing to 208 Vermont nurseries, landscapers, and others who have purchased hemlock nursery stock in the past, regarding the availability of locally grown nursery stock at the state tree nursery. The Vermont Agency of Agriculture, Food, and Markets continues to monitor nurseries for possible introductions of hemlock woolly adelgid on live trees.

Pear Thrips, *Taeniothrips inconsequens*, damage was noticeable statewide, and injury was evident in many sites that also had frost damage. Thrips emerged early and in greater numbers than in recent history in some locations. The conditions that kept sugar maple buds vulnerable to frost damage also allowed thrips feeding to impair leaf development. Thrips populations increased at the monitoring location in Underhill, with 1,021 caught on sticky cards, compared to 296 in 2009 and 350 in 2008 (Table 11). In mid-April, 2-3 thrips per bud were reported from a sugarbush in Reading.

Table 11. Total number of pear thrips caught on four yellow sticky cards at a monitoring site in Underhill, Vermont by date of sampling 2008-2010.

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

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Aphids *Cinara sp.*	Spruce, balsam	Essex Junction, Morrisville	Tremendous numbers of these were observed at the base of an ornamental spruce in Essex Junction; found on Christmas trees in Morrisville.
Aphids *Periphyllus sp.*	Sugar maple	Central Vermont	On ornamentals.
Ash flowergall mite *Aceria fraxiniflora*	Ash	Champlain Valley	Moderate populations.
Balsam Gall Midge *Paradiplosis tumifex*	Balsam fir	Scattered, some high elevation sites	Variable in Christmas tree plantations.
Balsam Twig Aphid *Mindarus abietinus*	Balsam fir	Champlain Valley and Southern Vermont	Damage lighter or similar to last year.
Balsam Woolly Adelgid *Adelges picea*			See narrative.
Beech Scale *Cryptococcus fagisuga*			See Beech Bark Disease narrative.
Boxelder Bug *Leptocoris trivittatus*	Boxelder	Statewide	Minor damage observed on boxelder trees; primary concern as a nuisance for homeowners who finds large colonies of adults seeking places to overwinter. Reports are up this year.
Cooley Spruce Gall Aphid *Adelges cooley*	Spruce	Widely scattered	Usual number of reports.
Cottony Maple Scale *Pulvinaria innumerabilis*	Silver maple	St. Albans	Light population.
Eastern Spruce Gall Adelgid *Adelges abietis*	Spruce	Statewide	Light to moderate damage reported.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Elongate Hemlock Scale *Fiorinia externa*	Hemlock		Not known to occur in Vermont, but targeted during surveys for hemlock woolly adelgid.
Erineum Gall Mite *Aceria elongatus*	Sugar maple	Common throughout	Often noted on ornamental trees.
Eriophyid Gall Mites *Eriophyes sp.*	Elm, Cherry	Springfield, Manchester Center	Associated with ornamentals.
Hemlock Woolly Adelgid *Adelges tsugae*			See narrative.
Honeylocust Plant Bug *Diaphnocoris chlorionis*	Honeylocust	Colchester	Heavy population on ornamental trees.
Lacebugs *Corythucha sp.*	Sycamore, Basswood and Elm	Statewide	Significant increase from last year; population heavy on some trees. Though common on some host trees, damage minimal.
Leafhoppers *Family Cicadellidae*	Ash	Colchester	Obvious feeding injury on roadside trees.
Lecanium Scale *Lecanium sp.*	Oak and other hardwoods	Groton and scattered elsewhere	Low populations.
Maple Bladder Gall Mite *Vasates quadripedes*	Sugar maple	Scattered	Usual low numbers noted on ornamentals.
Maple Spindle Gall Mite *Vasates aceris-crummena*	Sugar maple	Scattered throughout	Light populations on individual ornamental trees.
Oystershell Scale *Lepidospaphes ulmi*	Hardwoods	Southern Vermont	No dieback, but noticeable scale populations.
Pear Leaf Blister Mite *Phytoptus pyri*	Pear	Enosburg Falls	Mite causes rust-like spots on pear leaves and can also affect the blossom end of pear fruit.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Pear Thrips *Taeniothrips inconsequens*	Hardwoods	Statewide	See narrative.
Phylloxera Galls Family Phylloxeridae	Bitternut hickory	Middlebury	Moderate number of galls on ornamental tree.
Pine Bark Adelgid *Pineus strobi*	White pine	Widespread	Light to moderate populations.
Pine Leaf Adelgid *Pineus pinifoliae*	White Pine	Scattered	Numerous adults on previous year's needles in some locations.
Pine Spittlebug *Aphrophora parallela*	Conifers	Southern Vermont	Observed insects, but no damage noted.
Ragged Spruce Gall Aphid *Pineus similis*	Spruce	Stratton	Moderate population.
Spittlebug Family Cercopidae	Paper Birch	Waterbury, Morrisville	Moderate population.
Spruce Spider Mite *Oligonychus ununguis*	Conifers	Widely scattered	Moderate populations; buildup noted on Fraser fir Christmas trees in northern Vermont in late summer.
Western Conifer Seed Bug *Leptoglossus occidentalis*	Conifers	Statewide	Mostly observed entering homes in the fall. We have not yet documented damage to trees in Vermont.
Woolly Alder Aphid *Paraprociphilus tessellatus*	Silver Maple, Alder	Montpelier	Numerous aphids in flight; observed as curiosity and described as "floating specks of faint bluish lint."

Sapsucking Insects, Midges and Mites that were not reported in 2010 included, Black Pineleaf Scale, *Nuculaspis californica;* Hackberry Psyllids, *Pachypsylla celtidismamma* and *Pachypsylla celtidisvesicula*; Woolly Fold Gall, *Cecidomyidae*; Beech Blight Aphid, *Fagiphagus imbricator*; Birch Lacebug, *Corythuca palipes*; Boxelder Erineum, *Aceria negundi*; Hemlock Scale, *Abgrallaspis ithacae*; Pine Fascicle Mite, *Trisetacus alborum*; Red Pouch Gall, *Pemphigus rhois*; Vagabond Aphid, *Mordwilkoja vagabunda*.

BUD AND SHOOT INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Balsam Shootboring Sawfly *Pleuroneura brunneicornis*	Balsam fir	Northern Vermont Christmas tree plantations	Although damage was expected to be higher in 2010 than in 2009, it was masked by the widespread heavy frost damage.
Common Pine Shoot Beetle *Tomicus piniperda*	Pines		Not observed and no damage reported. A federal quarantine is in place to limit the spread of this exotic insect into non-affected states. Pine material is free to move inside Vermont. Delimiting surveys conducted from 1999-2005 confirmed the presence of this insect in 8 Vermont Counties.
Oak Twig Pruner *Elaphidionoides parallelus*	Red oak	Charlotte	Significant twig drop.
White Pine Weevil *Pissodes strobi*	White pine, Norway spruce	Throughout	Scattered damage at usual levels.

Bud and Shoot Insects not reported in 2010 include Allegheny Mound Ant, *Formica exsectoides*; European Pine Shoot Borer, *Eucosma gloriola*; Maple Petiole Borer, *Caulocampus acericaulis*.

ROOT INSECTS

DISEASE	HOST(S)	LOCALITY	REMARKS
Japanese Beetle *Popillia japonica*	Many	Throughout	Populations low throughout the state.
June Beetle *Phyllophaga* spp.	Many	Throughout	Notably fewer adults observed this year.

Root Insects not reported in 2010 include Conifer Swift Moth, *Korsheltellus gracilis*; Root aphid, *Prociphilus similis*.

BARK AND WOOD INSECTS

Asian Longhorned Beetle, *Anoplophora glabripennis,* was not observed and is not known to occur in Vermont.

Vermont continued to participate in the expanded regional Forest Pest Outreach and Survey Project, focused on both Asian longhorned beetle and emerald ash borer. The objective of this project is to promote early detection through increased public awareness and targeted surveys. The project is funded by USDA APHIS and the US Forest Service, and included eleven states in 2010. In Vermont, the project was carried out by the Department of Forests, Parks, and Recreation and the Agency of Agriculture, Food and Markets. August was declared "Asian Longhorned Beetle Awareness Month" by governor proclamation. Intensive one-day surveys were done of high risk locations in Rutland (2,379 trees) and St. Albans (1,369 trees). Outreach included an exhibit at the National Tree Farm Convention, training UVM students, and over fifty other events. Thirty-eight campgrounds were surveyed for both insects, including eight private campgrounds surveyed by UVM student volunteers.

Parallel activities were also conducted as part of an ARRA (American Recovery and Reinvestment Act) funded Public Campground Invasive Species Survey and Outreach Project, conducted at State Park and Green Mountain National Forest campgrounds. In 2010 the project employed 35 part time people. In addition to surveys, the project supported state park interpreters and Vermont Youth Conservation Corp educators who highlighted invasive species in 22 parks and several GMNF campgrounds, contacting a total of 14,775 visitors. Kiln dried firewood was also purchased to provide to State Park campers that had their wood seized.

Altogether, surveys were conducted at 103 camping areas as part of these projects. No target insects have been found. To date, 133 campgrounds have been surveyed, including all 54 Vermont State Park campgrounds (Table 12, Figure 26).

Table 12. Vermont campgrounds surveyed for Asian longhorned beetle and emerald ash borer by ownership, survey year, and project.

Ownership	2009		2010			Total
	VTFPR	UVM	VTFPR	ARRA	UVM	
GMNF				41		**41**
Municipal	1		1	0		**2**
Private	4	4	20	0	8	**36**
State	21		9	24		**54**
Total	**30**		**103**			**133**

2010 was the second year of our State Park firewood restrictions. Overnight campers were asked to burn any firewood brought from over 50 miles away within 24 hours. Firewood that couldn't be burned in that timeframe was collected and exchanged for local wood. In 2009, about 200 bags of exchanged firewood were collected, the 2010 total was near 400 (approx. 5 cords). The increase may have been due to a higher camper visitation in 2010. Although not an inclusive list, collected wood originated from Vermont, New Hampshire, Massachusetts, Maine, New York, Connecticut, New Jersey, Pennsylvania, Florida, and Quebec.

We continued to work with the Vermont Campground Association and reached out to all private campgrounds with firewood hand out materials, an article in their summer newsletter and a firewood ad in the Vermont Campground Guide. Our state firewood web site has been updated.

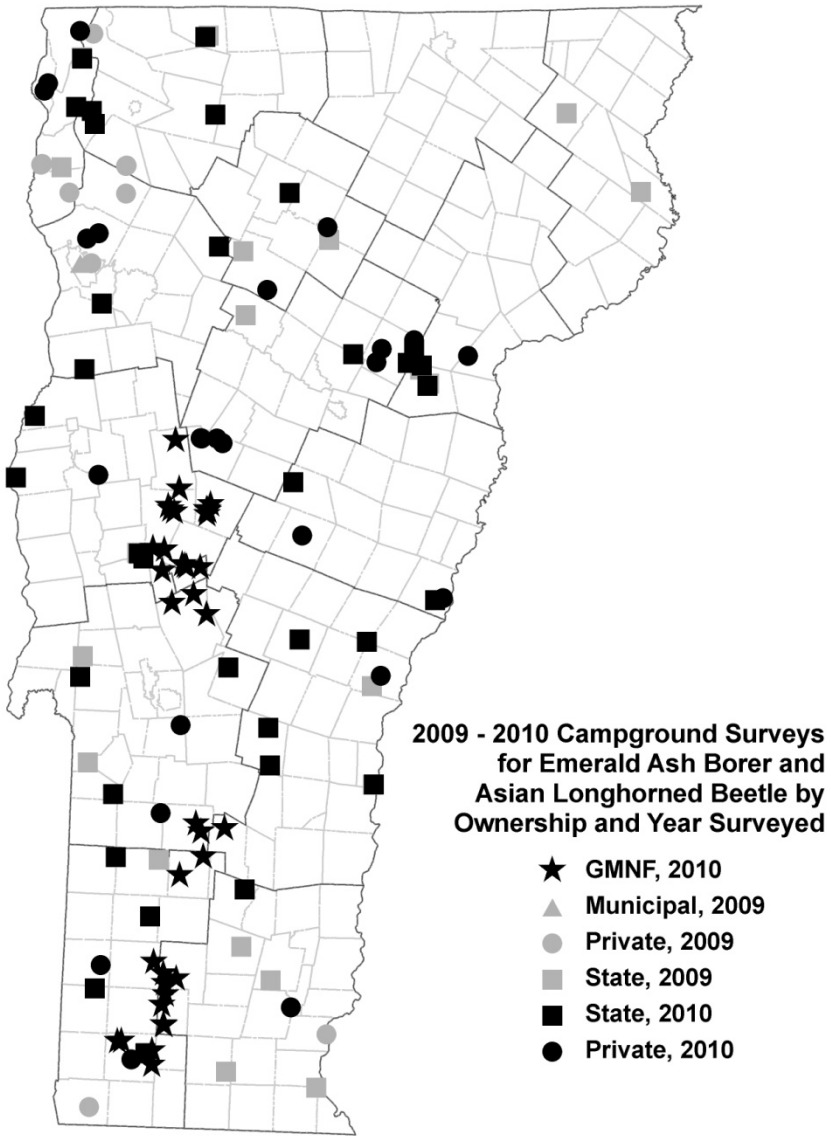


Figure 26. Campgrounds surveyed for Asian longhorned beetle and emerald ash borer by ownership and year surveyed.

Insects submitted as Asian longhorned beetle suspects included whitespotted and northeastern sawyer beetles (*Monochamus scutellatus* and *M. notatus*) as well as adult flower longhorned beetles (e.g., *Stictoleptura canadensis* and others), larvae of the sugar maple borer (*Glycobius speciosus*) and western conifer seedbugs (*Leptoglossus occidentalis*).

Emerald Ash Borer, *Agrilus planipennis,* was not observed and is not known to occur in Vermont. Emerald ash borer awareness and survey programs were included in the Northeast Forest Pest Outreach and Survey Project and American Recovery and Reinvestment Act project described under Asian longhorned beetle. In addition, several surveys specific to emerald ash borer were conducted.

The Agency of Agriculture, Food and Markets, led an effort to deploy purple traps at 480 campgrounds and other high risk sites (Figure 27). Very few buprestids were collected, with most caught during the mid-season lure change. No emerald ash borers were detected on the traps. USDA-PPQ will likely be setting over 2,000 purple traps next year throughout the state as part of the national survey.

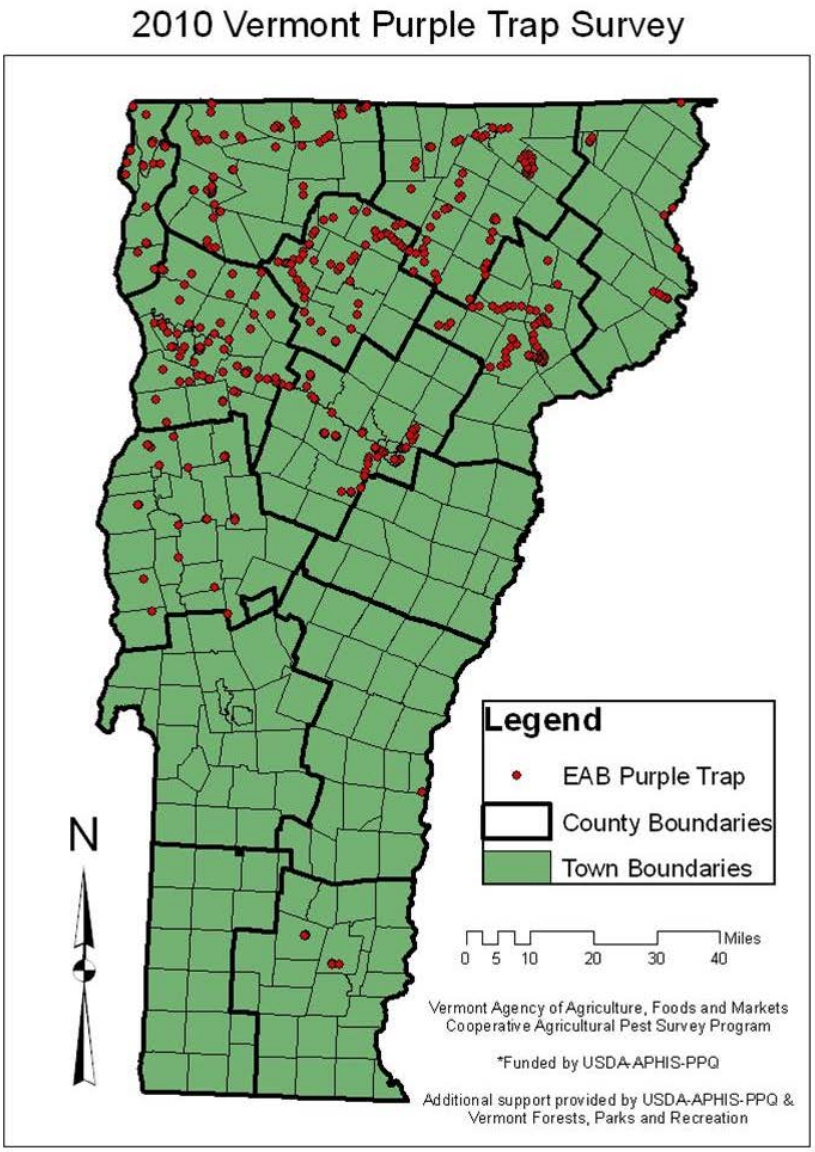


Figure 27. Location of Cooperative Agricultural Pest Survey Program emerald ash borer purple panel traps. One trap per site in 2010. *Credit: Vermont Agency of Agriculture, Food, and Markets.*

In addition, survey and monitoring efforts in Vermont and nine other states have involved locating and observing *Cerceris fumipennis*, a wasp that provisions the egg chambers of its nest with buprestid beetles, including emerald ash borer if it is present in the area. These efforts offer an efficient opportunity to augment more traditional trapping approaches that are being employed for early detection and monitoring of emerald ash borer.

Since 2009, cooperators in Vermont have surveyed 250 sites preliminarily selected through use of Geographic Information Systems to focus on sites with: a) soil characteristics conducive to wasp nest excavation and successful colony establishment; b) recreational sites likely to offer a combination of open exposure for nests and proximity to trees (host material for the beetles that the wasps collect); and c) proximity to one or more risk factors (potential introduction pathways) for emerald ash borer.

In 2010, 38 Vermont sites were identified as hosting active *Cerceris* nests (Figure 28 and Table 13). Eight of these were also visited and found active in 2009. In 2009, 77 buprestids were collected at 10 sites; in 2010, nearly 200 buprestids were collected with the assistance of 20 volunteers at 38 sites. These collections have led to a number of new buprestid presence records for the state but have not identified any emerald ash borer in Vermont to date. Sites in which colonies were observed in both years are identified with two site numbers.

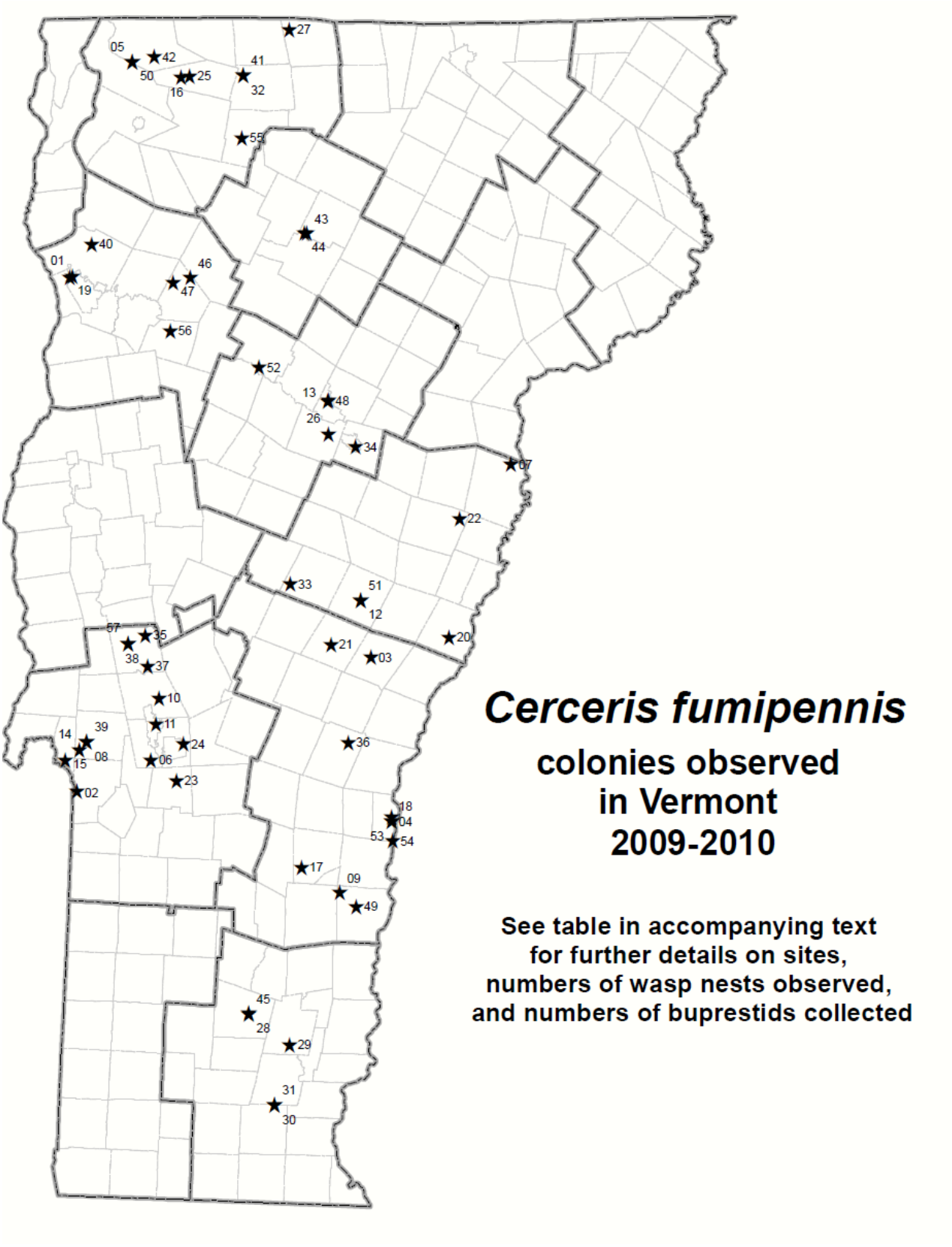


Figure 28. *Cerceris fumipennis* colonies observed in Vermont 2009-2010.

Table 13. Vermont sites where *Cerceris fumipennis* nests were found 2009-2010. Data include site name, town, county, year, number of nests, number of Buprestid beetles collected and coordinates.

Map #	SITE	TOWN	COUNTY	YEAR	# NESTS	# BUPRESTIDS	LAT	LONG
01	Flynn School	Burlington	Chittenden	2010	50	0	44.51684589	-73.26108473
02	Poultney Elementary School	Poultney	Rutland	2010	60	11	43.52524994	-73.23580212
03	Sharon Elementary School	Sharon	Windsor	2010	60	2	43.78456741	-72.45735727
04	Windsor Town Recreational Fields	Windsor	Windsor	2010	50	6	43.46920000	-72.40330000
05	Mississquoi Valley Union HS	Swanton	Franklin	2010	50	35	44.93069067	-73.10357770
06	West Rutland Recreation Area: Sabotkas	West Rutland	Rutland	2010	45	42	43.58565782	-73.04068113
07	Blue Mountain Union HS	Newbury	Orange	2010	45	0	44.15526664	-72.08138042
08	Castleton Hubbardton Elementary School	Castleton	Rutland	2010	40	22	43.62038118	-73.21110849
09	Ben and Jerry's Homemade Inc	Springfield	Windsor	2010	39	0	43.33193690	-72.54018728
10	Lothrop School	Pittsford	Rutland	2010	35	0	43.70493289	-73.01963408
11	Proctor Jr/Sr HS	Proctor	Rutland	2010	35	0	43.65552877	-73.02812882
12	Tunbridge Town Recreational Field	Tunbridge	Orange	2010	34	5	43.89564366	-72.48398258
13	Montpelier North Branch Park	Montpelier	Washington	2010	29	6	44.27824103	-72.57290068
14	Hydeville Recreation Ballfield	Castleton	Rutland	2010	25	0	43.60497243	-73.22995645
15	Fair Haven Recreation Field	Fair Haven	Rutland	2010	15	9	43.58435750	-73.26740269
16	Sheldon Elementary School	Sheldon Junction	Franklin	2010	10	0	44.90175465	-72.97113779
17	Greven Field	Cavendish	Windsor	2010	9	0	43.38002449	-72.63971234
18	Ascutney Cemetery	Windsor	Windsor	2010	9	0	43.47793123	-72.40334413
19	Starr Farm Off Leash Dog Park	Burlington	Chittenden	2010	6	4	44.51282552	-73.26727905
20	Union Village Dam	Thetford	Orange	2010	6	7	43.82355366	-72.24928107
21	Hitching Post Farm	Royalton	Windsor	2010	6	0	43.81042574	-72.56248962
22	Corinth Fairgrounds	Corinth	Orange	2010	5	0	44.05186947	-72.21949804
23	Mill River Union HS	Clarendon	Rutland	2010	4	0	43.54600620	-72.97194561
24	Rutland High School	Rutland City	Rutland	2010	2	0	43.61684318	-72.95455174
25	Sheldon Little League American Legion Ballfield	Sheldon Junction	Franklin	2010	1	0	44.90290000	-72.94750000
26	Berlin Elementary School	Berlin	Washington	2010	1	0	44.21510783	-72.57119984
27	Richford Playground	Richford	Franklin	2010	55	10	44.99379295	-72.67779230
28	Stephen Ballantine Memorial Field	East Jamaica	Windham	2010	30	25	43.09862651	-72.77922505
29	West River Camp-a-rama	Townshend	Windham	2010	20	17	43.03910000	-72.67130000
30	Old gravel pit on Augur Hole-North	Marlboro	Windham	2010	12	0	42.92244142	-72.71124746
31	Old gravel pit on Augur Hole-South	Marlboro	Windham	2010	8	0	42.92244142	-72.71124746
32	Enosburg Elementary School	Enosburg	Franklin	2010	8	0	44.90535843	-72.80203543
33	Randolph Municipal Recreation Area	Randolph	Orange	2010	7	0	43.92580000	-72.67150000

Map #	SITE	TOWN	County	YEAR	# NESTS	# BUPRESTIDS	LAT	LONG
34	Spaulding High School	Barre City	Washington	2010	6	0	44.18991022	-72.49683734
35	Neshobe Elementary School	Forestdale	Rutland	2010	2	0	43.82611945	-73.05709621
36	Vail Field	Woodstock	Windsor	2010	1	0	43.62060000	-72.51740000
37	Otter Valley Union HS	Brandon	Rutland	2009	6	0	43.76580000	-73.05140000
38	Estabrook Recreation Field	Brandon	Rutland	2009	3	0	43.81080000	-73.10339999
39	Castleton Hubbardton Elementary School	Castleton	Rutland	2009	50	5	43.62040000	-73.21110000
40	Home stone patio	Colchester	Chittenden	2009	1	0	44.57860509	-73.20973187
41	Enosburg Elementary School	Enosburg	Franklin	2009	4	2	44.90535843	-72.80203543
42	Highgate Elementary	Highgate	Franklin	2009	100	0	44.94046619	-73.04409297
43	Lamoille Union HS	Hyde Park	Lamoille	2009	10	0	44.60260000	-72.62870000
44	Rte 15 ballfield	Hyde Park	Lamoille	2009	3	0	44.60130080	-72.63611535
45	Stephen Ballantine Memorial Field	East Jamaica	Windham	2009	116	2	43.09857748	-72.77923871
46	Mills Riverside Park	Jericho	Chittenden	2009	12	0	44.51617474	-72.94257732
47	Jericho Elementary School	Jericho	Chittenden	2009	12	0	44.50577620	-72.98897718
48	Montpelier North Branch Park	Montpelier	Washington	2009	6	0	44.27980000	-72.57140000
49	Riverside Park	Springfield	Windsor	2009	30	1	43.30480000	-72.49530000
50	Mississquoi Valley Union HS	Swanton	Franklin	2009	20	6	44.93070081	-73.10357772
51	Tunbridge Town Recreational Field	Tunbridge	Orange	2009	30	22	43.89564364	-72.48419978
52	Old outdoor ice rink	Waterbury	Washington	2009	1	0	44.34300000	-72.75720000
53	Windsor Town Recreational Fields	Windsor	Windsor	2009	200	53	43.46920000	-72.40330000
54	Back Mountain Gravel Pit	Windsor	Windsor	2009	15	1	43.43140000	-72.39990000
55	Bakersfield Elementary School	Bakersfield	Franklin	2009	10	0	44.78509127	-72.80475991
56	Camels Hump Middle School	Richmond	Chittenden	2010	6	0	44.41304097	-72.99591094
57	Estabrook Recreation Field	Brandon	Rutland	2010	6	0	43.81080000	-73.10340000

Buprestid identifications for 2008-2009 are included in Table 14. Besides the 77 buprestids collected from *Cerceris* sites in 2009, note that Table 14 includes 24 specimens taken from emerald ash borer purple sticky traps that were deployed in 2008 and 2009 through the Agency of Agriculture. (Refer to "How collected" column to determine method of capture.)

Of the 77 intact buprestids collected at *Cerceris* nest sites in 2009, 50 were *Dicerca divaricata*. Fragments such as wing covers, abdomens, and headless buprestids collected at *Cerceris fumipennis* sites in 2009 were all *Dicerca* spp. Those numbers are not reflected in total catch for 2009.

Table 14. Buprestid beetles collected in Vermont in 2008-2009 during *Cerceris fumipennis* biosurveillance and purple trap surveys. Table includes species list, numbers collected per site, details on location, how the beetles were collected and date of collection.

Species	No	County	Town	Site	Coordinates (NAD 83)	How collected?	Date
Agrilus anxius Gory	11	Franklin	Georgia	VTEAB09120, Georgia Rest Area I89 North Bound	44.74694, -73.07789	Purple Trap	8/13/2009
Agrilus arcuatus	1	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Stolen from *Cerceris*	7/28/2009
Agrilus politus (Say)	1	Franklin	Georgia	Trap VTEAB09120, Georgia Rest Area I89 North Bound	44.74694 -73.07789	Purple Trap	8/13/2009
Agrilus sayi Saunders	1	Grand Isle	Grand Isle	Trap VTEAB0869, Grand isle State Park	44.68672 -73.29075	Purple Trap	9/10/2009
	1	Grand Isle	Grand Isle	Trap VTEAB09072, Grand Isle	44.68708 -73.292207	Purple Trap	7/31/2009 or 9/11/2009
Buprestis maculativentris Say	1	Franklin	Enosburg	Enosburg Jr/Sr High School	44.90565 -72.80449	Dropped by *Cerceris*	8/4/2009
Buprestis striata F.	1	Windsor	Windsor	Back Mtn. Gravel Pit	43.431353 -72.39985	Stolen from *Cerceris*	7/23/2009
Chrysobothris femorata (Olivier)	2	Caledonia	Groton	Trap VTEAB0833, Stillwater Campground	44.2776 -72.2705	Purple Trap	7/29/2008
Chrysobothris sexsignata (Say)	1	Rutland	Castleton	Castleton-Hubbardton Elementary School	43.61962 -73.21139	Stolen from *Cerceris*	7/25/2009
	1	Chittenden	Williston	Trap VTEAB0876, Williston I-89 Northbound Rest Area	44.43642 -73.07801	Purple Trap	7/24/2008
	1	Washington	Moretown	Trap VTEAB0811, Wimble Woods	44.25761 -72.71982	Purple Trap	6/18/2008
	1	Addison	Cornwall	Trap VTEAB08 BB, Morse Road	43.96660 -73.17881	Purple Trap	9/8/2008
	1	Addison	Addison	Trap VTEAB09102, DAR State Park	44.055962 -73.41456	Purple Trap	9/14/2009
Dicerca caudata LeConte	1	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Dropped by *Cerceris*	8/3/2009

Species	No	County	Town	Site	Coordinates (NAD 83)	How collected?	Date
	2	Rutland	Castleton	Castleton-Hubbardton Elementary School	43.61962 -73.21139	Dropped by *Cerceris*	8/5/2009
	8	Orange	Tunbridge	Tunbridge Town Rec Field	43.89534 -72.48417	Dropped by *Cerceris*	8/18/2009
	1	Windham	Jamaica	Stephen Ballantine Memorial Ballfield	43.09994 -72.77928	Stolen from *Cerceris*	7/30/2009
	1	Windham	Jamaica	Stephen Ballantine Memorial Ballfield	43.09994 -72.77928	Dropped by *Cerceris*	7/30/2009
Dicerca divaricata (Say) (cont')	2	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Dropped by *Cerceris*	8/3/2009
	9	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Dropped by *Cerceris*	7/28/2009
	1	Orange	Tunbridge	Tunbridge Town Rec Field	43.89534 -72.48417	Dropped by *Cerceris*	9/1/2009
	4	Franklin	Swanton	Mississquoi Valley Union HS	44.93229 -73.10470	Dropped by *Cerceris*	8/13/2009
	1	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Stolen from *Cerceris*	7/23/2009
	1	Windsor	Springfield	Riverside Park	43.30483 -72.49527	Dropped by *Cerceris*	7/23/2009
	1	Franklin	Bakersfield	Bakersfield Elementary School	44.78405 -72.80314	Dropped by *Cerceris*	8/4/2009
	2	Chittenden	Colchester	Not given*	44.54369 -73.14767	Dropped by *Cerceris*	8/9/2009
	1	Grand Isle	Maidstone	Trap 42, Maidstone State Park	44.63616 -71.64536	Purple Trap	7/25/2009
	2	Franklin	Georgia	Trap VTEAB09120, Georgia Rest Area	44.74694 -73.07789	Purple Trap	8/13/2009
	1	Orange	Tunbridge	Tunbridge Town Rec Field	43.89534 -72.48417	Stolen from *Cerceris*	9/4/2009
	1	Windsor	Bethel	Trap VTEAB09-021, Silver Lake State Park	43.73163 -72.61510	Purple Trap	8/14/2009
	1	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Dropped by *Cerceris*	7/28/2009
Dicerca lurida (F.)	1	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Dropped by *Cerceris*	8/3/2009
Dicerca tuberculata (G&L)	1	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Dropped by *Cerceris*	7/28/2009
Phaenops fulvoguttata (Harris)	1	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Dropped by *Cerceris*	8/3/2009
	1	Franklin	Enosburg	Enosburg Jr/Sr High School	44.90565 -72.80449	Dropped by *Cerceris*	8/4/2009
	1	Windsor	Windsor	Windsor Town Rec Field	43.46924 -72.40329	Stolen from *Cerceris*	7/28/2009
	1	Windsor	Windsor	Windsor Town Rec Field	43.469240 -72.403290	Dropped by *Cerceris*	7/28/2009
Poecilonota cyanipes (Say)	1	Franklin	Swanton	Mississquoi Valley Union HS	44.93229 -73.10470	Dropped by *Cerceris*	8/13/2009

2010 records provided below (Table 15) include a list of species, whether they were associated with *Cerceris fumipennis* sites or captured on purple traps, and counts. For more details on sites, dates and methods of collection for these specimens, contact the Forest Biology Lab. Taxonomic assistance for this work has been and continues to be provided by E. Richard Hoebeke at Cornell University.

Table 15. Buprestid beetles collected in 2010 during *Cerceris fumipennis* biosurveillance and purple trap surveys.

Species	Number Collected		
	At Cerceris Sites	On Purple Traps	Total
Agrilus anxius Gory	7	18	25
Agrilus bilineatus (Weber)		2	2
Agrilus spp. undetermined	1		1
Buprestis maculativentris Say	2		2
Buprestis striata F.	3		3
Chrysobothris chlorocephala	1		1
Chrysobothris femorata (Olivier)		2	2
Chrysobothris sexsignata (Say)	9	3	12
Chrysobothris spp. undetermined		2	2
Dicerca caudata LeConte	13		13
Dicerca divaricata (Say)	121	13	134
Dicerca lurida (F.)	11	1	12
Dicerca tenebrica (Kirby)	9	1	10
Dicerca tenebrosa (Kirby)	1		1
Dicerca tuberculata (G&L)	2	1	3
Dicerca spp. undetermined	7		7
Eupristocerus cognitans (Weber)	1		1
Phaenops fulvoguttata (Harris)	3	1	4
Poecilonota cyanipes (Say)	6		6
Total	**197**	**44**	**241**

Besides the species listed in Tables 14 and 15 above, other buprestids that are part of our collection through 2010 include *Actenodes acornis* (Say), *Agrilus ruficollis* (F.), *Buprestis aurulenta* L., *Chrysobothris cribrarium*, and *Chrysobothris harrisi* (Hentz). Buprestids collected at Foss Farm in Massachusetts on July 30, 2008 at a *Cerceris* training session, and identified by E. Richard Hoebeke this year, included *Agrilus arcuatus* (Say) (2 specimens), *Agrilus bilineatus* (Weber) (1), *Brachys ovatus* (Weber) (2), *Buprestis nutalli* Kirby (1), *Buprestis striata* F. (1), *Dicerca caudata* LeConte (1), *Dicerca divaricata* (Say) (8), *Dicerca punctulata* (Schoenherr) (1), and *Dicerca tenebrica* (Kirby) (1).

Buprestids submitted by the public as emerald ash borer suspects included *Buprestis striata* and *Dicerca* spp. Among the other insects submitted by the public as suspects were the six-spotted tiger beetle, *Cicindela sexguttata*, and ground beetles in the genera *Carabus* and *Calosoma*.

After three years of negative surveys, a single **European Wood Wasp,** *Sirex noctilio*, specimen was collected in Burlington this year in an exotic woodboring bark beetle trap. The location was the McNeil wood energy plant. The Lindgren funnel trap was baited with a triple lure, a three-part attractant primarily designed to attract *Ips* species. The area in which the trap was hung was in close proximity to the McNeil plant's storage site for logs that are eventually slated for chipping. The European wood wasp was likely transported to the site via one of these logs. The only previous time the wasp was detected in Vermont was in 2007, in Lamoille County, so this makes the second confirmed detection in the state. USDA-PPQ deployed 135 traps for the European wood wasp this year (10 in each county except in Grand Isle County) but did not trap any European wood wasps in these traps. It is unclear whether PPQ will continue trapping for the European wood wasp in 2011. There are no federal or state quarantines on this pest.

Trypodendron Bark Beetle Surveys

In 2010, 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. We used Uni-Traps and Lindgren funnel traps. Lures deployed depended on stand type. In the spruce stand, we used lineatin pheromone lure, and low release alpha-pinene and ethanol. Alpha-pinene was not used in the birch stand, as it is a deterrent to the *Trypodendron* species that might be found in hardwood stands. In those stands, we used a combination of lineatin, low release 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).

We trapped *Trypodendron* beetles at three sites: two yellow birch stands and a red spruce stand, all in Lincoln (Addison County). A total of five traps were deployed. In one of the birch sites, we used both a Lindgren funnel trap and a Uni-trap. The second birch site contained two Lindgren funnel traps, and the spruce site contained a single Uni-trap.

A total of 454 bark beetles was collected in the traps. Of these, 61 were *Trypodendron* beetles, including five different species: *T. lineatum*, *T. betulae*, *T. retusum*, *T. rufitarsis* and *T. borealis*. The most numerous species of bark beetle collected during the survey (350 specimens) was *Anisandrus sayi.* Others species of Scolytinae collected during the survey included *Xyloterinus politus* (7), *Anisandrus dispar* (1), *Xyleborinus alni* (26), *Monarthrum fasciatus* (1), *Monarthrum mali* (3), *Gnathotrichus materiarius* (2), *Dryocetes autographus* (2), and *Hylesinus aculeatus* (1).

Table 16. Trap sites and collection dates for *Trypodendron* taxonomic survey conducted in Vermont in 2010. Data include counties, towns, coordinates, trap and lure types, host trees, first and last 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, Birch Site 1	44.03690 -73.00305	Lindgren funnel trap	UHR Ethanol + birch branch	Birch, Yellow	30-Apr-10	07-May-10	1	0	0	1	0
					13-May-10	21-May-10	0	0	0	0	0
					21-May-10	27-May-10	0	0	0	0	0
					27-May-10	04-Jun-10	0	0	0	0	0
		Uni-trap	Lineatin + ethanol	Birch, Yellow	10-Mar-10	07-Apr-10	0	0	1	0	1
					07-Apr-10	14-Apr-10	0	0	0	2	0
					30-Apr-10	07-May-10	0	0	1	0	0
					21-Apr-10	21-May-10	0	0	0	0	0
				TOTALS			1	0	2	3	1
Addison Co., Lincoln, Birch Site 2	44.05932 -73.00564	Lindgren funnel trap with lure	UHR Ethanol + birch branch	Birch, Yellow	21-Apr-10	30-Apr-10	0	0	0	2	0
					30-Apr-10	07-May-10	0	0	0	0	0
					13-May-10	21-May-10	0	0	0	0	0
					21-May-10	27-May-10	0	0	0	0	0
					27-May-10	04-Jun-10	0	0	0	0	0
				TOTALS			0	0	0	2	0
Addison Co., Lincoln, Site 2	44.03560 -73.00116	Uni-trap	Lineatin, alpha-pinene + ethanol	Spruce, Red	10-Mar-10	19-Mar-10	0	0	0	0	1
					19-Mar-10	25-Mar-10	0	0	0	0	7
					25-Mar-10	01-Apr-10	0	0	0	0	4
					01-Apr-10	07-Apr-10	0	0	4	0	14
					14-Apr-10	30-Apr-10	0	0	1	0	0
					30-Apr-10	07-May-10	0	0	3	0	0
					21-May-10	27-May-10	0	13	0	0	0
					27-May-10	04-Jun-10	0	4	0	0	1
				TOTALS			0	17	8	0	27
				GRAND TOTALS			1	17	10	5	28

OTHER BARK AND WOOD INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Ash Bark Beetle *Hylesinus aculeatus*	Ash	Scattered reports	Galleries observed in downed ash; numerous adults emerging from firewood and logs.
Asian Longhorned Beetle *Anoplophora glabripennis*			See narrative.
Bronze Birch Borer *Agrilus anxius*	Birch	Scattered observations	Associated with ornamentals; adult beetles were taken from emerald ash borer purple sticky traps and *Cerceris* sites.
Brown Prionid *Orthosoma brunneum*	Hardwoods	Champlain Basin, Waterbury	Numbers of observations of adult beetles were up this year.
Brown Spruce Longhorned Beetle *Tetropium fuscum*			Not known to occur in Vermont.
Carpenter Ant *Camponotus spp.*	Various	Widespread observations	Most ants observed in downed trees or homes.
Emerald Ash Borer *Agrilus planipennis*			See narrative.
European Shothole Borer *Anisandrus dispar*	Magnolia, apricot	Elmore	Adult beetles found in nursery stock; lives up to its name by leaving trees with holes resembling tiny shot holes.
European Woodwasp *Sirex noctilio*			See narrative.
Hemlock Borer *Phaenops fulvoguttata*			Collected at *Cerceris* sites and on emerald ash borer purple traps (see Table 15).
Maple Callus Borer *Synanthedon acerni*	Sugar maple	Weathersfield	Individual tree.

OTHER BARK AND WOOD INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Metallic Woodboring Beetles Family Buprestidae	Various	Sudbury, Fairfax, Middlebury, Underhill	Submitted as Emerald Ash Borer suspects; included *Buprestis striata* and *Dicerca* spp.
Northeastern sawyer *Monochamus notatus*	Conifers	Scattered observations	No damage observed. Some adults seen in flight; some specimens submitted as Asian longhorned beetle suspects.
Osmoderma Beetles *Osmoderma eremicola* and *O. scabra*	Sugar maple	Calais, Waterbury	Sizable, fleshy scarab larvae found in moist, frass-filled chambers at the bottom of hollow sections of a tree, where multiple roots join, or where rot occurring.
Pigeon Tremex *Tremex columba*	Hardwoods	Scattered throughout	Common in declining trees. Several calls involved pigeon tremex tunnels that were mistaken for Asian longhorned beetle damage.
Pine Engraver *Ips pini*	Pine	Scattered throughout	Associated with decline and common in stressed trees; reared from felled red pine at site where trees were declining.
Pine Gall Weevil *Podapion gallicola*	Red Pine	Statewide	Continues to be noticeable in red pine plantations. See Red Pine Decline.
Powderpost Beetles Families Anobiidae, Bostrichidae and Lyctidae	Various	Chittenden, Bennington, Georgia, Barre	Numerous beetles found in log cabin; others emerging from lumber. Specimens from Georgia were Anobiids in the genus *Priobium*, probably *P. sericeum*. Anobiids from Barre packing material were *Sinoxylon* sp.
Redheaded Ash Borer *Neoclytus acuminatus*	Ash	Champlain Valley	Moderate populations.
Ribbed Pine Borer *Rhagium inquisitor*	Pine	Cabot, Morrisville	Beetle landed on forester; others collected near camp in vicinity of heavily weakened and dying trees.

OTHER BARK AND WOOD INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Round-headed Apple Tree Borer *Saperda candida*	Apple, Linden	Widely scattered	Observed on single trees in ornamental and orchard settings.
Smaller Japanese Cedar Longhorned Beetle *Callidiellum rufipenne*			Not known to occur in Vermont.
Sugar Maple Borer *Glycobius speciosus*	Sugar maple	Common throughout	In some sites, apparently associated with intermediate trees. Damage occasionally mistaken for Asian Longhorned Beetle by the public.
Tanbark Borer *Phymatodes testaceus*	Oak	Middlebury, Grand Isle	Emerged from firewood.
Whitespotted Sawyer *Monochamus scutellatus*	White pine	Scattered throughout	Generally causing incidental damage on cut or damaged pine. Beetles in flight occasionally seen and submitted as suspect Asian longhorned beetle. Landowners curious about munching sounds coming from downed trees. Some adult beetles found in log cabin.

Bark and Wood Insects not reported in 2010 include Allegheny Mound Ant, *Formica exsectoides*; Elm Bark Beetle, *Hylurgopinus rufipes* and *Scolytus multistriatus*; Locust Borer, *Megacyllene robiniae*; Pitted Ambrosia Beetle, *Corthylus punctatissimus*.

FRUIT, NUT AND FLOWER INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Asiatic Garden Beetle *Autoserica castanea*	Many	Champlain Valley, Walden, Cabot	Moderate to heavy populations.
Rose Chafer *Macrodactylus subspinosus*			See table in Hardwood Defoliators.
Western Conifer Seed Bug *Leptoglossus occidentalis*			See table in Sapsucking Insects, Midges and Mites.

Fruit, Nut and Flower Insects not reported in 2010 include Ash Flowergall Mite, *Aceria fraxiniflora*; Butternut curculio, *Conotrachelus juglandis*; Mossy Rose Gall, *Diplolepis rosae*; Plum Curculio, *Conotrachelus nenuphar*.

STEM DISEASES

Mortality from the recent spike in **Beech Bark Disease** caused by *Cryptococcus fagisuga* and *Neonectria faginata* continues statewide, although appears to be tapering off. Advanced decline was commonly reported, with 14,738 acres mapped during aerial surveys, a decrease from 25,469 acres in 2009 (Table 17 and Figure 29). This is an increase from 2008, but similar to 2007. The Agency of Natural Resources is finalizing management guidelines to optimize yields in beech mast production areas. These guidelines will incorporate beech bark disease symptoms as well as wildlife needs.

Table 17. Mapped acres of beech bark disease in 2010.

County	Acres
Addison	251
Bennington	682
Caledonia	2,125
Chittenden	591
Essex	3,669
Franklin	238
Grand Isle	0
Lamoille	12
Orange	1,178
Orleans	1,678
Rutland	923
Washington	349
Windham	1,935
Windsor	1,109
Total	14,738

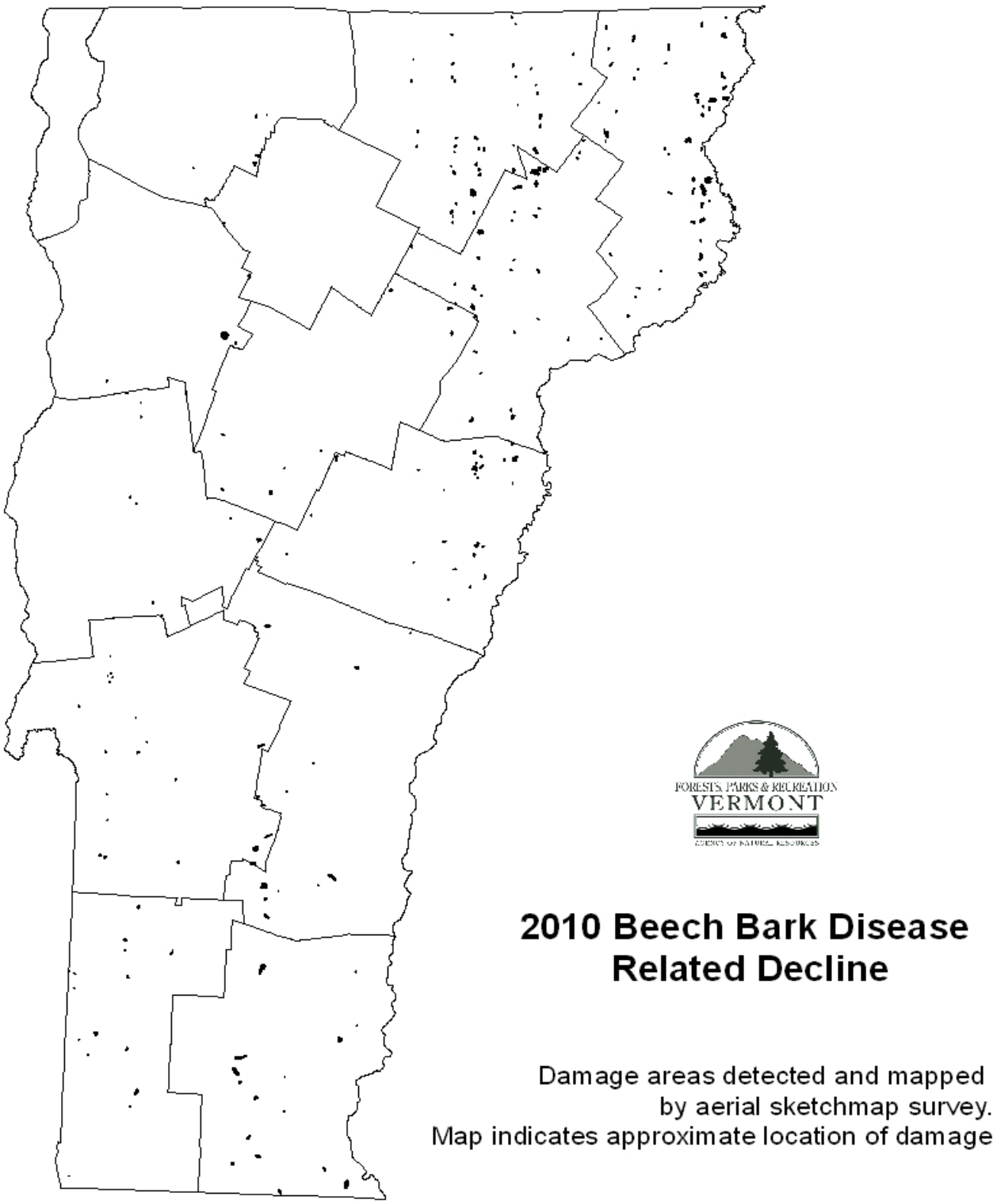


Figure 29. Beech bark disease related decline mapped in 2010. Mapped area includes 14,738 acres.

Levels of **Butternut Canker**, *Sirococcus clavigignenta-juglandacearum*, remain stable, with most surviving butternuts showing symptoms of the disease.

We continued a project to preserve butternut germplasm in collaboration with the states of Iowa, Connecticut, Pennsylvania, and Indiana, and coordinated in Vermont by Dr. Dale Bergdahl of Plant Technologies LLC. Scion collections were made from likely candidate butternut trees in Chittenden, Franklin and Washington counties during the winter of 2010. A total of 43 trees were sampled. Some scions from each tree were sent to Dr. Jeanne Romero-Severson at Notre Dame University for genetic testing to be sure that the trees were pure butternut. All of the trees sent for grafting were found to be pure.

Of the 43 sample trees, 33 were sent for grafting to Mark Coggeshall in Missouri. (The trees that were collected from late in the winter were not suitable for grafting due to their lack of dormancy.) Plans are to continue scion collection this winter on some of these potential sources and to make progress on securing a site to eventually outplant the grafts.

Publicity has been an important component of this project. An interview on VPR generated quite a bit of interest from the public. Many reports were received from interested citizens volunteering their trees to be considered as candidates for grafting.

Flagging and mortality from **Dutch Elm Disease**, *Ophiostoma novo-ulmi*, were commonly observed. Wet springs often allow the disease to spread more quickly through a diseased tree, while dry summers may exacerbate wilting. In June of 2010, The Nature Conservancy planted 30 "tolerant" American elms at each of three Vermont sites (in Cornwall, Maidstone, and Shelburne). The stock included 6 parent "selections" from the USFS tree nursery in Delaware, Ohio. Silver maple saplings were planted between the elms to serve as "guard" trees to delay root grafting among the elms. The hope is that local elms will cross-pollinate with the disease-tolerant planted elms, and the offspring will have a better chance of survival. The plants will be monitored for mortality in spring 2011 and periodically thereafter.

Sirococcus Shoot Blight, caused by, *Sirococcus conigenus,* was identified by Isabel Munck, of the US Forest Service from dying shoots collected in red pine plantations in Chelsea and Williamstown. At the Chelsea Municipal Forest site, the fungus was also found on dead shoots from understory red pine regeneration. Diplodia shoot blight was also found at the Williamstown site, but is thought to be less important in causing tree decline at that location. Red pines next to the edge of openings in the canopy were most severely affected.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Annual Canker *Fusarium* sp.	Red maple	Occasionally noted throughout	Individual trees.
Ash Yellows *Candidatus* Phytoplasma fraxini	Ash	Widely scattered	Continues to be associated with ash decline. Most noticeable at lower elevations.
Beech Bark Disease *Cryptococcus fagisuga* and *Nectria coccinea* var. *faginata*			See narrative.
Black Knot *Dibotryon morbosum*	Black cherry	Widespread, common throughout	More noticeable than 2009 in Taconic Mountains, but otherwise at consistent levels.
Butternut Canker *Sirococcus clavigignenta-juglandacearum*			See narrative.
Chestnut Blight *Cryphonectria parasitica*	Chestnut	Champlain Valley and Southern Vermont	Common where chestnut occurs.
Cytospora Canker *Leucostoma kunzei*	Spruce, Fir	Widespread	Common on ornamentals.
Dutch Elm Disease *Ophiostoma novo-ulmi*			See narrative.
Fir-Blueberry Rust *Pucciniastrum geoppertianum*	Blueberry	Lunenburg	Causing witches brooms on blueberry bushes.
Hypoxylon Canker *Hypoxylon pruinatum*	Aspen	Champlain Valley, Central Vermont	Average levels.
Nectria Canker *Nectria galligena*	Hardwoods	Statewide	Average levels.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Phomopsis Gall *Phomopsis* sp.	Hickory	St. Albans	Street trees.
Red Ring Rot *Phellinus pini*	Conifers	Widely scattered	Common in overstocked and overmature stands and on wet sites.
Verticillium Wilt *Verticillium albo-atrum*	Sugar maple	West Pawlet	4" dbh tree quickly died during summer - discoloration (bluish green) on cambium around base of Sugar Maple (Legacy variety).
White Pine Blister Rust *Cronartium ribicola*	White pine	Widely scattered	Rarely causing significant damage.
Yellow Witches Broom Rust *Melampsorella caryophyllacearum*	Balsam fir	Widely scattered	Levels comparable to 2009.

Stem Diseases not reported in 2010 include Caliciopsis Canker, *Caliciopsis pinea*; Delphinella Tip Blight of Fir, *Delphinella balsamae*: Eastern Dwarf Mistletoe, *Arceuthobium pusillum*, Fireblight, *Erwinia amylovora*; Oak Wilt, *Ceratocystis fagacearum*; Sapstreak, *Ceratocystis coerulescens*; Scleroderris Canker, *Ascocalyx abietina*; Sirococcus, *Sirococcus strobilinius*; Woodgate Gall Rust, *Endocronartium harknessii*.

FOLIAGE DISEASES

Brown Spot Needle Blight, caused by *Scirrhia acicola,* was heavy again on red and white pine for the 5th consecutive year. Previous year needles on many trees browned up in early spring.

Widespread **White Pine Needle Damage** developed suddenly in late May. One-year old needles changed color, especially on lower branches. The symptoms were attributed to a combination of spring weather and disease fungi.

Brown spot needle blight**,** caused by *Scirrhia acicola,* and Canavirgella needlecast, caused by *Canavirgella banfieldii,* were both commonly associated with the damage. We collected white pine samples from 7 locations. Of these, *S. acicola* was identified from all sites, and *C. banfieldii* was identified from 3. Fungal disease symptoms in 2010 reflect above average precipitation in May and June of 2009.

May weather seemed to have been the trigger for the early symptom expression. Discoloration of 1-year old foliage on white pine has been documented when warm spring weather is followed by hard frost. Although some of the symptoms were noticeable before late May, the temperatures in the 90's on the 25th and 26th, may have triggered the sudden desiccation of injured foliage.

Trees looked better, but thin, once new growth emerged and brown needles had been cast. Because topmost branches were rarely affected, most trees are expected to recover. We have been reporting heavy pine needlecast since 2005, but are not aware of significant impacts to tree health outside of wet areas where the fungus disease is unusually heavy and trees are already stressed by soil saturation.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Anthracnose *Glomerella* spp. *Apiognomonia* spp. *Gloeosporium* spp.	Hardwoods	Scattered throughout	Light to moderate damage. In some sites, anthracnose was combined with *Septoria*, scorch and maple trumpet skeletonizer.
Apple Scab *Venturia inaequalis*	Apple	Widely scattered	Down from previous years.
Arborvitae Leaf Blight *Pestalotiopsis* sp.	Arborvitae	Springfield	Moderate damage to hedge.
Ash Anthracnose *Gloeosporium aridum*	Ash	Widely scattered	Level comparable to 2009.
Brown Spot Needle Blight *Scirrhia acicola* *Mycosphaerella dearnessii*			See narrative under Brown Spot and White Pine Needle Damage.
Canavirgella Needlecast *Canavirgella banfieldii*			See narrative under White Pine Needle Damage.
Cedar-Apple Rust *Gymnosporangium spp.*	Apple, cedar	Throughout	Widespread in apple orchards and elsewhere, moderate levels.
Fir Fern Rust *Uredinopsis mirabilis*	Balsam fir	Scattered reports	Levels comparable to 2009.
Giant Tar Spot *Rhytisma acerinum*	Norway maple	Throughout	Heavy and noticeable in many areas, but premature defoliation minimal.
Hemlock-Poplar Rust *Melampsora abietis-canadensis*	Hemlock	Manchester Center	On hemlock, this rust fungus produces yellow spermagonia and powdery aecia form on the needles, green stems, and cones. Later, infected shoot tips die and the cones may shrivel, blacken, and hang as mummies.
Juniper Blight *Phomopsis* or *Kabatina*	Skyrocket junipers	Hyde Park	Junipers totally brown from the blight.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Maple Anthracnose *Gloeosporium sp.*	Maple	Sharon	Riparian area.
Poplar Leaf Blight *Marssonina spp.*	Balsam poplar	Eastern Vermont	Moderate to heavy. 256 acres mapped during aerial surveys.
Powdery Mildew *Eryiphaceae* *Erysiphe polygoni*	Hardwoods	Widely scattered	Heavy on Norway maple in St. Albans.
Rhizosphaera Needlecast of Spruce *Rhizosphaera kalkhoffi*	Spruce	Throughout	Moderate to occasionally heavy damage. Some blue spruce mortality observed from previous defoliations. Norway spruce defoliation observed in Manchester. Usual number of homeowner calls.
Septoria Leaf Spot *Septoria aceris*	Maple	Throughout	Common, light to moderate damage. Also observed on NAMP plots and state-leased sugarbushes.
Septoria Leaf Spot *Septoria betulae*	Birch		See hardwood defoliators: Birch Defoliation.
Swiss Needlecast *Phaeocryptopus gaeumannii*	Douglas fir	Wilmington	Heavy in lower crowns of hedge trees.
Tar Spots *Rhytisma acerinum* *Rhytisma punctatum*	Maple	Widely scattered	Minor tar spots on native maples.
Willow Scab *Venturia saliciperda*	Willow	Chittenden, Rutland and Windham Counties	Causes scab-like, black lesions on willow shoots. Early signs include masses of olive green spores along the veins on the underside of leaves. Noticeable defoliation noted in riparian sites and other wet areas.

Foliage Diseases not reported in 2010 include Balsam Fir Needlecast, *Lirula nervata*; Cyclaneusma Needlecast, *Cyclaneusma minus*; Dogwood Anthracnose, *Discula destructiva*; Larch Needlecast, *Mycosphaerella sp.*; Lophodermium Needlecast, *Lophodermium seditiosum*; Rhabdocline Needlecast, *Rhabdocline pseudotsugae*; Rhizosphaera Needle Blight, *Rhizosphaera pini*.

ROOT DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Armillaria or Shoestring Root Rot *Armillaria* spp.	Many	Widespread	Associated with red pine decline and defoliation-related decline. Continues to be an increasing problem in Christmas tree plantations that are on their third or fourth rotation, especially choose and cut plantations. Common on stressed trees and stands.
Brown Cubical Rot *Polyporous schweinitzii*	White Pine	Lincoln	Poorly drained stand.
Dead Man's Fingers *Xylaria* sp.	Sugar maple	Scattered throughout	Occasionally observed.

Root Diseases not reported in 2010 include Annosus Root Rot, *Heterobasidion annosum*; Tomentosus Root Rot, *Inonotus tomentosus.*

DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

Birch Decline and Mortality appears to be stable with 1,017 acres mapped in 2010 compared to 1,743 in 2009 (Table 18). Most of this damage is old mortality that remains evident, especially on paper birch at upper elevations.

Table 18. Mapped acres of birch decline and mortality in 2010.

County	Acres
Bennington	83
Chittenden	240
Lamoille	127
Orange	23
Orleans	16
Rutland	276
Washington	251
Total	**1,017**

Drought symptoms on hardwoods were mapped on 5,970 acres in southern Vermont. Noticeable symptoms developed in late July/early August. Damage was heaviest on ridges, rocky ledges, some N and NE facing slopes, and to ornamentals in sunny, dry sites. Heavy damage was not common, and because drought conditions developed late in the growing season, the impact on tree health should be minimal. Drought may have contributed to lack of refoliation from frost and to shoot casting of Norway spruce.

Table 19. Mapped acres of drought symptoms on hardwoods in 2010.

County	Acres
Bennington	1,818
Caledonia	184
Essex	70
Orange	145
Orleans	174
Rutland	562
Washington	67
Windham	1,825
Windsor	1,124
Total	**5,970**

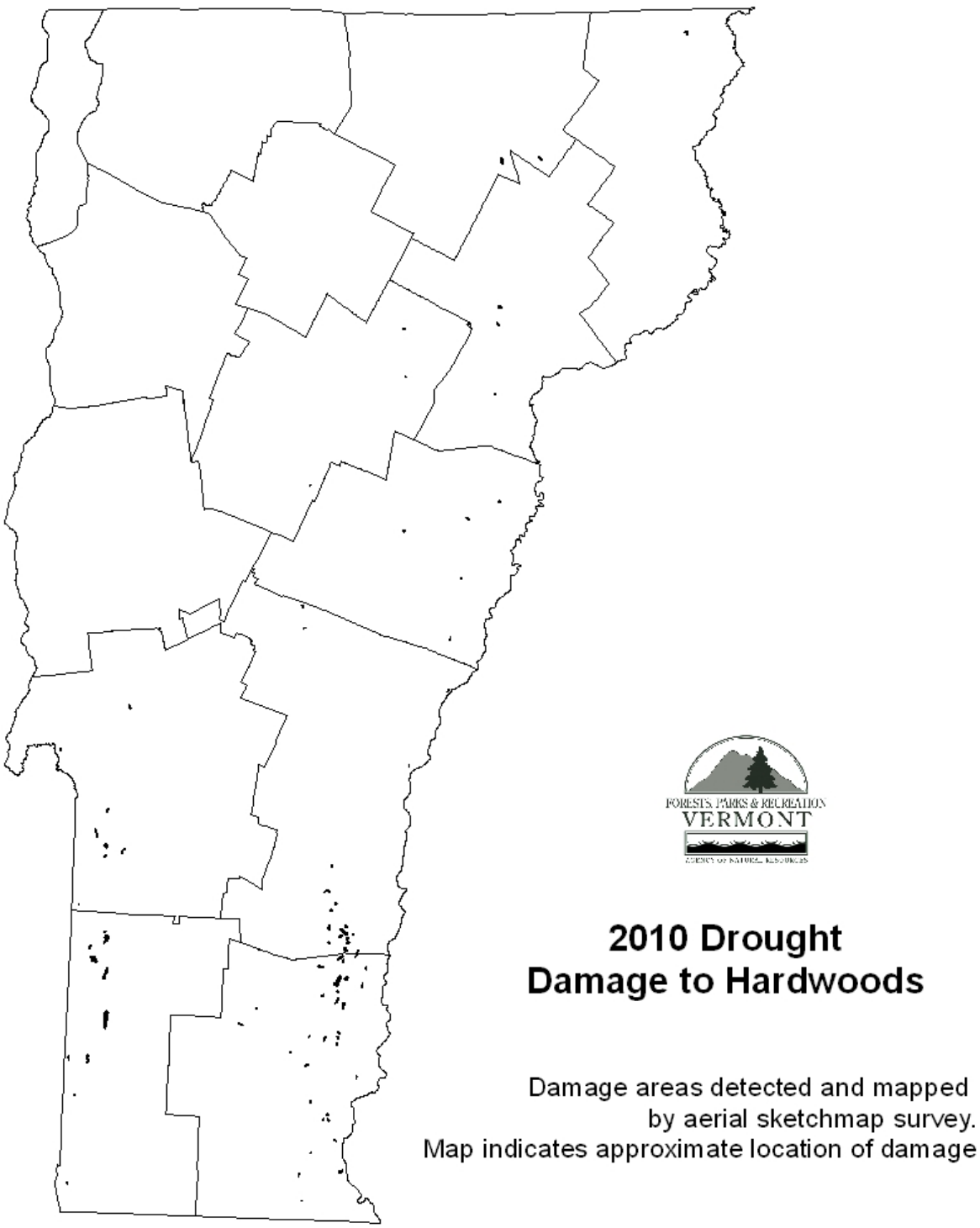


Figure 30. Drought damage to hardwoods mapped in 2010. Mapped area includes 5,970 acres.

Frost Damage was widespread due to below-freezing temperatures, statewide, during the week of May 9th. With an early spring, including leafout of sugar maple several weeks ahead of normal, many trees were vulnerable, resulting in 414,901 acres of damage mapped (Table 20, Figure 31). Damage in much of the state was most commonly reported at locations above 1500´. Sugar maple was widely affected, with substantial damage to white and yellow birch, poplar, red maple, and beech. Ash was generally unaffected. In southern valleys, however, species that break bud later, such as oak, sycamore, and black locust, did sustain damage. Christmas tree growers statewide also reported moderate to severe damage on balsam fir.

Although most trees refoliated shortly after the freeze event, new growth did not fully expand. Some did not refoliate at all, and retained damaged leaves all summer. During aerial surveys between mid-August and late September, 23,394 acres of spring frost damage were still visible. Intermittent dry periods may have been responsible for the incomplete refoliation.

Recommendations, *Evaluating Sugarbush Recovery from 2010 Frost Damage*, were developed and are available online at http://www.vtfpr.org/protection/idfrontpage.cfm . If trees refoliate fully, they can recover quickly from a single May defoliation. If they don't, foliage is compromised for an entire growing season, and trees are at risk. Although sugar maples have been in generally good health because of several years with ample precipitation, additional stress in 2011 could initiate decline and mortality.

Table 20. Area of frost damage mapped in 2010 during late spring (May 27- June 15) and late summer (August 24-September 28) aerial surveys.

County	Acres Mapped in late Spring	Acres Mapped in Late Summer
Addison	13,567	2,076
Bennington	83,206	8,645
Caledonia	21,772	1,153
Chittenden	6,326	1,467
Essex	14,419	852
Franklin	4,851	465
Grand Isle	0	0
Lamoille	14,233	658
Orange	33,244	1,452
Orleans	25,187	976
Rutland	60,774	4,020
Washington	34,308	1,105
Windham	44,733	82
Windsor	58,282	442
Total	**414,901**	**23,394**

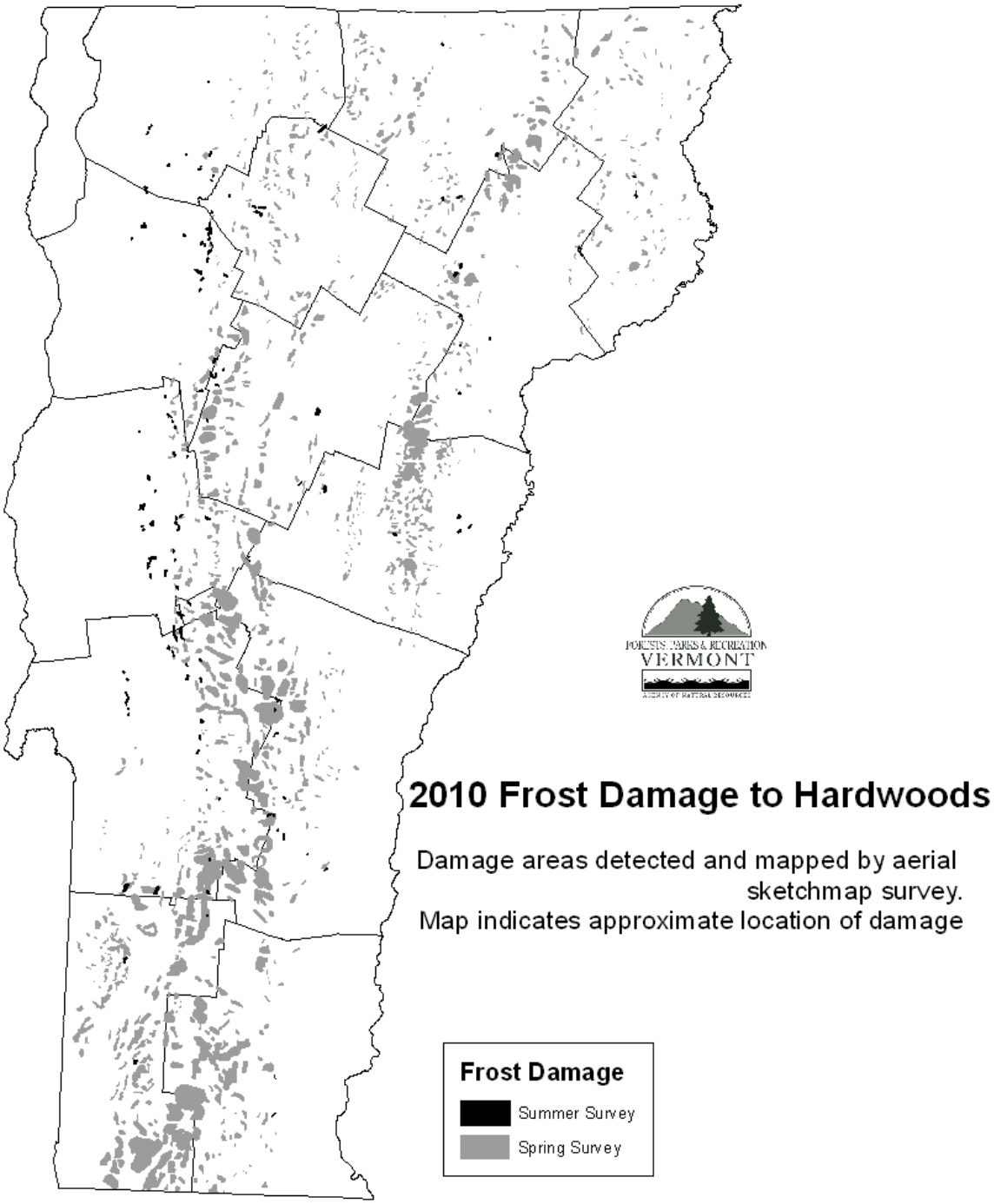


Figure 31. Spring frost damage to hardwoods mapped in 2010. Mapped area was 414,901 acres during late spring surveys and 23,394 acres during late summer surveys.

Frost damage was assessed in June on 25 North American Maple Project plots, and the remaining 5 during summer assessments. All but 8 plots had damage, and 5 had damage averaging over 60%.

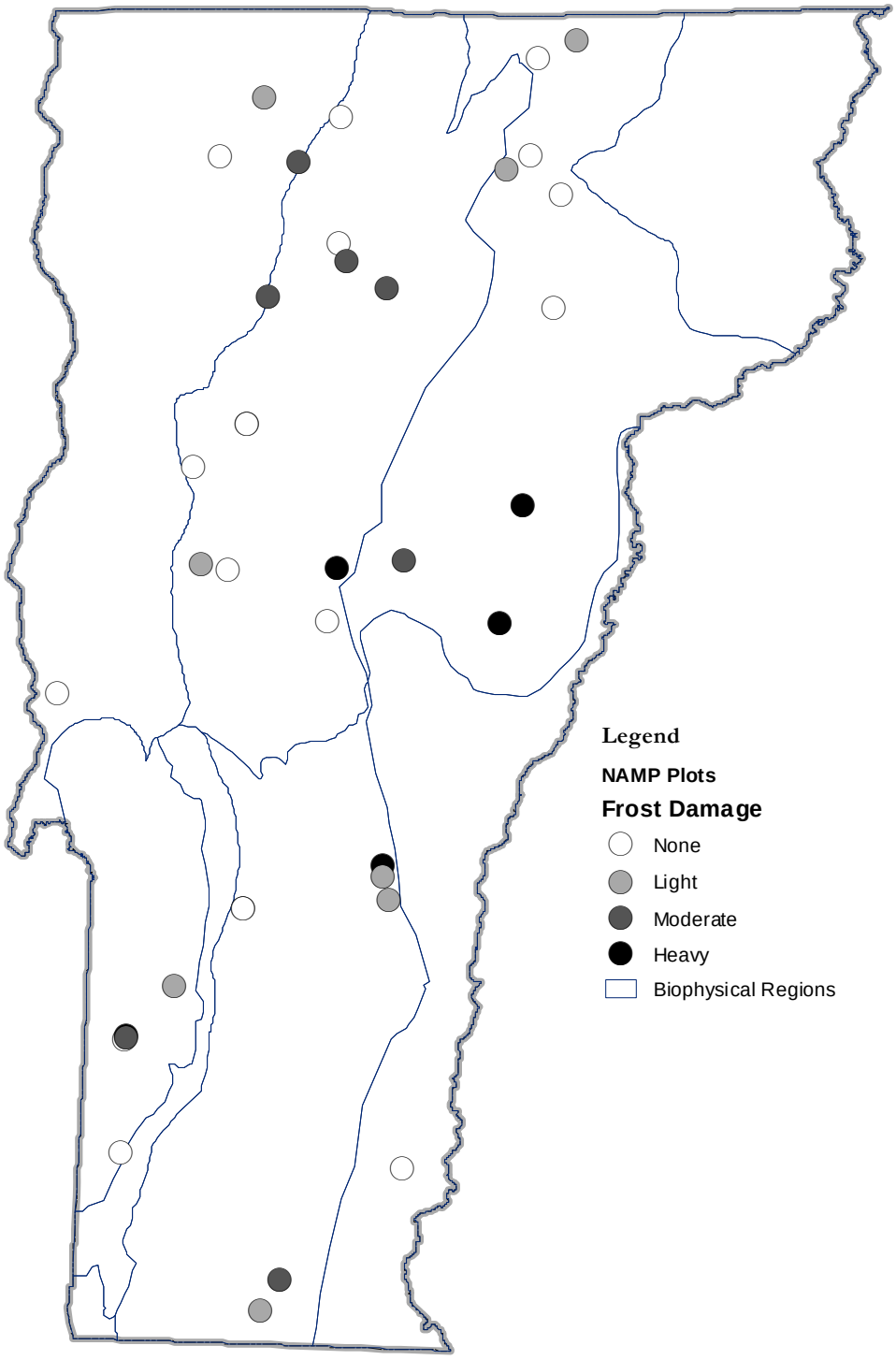


Figure 32. Severity of frost damage on all 30 North American Maple Project plots. Severity ratings, based on % of canopy foliage affected: 0 = none observed, light = <30%, moderate = 31-60%, heavy = >60% .

Twenty additional sites with frost damage were sampled, statewide, between May 26th and June 16th. Average elevation was 1,900´. All sites had sugar maple damage to the upper crown, in 60% over half the foliage was damaged. Regeneration had frost damage in 70% of the sites, and refoliation was underway in 80%.

To evaluate refoliation and potential tree stress, twenty sugar maples at each of the six maple sap production areas on state lands were evaluated in September. Average defoliation in five of the six still exceeded 30% (Figure 33). Average transparency in these areas was 30%, compared to a normal value of less than 25% for canopy sugar maples (Figure 34). Taphole closure in 2010 did not appear to be related to the severity of frost damage (Figure 35).

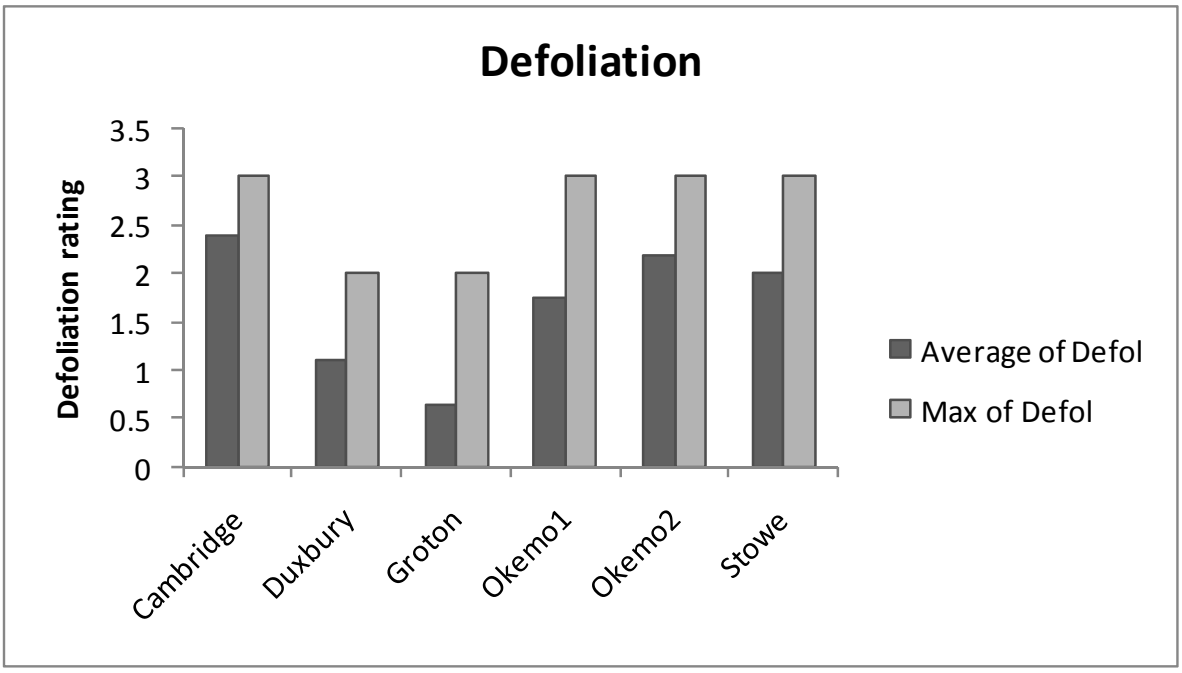


Figure 33. Average and maximum defoliation ratings of 20 canopy sugar maples in each of six sap production areas in September, 2010 following a late-spring frost. Defoliation Rating Scale: 1=0-30%, 2=31-60%, 3=61-100% defoliation.

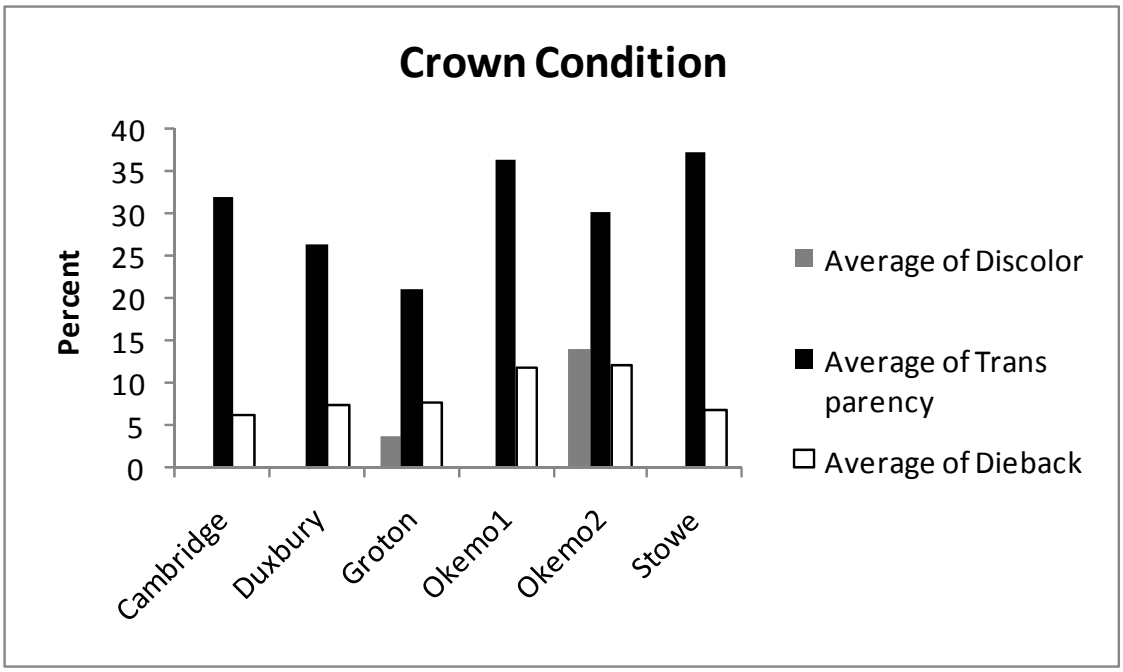


Figure 34. Average percent of leaves with discoloration, average foliage transparency, and average percent dieback ratings of 20 canopy sugar maples in each of six sap production areas in September, 2010 following a late-spring frost.

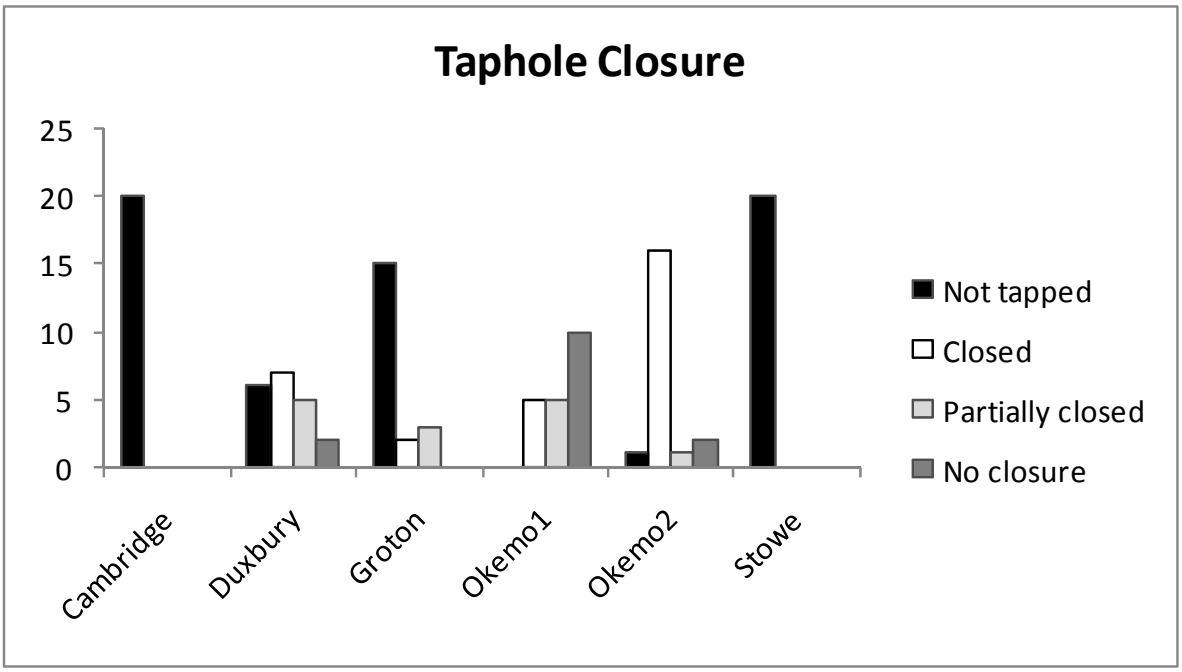


Figure 35. Number of trees in each taphole closure category for 20 canopy sugar maples in each of six sap production areas in September, 2010 following a late-spring frost.

Larch Decline continues, with some new mortality in pockets of previously dead trees. During aerial surveys, 352 acres were mapped, compared to 1,027 acres in 2009. (Table 21).

Table 21. Mapped acres of larch decline in 2010.

County	Acres
Caledonia	61
Essex	77
Franklin	53
Orange	46
Orleans	117
Total	**352**

Decline and mortality on **Wet Sites** remains common, although the mapped area decreased to 1,708 acres, compared to 5,049 acres in 2009 (Table 22). Wet site conditions continue to cause decline where Fraser fir are planted for Christmas trees.

Table 22. Mapped acres of decline and mortality on wet sites in 2010.

County	Acres
Addison	22
Bennington	73
Caledonia	141
Essex	635
Franklin	31
Orange	182
Orleans	367
Rutland	56
Washington	106
Windham	52
Windsor	43
Total	**1,708**

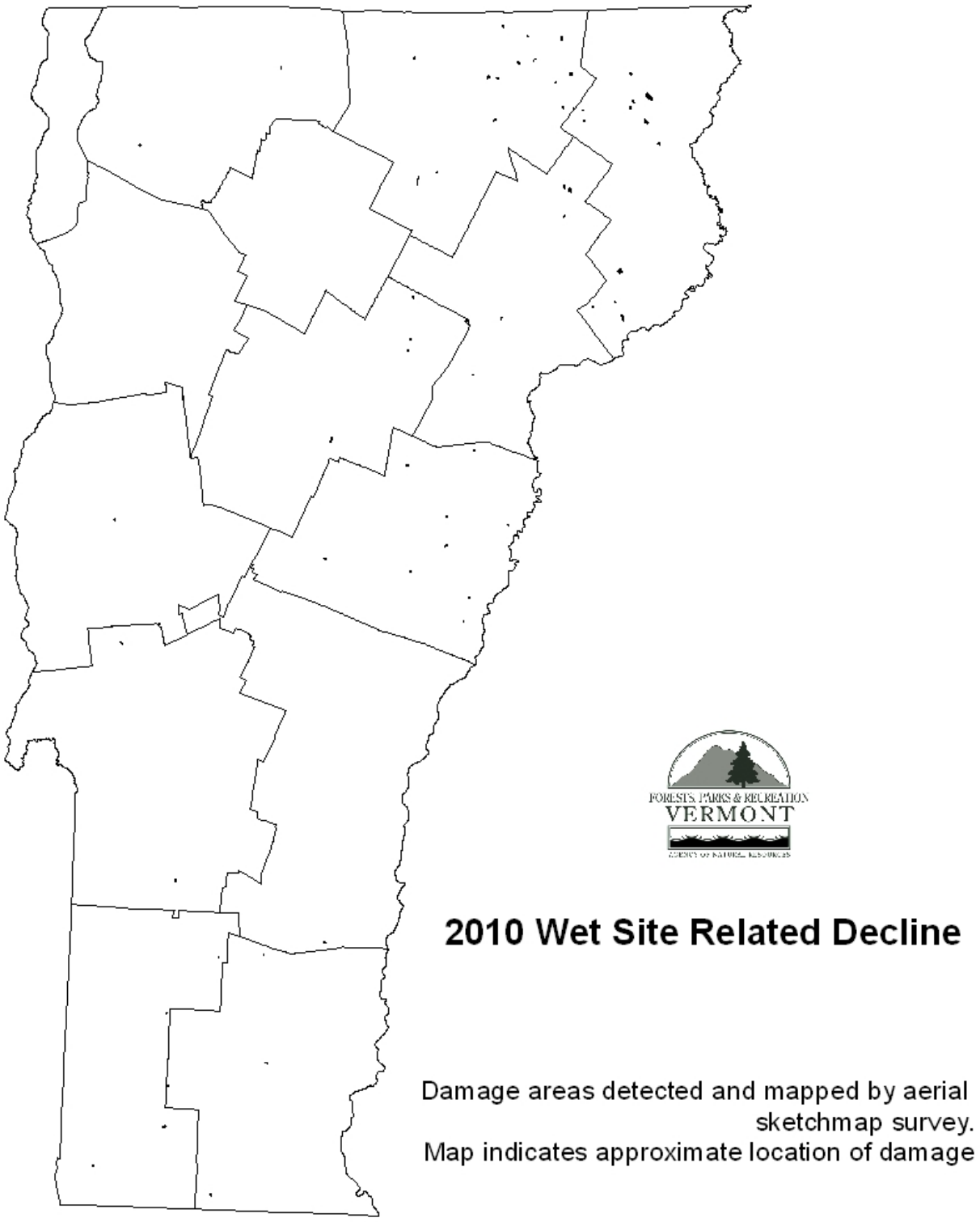


Figure 36. Wet-site related decline and mortality mapped in 2010. Mapped area includes 1,708 acres.

Wind Damage occurred following several severe storms.

Damage from a December 2009 winter storm was evaluated in February, with 527 acres mapped in Addison County.

Back to back storms during the week of February 22 with heavy wet snow and high winds brought down trees in southern Vermont. Hardest hit were Windsor, Bennington and Rutland counties.

A severe storm with straight-line winds on May 26 brought down trees and power-lines. The damage occurred from winds between 50 and 60 mph, with the highest concentration of damage across Addison and Rutland Counties. Near Lake St. Catherine in Poultney, this storm snapped and uprooted trees, downing trees from North to South.

A June 5th tornado damaged trees in Craftsbury, where 44 acres were mapped during aerial surveys.

Localized damage from a severe storm on July 21 snapped trees 30 feet off the ground in a narrow path from straight line winds at speeds up to 90 mph in Chelsea/Brookfield area.

The severe wind storm in Chittenden and surrounding counties on December 1, 2010 snapped tree trunks and uprooted trees. The wind was from the south east and blew most trees towards the northwest. Much of the damage was from the domino effect of one large tree wiping out its neighbors on the way down. Damage was spotty, lots of scattered single-trees and small-group windthrows, but also some large areas of intertwined, broken and uprooted trees. A wide variety of species were damaged, especially pines, spruces and fir trees. Towns most affected included: Jericho, Underhill, Westford, Huntington, Richmond, Williston, Hinesburg, and Cambridge. Reports of hundreds of sugar maple trees damaged and lying across sugaring pipelines came from Underhill, Westford and Williston. The Hinesburg Town Forest lost some long-tended red and white pine and Norway spruce plantations. The subsequent two-feet of snow made assessments difficult and dangerous.

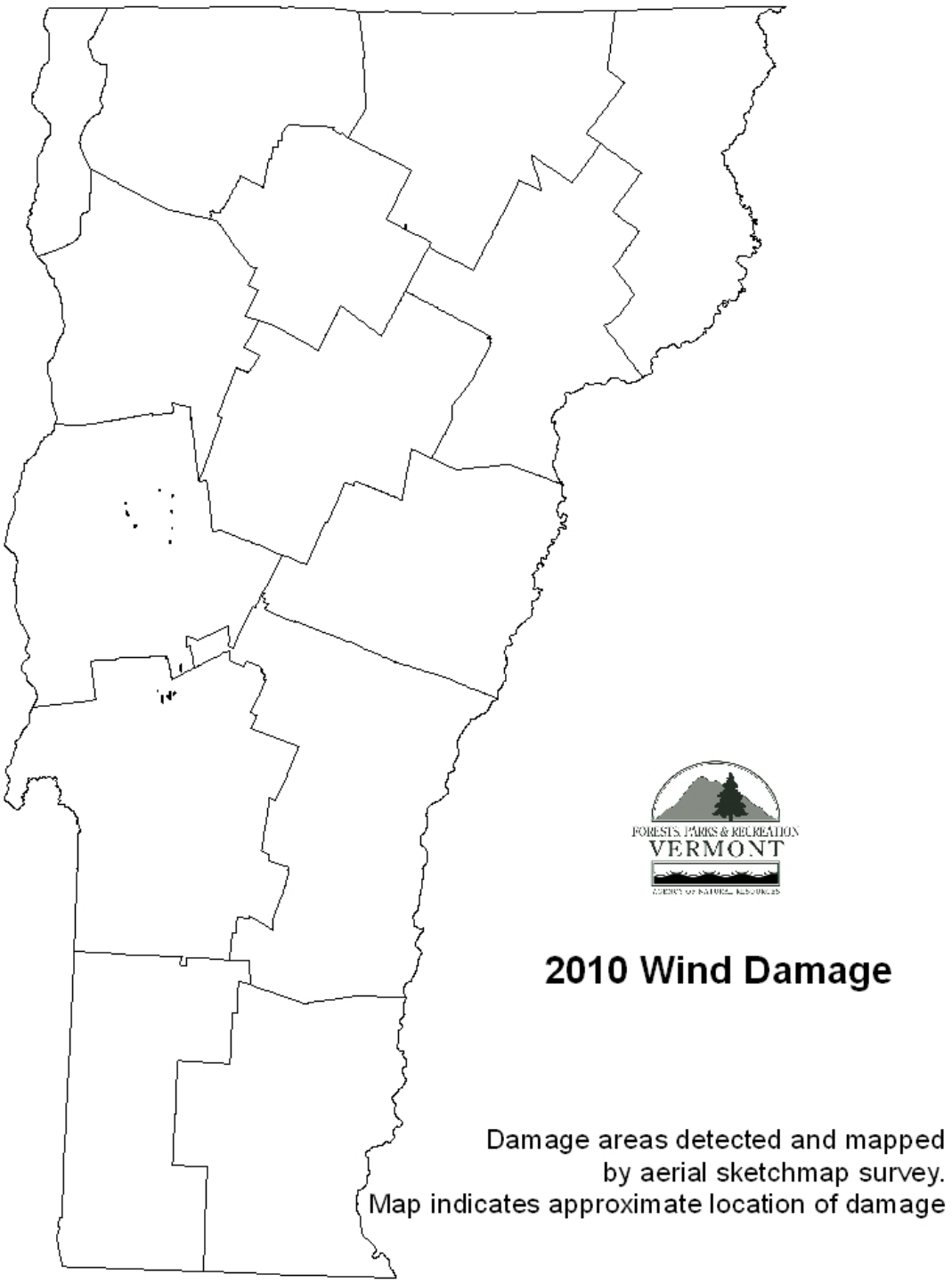


Figure 37. Wind damage mapped February – September, 2010. Mapped area includes 571 acres.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

CONDITION	HOST(S)	LOCALITY	REMARKS
Ash Dieback	Ash	Scattered in southern Vermont and Champlain valleys	Moderate to heavy.
Birch Decline			See narrative.
Drought			See narrative.
Fire Damage	Conifers and hardwoods	Milton	Two acre fire in Milton resulted in hardwood sapling damage and white pine mortality.
		Vernon	A 14 acre fire killed many white pine saplings.
Flooding			See Wet Site related decline.
Frost Cracks	Sugar Maple	St. Albans	Significant; every ornamental tree along drive affected.
	Ash	Springfield	
Frost Damage			See narrative.
Girdling Roots	Many	Scattered throughout	Occasional occurrence on ornamentals.
Hail	Many	Rutland, Chittenden and Franklin Counties	Accompanied by strong winds.
Hardwood Chlorosis	Sugar maple and other hardwoods		Although common in 2008 and 2009, not observed in 2010.
Hardwood Decline and Mortality	Maple and other hardwoods		Hardwood decline and mortality significantly less common than normal due to good growing conditions in recent year. 7,117 acres of premature autumn color mapped during aerial surveys. See Trends in Forest Health.
Heavy Seed	White Ash	Albany	Signs of decline from heavy seed in 2009. For information about heavy seed production not associated with symptoms of tree stress, see Weather and Phenology narrative.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

CONDITION	HOST(S)	LOCALITY	REMARKS
Herbicide Injury	Fir	Southern Vermont	Mortality to recently transplanted Christmas trees following an application of Westar.
Ice Damage	Many	Southeastern Vermont	Stands recovering from ice damage in December 2008.
		Mountains	Damage contributes to decline at high elevation sites.
Improper Planting	Many	Scattered throughout	Ornamentals.
Larch Decline			See narrative.
Ozone Injury	White Pine, Black Cherry	Clarendon, Rupert, Dorset	Only light injury noted in 3 of 10 monitoring sites.
Red Pine Decline	Red Pine	Widely scattered	Substantial shoot dieback and mortality in some sapling through sawtimber sized stands. Organisms identified include shoot blight, pine gall weevil, and Armillaria.
Salt Damage	Many	Throughout	Less damage this year.
Shoot Casting	Hemlock	Corinth, Springfield	Shoots distributed on the forest floor in mid-winter. Cause unknown, but possibly wind.
	Norway Spruce	Manchester, Winhall	Cause unknown, but possibly cladoptosis due to dry conditions.
Snow Breakage	Many	Western Franklin County	Moderate to heavy.
Spruce/Fir Dieback and Mortality	Balsam fir, Red spruce	Scattered throughout	588 acres of spruce mortality mapped during aerial surveys. See Balsam Woolly Adelgid.
Wet Site			See narrative.
Wind Damage			See narrative.

ANIMAL DAMAGE

ANIMAL	SPECIES DAMAGED	LOCALITY	REMARKS
Beaver	Many	Widely scattered	Damage levels remain stable. Also see Beaver Beetle under Miscellaneous Observations, Coleoptra.
Deer	Hardwoods	Scattered throughout	Significant damage to regeneration in some stands.
Moose	Many	Scattered	Scattered moderate damage to understory. Noted increase in some sites.
Porcupine	Many	Scattered	Generally consistent with previous years, though increased damage noted in some areas.
Sapsucker	Many	Common throughout	Damage at usual levels.
Snail- Blunt Ambershell *Oxyloma retusum*	Various	Widespread in wet lowland sites	High numbers reported from the Northeast Kingdom, West Fairlee, Fairlee, Thetford, and other sites.
Squirrel	Norway spruce, sugar maple and others	Scattered throughout	Scattered shoot clipping.

Animal Damage not recorded in 2010 included cattle, mouse and vole.

MISCELLANEOUS OBSERVATIONS

LEPIDOPTERA: BUTTERFLIES AND MOTHS

INSECT	LIFE STAGE OBSERVED	LOCALITY	REMARKS
Bedstraw Hawkmoth *Hyles gallii*	Caterpillar	Middlebury	Late instar larvae often seen wandering across roads in late summer.
Blinded sphinx *Paonias excaecatus*	Adults	Morrisville	Larvae of this species are among the most commonly encountered sphingids in many northeastern hardwood forests.
Camouflage Looper *Synchlora aerata*	Caterpillar	Springfield	Detritus-covered looper.
Definite Tussock Moth *Orgyia definita*	Caterpillar	Plainfield	Feeds on a variety of hardwood trees.
Giant Swallowtail *Papilio cresphontes*	Adult	Addison	Giant Swallowtail photo was taken and identification confirmed in Addison on July 30, 2010. This species is known to stray north, but we have not recorded it in Vermont in the past. This represents the 105th butterfly species found in Vermont. Another observer reported seeing a Giant Swallowtail a few days later just a few miles north of the first sighting. Same one? Perhaps. Also, a probable quick sighting was reported at Dead Creek in August.
Hitched Arches *Melanchia adjuncta*	Caterpillar	Waterbury	Velvety larva with green "slashes".
Imperial Moth *Eacles imperialis*	Caterpillar	Grand Isle	*Eacles imperialis* is rare in Vermont, listed as species of special concern 1990. The checklist noted the last one seen in Vermont was in 1934 until one was collected in July of 1999.

LEPIDOPTERA: BUTTERFLIES AND MOTHS

INSECT	LIFE STAGE OBSERVED	LOCALITY	REMARKS
Large Tolype *Tolype velleda*	Caterpillar	Groton	On beech.
Large Yellow Underwing *Noctua pronuba*	Caterpillar	Rutland	Larvae on snow.
Maple Spanworm *Ennomus magnari*	Adult	Middlebury	Cryptic in both the adult and larval stages.
Milbert's Tortoiseshell *Nymphalis milberti*	Adult	Hyde Park	Larval stage feeds on stinging nettles.
Monkey Slug *Phobetron pithecium*	Caterpillar	Lincoln	Adult is known as the "hag moth".
Mourning Cloak *Nymphalis antiopa*	Adults	Scattered	At large.
Polyphemus *Antheraea polyphemus*	Cocoon	Williamstown	Single cocoon found; adult moth emerged in lab in May.
Red Admiral *Vanessa atalanta*	Caterpillar	Not given	Numerous on wood nettle.
Sphinx moth *Family Sphingidae*	Pupa	Springfield	Found in garden.
Tomato Hornworm *Manduca quinque*	Caterpillar	Morrisville	Both green and brown color forms occur.
Variable Carpet *Anticelea vasiliata*	Adult	Hyde Park	Large number outside windows during night in mid-May.
Virginian Tiger Moth *Spilosoma virginica*	Caterpillar	Burlington	Also known as yellow bear caterpillar.
White-spotted Sable *Anania funebris glomeralis*	Adult	Okemo Mountain, Ludlow	Feeds on goldenrod.

CELOPTERA: BEETLES

INSECT	LOCALITY	REMARKS
Anobiid Beetle *Priobium sericeum*	Georgia	Numerous in home.
Beaver Beetle *Leptinillus validus*	Westminster	A beaver trapper in Westminster submitted numerous specimens of the beetle *Leptinillus validus* (an ectoparasitic of beaver) to the lab this year. This is one of two members of the family Leiodidae associated with beavers that have been found in Vermont. The other is *Platypsyllus castoris*.
Black Carpet Beetle *Attagenus unicolor*	Morrisville	Numerous in kitchen.
Black Spruce Borer *Asemum striatum*	Morrisville	Emerged from cut logs.
Bostrichidae Beetle *Sinoxylon poss. S. ruficorne*	St. Albans Barre	Emerged from wooden pallets from Indonesia and found in packing material at granite company.
Clover Weevil *Trachyphloeus sp.*	Williston	Entering home.
Cross-toothed Rove Beetle *Oxyporus quinquemaculatus*	South Woodbury	Found in mushroom.
Dark Mealworm *Tenebrio obscurus*	Waterbury	Roaming in kitchen.
Dusky Firefly *Ellychnia corrusca*	Lincoln, Newfane	Seen resting on sugar maple.
Forked Fungus Beetle *Bolitotherus cornutus*	Groton	Found on emerald ash borer purple sticky trap.
Grapevine Beetle *Pelidnota punctata*	Brattleboro	Observed in garden.
Green Leaf Weevil *Polydrusus sp.*	Essex Junction	Beautiful weevil covered with metallic green scales.

CELOPTERA: BEETLES

INSECT	LOCALITY	REMARKS
Ground Beetle *Harpalus pensylvanicus*	Alburg	Entered home when apparently lured to lights in summer.
Harris's Diving Beetle *Dytiscus harrisi*	Addison	Wandering near pond in March.
Larder Beetle *Dermestes lardarius*	Lincoln, Barre	Common household pest.
Lily Leaf Beetle *Lilioceris lilii*	Stowe, Hardwick	Serious pest to lily growers.
Milkweed Longhorn *Tetraopes tetrophthalmus*	Alburg, West Burke	Larvae bore into the stems and roots of the milkweed plant; adults eat the leaves and buds of the milkweed.
Multicolored Asian Lady Beetle *Harmonia axyridis*	Widespread observations	Numbers higher than in past years in many areas.
Saw-toothed Grain Beetle *Oryzaephilus surinamensis*	Burlington, Waterville	Common stored product pest.
Scarab *Dichelonyx sp.*	Hyde Park	Feeds on roots of trees.
Short-winged Blister Beetle *Meloe angusticollis*	Scattered observations	Sluggish adults are often seen in early spring or late fall.
Silphid ("Burying") Beetle *Nicrophorus sayi*	Lincoln	Found in basement; feed on carcasses of dead birds and rodents.
Six-spotted Tiger Beetle *Cicindela sexguttata*	Scattered observations	Reported as emerald ash borer suspects.
Stag Beetle *Lucanus sp.*	Brattleboro	Observed in garden.
Strawberry Root Weevil *Otiorhynchus ovatus*	Middlebury	Observed as nuisance household invaders.
Tiny Longhorned Beetle *Urgleptes querci*	Colchester	Notable for its tiny size and lengthy antennae.

CELOPTERA: BEETLES

INSECT	LOCALITY	REMARKS
Twice-stabbed Lady Beetle *Chilocorus stigma*	Morrisville	On beech infested with beech scale.
Weevil *Rhinorincus sp, poss. R. pyrrhopus*	Cambridge	Not much is known about the biology of these weevils.
White Marked Spider Beetle *Ptinus fur*	Walden	Numerous beetles found in bathroom and kitchen.

HYMENOPTERA: WASPS, BEES, ANTS AND SAWFLIES

INSECT	LOCALITY	REMARKS
Black Carpenter Ants *Camponotus pennsylvanicus*	Barre St. Johnsbury	Household.
Carpenter Ant (One of several species that fall under this common name) *Camponotus noveboracensis*	Weathersfield	Found in bathroom.
Plasterer or Cellophane Bee *Colletes inaequalis*	Shelburne	This is a bee that emerges in early spring and specializes on willow pollen. It is common and nests in aggregations in sandy or hard packed soils.
Great Golden Digger Wasp *Sphex ichneumoneus*	Shelburne, Castleton, West Rutland, Cornwall	These formidable ground-dwelling wasps provision their young with paralyzed cricket, katydid, or other related insects.
Honey Bee *Apis mellifera*	Morrisville	Swarm hanging on cedar tree.
Leaf-cutting bees *Osmia sp.*	Montgomery	Seen in crevices between cedar shakes.
Megarhyssa wasp *Megarhyssa spp.*	Scattered locations	Associated with declining trees that contain pigeon tremex larvae.
Paper wasps *Polistes sp.*	Morrisville	Nest on window frame; larvae dropping out as window opened and closed.
Parasitic Wood Wasp *Orussus terminalis*	Woodstock	Under bark of dead red pine.
Pavement Ants *Tetramorium caespitum*	Colchester	Numerous in dooryard during mating flight.
Smaller Yellow Ant *Acanthomyops claviger*	Waterbury Center	Around foundation of home.

DIPTERA: FLIES

INSECT	LOCALITY	REMARKS
Deer Ked Lipoptena cervi	Shelburne, Waterbury	Frequently mistaken by hunters as ticks.
Phantom Cranefly *Bittacomorpha clavipes*	Scattered reports	Found in aquatic or swampy areas, these flies with white-banded legs float in the wind like phantoms.
Drain Flies *Psychoda alternata*	Bethel, Waterbury	Eggs, larvae and pupae can be found in the muck and slime that accumulates on the sides of drains and pipes.
Syrphid Fly *Temnostema sp*	Hyde Park	Potter wasp mimic. Some larvae in this genus feed on decaying wood of deciduous trees.
Robber Fly *Ceraturgus sp.*	Underhill	Observed carrying beetle prey.
Tachinid Fly *Hystricia abrupta*	West Topsham	Bristly parasitoid of insect larvae.
Blow Fly *Family Callophoridae*	Richmond	Adult metallic flies troublesome in home; larvae of most species are scavengers of carrion and dung.

SPIDERS

INSECT	LOCALITY	REMARKS
Barn Spider *Araneus cavaticus*	Fayston and elsewhere	Common orb-weaver that is often found around homes and outbuildings.
Black Widow Spider *Latrodectus sp.*	Northfield	Associated with a shipment of crickets.
Fishing Spider *Dolomedes tenebrosus*	Burlington and elsewhere	Sometimes found far from water, usually in wooded settings.
Jumping Spider *Platycryptus undatus*	Burlington	Found on boat after fishing trip.
Long-jawed Spider *Teteragnatha elongata*	Waterbury	Individuals build orb webs over or near water.
Orb-weaving Spider *Araneus saevus*	Huntington and elsewhere	Dark colored orb weaver that makes its home in forested and residential areas.
Orb-weaving Spider *Neoscona sp.*	Cavendish	Another common orb-weaver that is often found around homes and outbuildings.
Sheetweb Spider *Family Linyphiidae*	Swanton	A large series of sheet webs were observed in grassy area. Spiders hang underneath the web and wait for prey.

MISCELLANEOUS ORDERS

ORDER	INSECT	LOCALITY	REMARKS
Orthoptera	Northern Green-striped Grasshopper *Chortophaga viridifasciata*	Dorset	Often the first adult grasshopper seen in Vermont in the spring.
Collembola	Snow Fleas Prob. *Hypogastrura nivicola*	Burlington	Observed in snow around home.
Phasmatodea	Northern Walkingstick *Diapheromera femorata*	Manchester	Native species found in deciduous woods.
Hemiptera	Dog Day Cicada *Tibicen canicularis*	Middlebury	Adults appear (or are more likely heard) in late summer.
Phthiraptera	Head Lice *Pediculosis capitis*	Morrisville	
Plecoptera	Giant Stonefly *Pteronarcys sp.*	Barre	Adults are nocturnal and are often lured to lights.
Blattodea	German Cockroach *Blattella germanica*	Colchester	In public building.
Hemiptera	Miridae *Plagiognathus sp.*	Middlebury	Feeding on yarrow.

OTHER ARTHROPODS

ARTHROPOD	LOCALITY	REMARKS
Pseudoscorpion *Chelifer cancroides*	Waterbury, Springfield	Harmless and usually secretive creatures that are apt to surprise homeowners with their appearance.
House centipede *Scutigera coleoptrata*	Waterbury	House centipedes feed on spiders, bedbugs, ants, and other household arthropods.
Millipedes *Order Diplopoda*	Scattered reports	Numerous in some garages.
Velvet Mites *Family Trombidiidae*	Burlington and elsewhere	Large red velvet mites found in the soil, soil litter, and other terrestrial habitats.

TICKS

TICK	LOCALITY	REMARKS
American Dog Tick *Dermacentor variabilis*	Widespread records	Ten specimens sent to Forest Biology Lab for species confirmation; an additional 130 personally acquired and identified by our field staff.
Deer Tick Ixodes scapularis	Widespread records	22 submitted to Forest Biology Lab for species confirmation; additional specimens identified by others and reports sent to us.
Lone Star Tick *Amblyomma americanum*	NY and MD	Found biting Vermonters, but thought to be acquired out-of-state.
Winter or Moose Tick *Dermacenter albipictus*	Waitsfield	Very numerous on cat brought into veterinary practice.

INVASIVE PLANTS

Non-Native Invasive Plants continue to prevent regeneration of native species, especially in southern, central, and northwestern Vermont.

As part of the state assessment for the 2010 Vermont Forest Resources Plan, a map was produced of known occurrences of invasive plants (Figure 38). Existing invasive plant records from the Invasive Plant Atlas of New England (IPANE) were downloaded, organized by town, and stratified by 13 species of importance to forest health. In addition to these records, previous observations from FPR staff were used. Species included were oriental bittersweet, common buckthorn, glossy buckthorn, honeysuckles, burning bush, Japanese barberry, garlic mustard, goutweed, Norway maple, autumn olive, common barberry, amur maple, white poplar, black locust, and multiflora rose.

Invasive plant surveys were part of Phase I of the 2-year American Recovery and Reinvestment Act grant described under Bark and Wood Insects. Plants surveyed were primarily from the Quarantine list and Vermont Invasive Exotic Plant Committee Watch list. A total of 37 state parks were surveyed which included 2,100 individual campsites. On the Green Mountain National Forest (GMNF), 41 recreation sites including 300 dispersed campsites and 160 miles of hiking trails including sections of the Long Trail and Appalachian Trail were surveyed.

A wide range of non-native invasive plants (NNIPs) were found with honeysuckle, buckthorn, goutweed, barberry, garlic mustard and wild chervil being the most common. At Vermont State Parks, bittersweet and multiflora rose were among the most common species (Table 23). As expected, the presence of NNIPs followed human use patterns. More plants were found on lower elevation areas that have been disturbed, especially parks in the Champlain Valley. The higher elevation and less disturbed sites, mainly in the GMNF, had fewer NNIPs. Only a few sites on the GMNF were free of NNIPs.

Planning for Phase II has begun which will include prioritizing areas from the 2010 surveys to be targeted for management of NNIPs. On-the-ground management will take place in the summer of 2011.

Other initiatives around the state include:

- The creation of a Cooperative Invasive Species Management Area (CISMA) around the Ottauquechee watershed.
- The creation of a database to capture invasive plant information on Agency of Natural Resources lands.
- A statewide database for capturing invasive plant location information for the general public in Vermont.
- The creation of a “Best Management Practices” manual for invasives in the forest.

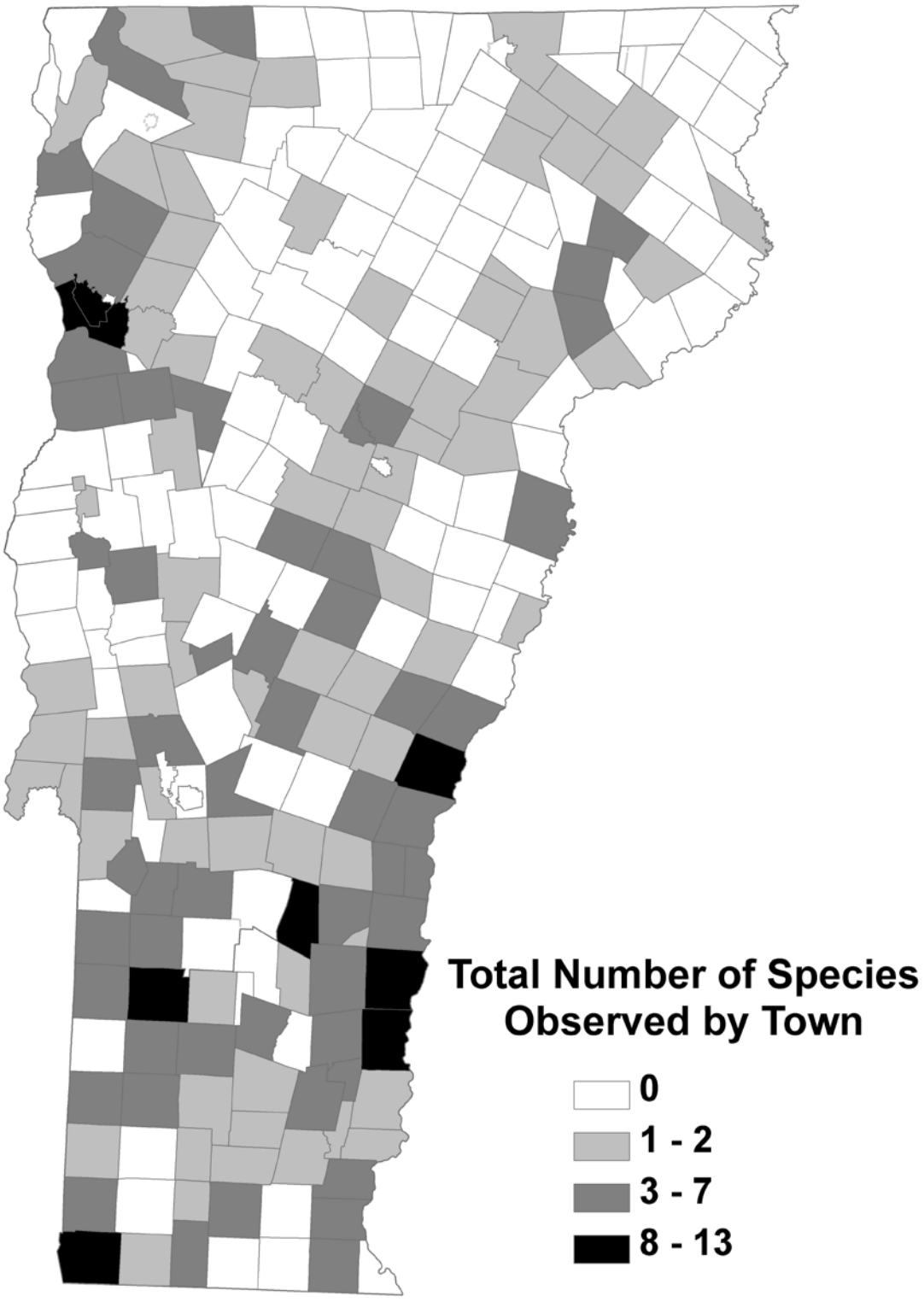


Figure 38. Total number of species of invasive terrestrial plants important to forest health with known occurrences by town, as reported in the 2010 Vermont Forest Resources Plan, Spring, 2010.

Table 23. Vermont State Parks results from the ARRA campground survey, showing the number of parks where invasive plants were observed, by plant species or species group.

Plant	Number of Parks
Buckthorn	26
Honeysuckle	26
Barberry	21
Bittersweet	19
Goutweed	19
Garlic Mustard	16
Multiflora Rose	12
Knotweed	11
Loosestrife	9
Black Locust	8
Burning Bush	8
Dames Rocket	8
Chervil	6
Amur Maple	5
Autumn Olive	5
Norway Maple	5
Phragmites	5
Black Swallowort	3
Giant Hogweed	2

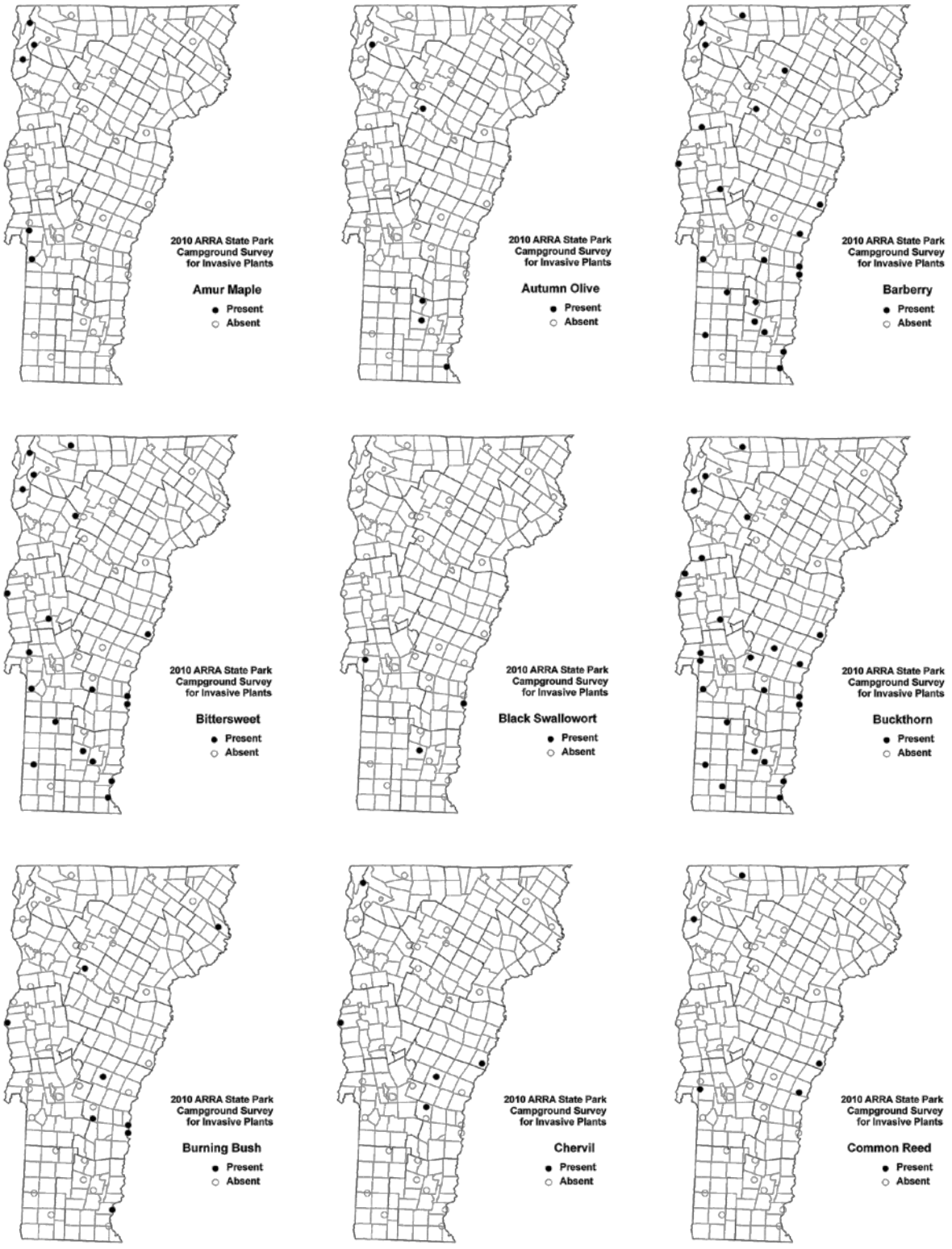
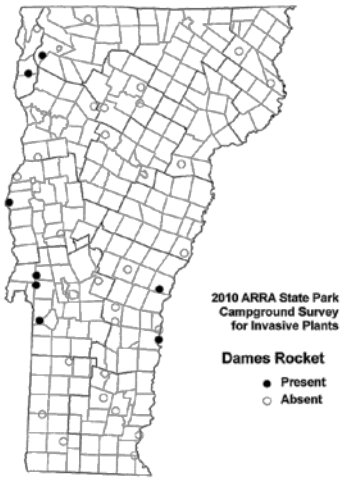
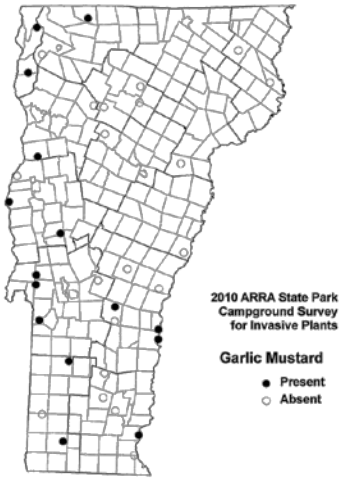
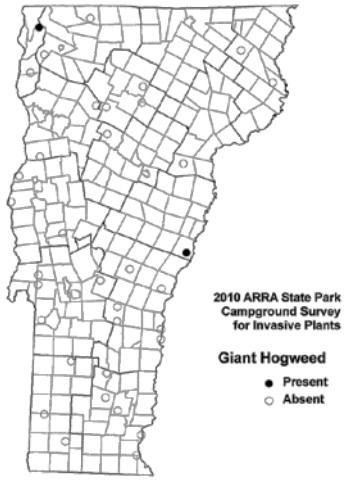
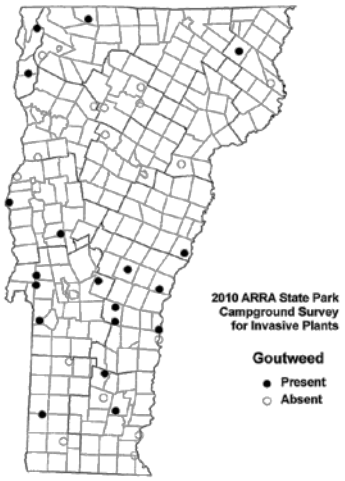


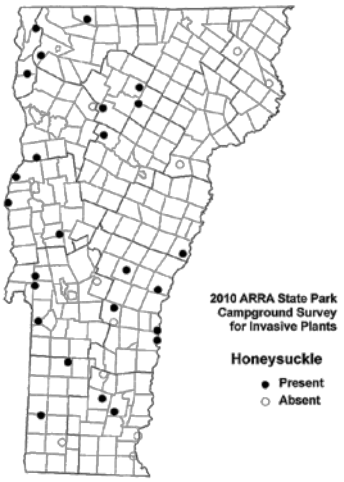
Figure 39. Non-native invasive plants observed at Vermont State Parks by ARRA survey crews, summer 2010, by species or species group.

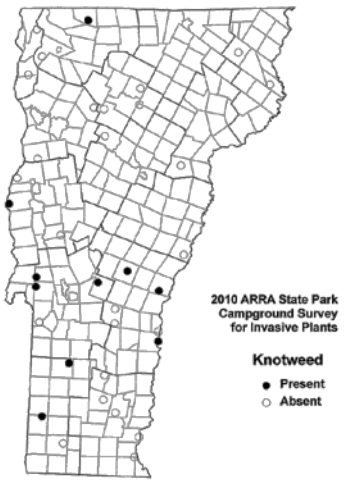

2010 ARRA State Park
Campground Survey
for Invasive Plants
Dames Rocket
Present
Absent

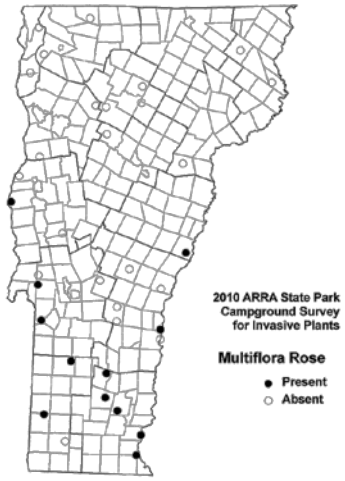

2010 ARRA State Park
Campground Survey
for Invasive Plants
Garlic Mustard
Present
Absent

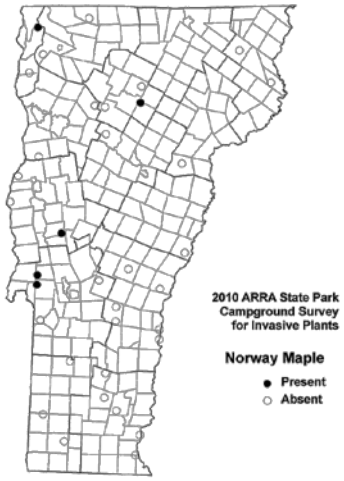

2010 ARRA State Park
Campground Survey
for Invasive Plants
Giant Hogweed
Present
Absent

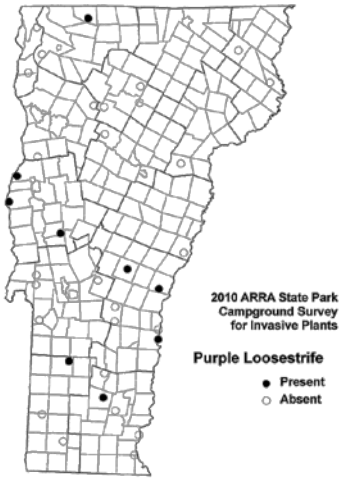

2010 ARRA State Park
Campground Survey
for Invasive Plants
Goutweed
Present
Absent


2010 ARRA State Park
Campground Survey
for Invasive Plants
Honeysuckle
Present
Absent


2010 ARRA State Park
Campground Survey
for Invasive Plants
Knotweed
Present
Absent


2010 ARRA State Park
Campground Survey
for Invasive Plants
Multiflora Rose
Present
Absent


2010 ARRA State Park
Campground Survey
for Invasive Plants
Norway Maple
Present
Absent


2010 ARRA State Park
Campground Survey
for Invasive Plants
Purple Loosestrife
Present
Absent

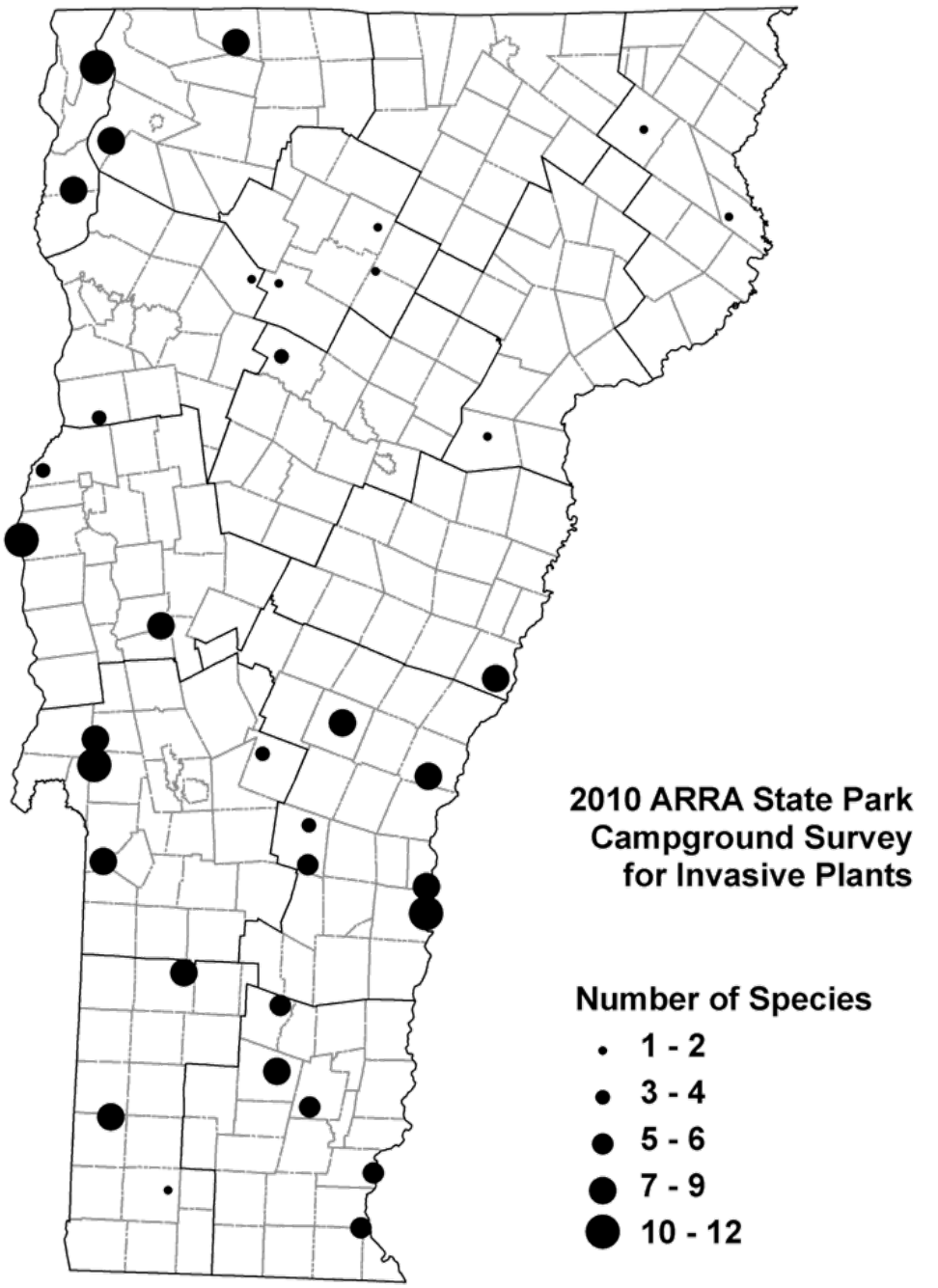


Figure 40. Number of species of non-native invasive plants observed at Vermont State Parks by ARRA survey crews, summer 2010.

Sugar Maple Health in 2010

In Vermont's North American Maple Project (NAMP) plots, 95% of the sugar maples had little dieback in 2010 (dieback <15%). This is an improvement from recent years. However, a late-spring frost combined with pear thrips defoliation, damaged leaves and resulted in lower than normal overall crown health (crown health index 4% worse than the long-term average) (Figure 41).

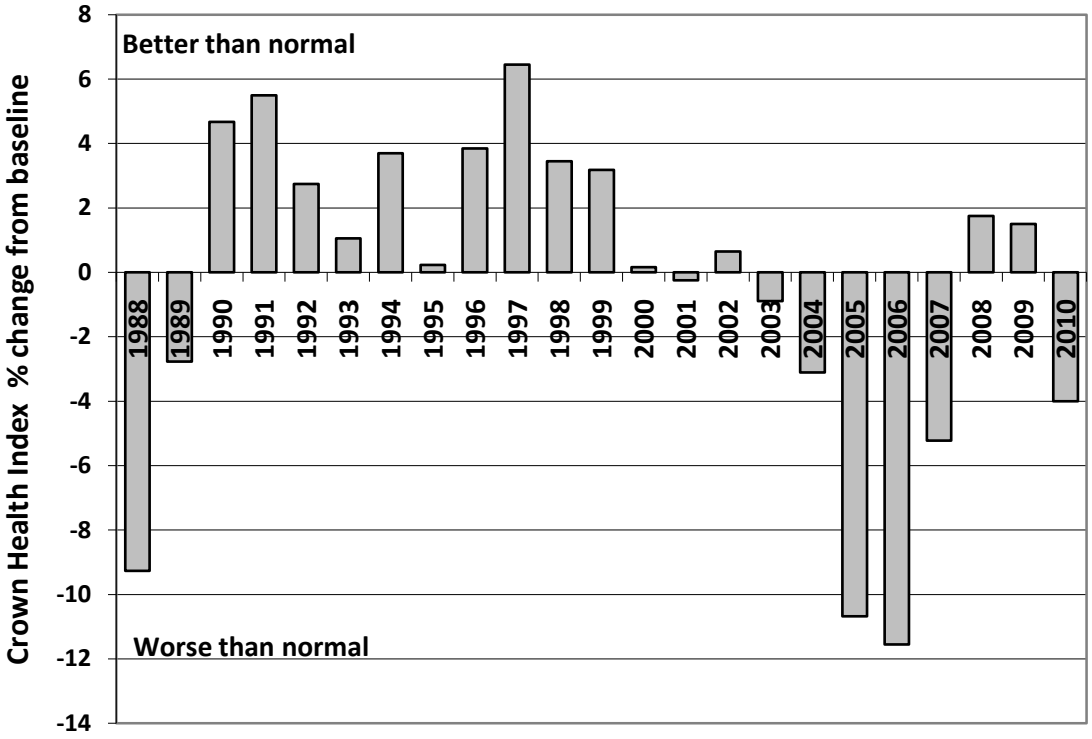


Figure 41. Trend in sugar maple crown health index from 30 monitoring sites.

Summary of Findings from 20-Years of Monitoring

Twenty-four monitoring plots were monitored from 1988-2007 and provide results about how sugar maple trees growing in sugarbushes as compared with non-sugarbushes grow and respond to a variety of disturbances.

- Average annual mortality in sugarbushes (0.48%) was significantly less than in non-sugarbushes (0.93%) over the 20 year period (Figure 42). Both were within the normal range for hardwood mortality.
- There were no significant differences in average annual dieback, transparency or vigor between sugarbushes and non-sugarbushes.
- Sugarbushes were more likely to be defoliated by forest tent caterpillar than non-sugarbushes (Figures 43 and 44).
- Change in diameter growth was similar between sugarbush and non-sugarbushes before the 1998 ice storm. Following the ice storm, non-sugarbush growth rate exceeded that of sugarbushes (Figure 45).

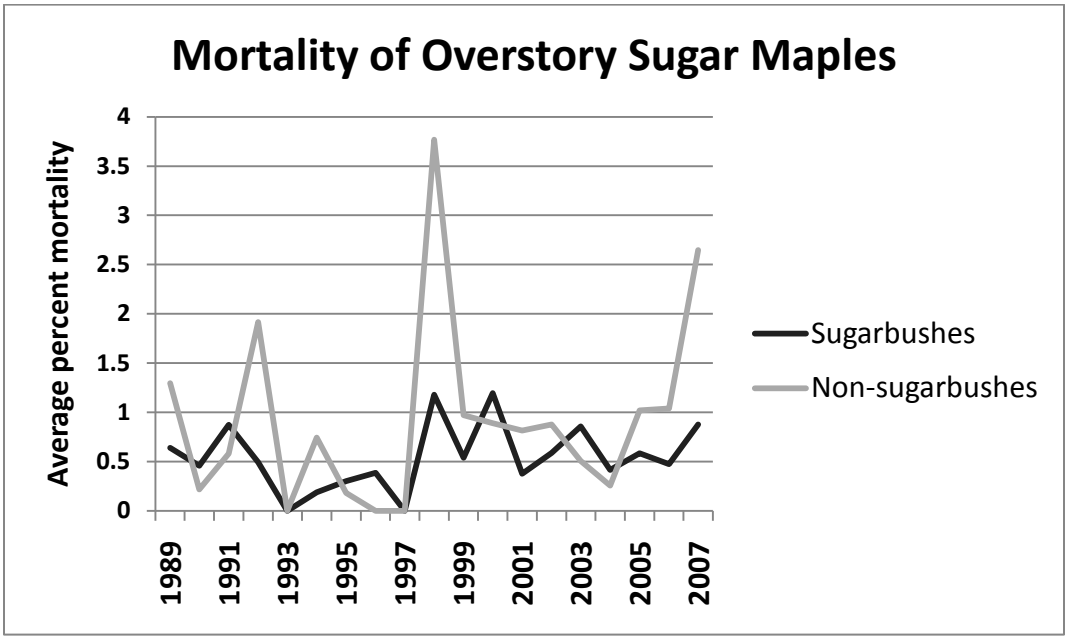


Figure 42. Trend in sugar maple mortality in sugarbush and non-sugarbush sites. Twenty-four NAMP monitoring plots.

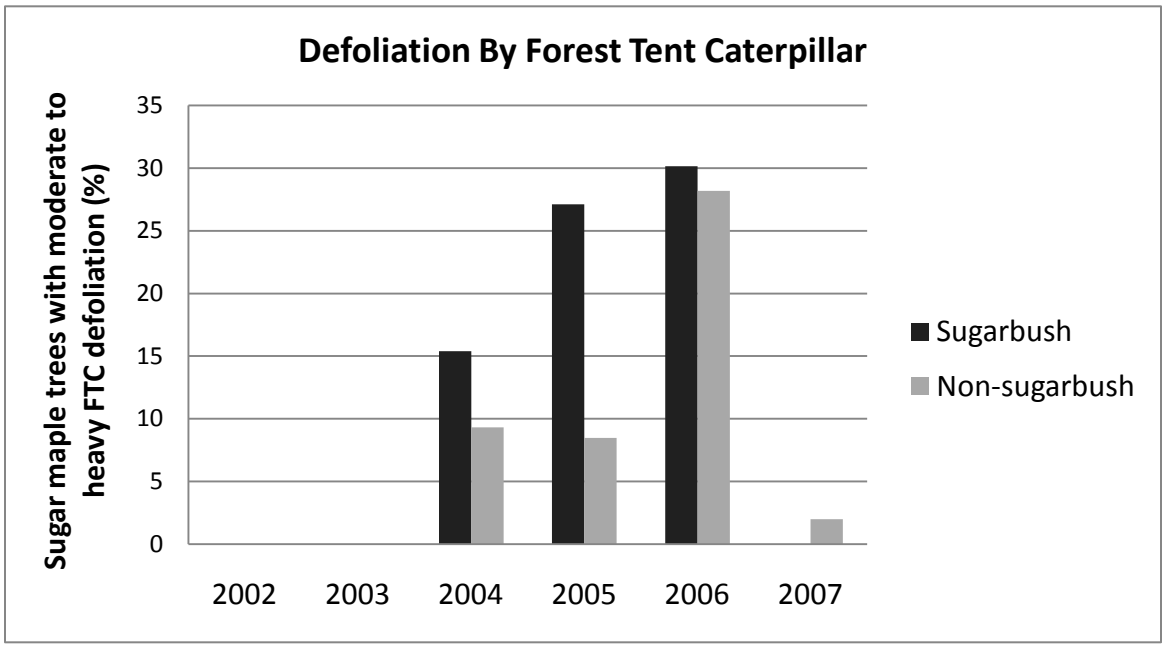


Figure 43. Heavy defoliation by forest tent caterpillar in sugarbush and non-sugarbush sites.

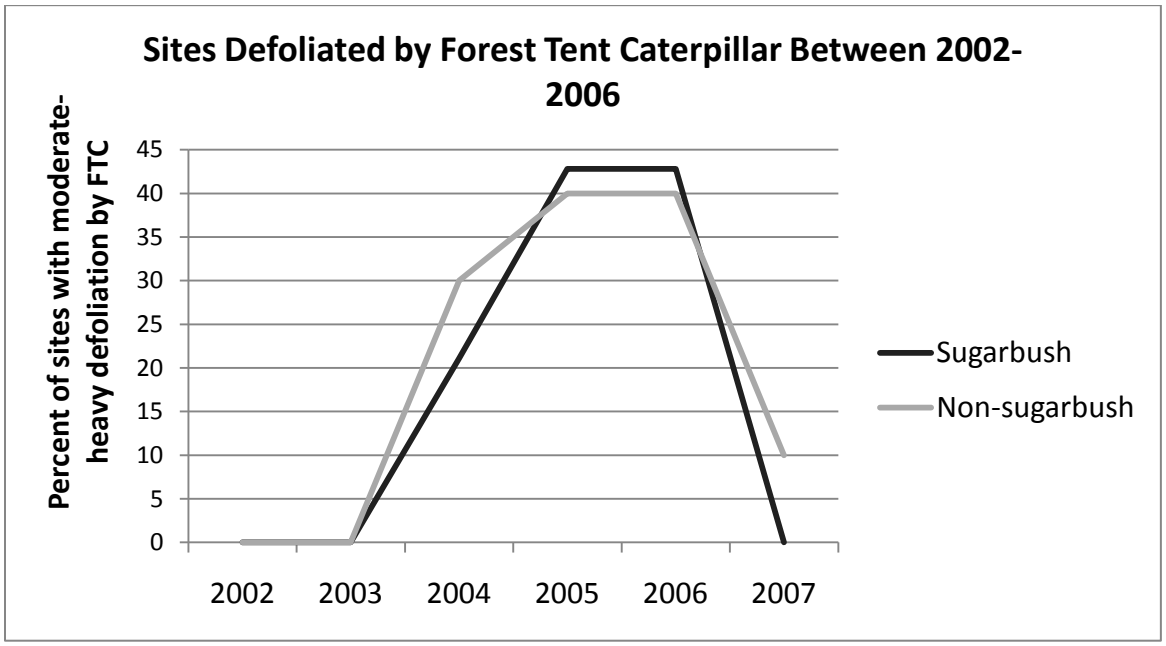


Figure 44. Sites with heavy defoliation by forest tent caterpillar.

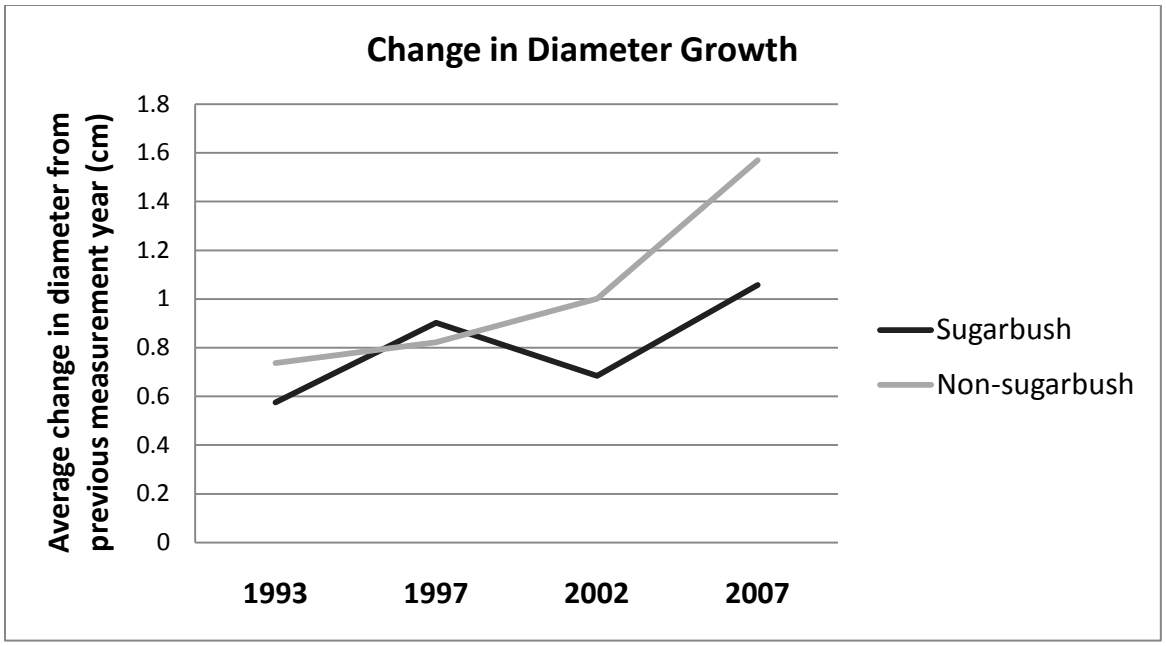


Figure 45. Change in sugar maple diameters in sugarbush and non-sugarbush sites.

Other findings from NAMP (1988-2007)

- Sugar maple tree health was the same in both **tapped** and **untapped** stands.
- **Healthy trees** were those with 0-15% dieback.
- Most trees **recovered** with 20-35% dieback.
- Most trees **didn't recover** with over 35% dieback.
- **Annual mortality** of canopy trees was 0.9%.
- Mortality from the 1998 **ice storm** rose to 2.3%.
- **Surviving trees** from the 1998 ice storm with heavy limb loss recovered in a few years.
- Good **soil nutrition** improved recovery following defoliation.
- Sites with **low soil calcium** levels did not resume radial growth for several years following pear thrips defoliation.
- Long-term health effects of the 1999 and 2001 **droughts** were evident through 2007.
- **Forest tent caterpillar** defoliation in 2003-2006 increased tree mortality to 1.6%, and was more significant in stands with less tree diversity.
- **Non-native invasive plants** are an increasing concern to forest health and were found at 25% of these sites.

Trends in Forest Health at Vermont Monitoring Cooperative site at Mount Mansfield

Forest health monitoring on the west slope of Mount Mansfield showed continued better-than-average crown condition index (Figure 46). Eight plots with 4-subplots each, located in pairs at 4 elevations, 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. Trees on summit plots were less healthy than those at lower elevations (Figure 47). Crown breakage from past wind/ice storms was evident on upper elevation plots. One plot at 2200 feet increased annual mortality to 2.3% with the loss of several birch trees, assumed to be drought related.

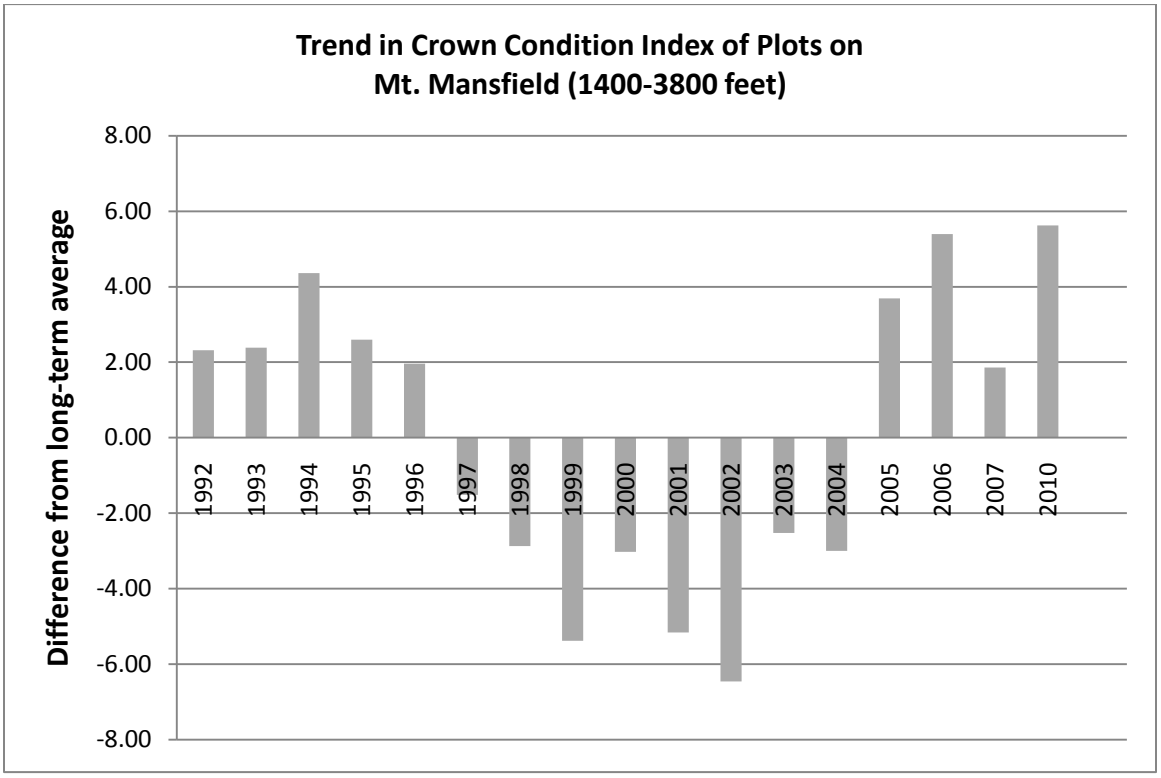


Figure 46. Trend in the crown condition index compared to the long-term average for all 8 plots on the west slope and summit of Mount Mansfield.

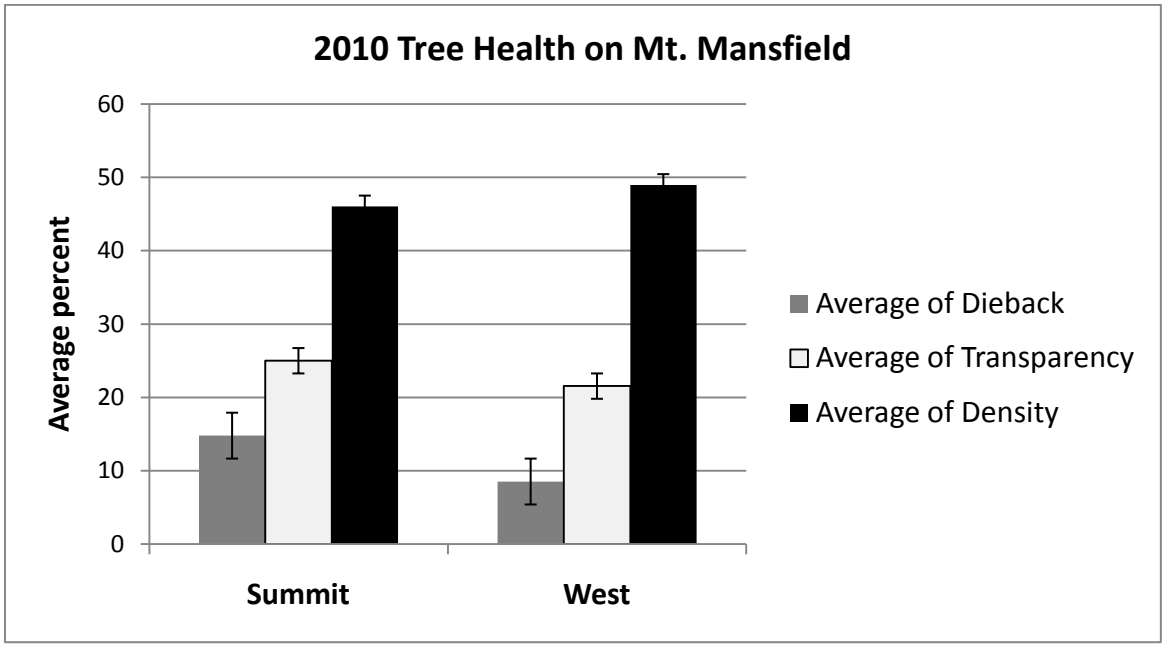


Figure 47. Comparisons of crown health indicators for summit plots and west slope plots on Mount Mansfield for 2010.

Climate Change

Vermont state government, academic institutions, businesses and non-government organizations are working together on climate change issues through the Vermont Climate Collaborative: http://www.uvm.edu/~vtcc/

The Vermont Agency of Natural Resources updated the state greenhouse gas inventory in 2010. Vermont reduced emissions since the last inventory in 2007 in part because of reduced vehicle use, increased energy efficiency of homes and businesses, and increased reliance on low-emitting electrical generating sources. Forest sequestration of carbon dioxide continues to increase although at a slower rate. However, to reach the Governor's targets for reducing GHG to 25% below 1990 levels by 2012, bold new initiatives are needed. http://www.anr.state.vt.us/anr/climatechange/Vermont_Emissions.html

A Vermont Agency of Natural Resources team was formed in 2010 to identify climate change impacts to natural resources and built infrastructure and develop plans to adapt to these changes. An initial assessment of potential impacts will be available in January 2011. This and other forest-related information can be found at: http://www.vtfpr.org/htm/for_climatechange.cfm