FOREST INSECT AND DISEASE CONDITIONS IN VERMONT 2007

FOREST, PARKS & RECREATION
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http://www.vtfpr.org/

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FOREST INSECT AND DISEASE CONDITIONS IN VERMONT

CALENDAR YEAR 2007

Scott Pfister, Chief of Forest Resource Protection, participating in hemlock woolly adelgid eradication effort in Rockingham, June 2007..

PREPARED BY:

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AGENCY OF NATURAL RESOURCES
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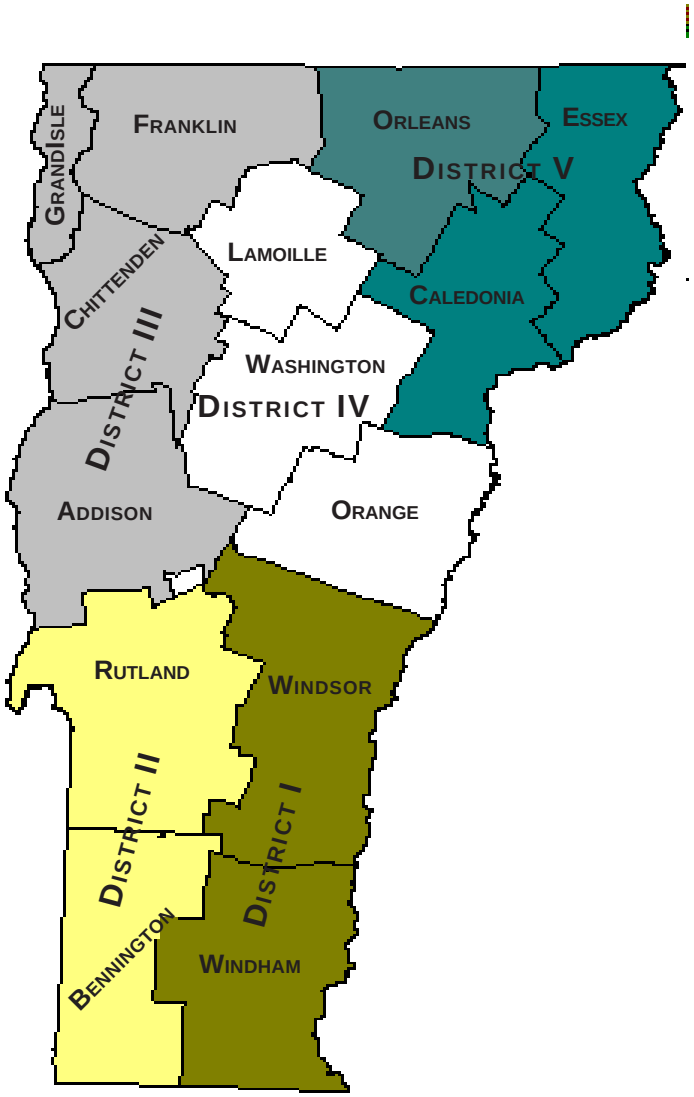

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2007 VERMONT FOREST INSECT AND DISEASE HIGHLIGHTS

Arborvitae Leaf Miner, *Argyresthia thuiella,* populations appeared to be increasing in 2007. .Light damage was aerially detected on 257 acres, mostly in northern Vermont.

Balsam Woolly Adelgid, *Adelges piceae,* populations have rebounded in some locations, probably due to consecutive warm winters. .Heavy bole infestations were observed in Plymouth, Springfield, Wardsboro and Groton.

Beech Bark Disease, caused by *Cryptococcus fagisuga* and *Neonectria faginata,* remained widespread, with 61,859 acres of beech dieback and mortality mapped statewide. Populations of beech scale remained low and the much higher-than-normal disease levels of recent years seem to be tapering off.

Birch Decline was mapped on 3,563 acres in 2007. Although birch decline remains evident on paper birch at upper elevations, fewer acres were detected.

Brown Spot Needle Blight, caused by *Scirrhia acicola and Mycosphaerella dearnessii,* was again heavy and widespread on white pine this year, causing previous year needles on many trees to brown up in early spring. Symptom severity was highly variable from tree to tree. Trees looked better once new growth emerged and brown needles had been cast.

Maple Anthracnose, caused by *Discula* spp., became widespread late in the season. It was the "common denominator" of the late-season sugar maple defoliation that was mapped on 102,551 acres statewide. This defoliation was most common in the south-central and western Green Mountains. A number of defoliators also played a role: maple trumpet skeletonizer and Septoria leaf spot were particularly significant in northern areas and saddled prominent in southern areas. Pear thrips and maple leaf cutter were also locally important. In parts of Franklin and Grand Isle Counties, windburn also contributed to the damage.

Although we are no longer actively surveying for the **Common Pine Shoot Beetle**, *Tomicus piniperda,* a single specimen was captured in a European woodwasp (*Sirex noctilio*) survey trap between June 15 and 29 in Ferrisburgh. In sites where these beetles were previously captured in pheromone traps, tree damage is difficult to find and is limited to new shoot injury. 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. Quarantine details can be found at: www.vtfpr.org/protection/for_protect_forhealth.cfm.

Drought was responsible for late-season leaf browning and defoliation of oak, maple, and other hardwoods that were mapped on 8,484 acres statewide. Most of the damage was observed on ledgey sites with shallow soils.

Detection surveys for **Emerald Ash Borer**, *Agrilus planipennis*, continued in Vermont in 2007. Since many exotic organisms are first detected by individuals outside of the State Forestry staff, we continued to focus on general outreach geared towards informing a broad array of groups on emerald ash borer risks, identification and reporting.

Forest Tent Caterpillar, *Malacosoma disstria***,** populations collapsed statewide. Although noticeable feeding was reported from northern Windsor County, Orange County (particularly a portion of one sugarbush in Braintree) and northeastern Addison County, no significant defoliation was observed from the ground or mapped during aerial surveys.

Gypsy Moth, *Lymantria dispar,* populations remained low with no defoliation mapped during aerial surveys.

Hardwood Chlorosis was noticeable in some areas, and was mapped on 1,932 acres. Some of the mapped damage was in sugar maple stands previously defoliated by forest tent caterpillar. Elsewhere, however, other

species were affected, including aspen, hophornbeam, and birch species. Late season drought may have contributed to the chlorosis.

Hemlock Woolly Adelgid, *Adelges tsugae,* was detected for the first time on mature trees in Vermont. All of the infested trees were in Windham County: a single tree in Rockingham and at least nine in Brattleboro. The insect was thought to have been brought to Vermont by birds, since all of the infested trees were near bird baths or feeders. The introduction likely occurred two or three years ago. The lack of severe cold temperatures in recent winters may have contributed to adelgid survival in the state.

Larch Decline, caused by past drought and an increase in eastern larch beetle populations, continued to expand. Damage was mapped on 3,918 acres, double the area that was affected last year.

There was an increase in mapped areas of **Logging-Related Decline** this year. The total area mapped during aerial survey was 3,778 acres widely scattered throughout the state. Logging prior to defoliation increased the impact of forest tent caterpillar in some stands.

Oystershell Scale, *Lepidosaphes ulmi*, populations caused light damage to beech in scattered locations. Heavy infestations were noted on green ash in Chittenden County.

In 2007, 11 locations were visited to survey for **Ozone Injury** on bioindicator plants. Symptoms of ozone injury (stippling on upper leaf surface) were recorded at only one location in Rupert.

Pear Thrips, *Taeniothrips inconsequens*, damage to sugar maple was mostly light, but more common than in 2006. Scattered moderate-heavy damage was observed at higher elevation hardwood stands in the Green Mountains and the Taconics.

Saddled Prominent, *Heterocampa guttivata***,** feeding was reported throughout the region in 2007 and contributed to the widespread sugar maple defoliation mapped during aerial surveys. Though the defoliation was more widespread than in 2006, intensity decreased. Evidence of defoliation was common but was mostly light.

Septoria Leafspot of birch, caused by *Septoria betulae*, was widespread again this year, causing late-season browning and defoliation that was mapped on 25,278 acres.

Shoestring Root Rot, caused by *Armillaria* species, has become increasingly common as a cause of Christmas tree mortality, especially for plantations with more than two generations of trees and plantations where inter-planting near old stumps is practiced. Fraser fir appears to be more susceptible than native balsam fir, while balsam-Fraser crosses appear to be intermediate in susceptibility.

The exotic **Sirex Woodwasp**, *Sirex noctilio,* was detected in Vermont for the first time in 2007 when a single specimen was captured in a baited trap that was deployed in Stowe by the Vermont Agency of Agriculture, Food, and Markets. No infested trees were observed, but surveys will continue in the vicinity in 2008.

Spruce-Fir Decline was mapped on 9,535 acres statewide and remains common at high elevations and in stands previously affected by balsam woolly adelgid.

Wind Damage was sometimes severe as a result of a windstorm, dubbed a "nor'icane" by the media, on April 16th. The heaviest damage was in the City of Rutland and in parts of the Northeast Kingdom. Although many species were affected, conifers were particularly likely to be either windthrown or snapped. Tree damage led to power outages in much of the region.

A special aerial survey was flown in May to map wind damage in the Rutland and the Northeast Kingdom areas. Additional damage was mapped during routine surveys in late summer. In all, 6,090 acres of damage were mapped.

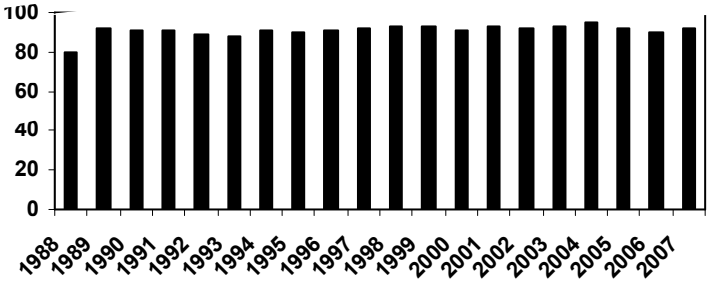
VERMONT 2007 FOREST HEALTH MANAGEMENT RECOMMENDATIONS

Reported by the State of Vermont Department of Forests, Parks and Recreation

This report summarizes information of particular importance to forest managers. Additional information can be found in the complete report on Forest Insect and Disease Conditions in Vermont 2007 or in separate summaries for sugarbush and Christmas tree managers. For assistance in identifying pests, diagnosing forest health problems, on-site evaluations, and insect population sampling, or to obtain copies of defoliation maps, management recommendations, and additional literature, contact Forest Resource Protection personnel or your County Forester.

General Tree Condition continued to be good in 2007, although dry conditions in the last half of the growing season will have an impact on tree health next year. On the downside, two exotic insects, hemlock woolly adelgid and European woodwasp, were detected in Vermont, while emerald ash borer is approaching the region.

% of Sugar Maples Rated Healthy

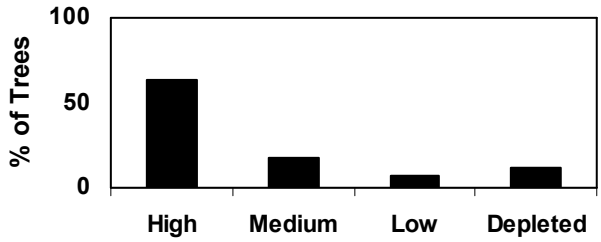


Heavy winds did cause locally severe damage. In wind-damaged softwood stands, bark beetles build up quickly. If salvage needs to be prioritized, assess infestations in stands with a high proportion of windthrown trees separately from those where broken stems predominate.

There were no major new problems in **Oak, Beech, Spruce, Fir or Larch** stands. Late season dry conditions in 2007 may initiate decline on dry or wet sites. In existing areas of softwood decline, harvesting activities should be done in large groups, patch clearcuts, or other non-selective methods.

Most **Sugar Maple and other Hardwood**s in southern, central, and western Vermont are recovering well from the forest tent caterpillar outbreak. Although defoliation was widespread in 2006, good growing conditions and adequate rainfall allowed the trees to refoliate quickly and replenish their carbohydrate reserves. In fall 2006, starch levels were high in 2/3 of the sugar maple roots from defoliated stands that we evaluated. There are some stands where tree health has declined following defoliation, most often on dry or wet sites, or in areas that had been recently thinned.

Fall 2006 Starch Ratings of Sugar Maples in Defoliated Stands



The condition of sugar maple stands in 2007 should clarify whether or not the impact of forest tent caterpillar defoliation remains a concern. If there has been an increase in dieback, or if leaves were small or chlorotic, continue to postpone thinning. If trees had a full crown of green leaves in 2007, it's probably safe to resume routine management activities.

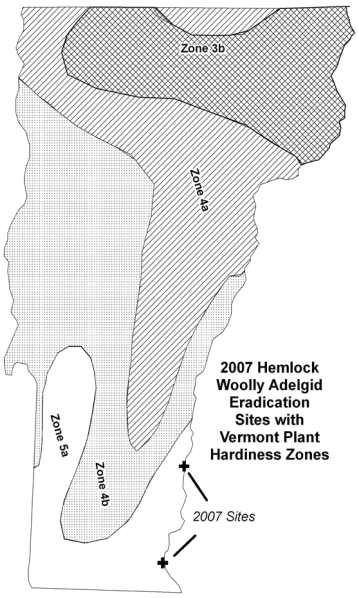
In late August and September, 100,000 acres of sugar maple defoliation were mapped during aerial surveys. Most was caused by late season defoliators like maple trumpet skeletonizer and anthracnose, and we expect the impact on tree health to be minimal. Other causal agents, including pear thrips and saddled prominent, were locally important.

Ash continues to be threatened by the advance of emerald ash borer, which is now established in western Pennsylvania. We will be preparing an action plan in 2008 so we will be more prepared if/when the insect arrives in Vermont. In the meantime, there are things you can do. Discourage the use of green ash in urban plantings. Also, educate friends, co-workers, and clients about the risk of transporting insects in firewood. When you go camping, acquire your firewood on-site.

Abnormal levels of **Hickory** mortality have not been reported from Vermont, but have been seen in the mid-Atlantic states and the Midwest. The cause of the mortality is under investigation. We would be interested in hearing about Vermont stands with hickory mortality. More information can be found at dnr.wi.gov/forestry/fh/pdf/HickoryMortalityFactsheet.pdf.

Research continues on both **Chestnut** blight and **Butternut** canker. Scientists are looking for resistant trees. If you know of pole-sized or larger, disease-free individuals of either host species, please let us know.

Hemlock woolly adelgid was found on native hemlocks in Windham County in 2007. This is the first known natural spread into Vermont and illustrates that the insect can survive here, at least through abnormally warm winters.



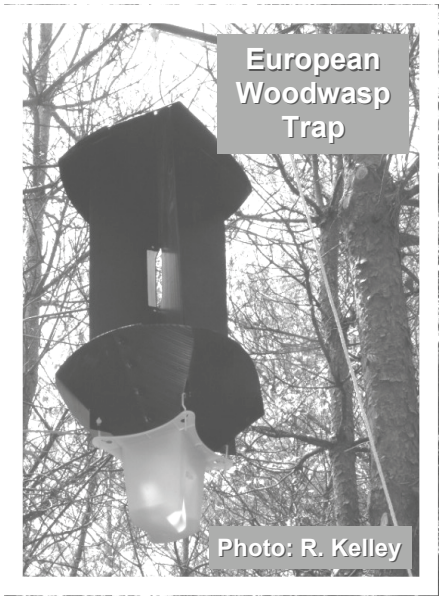
When is winter cold enough to stop hemlock woolly adelgid? Research from Massachusetts suggests that "cold enough" is when there are at least 77 days when the temperature goes below 15ºF, or a single day when it drops to -30º, or when the daily average from December to March is 23º or lower.

The known infestations are under eradication. We plan to fight this insect aggressively as long as we believe its establishment in Vermont can be delayed. Please notify us of any white woolly masses on hemlock you think may be adelgid.

By quarantine, hemlock nursery stock from infested counties outside Vermont may not be brought into the state. Hemlock logs, lumber with bark, and chips are admissible only to sites with a compliance agreement.

New Hampshire and Maine have similar restrictions. We can provide a Proof of Origin certificate, for hemlock cut in Vermont, if you are asked to provide one by a sawmill or other destination in these states.

Although the risk that hemlock woolly adelgid may become established in Vermont is increasing, we continue to discourage pre-infestation salvage. To date, this insect has not been as devastating in New England as it has been in the southeastern United States. Additional information on managing threatened hemlock forests is online at harvardforest.fas.harvard.edu/publications/pdfs/Orwig_HWA_fact_sheet_2005.pdf.



Hard Pines continue to host more than their share of native and exotic pests. In 2007, European woodwasp was detected in Vermont for the first time. The insect was caught in a trap in Stowe. We have no knowledge of any infested trees. Surveys will continue in 2008. Quarantine restrictions on the movement of pine materials are in development for this pest . European woodwasp is more successful in stagnated stands, so management that promotes deep crowns and removes unthrifty trees will make pines more resistant. Silvicultural guidelines have recently been published for reducing the potential impact of this insect. With the added stress of drought and of Diplodia shoot blight, which was unusually severe in 2007, this is a good time to check on the health of red pine stands.

We continue to expect a decline in the health of **White Pine** on wetter sites. Recent growing seasons which bounced from unusually wet to dry in late 2007, are likely to have caused root mortality. In addition, many pines on these sites have had heavy needle loss from brown spot needle blight in both 2006 and 2007.

Sites should be inspected for **Invasive Exotic Plants** wherever management activities are planned. It may be worthwhile to eradicate isolated plants so they don't spread following disturbance, or to control a more significant invasion before a regeneration cut. You must be a certified pesticide applicator through the Vermont Agency of Agriculture to apply herbicide on any land you do not own. We plan to begin developing Vermont-specific invasive plant management guides in 2008.

For more information contact:	Windsor & Windham Counties……..	Springfield (802) 885-8855
	Bennington & Rutland Counties……	Rutland (802) 786-3851
	Addison, Chittenden & Grand Isle Counties……..	Essex Junction (802) 879-6565
	Orange & Washington Counties……..	Barre (802) 476-0170
	Lamoille & Washington Counties……	Morrisville (802) 888-5733
	Caledonia, Orleans & Essex Counties……	St. Johnsbury (802) 751-0110

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 was flown between August 13 and September 18th to document late season defoliators and general forest condition. A special survey was flown in parts of Rutland County and the Northeast Kingdom on May 21st and 24th to map wind damage. All surveys were conducted using a digital sketchmapping system.

ACKNOWLEDGEMENTS

Thanks to the many individuals who contributed to this report, including John Barrows (retired), Mary Burnham, Dan Dillner, Jim Esden, Tess Greaves, Ellen Hinman, Jay Lackey, Lars Lund, Hollis Prior (retired), Pete Reed (retired), Allan Sands (retired), and Tom Simmons from our Forest Resource Protection staff. Assistance in conducting aerial detection surveys, ground checks and other information was provided by members of our Forest Management staff, including Louis Bushey, Jeremy Goetz, Aaron Hurst, Mike Johnson, Matt Leonard, Eric Hansen, and Sam Schneski. Diagnostic and pest management assistance were provided by Scott Costa and Margaret Skinner from the University of Vermont; Jon Turmel, Emilie Inoue, Tim Schmalz, Matt Wood and Cary Giguere from the Vermont Agency of Agriculture; Kyle Lombard from New Hampshire's Division of Forests and Lands; Charlie Burnham and Ken Gooch from the Massachusetts Division of Forests and Parks; Richard Cowles, CT Agricultural Experiment Station; Dave Struble, Maine Forest Service; Shelly Stiles, Bennington County Conservation District; Dennis Souto, Margaret Miller-Week and Kevin Dodds from the USDA Forest Service. Assistance in conducting aerial surveys and processing map data was provided by Bill Frament and Tom Luther from the US Forest Service, Forest Health Protection; and Joanna Grossman, Vermont Monitoring Cooperative.

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WEATHER AND PHENOLOGY

2007 weather statistics based on Burlington data are summarized in Figure 1. Unless otherwise noted, all temperature and precipitation reports in the narrative below are from our Essex weather station.

Late fall and early winter 2006 were very warm and wet. From the 1st until the 20th of November, there were only 5 overnight low temperatures below freezing. The average daytime high was 52° F, and 2.33" of rain fell during the period. The month was the second warmest November on record in Burlington—posting two daily all-time high temperature records on the 17th (70°F) and the 30th (63°F). December wasn't much different. It too was the second warmest December on record in Burlington, and the two months combined were the warmest November/December duo.

With January running nearly 20° above normal, there were fears of "A Year Without Winter." A very fast west-to-east jet stream, high above Canada, continually blocked the frigid arctic air from plunging southward. By January 6th, not even a skim of ice covered the bays of Lake Champlain, and many frustrated ice fishermen were left waiting on the shore. The ski report from Mad River Glen (where they do not make snow) on January 9th stated simply, "The pub opens at 11:00 AM."

The first 6" snowfall for the Champlain Valley fell on Martin Luther King Day, and the temperatures took a dive after that for the rest of the month. The last seven days of January had low temperatures in the teens below zero each night (-15° F on the 25th and -17° F on the 30th). Cold temperatures were recorded throughout the State during this time. On the morning of the 30th, Island Pond had a low of -32 ° and East Berkshire recorded -28 °.

Even after such a mild start to the winter season, there were 30 days with zero or below for overnight lows recorded throughout the rest of the winter. Because of the warm early winter temperatures, the lakes remained open as a moisture source for lake effect snows. In one phenomenal week in early February, Redfield, New York recorded 136" of snow as the cold winds blew across the open waters of Lake Ontario. Such snows occur in narrow bands (only 15-20 miles wide) and shift north and south depending on the slant of the westerly winds.

In a case of "be careful what you ask for," the snow finally arrived in Vermont in a big way. The Valentine's Day blizzard began in the wee hours of the morning and it snowed steadily for 24 hours. Snow totals ranged widely from 1 ½ to 2+ feet throughout the state. Unofficial reports of over 4 feet were measured at Bolton Valley and Jay Peak ski areas. The Essex station recorded 27.7" of snow with a water content of 2.33". Snow fell at a rate of 1 to 4 inches an hour and winds blew up to 35 MPH making visibility near zero and wind chills bitterly cold. Blizzard conditions are not common in Vermont. In fact, the National Weather Service has only issued blizzard warnings three times in the last 25 years.

Everyone was snowed in. Nearly every school in Vermont was closed as well as many stores, businesses, banks and state government. Travel was nearly impossible. All tractor trailers were ordered off the interstates and all state roadways. Nearly every flight was cancelled out of Burlington Airport, and Amtrak halted service north of Springfield, Massachusetts. Eleven barn roofs collapsed; and many people were admitted to hospital emergency rooms suffering from carbon monoxide exposure due to the snow blocking their outside heating vents. At least four deaths were blamed on the blizzard from elderly people suffering heart attacks while shoveling. Avalanche warnings were posted for the Green Mountains and the Adirondacks.

This deep snow proved to make for slow going as maple sugarmakers began to tap their trees for the upcoming season. The large producers, with many thousands of taps, were especially hindered. Needless to say, the ski areas were ecstatic with enough white stuff to last for months. Another holiday storm hit on St. Patrick's Day (14" at Essex). Fears of a year without winter were long forgotten.

The dramatic turn to cold and snow in late January gave an almost normal start to the timing of the maple sugaring season. Predictions of a very early season did not develop. There are always wide variations in the quality and quantity of any given maple syrup crop. The gathering methods are so diverse, and the weather is far from uniform across the state…or even across a single town. In general, the 2007 season was slightly down

from the theoretical average—with the northern part of the state doing slightly better than the southern counties. Producers using only buckets reported an average yield per tap of only 57% compared to sugarmakers with tubing and vacuum. The sugaring season in a nutshell: the total production was close to average; the color was generally darker; the season ran later that usual; and the tapping process was complicated by deep, February snow.

The snowpack in the valleys slowly and steadily melted away to nothing by the end of March. A couple of light, early April snows kept the ground white. Plants were slow to open their buds (Figures 2-5 and Table 1). On April 15 and 16 a powerful nor'easter with hurricane-like winds brought down trees and powerlines. It started as rain, changed to wet snow, and then back to rain. Up to 17 inches of snow in parts of the state accompanied this storm while other areas received rain, sleet and lesser amounts of snow. High winds came on the tail end of the storm causing many trees to break and/or blow over. Damage was most severe in the Rutland area with wind gusts to 70 mph and in the Northeast Kingdom, specifically the Guildhall area. Fairbanks Museum in St. Johnsbury recorded wind speeds of 55 mph.

Just three days later a warm, dry spell began (Figure 6). A lot of fine fuels dried out rapidly and the table was set for the spring fire season. This would lead to a red flag warning being issued on April 23rd. By early May the very dry, cool air prompted a second red flag warning (May 4th). Precipitation amounts were generally below normal from mid-April to the end of June—especially in northern Vermont. Warm temperatures from May 9th to May 11th jumped the green up in the valleys and lower elevations—catching up from the slow start and lowering the fire danger.

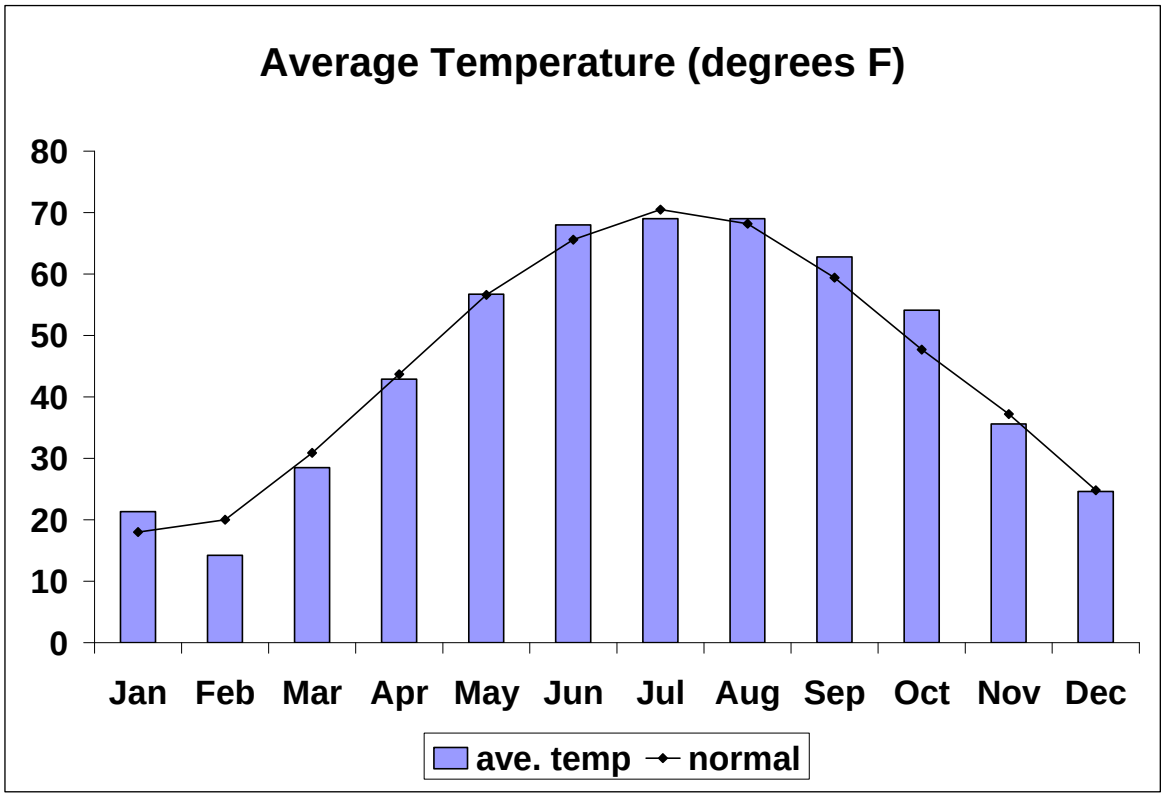
The month of June had very regular fluctuations in the weather systems. A couple of days of hot weather were followed by a break with a few days in the 70's, then back to the upper 80's and 90's again for a couple of days, etc. Back-to-back record setting days occurred in late June (26th, 27th) with a high temperature of 96° F! July was wet. Precipitation was above normal to way above normal across the state. From July 9th through the 13th, there were thunderstorms almost every day…leaving central Vermont with significant flooding. There were 12 days of 90° F or higher temperatures throughout the summer, with the highest being that 96° F in late June.

August and early September were very dry. August recorded only 1.64" of rain at Essex, and September was well below normal with 2.12" of rain. A stretch of eleven days in a row with only a sprinkle of rain (8/26-9/5) left many gardeners and homeowners running for the hose to save their plants. According to some, this late summer dry spell would show up later in the quality of the fall foliage. The last frost was on May 6th, and the first frost of the fall did not occur until October 13th giving the Champlain valley 160 frost-free growing days. Growing degree days (figured on a base of 50° F) were 19% above the long-term average.

A fast moving storm with 40 mph straight line winds and lightning on August 27th caused extensive damage to trees, roofs and powerlines in the Northeast Kingdom, especially the towns of Burke, Sutton, Sheffield, Wheelock, Danville, St. Johnsbury and Lyndonville. Lightning storms on August 30th started two fires in the Connecticut River valley. The dry ground fuels smoldered for several days before the smoke was detected.

With no hard frosts to get the show going, the fall foliage season seemed slow to start (Figure 7). Many observers estimated a one to two week lag. The mild weather was hard to complain about though. It gave all the leaf-peepers many pleasant days to enjoy the colors. The warm, dry, late summer did seem to affect the upper elevation trees the most—causing their leaves to fade and fall without much of a flair. Climate change was mentioned as a factor as people sought an explanation for the unusual season. Whether you thought the season was dreary or famously beautiful, there were, as always, snapshots of spectacular natural beauty to be enjoyed throughout the state.

Fruiting was heavy on hickories, wild apples, and grapes. There was little seed production on sugar maples. Beechnuts and acorns were down from 2006.



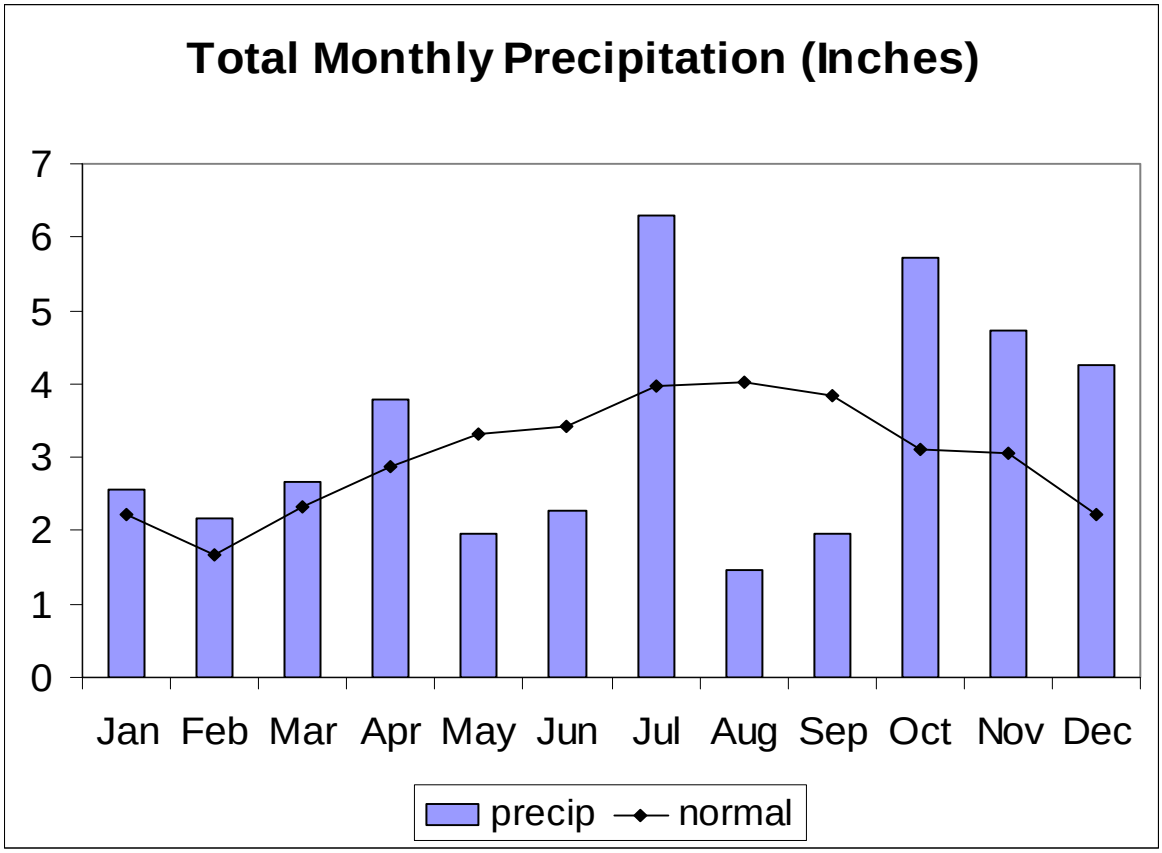


Figure 1. Monthly average temperature and monthly total precipitation in 2007, compared to normal for Burlington, Vermont. *Normals are for years 1971-2000.*

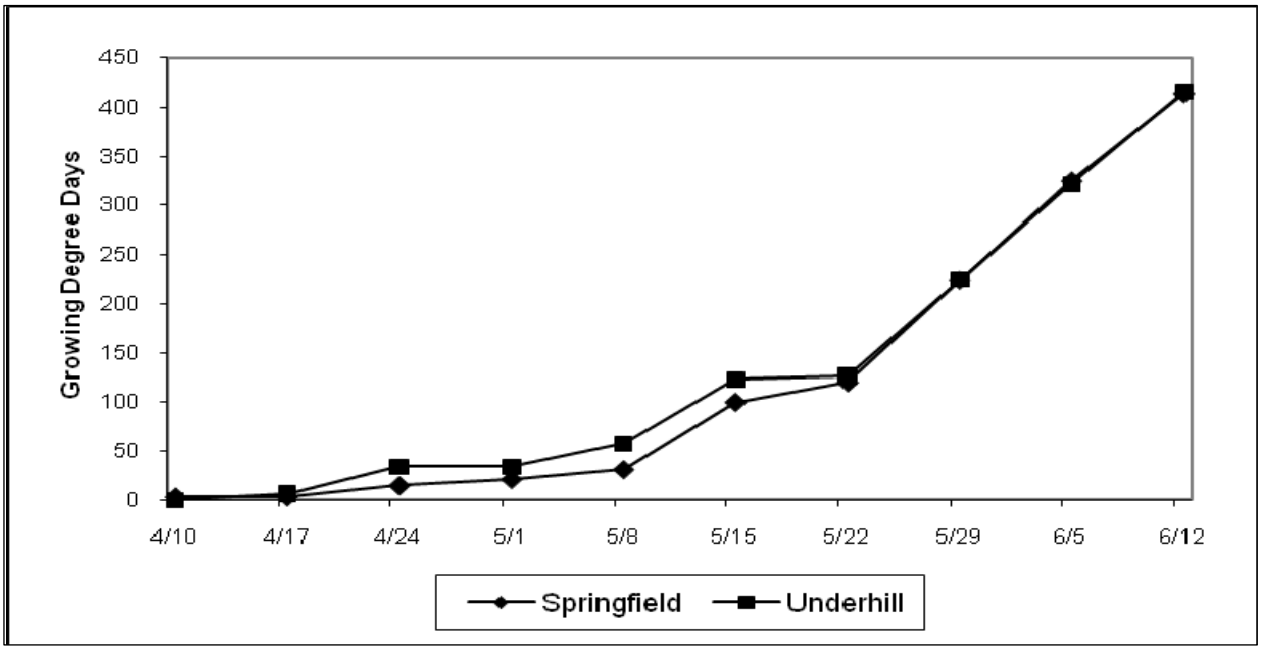


Figure 2. 2007 weekly spring cumulative growing degree days for Springfield and Underhill, Vermont. 50°F is used as the threshold of development.

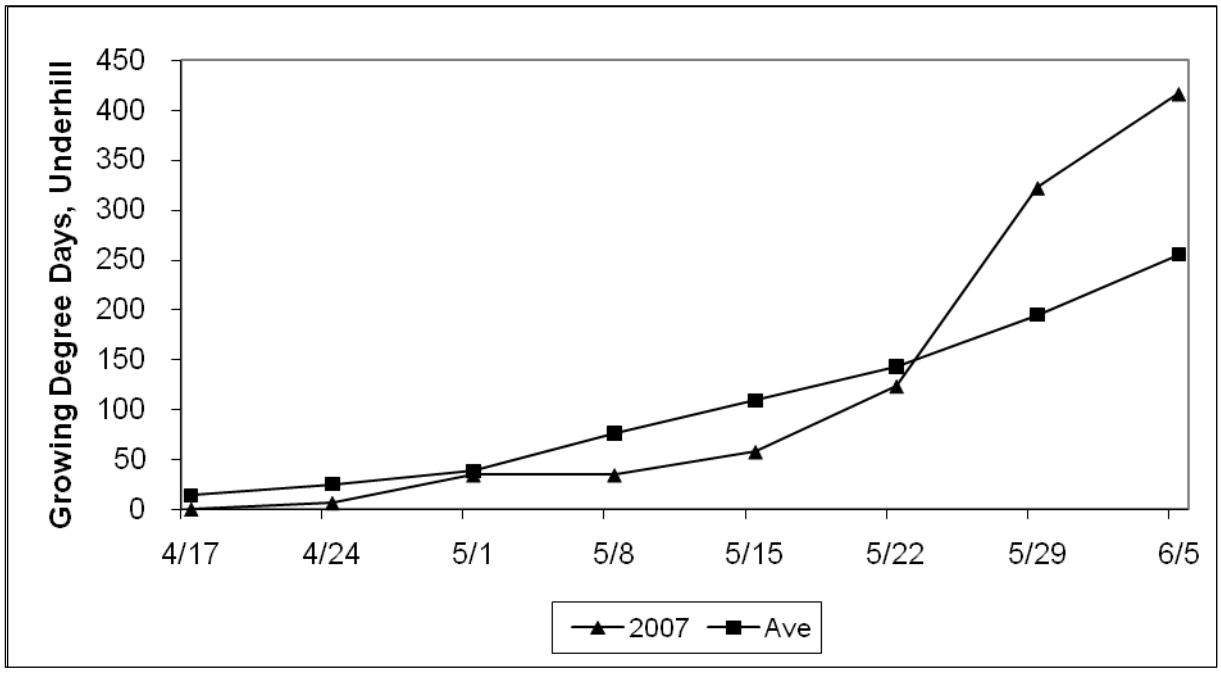


Figure 3. Weekly spring cumulative growing degree days for Underhill, Vermont, in 2007 compared with mean 1993-2007 accumulations. 50°F is used as the threshold of development.

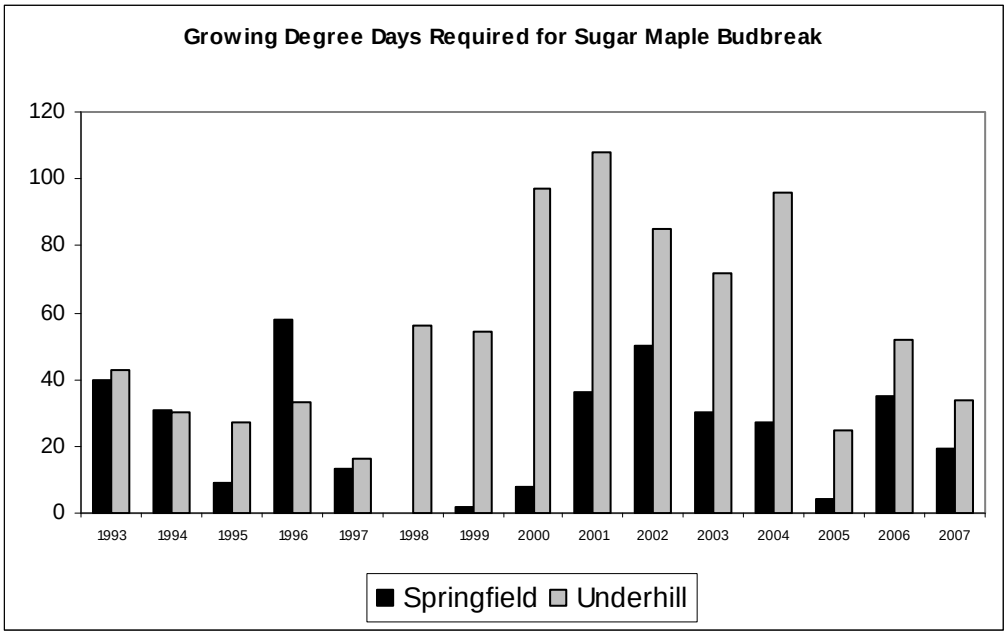


Figure 4. Growing degree days for sugar maple budbreak in Springfield and Underhill 1993-2007.

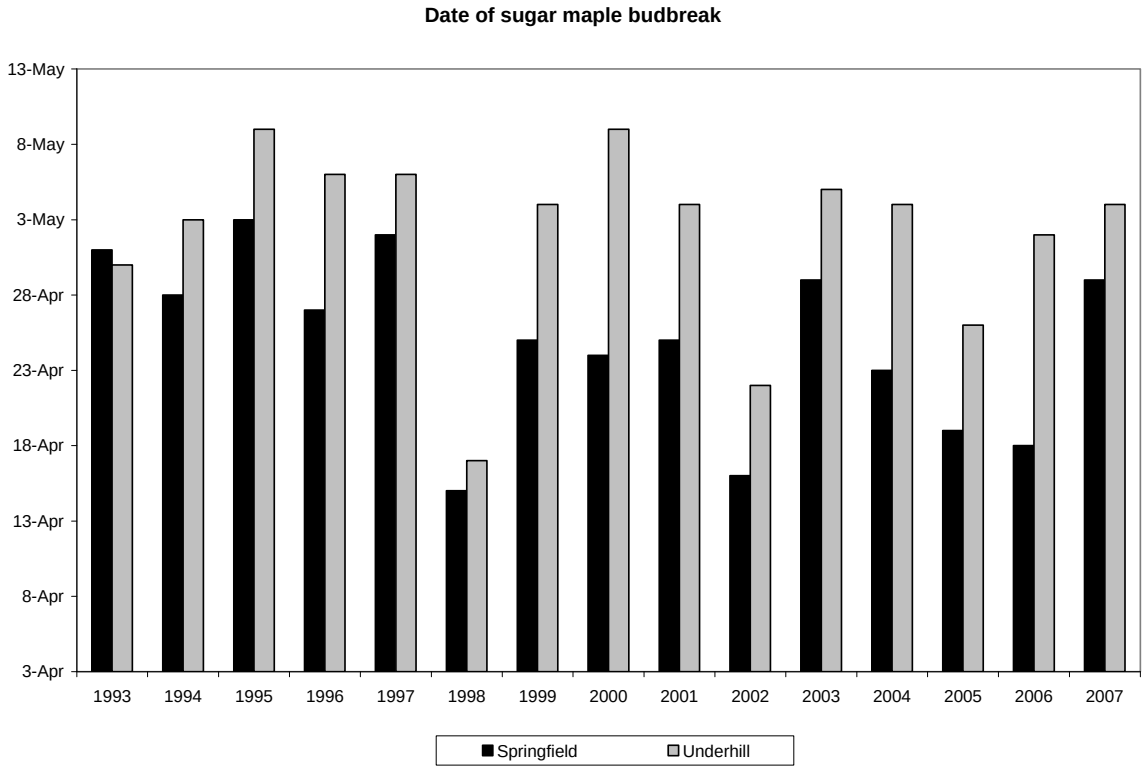


Figure 5. Dates of sugar maple budbreak in Springfield and Underhill, Vermont, 1993-2007.

Table 1. First observation dates of phenological development and growing degree day accumulation from 2 sites in Vermont. 50°F is used as the threshold of development.

Biological Indicator	Springfield	Underhill
PLANT DEVELOPMENT		
Showing Green		
FIR, BALSAM		5/11 (112)
Budbreak		
Ash, White	5/2 (23)	5/8 (57)
Cherry, Black	4/26 (15)	
Fir, Balsam		5/14 (117)
Hemlock	5/14 (90)	5/26 (200)
Maple, Red	4/28 (19)	
Maple, Sugar	4/29 (19)	5/4 (34)
OAK, RED	5/4 (23)	
SHADBUSH	4/26 (15)	
Flowers		
Aspen, Quaking	4/20 (4)	
Elm, American	4/22 (6)	
Honeysuckle, Tartarian		
Lilac (first flowers)		5/25 (188)
Maple, Red	4/22 (6)	4/27 (34)
Maple, Silver		
Maple, Sugar	4/29 (19)	5/7 (40)
PLUM, CANADA		
Shadbush		5/11 (112)
INSECT DEVELOPMENT		
Eastern tent caterpillar (first tent)		5/7 (40)
Pear thrips (first adults)		4/20 (1)
Pear thrips (first larvae)		5/11 (112)
OTHER OBSERVATIONS		
Full Green up	5/8 (213)	

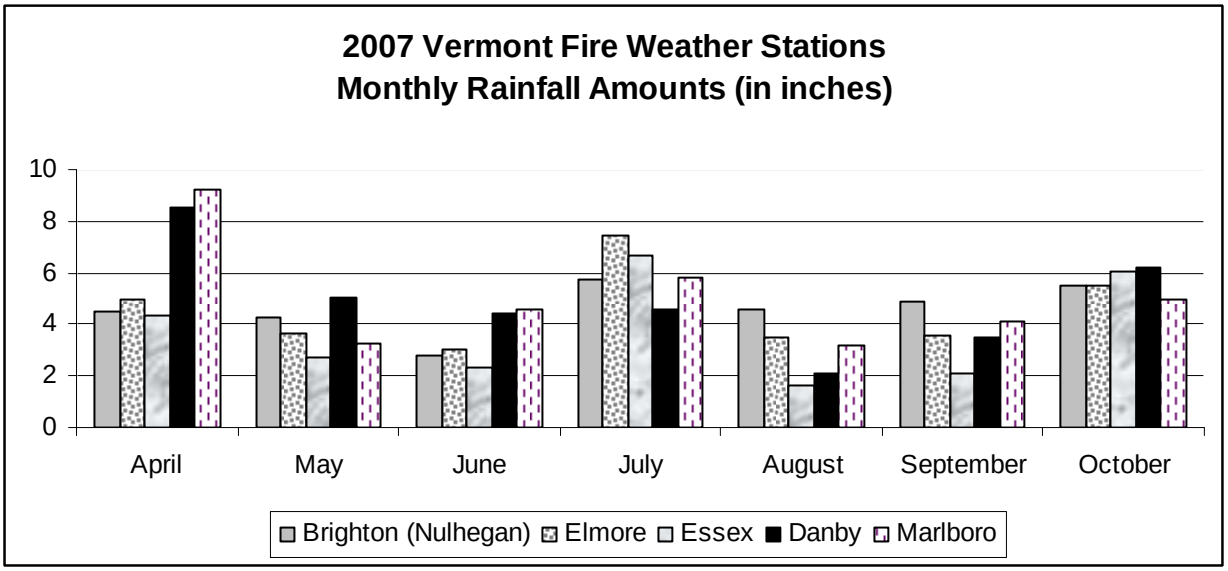


Figure 6: Monthly rainfall amounts (in inches) at Vermont fire weather observation stations through fire season, April - October, 2007.

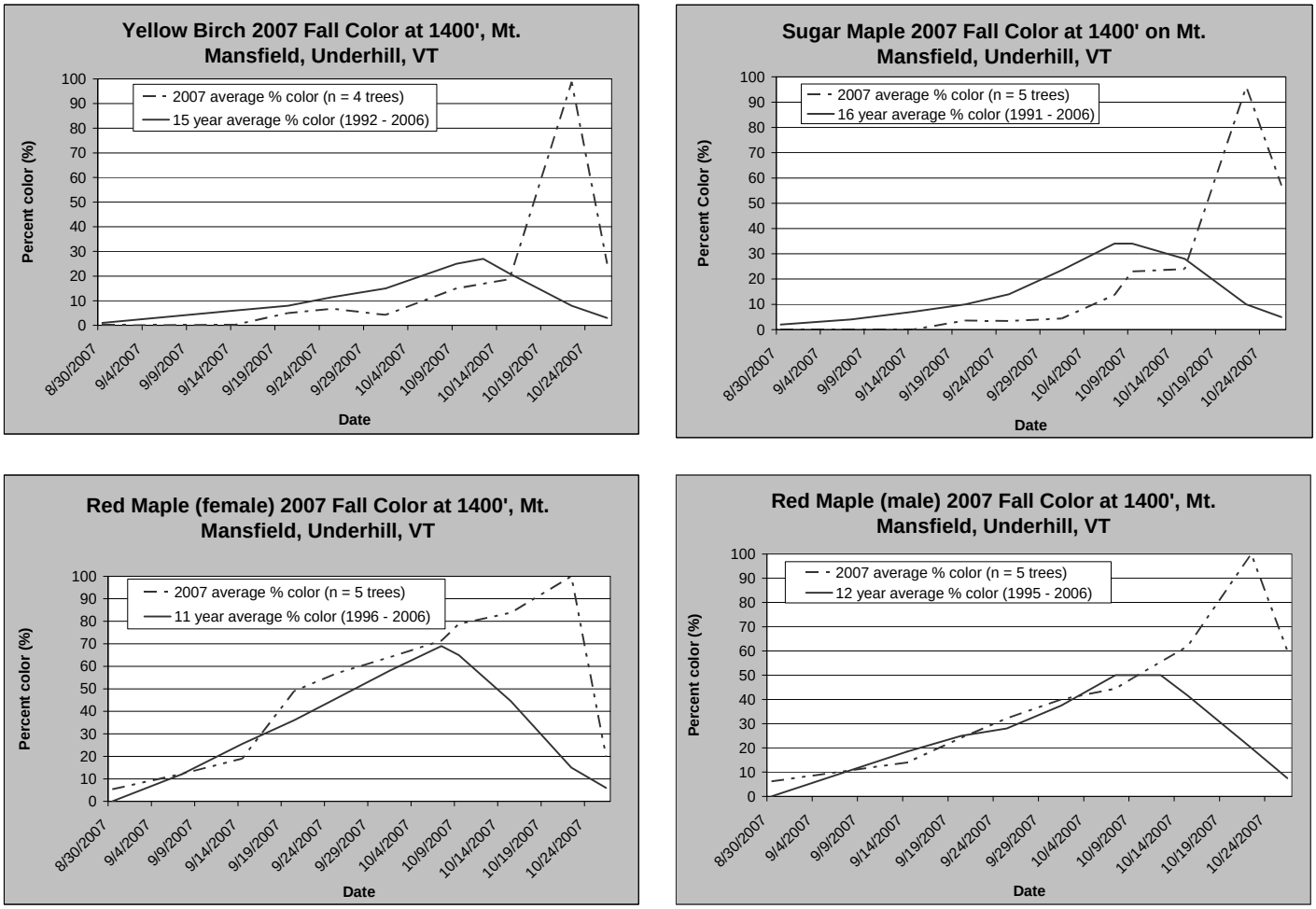
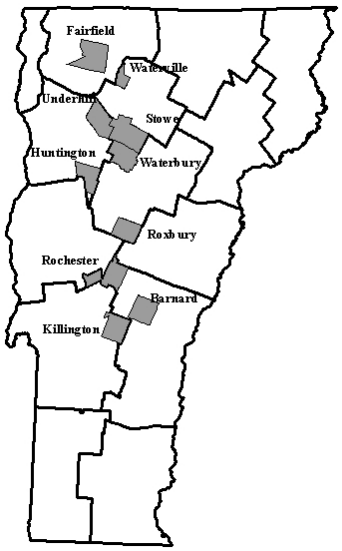


Figure 7. Progression of fall color for Yellow Birch, Sugar Maple and Red Maple at 425M at Mt. Mansfield Vermont.

HARDWOOD DEFOLIATORS

Forest Tent Caterpillar, *Malacosoma disstria***,** populations collapsed statewide. Although noticeable feeding was reported from northern Windsor County, Orange County (particularly a portion of one sugarbush in Braintree) and northeastern Addison County, no significant defoliation was observed from the ground or mapped during aerial surveys.

Moth catch in pheromone traps dropped to their lowest level since 2002, but numbers remained high in Killington and Rochester and increased in Fairfield and Roxbury. (Figure 8 and 9).



Average # of moths caught/trap

	2002	2003	2004	2005	2006	2007
Barnard	4.6	12.3	23.0	----	----	----
Castleton	----	----	----	17.0	17.3	8.0
Fairfield	----	1.3	1.7	----	4.3	4.7
Huntington	9.2	6.7	5.0	15.7	16.0	6.3
Huntington (NAMP 027)	6.0	6.7	10.0	----	----	----
Killington	6.8	9.7	20.0	15.3	21.0	17.3
Rochester	5.9	4.7	9.0	4.7	29.0	10.3
Roxbury	16.0	14.7	13.3	7.3	22.0	22.7
SB 2200	3.8	11.7	18.3	23.3	35.3	6.3
VMC 1400, Underhill	3.6	3.0	0.3	7.3	9.3	2.7
VMC 2200, Underhill	3.0	7.0	6.3	11.7	6.3	4.7
VMC 3800, Stowe	1.0	2.7	10.3	26.0	5.7	5.0
Waterbury	2.0	0.7	2.0	41.0	22.3	0.3
Waterville	0.0	1.3	1.3	17.7	24.7	2.7
Average	**5.2**	**6.9**	**10.0**	**17.0**	**17.8**	**7.6**

Figure 8. Average number of forest tent caterpillar moths caught in pheromone traps, 2002-2007. There were 4-5 traps per location in 2002 and 3 traps per location in 2003-2007.

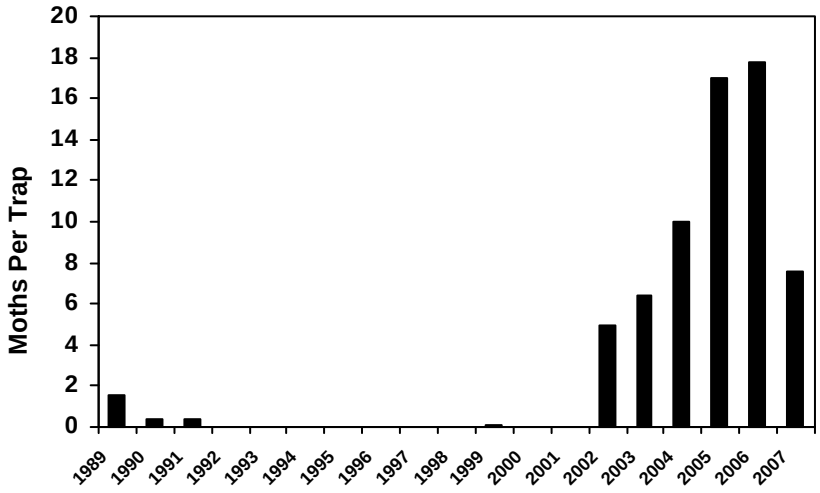


Figure 9. Average number of forest tent caterpillar moths caught in pheromone traps 1989-2007. Five multi-pher traps per site baited with RPC 2-component lures through 2001. PheroTech lures were used in 2002-2007. Three traps per site in 2003-2007.

Although 2006 moth catches had been similar to 2005, overwintering egg mass counts in 2006-07 were much lower than the previous year. Surveys were conducted at 116 sugarbushes statewide. Egg mass counts averaged 0.5 new egg masses per ten 30" branches, compared to 4.6 new egg masses per 10 branches in the 191 sugarbushes surveyed in winter 2005-06 (Figure 10). On average, 81% of the egg masses on the twigs had already hatched, indicating that they dated from winter 2005-06 or before (Figure 11).

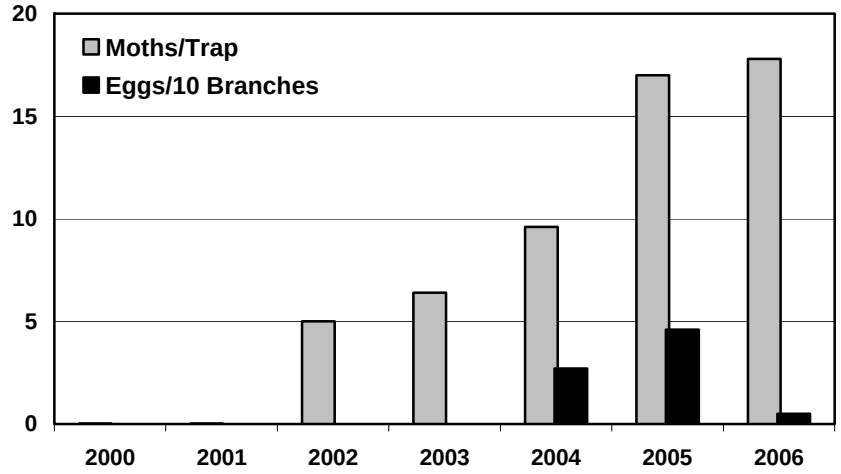


Figure 10. Statewide average of number of forest tent caterpillar moths caught per pheromone trap and number of new egg masses per ten 30" branches by year.

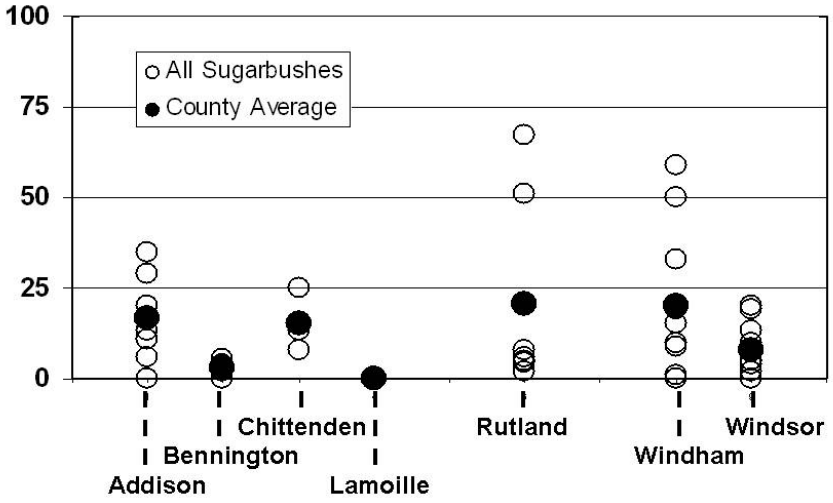


Figure 11. Percent of forest tent caterpillar egg masses that were new (unhatched in winter 2006-07) per sugarbush sampled, and by county average, in winter 2006-07. Data from 49 sugarbushes.

Egg mass counts per 10 branches averaged 0.79 in sugarbushes that had not been sprayed in 2006 compared to 0.36 in sugarbushes that had been sprayed. In unsprayed sugarbushes, 38.3% of the egg masses were new, compared to 9.5% in sprayed sugarbushes.

Following the January warm spell, unhatched egg masses were brought to the Forest Biology Lab to determine viability. The egg masses contained an average of 166 eggs, ranging from 0 to 199 eggs per egg mass. Eight percent of the eggs were parasitized, and caterpillars hatched from 67% of them.

Defoliation was predicted in only two of the sugarbushes surveyed, which were located in the Champlain Valley. Caterpillar feeding was noticeable early in the season in these stands, but populations collapsed before heavy defoliation occurred.

In some stands, tree dieback and mortality had developed following defoliation. In all, 539,841 acres were mapped as defoliated by forest tent caterpillar at least once between 2004-2006. Of this area, 102,619 acres were mapped as defoliated twice, and 10,299 acres were mapped as defoliated all three years. It is interesting to note that the cumulative defoliation of 663,000 acres over the 3 years is very similar to the 658,000 acres defoliated over 6 years for the previous outbreak of 1977-1982. Areas of severe decline are widely scattered, often on dry or wet sites or in areas that were recently thinned. Hardwood dieback and mortality attributed to forest tent caterpillar was mapped on 1,268 acres during aerial surveys (Table 2). This amount of dieback and mortality is much less than the 33,000 acres mapped following the 1977-82 outbreak.

Table 2. Mapped acreage of hardwood dieback and mortality in 2007 following forest tent caterpillar defoliation.

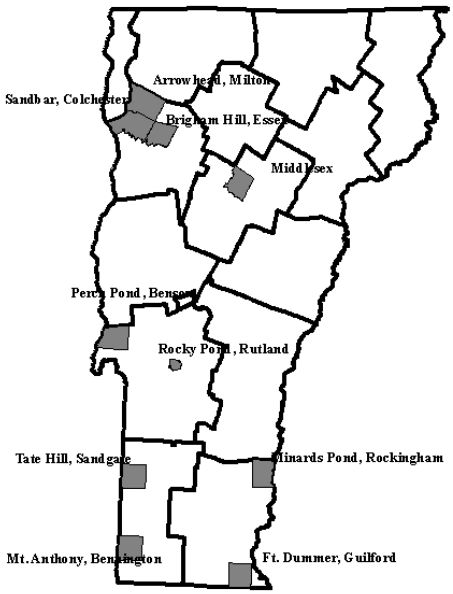
County	Acres
Bennington	96
Rutland	950
Windham	222
Total	**1268**

Forest tent caterpillar defoliation in combination with heavy feeding by lecanium scale was thought to be responsible for scattered mortality of sugar maple regeneration. Over a third of young sugar maples were dead in one stand in Windsor County.

Most often, trees have been recovering well. Although damage was widespread in 2006, the impacts on food reserves may have been less than expected because, in many cases, caterpillar populations were so heavy that defoliation occurred before leaves had expanded. Good growing conditions and adequate rainfall allowed the trees to refoliate quickly and replenish carbohydrate reserves. Overwintering starch reserves of defoliated trees were assessed by visual rating of potassium iodide-stained root sections. Starch levels were “high” in two-thirds of the trees evaluated, which were from 32 defoliated maple stands and sugarbushes. Dieback and transparency also improved on North American Maple Project plots (see Trends in Forest Condition).

According to a survey reported by the Proctor Maple Research Center, maple producers who had moderate or severe forest tent caterpillar defoliation in 2006 were less likely to report below average sweetness in spring 2007 than maple producers who had no defoliation the previous summer.

Gypsy Moth, *Lymantria dispar*, populations remained low with no defoliation mapped during aerial surveys. Occasional egg masses, larvae and feeding activity were reported, including areas outside the normal outbreak area for gypsy moth. Larval mortality from disease was also observed. Egg mass counts per $1/25^{th}$ acre monitoring plot at focal areas remained low on burlap-banded trees.



# of Gypsy Moth Egg Masses per 1/25th Acre Plot:

	2003	2004	2005	2006	2007
Arrowhead	1.5	2.5	0	0	0
Brigham Hill	2.5	2.0	1.5	0	0
Ft. Dummer	0	-----	0	0	0
Middlesex	0	2.0	0	0.5	2.0
Minards Pond	0.5	2.0	0	0	0
Mount Anthony	1.5	0	0	0	0
Perch Pond	0	0	0.5	1	0
Rocky Pond	0	0	0.5	3	3.0
Sandbar	3.0	1.5	0	0	0
Tate Hill	0	30.0	18.0	3	0
Average	**1.0**	**4.4**	**2.1**	**0.8**	**0.5**

Figure 12. Gypsy moth egg mass counts from focal area monitoring plots, 2007. Average of two 15 meter diameter burlap-banded plots per location.

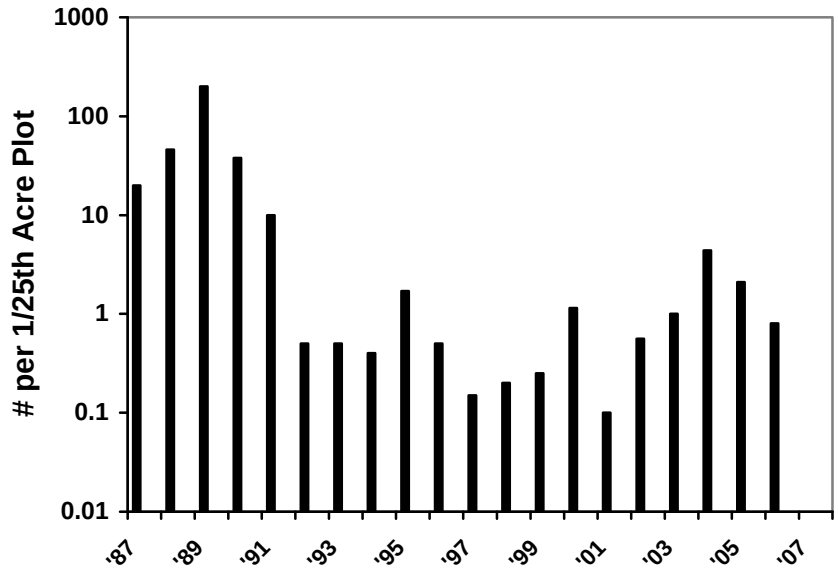


Figure 13. Gypsy moth egg mass counts from focal area monitoring plots, 1987-2007. Average of ten locations, two 15 meter diameter burlap-banded plots per location.

Saddled Prominent, *Heterocampa guttivata***,** feeding was reported throughout the region in 2007 and contributed to the widespread sugar maple defoliation mapped during aerial surveys (see Maple Anthracnose). Though the defoliation was more widespread than in 2006, intensity decreased. Evidence of defoliation was common but was mostly light. Exceptions included moderate damage to individual trees, and significant defoliation was reported for the Butternut Mountain to Laraway Mountain area of Lamoille County in mid-August. In southern Vermont, the heaviest damage was observed in the Readsboro-Whitingham area and the Pittsfield-Stockbridge area.

Defoliation in some areas that were moderately to heavily defoliated in 2006, decreased to light this year but the presence of moderate maple trumpet skeletonizer and leaf diseases often made these areas more noticeable from a distance. One of these areas in Greensboro was surveyed on July 5th for early larvae. Low defoliation potential was predicted based on 20 larvae for 21 leaf clusters sampled, and final defoliation averaged 17 percent.

Pheromone lures for saddled prominent were not available in 2007, so traps were deployed in only one location (Bolton) using the few 2006 lures that had been stored in the freezer. Of locations trapped in 2006, the Bolton site had had the highest moth count per trap (5.3 moths per trap). Average catch dropped to 1.0 moths per trap this year, compared to 0.7 moths in 2005. Freshness of the pheromone may have affected trap catch.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Beech Leaf Tier *Psilocorsis sp.*	Beech	Throughout	Commonly observed, but no significant damage. Actively feeding through late September.
Birch Leaf Folder *Ancylis discigerana*	Yellow birch Paper birch	Widely scattered	Light defoliation.
Birch Leaf Miner *Fenusa pusilla*	Paper birch	Throughout	Decreased to negligible levels this year.
Birch Skeletonizer *Bucculatrix canadensisella*	White birch Yellow birch	Throughout	Scattered light damage. Light defoliation.
Bruce Spanworm *Operophtera bruceata*			No damage reported.
Cecropia Moth *Hyalophora cecropia*	Apple	Morrisville	Two larvae seen.
Cherry Scallop Shell Moth *Hydria prunivorata*	Black cherry	Widely scattered	Increasing. Heavy on seedlings and saplings in scattered locations.
Early Birch Leaf Edgeminer *Messa nana*	White birch	Throughout	Unusually light. Damage seldom observed.
Eastern Tent Caterpillar *Melacosoma americanum*	Cherry Apple	Throughout	Population collapsed. Only occasional tents observed. Little damage reported.

INSECT	HOST(S)	LOCALITY	REMARKS
Fall Webworm *Hyphantria cunea*	Hardwoods	Throughout	Scattered heavy damage. Noticeable increase in much of northern Vermont.
Forest Tent Caterpillar *Malacosoma disstria*			See narrative.
Gypsy Moth *Lymantria dispar*			See narrative.
Hickory Tussock Moth *Lophocampa caryae*	Hardwoods	Rutland County Milton	Individual larvae on ash.
Japanese Beetle *Popillia japonica*	Many	Throughout	Increasing. Frequent light to moderate damage to ornamentals. Also seen eating the outer bark of fir Christmas trees in Essex.
Locust Leaf Miner *Odontata dorsalis*	Black locust	Widely scattered	Decreasing to only very light defoliation.
Maple Leaf Cutter *Paraclemensia acerifoliella*	Sugar maple	Throughout	Light feeding of lower crown foliage common.
Maple Trumpet Skeletonizer *Epinotia aceriella*	Sugar maple	Throughout	Very noticeable, especially in lower crowns. Large increase in damage, with widespread light to moderate defoliation. Contributed to sugar maple defoliation mapped during aerial surveys.
Maple Webworm *Tetralopha asperatella*	Sugar maple	Widespread	Decreasing. Only occasional webs seen.
Redhumped Oakworm *Symmerista canicosta*	Red oak	Springfield	Complete defoliation of a small tree.
Saddled Prominent *Heterocampa guttivata*			See narrative.
Satin Moth *Leucoma salicis*	Aspen	Bethel	Feeding on young trees.
Viburnum Leaf Beetle *Pyrrhalta viburni*	Viburnum species	Widespread	Increasing its geographic range, with heaviest damage in northeastern Vermont.
Imported Willow Leaf Beetle *Plagiodera versicloras*	Willow	Widespread	Light to moderate defoliation.

These hardwood defoliators were not reported in 2007. Alder Flea Beetle, *Altica ambient;* Birch Sawfly, *Arge pectoralis;* European Snout Beetle, *Phyllobius oblongus;* Maple Basswood Leaf Roller, *Sparganothis pettitana;* Maple Leafblotch Miner, *Cameraria aceriella;* Mountain Ash Sawfly, *Pristiphora geniculata;* Oak Leaf Tier, *Croesia semipurpurana;* Oak Skeletonizer, *Bucculatrix ainsliella;* Orange-humped Mapleworm, *Symmerista leucitys;* White Marked Tussock Moth, *Orgyia leucostigma.*

SOFTWOOD DEFOLIATORS

Arborvitae Leaf Miner, *Argyresthia thuiella*, and several closely related moths annually infest arborvitae and white cedars to some degree. Though not as heavy as in 2004, populations appeared to be increasing in 2007. Light damage was aerially detected on 257 acres, mostly in northern Vermont (Table 3).

Table 3. Mapped acres of damage by arborvitae leaf miner in 2007.

Addison	34
Caledonia	103
Chittenden	7
Franklin	4
Orange	50
Orleans	14
Washington	45
Total	257

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Arborvitae Leaf Miner *Argyresthia thuiella*			See narrative.
Larch Casebearer *Coleophora laricella*	Tamarack	Widely scattered in northern Vermont; also observed in Rutland County.	Light defoliation. Generally less noticeable than 2006.
Redheaded Pine Sawfly *Neodiprion lecontei*	Red Pine	Newfane	Ornamentals

Softwood defoliators not reported in 2007 included European Pine Sawfly, *Neodiprion sertifer;* European Spruce Needle Miner, *Taniva albolineana;* Introduced Pine Sawfly, *Diprion similis;* Spruce Budworm, *Choristoneura fumiferana;* Yellow-Headed Spruce Sawfly, *Pikonema alaskensis*

SAPSUCKING INSECTS, MIDGES, AND MITES

Balsam Woolly Adelgid, *Adelges piceae*, populations have rebounded in some locations, probably due to consecutive warm winters. Heavy bole infestations were observed in Plymouth, Springfield, Wardsboro and Groton. Dead trees remained noticeable from previously heavy populations, and mortality was mapped on 2,321 acres statewide (Table 4).

Table 4. Mapped acreage of damage by balsam woolly adelgid in 2007.

County	Acres
Addison	405
Bennington	93
Caledonia	1,366
Orange	172
Orleans	260
Washington	25
Total	2,321

Hemlock Woolly Adelgid, *Adelges tsugae*, was detected for the first time on mature trees in Vermont. All of the infested trees were in Windham County: a single tree in Rockingham and at least nine in Brattleboro. The insect was thought to have been brought to Vermont by birds, since all of the infested trees were near bird baths or feeders. The introduction likely occurred two or three years ago. The lack of severe cold temperatures in recent winters may have contributed to adelgid survival in the state.

In June, a seventy-foot hemlock in Rockingham was found to have been infested after it was cut. Its branches were burned on site. Logs from this tree and other hemlocks on the property were tarped for twelve days before being moved to a wood-burning facility. All other landownerships within a half-mile radius of the infested tree were visited following the detection. Hemlocks were inspected on any properties where they occurred. In all, 27 properties were visited, 1546 1-meter long branches were inspected visually, and an additional 242 trees were viewed through binoculars. No additional evidence of hemlock woolly adelgid was found.

In Brattleboro, the infestation was detected by an arborist and reported to the County Forester. Hemlocks were examined on most properties within a one-quarter mile radius of the original detection. In all, adelgids were found on four of the twenty properties with hemlock that were surveyed in the neighborhood.

Because of its limited extent, the infestation is under eradication. Two small trees were removed and burned off-site. The remaining 15 hemlocks on infested properties received a foliar spray in late August and a soil injection of imidacloprid (Xytect 75WSP @ 1.5 mg/1”DBH). Foliar sprays were either 1% horticultural oil for properties with light infestations or bifenthrin (Crosscheck @ 21.7 oz/100 gal) plus 1% horticultural oil for the more heavily infested property.

In mid-May, fourteen volunteers were trained to survey for hemlock woolly adelgid in cooperation with the Bennington County Conservation District. At least five Bennington County sites have been surveyed by the volunteers, and no adelgids have been detected.

Press releases alerted the public to look for hemlock woolly adelgid following both detections, resulting in a number of calls and follow-up visits. In addition, Forestry Division staff have been conducting surveys in Windham County. No additional infestations have been located.

Oystershell Scale, *Lepidosaphes ulmi*, populations caused light damage to beech in scattered locations. Heavy infestations were noted on green ash in Chittenden County. Dieback was not detected by aerial survey. Yearly counts of oystershell scale in survey plots at three tree canopy levels (suppressed, intermediate and codominant) at Camel's Hump State Forest are shown below (Table 5 and Figure 14).

Table 5. Number of oystershell scales on current year beech twigs in Camel's Hump State Forest, 1994-2007.

Average Number of Mature Viable Scales per Twig

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Suppressed	2.1	9	0.6	2.1	4	0.7	2.9	4.2	11	2.1	1.4	5.6	4	3.3
Intermediate	8.4	16.8	1.2	2.6	3.3	2.8	12.1	10.4	14.7	1.2	3.4	3.8	6.2	11.9
Codominant	3.4	11.3	0.2	4.5	4.2	2.7	7.3	1.4	4	0.7	2	2	3.4	9.6

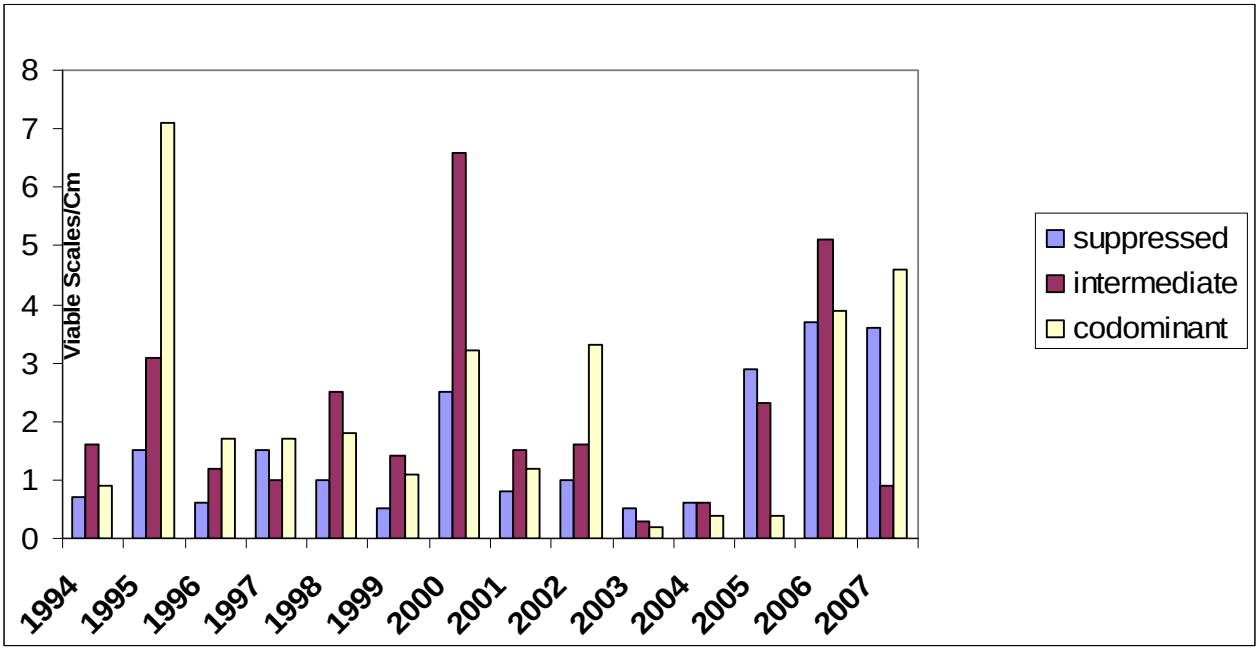


Figure 14. Oystershell scale population in three tree canopy levels in Camel's Hump State Forest, 1994-2007. Average for 10 current year twigs/tree per crown class, collected in autumn.

Pear Thrips, *Taeniothrips inconsequens*, damage to sugar maple was mostly light, but more common than in 2006. Scattered moderate-heavy damage was observed at higher elevation hardwood stands in the Green Mountains and the Taconics. Populations may have increased following heavy sugar maple flowering in 2006. Damage heavy enough to cause refoliation was observed in Rupert. Pear thrips feeding contributed to the sugar maple defoliation mapped during aerial surveys (see Maple Anthracnose).

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Balsam Gall Midge *Paradiplosis tumifex*	Balsam fir	Throughout	Populations increasing, with mostly light but some moderate to heavy damage in Christmas tree plantations.
Balsam Twig Aphid *Mindarus abietinus*	Balsam Fir	Throughout	Only scattered light damage to Christmas trees reported. Damage remains very light.
Balsam Woolly Adelgid *Adelges picea*			See narrative.
Beech Scale *Cryptococcus fagisuga*			See Beech Bark Disease.
Black Pineleaf Scale *Nuculaspis californica*	Mugo pine	Stowe	On ornamental plantings.
Boxelder Bug *Leptocoris trivittatus*	Boxelder	Throughout	Usual number of "nuisance invader" inquiries.
Cooley Spruce Gall Aphid *Adelges cooley*	Blue spruce White spruce	Scattered	Occasional damage observed.
Cottony Maple Scale *Pulvinaria innumerabilis*	Sugar maple	Chittenden County	Increase in populations.
Eastern Spruce Gall Adelgid *Adelges abietis*	White spruce	Widespread	Remains common on some ornamentals and Christmas trees.
Erineum Gall Mite *Aceria elongatus*	Sugar maple	Widespread	Scattered reports.
Hemlock Woolly Adelgid *Adelges tsugae*			See narrative.
Lacebugs *Corythucha sp.*	Sycamore, Elm, Basswood	Scattered	Foliage damage.
Lecanium Scale *Lecanium sp.*	Sugar Maple	Throughout	Populations remain low. See Forest Tent Caterpillar.
Oystershell Scale *Lepidospaphes ulmi*			See narrative.
Pear Thrips *Taeniothrips inconsequens*			See narrative.
Pine Bark Adelgid *Pineus strobi*	White Pine	Scattered	Occasionally heavy in southern towns, including Rupert, Brattleboro and Manchester. Little seen in northern Vermont.

INSECT	HOST(S)	LOCALITY	REMARKS
Pine Leaf Adelgid *Pineus pinifoliae*	White Pine	Bennington County	Some shoot dieback observed in the spring.
Pine Spittlebug *Aphrophora parallela*	Conifers White Pine	Scattered	Occasional trees with heavy damage.
Ragged Spruce Gall Aphid *Pineus similis*	Red spruce	Throughout	Remains common.
Terrapin Scale *Mesolecanium nigrofasciatum*	Sugar Maple	Brandon	Farther north than expected for normal range.
Spruce Spider Mite *Oligonychus ununguis*	Conifers	Scattered Throughout	Increase from 2006. Although very infrequent, heavy feeding observed on ornamentals and Christmas trees.
Woolly Alder Aphid *Paraprociphilus tessellatus*	Alder	Northeast	Populations noticeable, but less than in recent years.

Sapsucking insects, midges and mites that were not reported in 2007 included Aphids, *Cinara sp. and Periphyllus sp.;* Ash flowergall mite, *Aceria fraxiniflora;* Pine Needle Scale, *Chionapsis pinifoliae.*

BUD AND SHOOT AND ROOT INSECTS

Although we are no longer actively surveying for the **Common Pine Shoot Beetle**, *Tomicus piniperda*, a single specimen was captured in a European woodwasp (*Sirex noctilio*) survey trap between June 15th and 29th in Ferrisburgh. Interestingly, this same site was used in 2004 as part of our common pine shoot beetle survey and resulted in a positive record for Addison County. In sites where these beetles were previously captured in pheromone traps, tree damage is difficult to find and is limited to new shoot injury. 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. Quarantine details can be found at: www.vtfpr.org/protection/for_protect_forhealth.cfm.

OTHER BUD AND SHOOT INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Balsam Shootboring Sawfly *Pleroneura brunneicornis*	Fraser fir Balsam fir	Throughout	Very light damage to Christmas trees.
Common Pine Shoot Beetle *Tomicus piniperda*			See narrative.
Maple Petiole Borer *Caulocampus acericaulis*	Sugar Maple	Northeast	Some minor damage seen.
Pine Gall Weevil *Podapion gallicola*	Red Pine	Widespread, especially Windsor and Orange Counties	More noticeable than usual, perhaps due to heavy damage from Diplodia shoot blight on some trees. Often associated with red pine dieback and mortality.
White Pine Weevil *Pissodes strobi*	White Pine Blue Spruce	Throughout	Some damage, but populations appear to be stable at light levels.
Whitespotted Sawyer *Monochamus scutellatus*	White pine Balsam fir	Scattered	Some light damage to Christmas tree shoots and young forest trees.

Bud and shoot insects not reported in 2007 included Allegheny Mound Ant, *Formica exsectoides;* European Pine Shoot Borer, *Eucosma gloriole;* Oak Twig Pruner, *Elaphidionoides parallelus;* Pine False Webworm, *Acantholyda erythroceophala.*

ROOT INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Japanese Beetle *Popillia japonica*	Many	Throughout	Light to moderate levels.

Root insects not reported this year included Conifer Swift Moth, *Korsheltellus gracilis;* June Beetle, Phyllophaga *spp.*

BARK AND WOOD INSECTS

Detection surveys for **Emerald Ash Borer**, *Agrilus planipennis*, continued in Vermont in 2007. In addition, we worked to increase awareness of emerald ash borer signs and symptoms among forest resource professionals, workers in the green industry, forest landowners and the public to improve the likelihood of detecting emerald ash borer if it is present in Vermont. Since many exotic organisms are first detected by individuals outside of the State Forestry staff, we continued to focus on general outreach geared towards informing a broad array of groups on EAB risks, identification and reporting.

Detection surveys in 2007 consisted of visually inspecting dead and dying ash trees at 14 sites in six counties for evidence of emerald ash borer and other stressors (Table 6). In addition, we established trap trees to lure adult beetles on four state land sites where green ash, the favorite host of emerald ash borer, is common (Table 7) Both visual inspections and trapping efforts focused on high risk areas not previously surveyed, especially campgrounds in state and private parks, recent commercial developments where ash was planted and urban and community plantings where stock originated from potential emerald ash borer infested areas.

Highest priority for trap trees was green ash in western Vermont. At each location, a pair of ash trees was girdled. One tree per site will be felled and peeled in late winter, 2008 and the other tree will be left until the fall of 2008. Felling and peeling trap trees will enable us to look for characteristic galleries, splits in callus tissues, and other symptoms of infestation by emerald ash borer.

Table 6. Counties and numbers of sites surveyed visually for emerald ash borer in Vermont in 2007.

County	Number of Sites
Chittenden	5
Franklin	1
Lamoille	2
Washington	1
Windham	3
Windsor	2
Total Sites	14

Table 7. Locations of trap tree survey sites for emerald ash borer in Vermont, 2007.

County	Town	Site	GPS Points – (NAD83)	# of *Agrilus planipennis*
Grand Isle	Grand Isle	Grand Isle State Park	Site 1: N44.68922, W73.29852 Site 2: N44.68902, W73.29852	0
Grand Isle	North Hero	Knight Point State Park	Site 1: N44.77200, W73.29697 Site 2: N44.77208, W73.29724	0
Grand Isle	North Hero	North Hero State Park	Site 1: N44.90916, W73.23964 Site 2: N44.90917, W73.23949	0
Franklin	Swanton	Maquam WMA	Site 1: N44.92023, W73.15751 Site 2: N44.92024, W73.15725	0

Surveys were conducted in 2007 for the **Brown Spruce Longhorn Beetle**, *Tetropium fuscum*, a European beetle that has been found attacking and killing apparently healthy red spruce trees in Nova Scotia. Large, cross-vane Colossus Panel Traps, baited with brown spruce longhorn beetle lure (a host volatile) and UHR ethanol were used to survey four sites for the presence of this beetle in spruce stands in Caledonia, Franklin, and Orleans Counties.

No *Tetropium fuscum* beetles were caught at the survey sites, though a single specimen of an indigenous *Picea*-feeding species of *Tetropium* was found in a trap in Sutton in Caledonia County. Non-target Cerambycidae and Siricidae collected during the surveys were maintained for our permanent collection. Siricids included *Urocerus cressoni* and *Xeris spectrum spectrum*. A summary of trap locations, trapping dates and number of site visits appears in Table 8.

Table 8. Summary of site and collection data for 2007 Vermont survey for *Tetropium fuscum*, the brown spruce longhorn beetle. Data include counties, towns, GPS coordinates, host trees, trapping dates, numbers of visits, and numbers of *T. fuscum* collected during the survey. Numbers of other Cerambycids and numbers and species of Siricid wasps collected in traps were also recorded.

County	Town	GPS Points – (NAD83)	Host	Start/End dates	# of visits	Non-targets		# of *Tetropium fuscum*
						Ceramby-cids	Siricids	
Caledonia	Sutton	N44.64016 W72.06731	*Picea rubens*	6/5/07-8/20/07	6	6	4 (*Urocerus cressoni*)	0
Franklin	Berkshire	N45.0156, W72,72873	*Picea abies* plantation. Trap was hung in *P. abies.*	5/30/07-8/23/07	7	2	1 (*Urocerus cressoni*)	0
Orleans	Holland	N44.97390 W71.92900	*Picea rubens* and *P.glauca* within 100 meters. Trap was hung in *P.rubens.*	5/30/07-8/23/07	7	21	1 (*Xeris spectrum spectrum*)	0
Orleans	Jay	N44.98231 W72.49067	*Picea rubens* and *Abies balsamea* Trap was hung in *P. rubens.*	5/30/07-8/23/07	7	8	0	0
Totals						37	6	0

The **Oak Splendor Beetle**, *Agrilus biguttatus*, a major pest of oaks in Europe, causes damage similar to that of the two-lined chestnut borer (*Agrilus bilineatus*) in this country. The beetle is also associated with the European version of oak decline and has become more common within its natural range in recent years. *A. biguttatus* is not known at present to occur in the United States but, as part of the regional Cooperative Agricultural Pest Survey effort, this survey was conducted to supplement tracking efforts that are being conducted throughout the United States.

Log samples were collected at three sites in Chittenden, Grand Isle and Windham Counties respectively. White oak was sampled at two of the survey sites, and swamp white oak was taken at the third. Six bolts were collected from each of the three sites (Table 9). The oak bolts were transported to a rearing facility, where they were placed in individual rearing chambers constructed of builder's tubes 30 cm in diameter and 43 cm long. The back opening of the tube was covered with 5 mm luan mahogany, and the front opening was fitted with 1 mm screen that was secured with a metal band. A 4 cm hole was cut in the screen and the lid of a snap-on rearing cup was secured with silicon glue to the center of each screen.

Insects that emerged from the boles were collected and identified. No *Agrilus biguttatus* were reared from the log samples. However, members of four orders of insects were found in the collecting cups. These included Coleoptera (seven species in four families), Hymenoptera in four families, and one species of Psocoptera (bark lice).

A surprising number of non-target insects were reared from the logs collected at North Hero. A total of 50 specimens of *Xylotrechus colonus*, a Cerambycid beetle, emerged from the six log sections from that site. In addition, there were 11 specimens of another Cerambycid, *Urographis fasciatus*, 15 specimens (three species) of parasitic wasps, six other Cerambycids in two families, and a single sawfly.

Table 9. Summary of site and collection data for 2007 Vermont survey for *Agrilus biguttatus*, the oak splendor beetle. Data include counties, towns, GPS coordinates, log collection and end-of-rearing dates, oak species, and numbers of *Agrilus biguttatus* found.

County	Town	Site	GPS Points – (NAD83)	Dates of survey	Oak species	# of *Agrilus biguttatus*
Chittenden	Colchester	Niquette Bay State Park	N44.58565, W73.18850	5/2/07-9/22/07	*Quercus alba*	0
Grand Isle	North Hero	North Hero State Park	N44.90959, W73.24210	5/2/07- 9/22/07	*Quercus bicolor*	0
Windham	Brattleboro	Fort Dummer State Park	N42.81891, W72.56071	4/24/07-9/22/07	*Quercus alba*	0

The exotic **Sirex Woodwasp**, *Sirex noctilio*, was detected in Vermont for the first time in 2007 when a single specimen was captured in a baited trap that was deployed in Stowe by the Vermont Agency of Agriculture, Food, and Markets. No infested trees were observed, but surveys will continue in the vicinity in 2008.

Surveys conducted by the Department of Forests, Parks, and Recreation were negative for *S. noctilio.* Detection efforts were modified this year to include pine trap trees and unbaited traps (in place of host volatile-baited traps) as prescribed in sampling protocols developed by the USDA Forest Service. Trees of poor condition in stands that suffered from overstocked growing conditions, had suppressed or overtopped trees present, or had recently been affected by biotic or abiotic stressors were selected for trap trees.

Trap trees were girdled mechanically, chemically with the herbicide Dicamba, or through a combination of mechanical damage and applications of Dicamba. Dicamba treatments were made by injection into 3/16 or 3/4 inch holes drilled in test trees, or by application to trees that had been frilled by axe strokes around the tree. The bark remained, but was separated from the bole, and the herbicide was applied to the exposed wood. The mechanical girdles were placed as high as possible to maximize the bole area attractive to *S. noctilio*.

Regardless of girdling method used, a group of four trap trees was created at each of five sites. These trees were as close as possible to one another to maximize attraction to *S. noctilio*. Traps were put out on May 29, 2007 in Addison County and on May 23, 2007 in Chittenden County. Either an unbaited intercept panel trap or an unbaited Lindgren funnel trap was attached to each trap tree. Sites were visited every two weeks for a total of 10 visits between set up dates and October 5th, when traps were removed.

When trap collections were made, visual assessment of trap trees were conducted. Crowns of herbicide treated trees browned up about six weeks after treatment while approximately half of the mechanically girdled trees browned up by late summer. Crowns of the remaining mechanically girdled trees remained green. Trees were examined to determine the presence of small resin beads that are characteristic of attack by *S. noctilio.* Resin beading is considered suspicious and a possible sign that the tree is infested and would therefore require that further action be taken. No resin beads were observed on trap trees in Vermont. All trees were felled after the final trap collections.

Trap collections were screened by personnel at the Forest Biology Lab. No *Sirex noctilio* were collected in traps. Nine members of the family Siricidae, (seven *Tremex columba* and two *Sirex nigricornis*) were collected, and a total of 45 Cerambycidae and 389 Scolytidae were captured in the 20 traps (Table 10). A single specimen of the Common Pine Shoot Beetle, *Tomicus piniperda,* was collected from one of the traps in Ferrisburgh in Addison County.

County	Town	Site	GPS points NAD 83, DD		Trap Type*	Tree Species	Girdle Technique	Start/End Dates	Number of Visits	# *Sirex noctilio*	Other Siricids	# Cerambycids	# Scolytids
Addison	Ferrisburgh	A1	N44.23676	W73.23340	P	Scotch	Mechanical	May 29-Oct 5	10	0	0	1	1
		A2			F	Scotch	Mechanical			0	1 (*Tremex columba*)	3	1 (*Tomicus piniperda*)
		A3			P	Scotch	Mechanical			0	4 (*Tremex columba*)	4	0
		A4			F	Scotch	Mechanical			0	0	4	0
	Monkton	B1	N44.26471	W73.12776	F	Scotch	Mechanical	May 29-Oct 5	10	0	0	1	0
		B2			P	Scotch	Frill with Dicamba			0	0	1	7
		B3			F	Scotch	Mechanical			0	0	5	5
		B4			P	Scotch	Frill with Dicamba			0	1 (*Sirex nigricornis*)	4	3
	Shoreham	J1	N43.85723	W73.37009	P	Scotch	¾ inch hole with Dicamba	May 29-Oct 5	10	0	2 (*Tremex columba*)	5	14
		J2			F	Scotch	¾ inch hole with Dicamba			0	0	5	337
		J3			P	Scotch	¾ inch hole with Dicamba			0	0	4	4
		J4			F	Scotch	¾ inch hole with Dicamba			0	0	2	2
	Cornwall	M1	N43.98607	W73.19671	F	Scotch	Frill with Dicamba	May 29-Oct 5	10	0	0	0	1
		M2			P	Scotch	Mechanical			0	0	0	5
		M3			P	Scotch	Frill with Dicamba			0	0	0	1
		M4			F	Scotch	Mechanical			0	0	3	0
Chittenden	Jericho	FR1	N44.45292	W72.92146	F	Scotch	$^{3}/_{16}$ inch hole with Dicamba	May 23-Oct 5	10	0	0	2	3
		FR2			P	Scotch	$^{3}/_{16}$ inch hole with Dicamba			0	0	0	2
		FR3			F	Scotch	Mechanical			0	0	0	2
		FR4			P	Scotch	Mechanical			0	1 (*Sirex nigricornis*)	1	1
Totals										0	9	45	389

*Trap Type: F = Lindgren 8-funnel trap; P = IPM Tech Intercept Panel Trap

Table 10. Locations, tree species, girdling technique, trapping dates, numbers of visits and trap catch summaries for sites monitored for *Sirex noctilio* in Vermont, 2007.

OTHER BARK AND WOOD INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Asian Longhorned Beetle *Anoplophora glabripennis*			Not observed or known to occur in Vermont.
Bronze Birch Borer *Agrilus anxius*	White Birch Ornamental white birches	Green Mountains scattered	Observed in mortality areas. Occasionally observed.
Brown Spruce Longhorned Beetle *Tetropium fuscum*			Not observed or known to occur in Vermont. See narrative.
Eastern Larch Beetle *Dendroctonus simplex*			See Larch Decline.
Hemlock Borer *Melanophila fulvoguttata*	Hemlock	Windham County	Observed during surveys for hemlock woolly adelgid.
Japanese Cedar Longhorned Beetle *Callidiellum rufipenne*			Not observed or known to occur in Vermont.
Megarhyssa Wasp *Megarhyssa macrurus*	Sugar Maple	St. Johnsbury	Found laying eggs within dead areas of trees.
Northeastern Sawyer *Monochamus notatus*	Balsam Fir	Scattered	Associated with balsam woolly adelgid-related decline
Pigeon Tremex *Tremex columba*	Sugar Maple	St Johnsbury	Found on dead areas of trees.
Pine Engraver *Ips pini*	Red Pine	Scattered	Sometimes seen on trees with heavy Diplodia.
Round-headed Apple Tree Borer *Saperda candida*	Apple	Putney Underhill	On ornamentals Heavy damage to young trees
Sirex Woodwasp *Sirex noctilio*	Hard pines	Stowe	Single specimen collected in pheromone trap. See narrative.
Sugar Maple Borer *Glycobius speciosus*	Sugar maple	Throughout	Remains common.
Whitespotted Sawyer *Monochamus scutellatus*	White Pine Balsam fir, white pine	Throughout Throughout	Adults brought in as Asian longhorned beetle suspects A few adults seen. Stable.

Bark and Wood insects not reported in 2007 included Allegheny Mound Ant, *Formica exsectoides,* Carpenter Ant, *Camponotus spp,* Locust Borer, *Megacyllene robiniae,* Northern Engraver, *Ips borealis borealis,* Pitted Ambrosia Beetle, *Corthylus punctatissimus.*

FRUIT, NUT AND FLOWER INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Asiatic Garden Beetle *Autoserica castanea*	Many flowers and ornamentals	Widespread	Moderate levels.
Ash Flowergall Mite *Aceria fraxiniflora*	White ash	Northeastern VT	High level of damage on occasional trees.
Maggots in Butternuts *Rhagoletis sp.*	Butternut	Chester	Destroying husks.
Plum Curculio *Conotrachelus nenuphar*	Apple Plum	Throughout	Remains common.
Western Conifer Seed Bug *Leptoglossus occidentalis*	Conifers	Throughout	Many reports of incidental findings in houses. Adults common, but fewer reports than in past several years.

STEM DISEASES

Beech Bark Disease, caused by *Cryptococcus fagisuga* and *Neonectria faginata*, remained widespread, with 61,859 acres of beech dieback and mortality mapped statewide (Table 11, Figure 15). Populations of beech scale remained low and the much higher-than-normal disease levels of recent years seem to be tapering off.

Table 11. Mapped acreage of damage by beech bark disease in 2007.

County	Acres
Addison	583
Bennington	19,188
Caledonia	2,515
Chittenden	659
Essex	5,696
Franklin	504
Lamoille	5,392
Orange	6,033
Orleans	1,674
Rutland	5,786
Washington	4,206
Windham	6,058
Windsor	3,565
Total	**61,859**

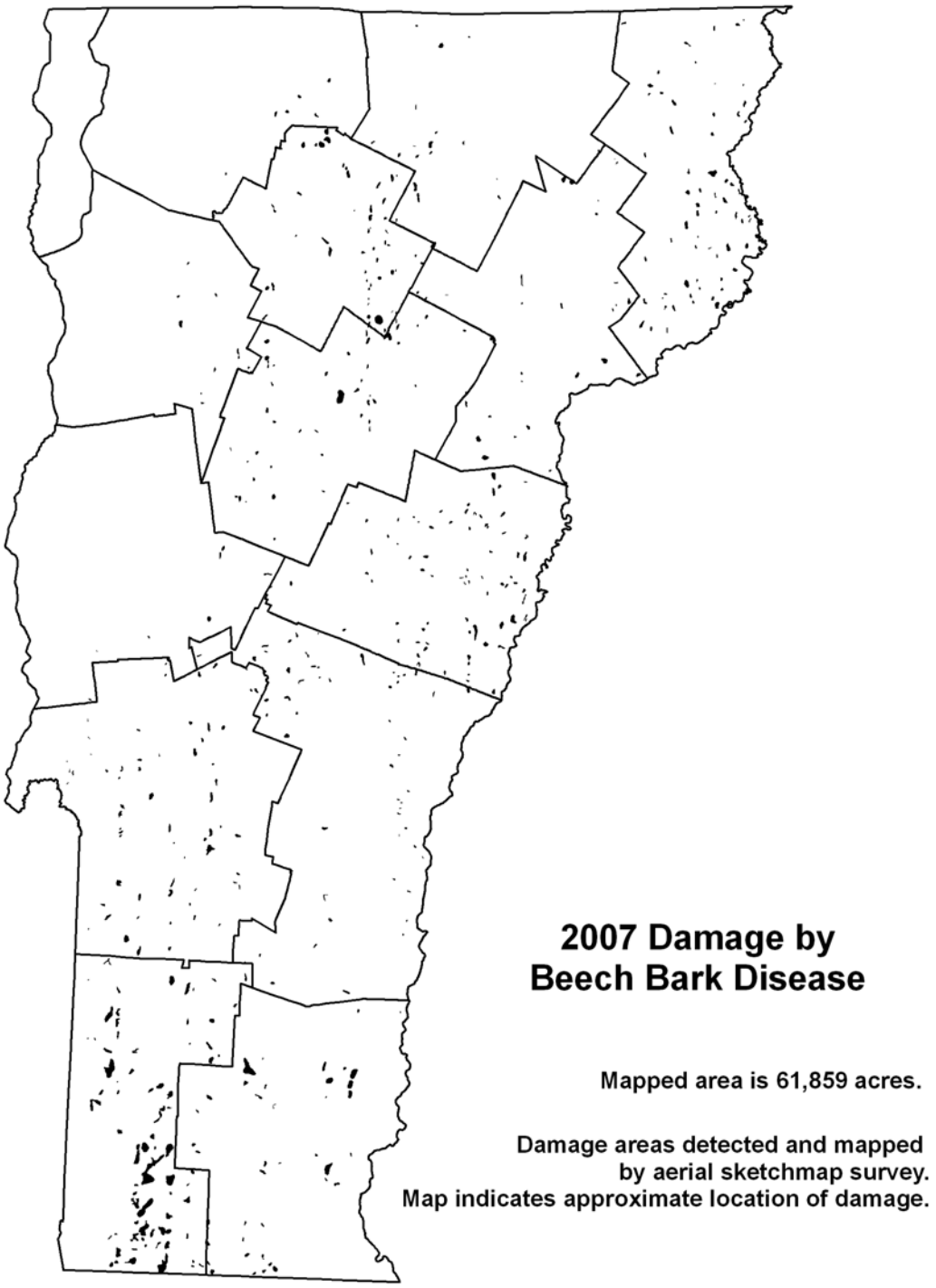


Figure 15. Mapped acres of Beech Bark Disease in Vermont in 2007.

OTHER STEM DISEASES

DISEASE	HOST	LOCALITY	REMARKS
Annual Canker *Fusarium sp.*	Maple	Kirby Derby	Causing branch dieback on some trees.
Ash Yellows *Mycoplasma-like organism*	White Ash	Widespread	Common. No change detected. Witches brooms commonly observed on declining ash.
Beech Bark Disease *Cryptococcus fagisuga* and *Nectria coccinea var. faginata*			See narrative.
Black Knot *Dibotryon morbosum*	Black Cherry	Throughout	Appears to be more common in colder areas of the Green Mountains where cherry is at the edge of its range.
Botryosphaeria Blight *Botryosphaeria sp.*	Apple	Barnet	Damage found on trees with old pruning wounds.
Butternut Canker *Sirococcus clavigignenta-juglandacearum*	Butternut	Throughout	Healthy butternuts occasionally reported.
Cedar-Apple Rust *Gymnosporangium juniperi-virginianae*	Northern white cedar	Widely scattered	Some galls on cedar. Decrease from 2006.
Chestnut Blight *Cryphonectria parasitica*	Chestnut	Windham County Berlin	Healthy young chestnuts remain common. Canker seen on large chestnut.
Cytospora Canker *Leucostoma kunzei*	Blue Spruce	Throughout	Scattered light damage with an occasional stressed tree with heavy damage. Expected to increase following heavy defoliation by Rhizosphaera.
Delphinella Tip Blight of Fir *Delphinella balsamae*	Balsam fir	Widely scattered	Increasingly seen on Christmas trees. Also heavy damage to an ornamental in Stowe.
Diplodia Shoot Blight *Diplodia pinea*	Red Pine Scots Pine Austrian Pine Mugo pine	Throughout	Unusually widespread heavy damage, especially where pines were already under stress. Red pine symptoms were mapped on 130 acres, statewide. Combined with other stressors such as brown spot needle blight and pine gall weevil in some locations, leading to red pine dieback.

DISEASE	HOST	LOCALITY	REMARKS
Dutch Elm Disease *Ceratocystis ulmi*	American Elm	Scattered	Symptoms common early in the season, perhaps due to the wet spring.
Fireblight *Erwinia amylovora*	Apple Pear	Stowe	Damage not as widespread as some years.
Hypoxylon Canker *Hypoxylon pruinatum*	Quaking Aspen	Throughout	Commonly observed. Heavy breakage following wind events in Rutland County.
Lilac Blight *Pseudomonas syringae*	Lilac	Throughout	Light damage
Maple Canker *Steganosporium spp.*	Sugar Maple	Occasional	Found occasionally on shaded or damaged branches.
Oak Wilt *Ceratocystis fagacearum*			Not reported or detected during aerial surveys.
Phomopsis Twig Blight *Phomopsis sp.*	Yew	Bennington	Hedge
Red Ring Rot *Phellinus pini*	White Pine	Throughout	Occasional damage to stressed stands.
Sapstreak *Ceratocystis coerulescens*	Sugar maple	Waterbury	Suspected cause of death of a large forest edge tree.
Venturia Shoot Blight *Venturia sp.*	Quaking Aspen	Weathersfield	Regenerating stand.
White Pine Blister Rust *Cronartium ribicola*	White Pine	Throughout	Normal levels. Remains common on ornamentals, forest trees and Christmas trees. Stable.
Woodgate Gall Rust *Endocronartium harknessii*	Scots pine	Widespread	Commonly found on dead and dying trees.
Yellow Witches Broom Rust *Melampsorella caryophyllacearum*	Balsam fir	Throughout	An increase in brooms was seen this year.

Stem diseases not reported in 2007 included Brown Cubical Rot, *Polyporus schweinitzii;* Brown Rot, *Monilinia fructicola;* Caliciopsis Canker, *Caliciopsis pinea;* Eastern Dwarf Mistletoe, *Arceuthobium pusillum;* Nectria Canker, *Nectria galligena;* Scleroderris Canker, *Ascocalyx abietina;* Sirococcus, *Sirococcus strobilinius;* Verticillium Wilt, *Verticillium albo-atrum.*

FOLIAGE DISEASES

Brown Spot Needle Blight, caused by *Scirrhia acicola and Mycosphaerella dearnessii*, was again heavy and widespread on white pine this year, causing previous year needles on many trees to brown up in early spring. By mid-June, the brown older foliage of infected white pines was particularly noticeable. Symptom severity was highly variable from tree to tree. On particularly susceptible trees, browning occurred throughout the crown. On other trees, symptoms were limited to lower branches, while neighboring trees appeared resistant. Trees looked better once new growth emerged and brown needles had been cast. The disease was also common on red pine and on Scots pine Christmas trees in Waterbury.

Maple Anthracnose, caused by *Discula sp*., became widespread late in the season. It was the "common denominator" of the late-season sugar maple defoliation that was mapped on 102,551 acres statewide (Table 12, Figure 16). This defoliation was most common in the south-central and western Green Mountains. A number of insect defoliators also played a role: maple trumpet skeletonizer and Septoria leaf spot were particularly significant in northern areas and saddled prominent in southern areas. Pear thrips and maple leaf cutter were also locally important. In parts of Franklin and Grand Isle Counties, windburn also contributed to the damage.

Low-elevation maple anthracnose was much less noticeable in 2007 than it was in 2006. Maple anthracnose caused symptoms on the abundant first-year seedlings which developed after the heavy 2006 seed crop.

Table 12. Mapped acreage of late-season sugar maple defoliation in 2007.

County	Acres
Addison	9,160
Bennington	788
Caledonia	3,102
Chittenden	774
Essex	2,761
Franklin	9,354
Grand Isle	127
Lamoille	17,538
Orange	6,406
Orleans	3,508
Rutland	15,318
Washington	12,941
Windham	2,840
Windsor	17,934
Total	**102,551**

Septoria Leafspot of birch, caused by *Septoria betulae*, was widespread again this year, causing late-season browning and defoliation that was mapped on 25,278 acres (Table 13, Figure 17). Insect damage in mapped areas was very sparse, with only light damage by birch leaf skeletonizer, and negligible damage by leaf mining sawflies.

Table 13. Mapped acreage of late-season white birch defoliation in 2007.

County	Acres
Bennington	2,164
Caledonia	1,834
Chittenden	105
Essex	9,124
Franklin	1,384
Lamoille	4,945
Orange	329
Orleans	470
Rutland	507
Washington	2,711
Windham	1,100
Windsor	606
Total	**25,278**

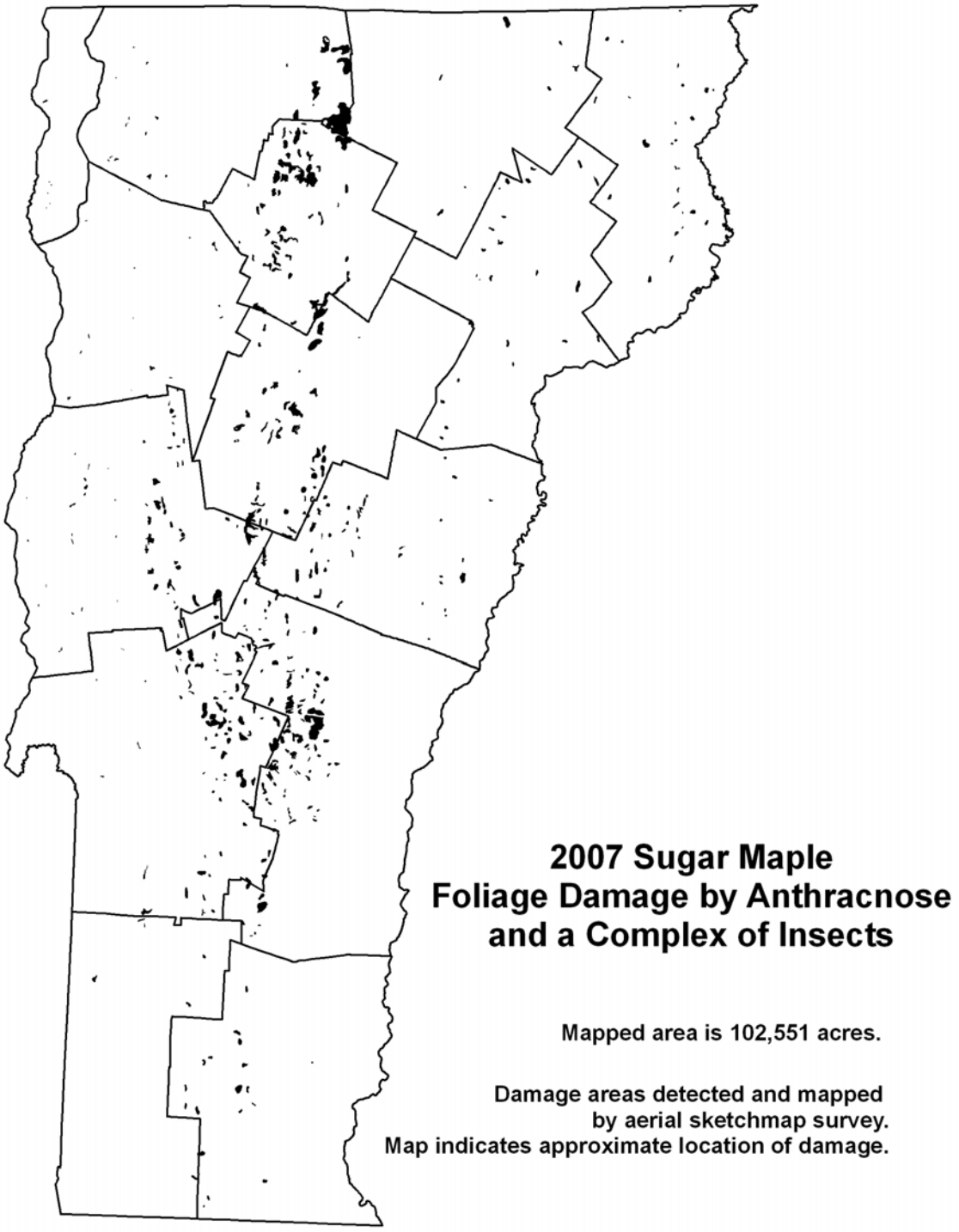


Figure 16. Mapped acres of sugar maple foliage damage by Anthracnose and a Complex of Insects in Vermont in 2007.

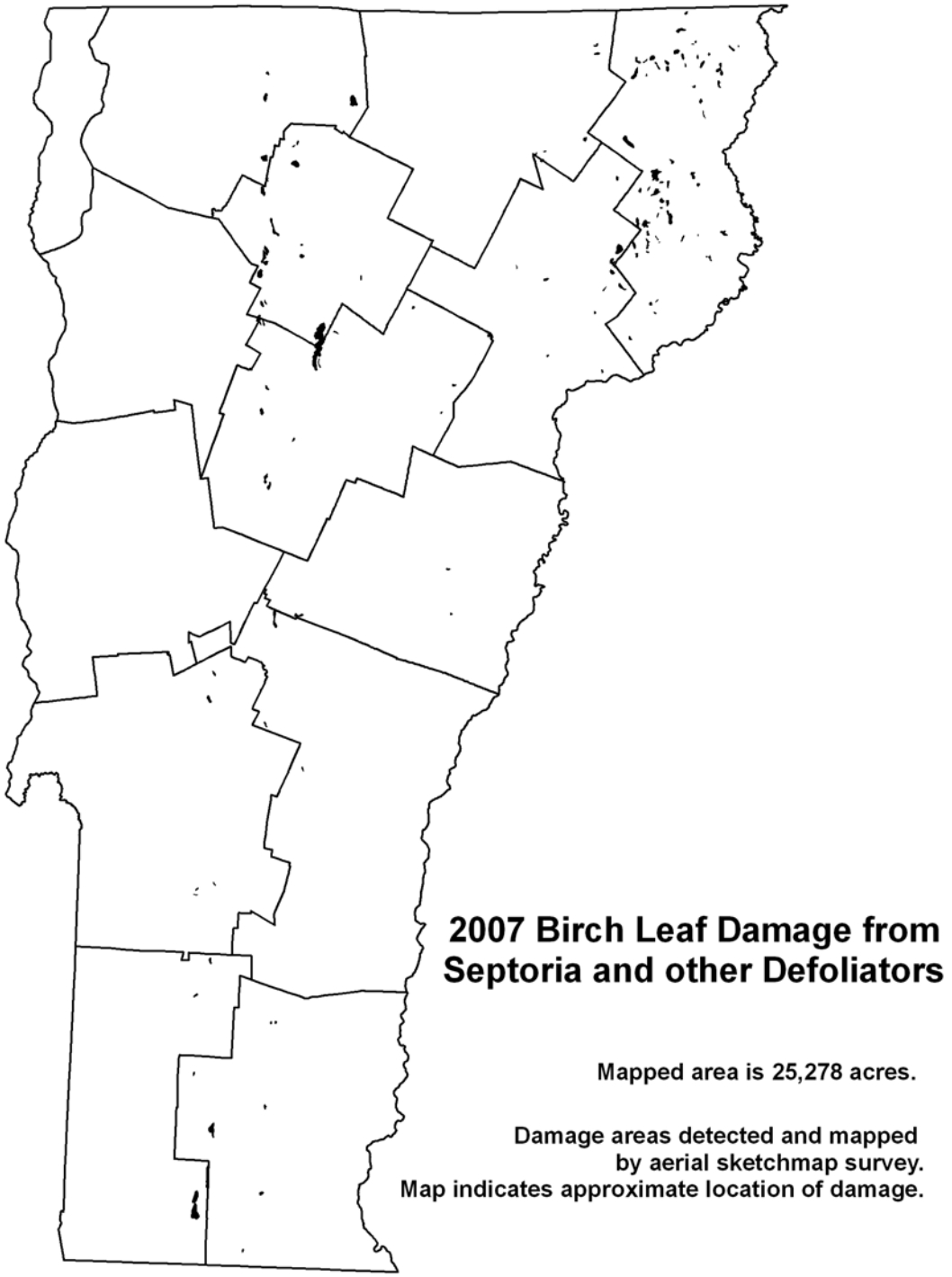


Figure 17. Mapped acres of birch leaf damage from Septoria and other defoliators in Vermont in 2007.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Actinopelte Leaf Spot *Actinopelte dryina*	Red Oak	Southern	Affecting ornamental trees
Anthracnose *Apiognomonia , Gloeosporium and Glomerella spp.*	Various hardwoods	Throughout	Light damage noticed on many trees.
Apple Scab *Venturia inaequalis*	Apple	Throughout	Common at light to moderate levels but less defoliation than 2006.
Ash Anthracnose *Gloeosporium aridum*	White Ash	Throughout	Responsible for widespread early leaf drop but less heavy than in 2006.
Balsam Fir Needlecast *Lirula nervata*	Balsam fir	Widespread	Increasingly common on Christmas trees, forest trees and some ornamentals.
Brown Spot Needle Blight *Scirrhia acicola*			See narrative.
Cedar-Apple Rust *Gymnosporangium spp.*	Apple	Widespread	Noticeable, but no severe damage.
Coccomyces Leaf Spot *Blumeriella jaapii*	Cherry	Sutton St. Johnsbury	Common, but no severe damage.
Cyclaneusma Needlecast (formerly Naemacyclus) *Cyclaneusma minus*	Scots Pine	Scattered	Occasionally seen on ornamentals and Christmas trees, although recently it is much less common than brown spot needle blight
Fir Fern Rust *Uredinopsis mirabilis*	Balsam Fir White Fir	Throughout	Extremely noticeable everywhere this year but most damage was light. Heavy damage to white fir Christmas trees in Woodbury. Alternate host fruiting was seen on both sensitive and bracken ferns.
Giant Tar Spot *Rhytisma sp.*	Norway Maple	Throughout	Remained common and unusually heavy but less severe than in 2006.
Maple Anthracnose *Gloeosporium sp.*	Sugar maple	Widespread	See narrative.
Oak Anthracnose *Apiognomonia quercina*	Red Oak	Widely scattered	Noticeable interior twig mortality and leaf scorch.
Oak Leaf Blister *Taphrina caerulescens*	Red Oak	Newfane, Chester, Springfield	Similar symptoms also observed on American Chestnut.

DISEASE	HOST(S)	LOCALITY	REMARKS
Phomopsis Blight *Phomopsis sp.*	Mountain Laurel	Guilford	Defoliation and dieback widespread in understory
Phyllosticta Needlecast *Phyllosticta sp.*	Sugar maple	Champlain Valley	Increase this year.
Rhizosphaera Needle Blight *Rhizosphaera pini*	Balsam Fir	Widespread	Increasingly common on Christmas trees, with scattered heavy damage, especially for mature trees that are somewhat crowded. Also commonly observed on forest trees.
Rhizosphaera Needlecast of Spruce *Rhizosphaera kalkhoffi*	White Spruce Blue Spruce	Throughout	Very heavy on ornamental trees throughout the state. Substantial variation in susceptibility. Causing considerable branch dieback on ornamentals and some Christmas trees.
Septoria Leafspot of Maple *Septoria sp.*	Sugar Maple	Throughout	Small spots coalescing by late summer contributing to leaf browning. Less noticeable in southern than in northern Vermont.
Septoria Leafspot of Birch *Septoria betulae*			See narrative
Snow Blight *Phacidium abietis*	Balsam Fir	Readsboro	Associated with dieback.
Tar Spots *Rhytisma acerinum* *Rhytisma punctatum*	Silver Maple Red Maple Silver Maple	Dorset, Poultney Throughout	Ornamentals Commonly observed
Tubakia Leaf Spot *Tubakia dryina*	Red Oak	Bennington	Ornamentals
Venturia Leaf Blight *Venturia macularis*	Poplar	Throughout	Common but no severe damage seen.
Weirs Cushion Rust *Chrysomyxa weirii*	Blue Spruce	Grafton, Middletown Springs, Brandon	Ornamentals
White Fir Needlecast Cause Unknown	White Fir	Woodstock Newfane	Defoliation of lower branches.

Foliage diseases not reported in 2007 included Dogwood Anthracnose, *Discula destructive;* Larch Needlecast, eg *Mycosphaerella sp.;* Linospora Leaf Blight, *Linospora tetraspora;* Lophodermium Needlecast, *Lophodermium seditiosum;* Poplar Leaf Blight, *Marssonina spp.;* Powdery Mildew, *Eryiphaceae;* Rhabdocline Needlecast, *Rhabdocline pseudotsugae;* Swiss Needlecast, *Phaeocryptopus gaeumannii;* White Pine Needle Blight, *Canavirgella banfieldii*; Willow Scab, *Venturia saliciperda*.

ROOT DISEASES

Shoestring Root Rot, caused by *Armillaria* species, has become increasingly common as a cause of Christmas tree mortality, especially for plantations with more than two generations of trees and plantations where inter-planting near old stumps is practiced. Fraser fir appears to be more susceptible than native balsam fir, while balsam-Fraser crosses appear to be intermediate in susceptibility. The disease was also associated with declining forest trees, including sugar maple and red oak decline following forest tent caterpillar defoliation in scattered southern Vermont locations and spruce decline in Berlin and Northfield.

DISEASE	HOST(S)	LOCALITY	REMARKS
Annosus Root Rot *Heterobasidion annosum*			Not reported.
Shoestring Root Rot *Armillaria spp.*	Many	Throughout	See narrative.

DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

Birch Decline and Mortality

Birch decline was mapped on 3,563 acres in 2007 (Table 14, Figures 18 and 19). Although birch decline remains evident on paper birch at upper elevations, fewer acres were detected. Most of the damage was at high elevations, in old mortality areas.

Table 14. Mapped acres of birch decline and mortality in 2007.

County	Acres
Addison	466
Bennington	438
Caledonia	0
Chittenden	239
Essex	0
Franklin	256
Grand Isle	0
Lamoille	119
Orange	0
Orleans	0
Rutland	655
Washington	1,061
Windham	0
Windsor	329
Total	**3,563**

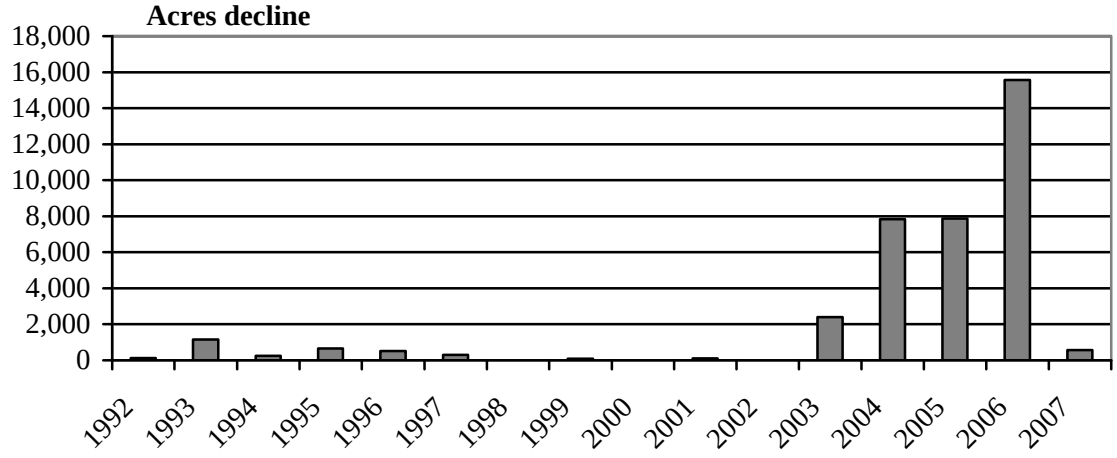


Figure 18. Trend in acres of birch decline and mortality from 1991 to present showing a dramatic decrease in 2007.

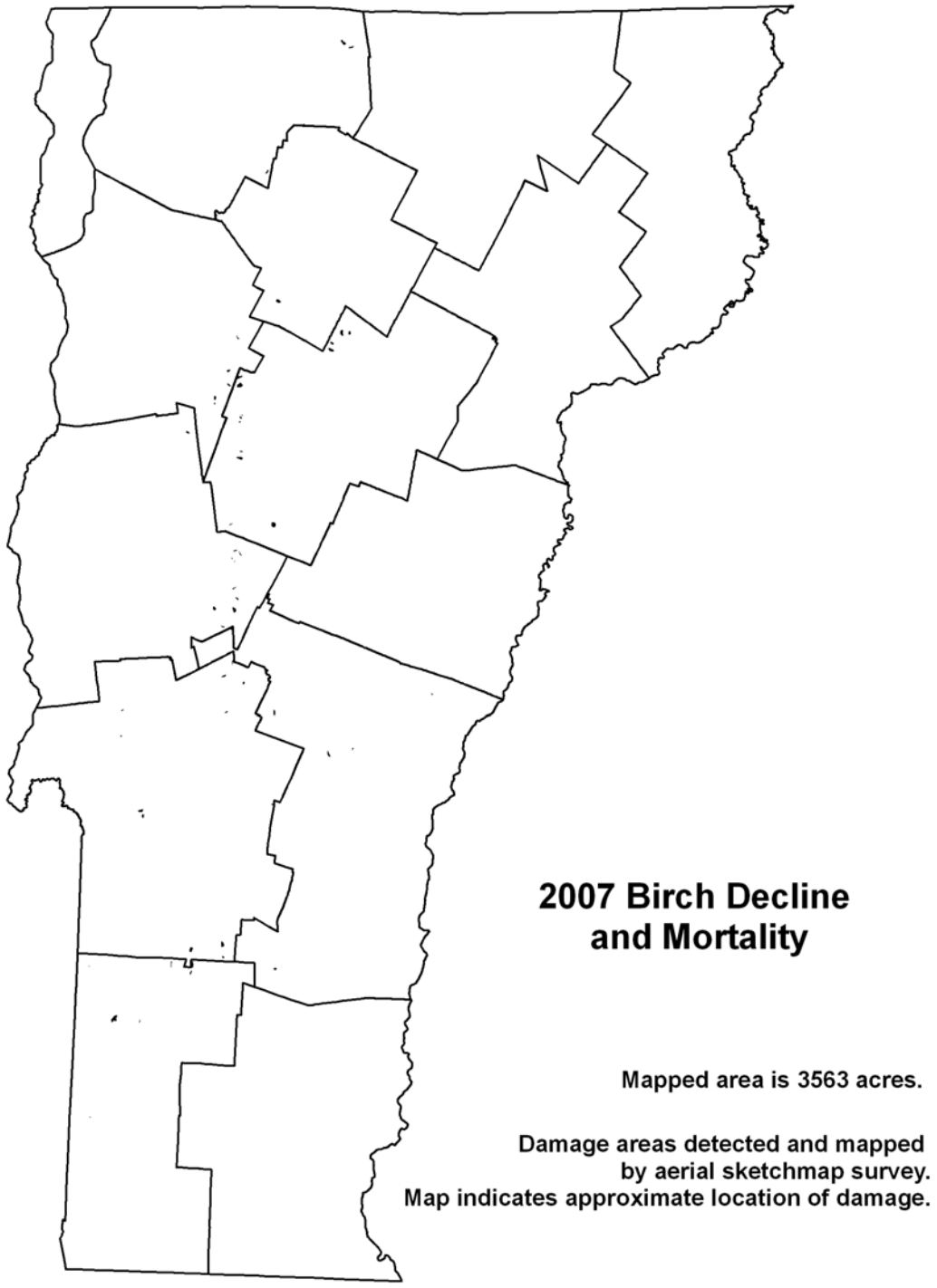


Figure 19. Birch decline and mortality in 2007. Mapped area is 3,563 acres.

Drought

Drought was responsible for late-season leaf browning and defoliation of oak, maple, and other hardwoods that were mapped on 8,484 acres statewide (Table 15, Figure 20). Most of the damage was observed on ledgey sites with shallow soils.

Table 15. Mapped acres with drought symptoms in 2007.

County	Acres
Addison	205
Bennington	14
Caledonia	82
Chittenden	182
Essex	35
Franklin	322
Orange	504
Rutland	375
Washington	1,124
Windham	2,115
Windsor	3,524
Total	**8,484**

Hardwood Chlorosis

Hardwood chlorosis was noticeable in some areas, and was mapped on 1,932 acres. Some of the mapped damage was in sugar maple stands previously defoliated by forest tent caterpillar. However, elsewhere, other species were affected, including aspen, hophornbeam, and birch species. Late season drought may have contributed to the chlorosis (Table 16).

Table 16. Mapped acres of hardwood chlorosis in 2007.

County	Acres
Addison	124
Bennington	750
Grand Isle	10
Rutland	1,048
Total	**1,932**

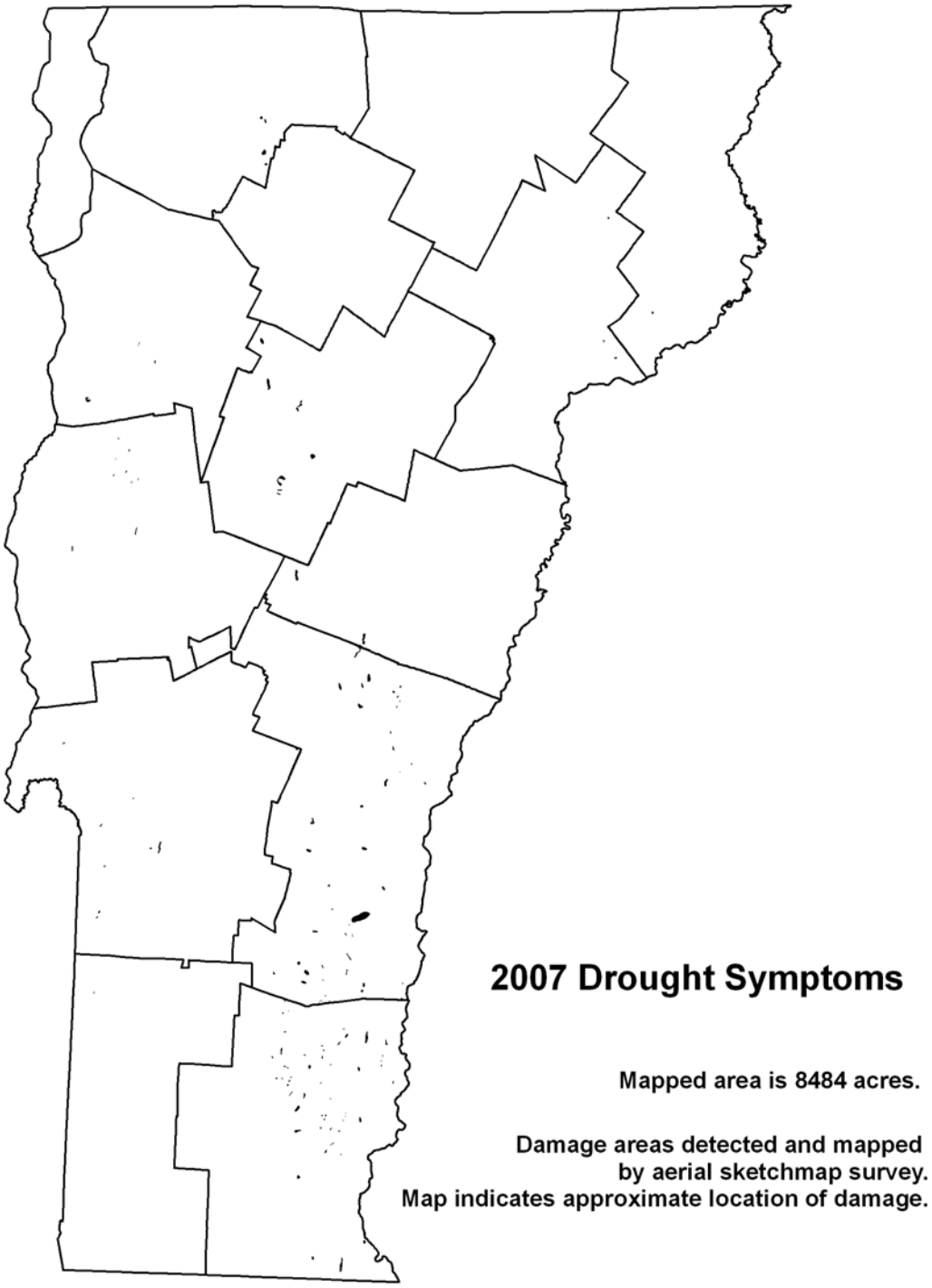


Figure 20. Drought symptoms in 2007. Mapped area is 8,484 acres.

Hardwood Decline and Mortality

Hardwood decline and mortality were uncommon in 2007 (Table 17, Figure 21). Good growing conditions with adequate moisture in most locations and little or no insect defoliation were likely contributing factors. Hardwood declines were mapped on 1,436 acres statewide, showing a decrease from the recent peak in 2003. See also Forest Tent Caterpillar.

Table 17. Mapped acres of hardwood decline and mortality in 2007.

County	Acres
Addison	38
Bennington	308
Rutland	482
Windham	363
Windsor	246
Total	1,436

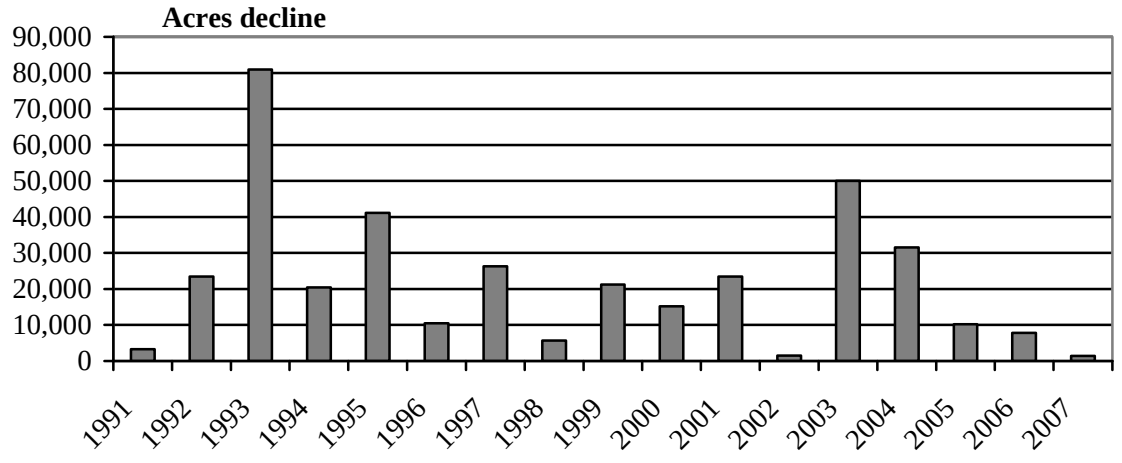


Figure 21. Trend in acres of hardwood decline and mortality from 1991 to present showing a decrease in 2007.

Larch Decline

Larch Decline, caused by past drought and an increase in eastern larch beetle populations, continued to expand. Damage was mapped on 3,918 acres, double the area that was affected last year (Table 18, Figure 22).

Table 18. Mapped acreage of larch decline in 2007.

County	Acres
Addison	32
Bennington	199
Caledonia	441
Chittenden	13
Essex	285
Franklin	622
Lamoille	126
Orange	293
Orleans	707
Rutland	150
Washington	1,050
Total	**3,918**

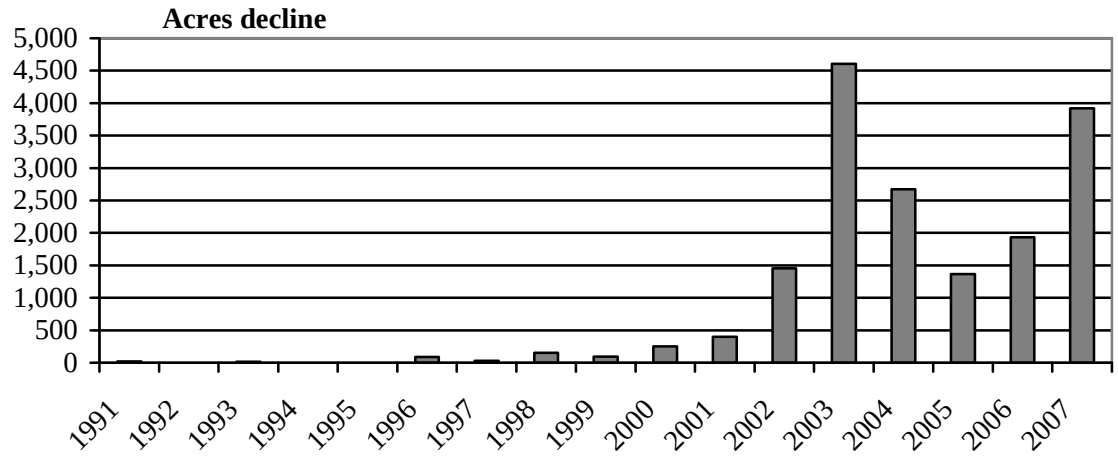


Figure 22. Trend in acres of larch decline from 1991 to present showing an increase in 2007.

Unthrifty Crowns Associated with Logging

There was an increase in mapped area of logging-associated decline this year. The total area mapped during aerial survey was 3,778 acres widely scattered throughout the state (Table 19). Logging prior to defoliation increased the impact of forest tent caterpillar in some stands.

Table 19. Mapped acres of unthrifty crowns associated with logging in 2007. Mapped area is 3,778 acres.

County	Acres
Bennington	142
Caledonia	327
Essex	170
Orange	99
Orleans	1,309
Rutland	831
Washington	210
Windham	361
Windsor	330
Total	3,778

Ozone Injury

In 2007, 11 locations were visited to survey for ozone injury on bioindicator plants. Symptoms of ozone injury (stippling on upper leaf surface) were recorded at only one location in Rupert (Table 20). Symptoms were found on black cherry, milkweed, white ash and blackberry. Information on symptoms of ground-level ozone injury on sensitive plant species is collected annually as part of the National Forest Health Monitoring Program. No symptoms of ozone injury were observed during other routine forest observations.

Table 20. Ozone bioindicator sites visited in 2007 and presence of ozone injury.

Town	Site Number	Severity of Injury
Bakersfield	4407277	none
Clarendon	4307268	none
Dover	4307215	none
Groton	4407222	none
Hancock	4307287	none
Lunenburg	4407168	none
Orange	4407223	none
Rupert	1050002	Present
Springfield	4307244	none
Sudbury	4307372	none
Waterford	4407137	Not sampled (dropped)
Woodstock	1050005	none

Spruce-Fir Decline and Mortality

Spruce-Fir decline was mapped on 9,535 acres statewide and remains common at high elevations and in stands previously affected by balsam woolly adelgid (Table 21, Figures 23 and 24).

Table 21. Mapped acres of spruce-fir decline and mortality in 2007.

County	Acres
Addison	129
Bennington	1461
Caledonia	174
Chittenden	80
Essex	2,668
Franklin	75
Grand Isle	0
Lamoille	204
Orange	1,064
Orleans	160
Rutland	1,362
Washington	930
Windham	733
Windsor	495
Total	9,535

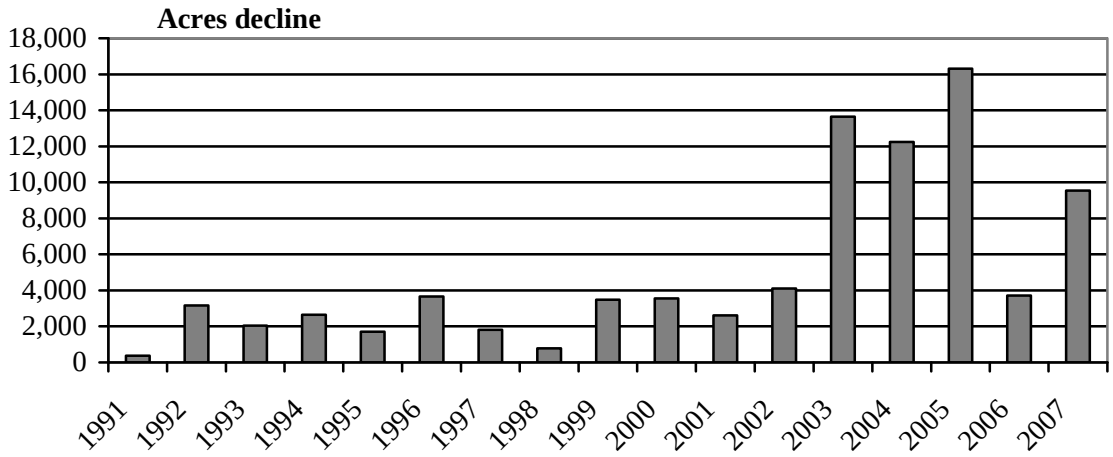


Figure 23. Trend in acres of spruce-fir decline and mortality from 1991 to 2007.

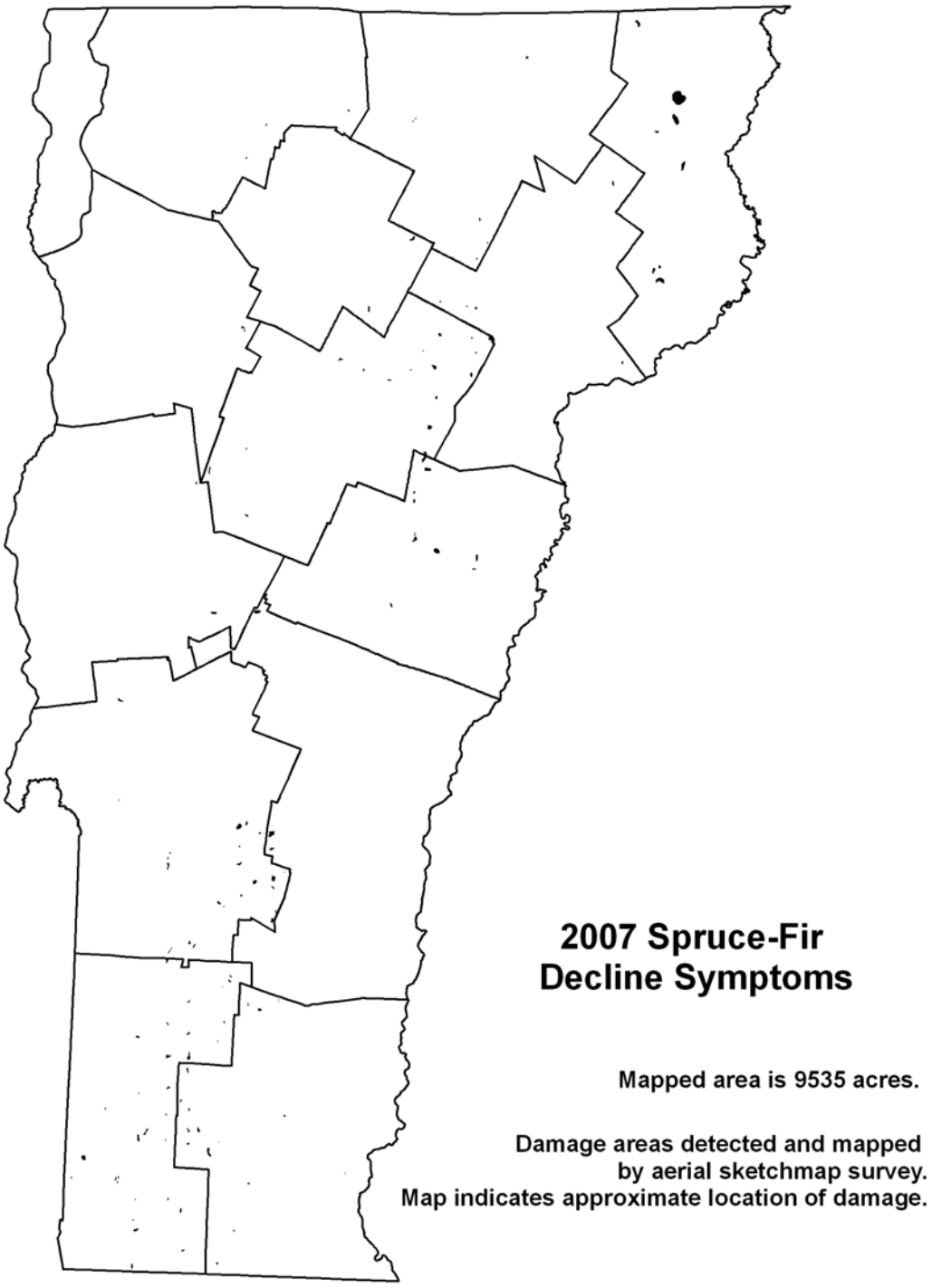


Figure 24. Spruce-fir decline and mortality mapped in 2007. Mapped area is 9,535 acres.

Wet Sites

The total mapped area of forest decline due to flooding was fairly stable this year. Aerial mapping showed 7,082 acres of decline associated with wet sites (Table 22, Figures 25 and 26).

Table 22. Mapped acres of dieback and mortality associated with wet site conditions in 2007.

County	Acres
Addison	622
Bennington	826
Caledonia	555
Chittenden	40
Essex	665
Franklin	557
Grand Isle	265
Lamoille	164
Orange	653
Orleans	1,690
Rutland	644
Washington	47
Windham	328
Windsor	27
Total	7,082

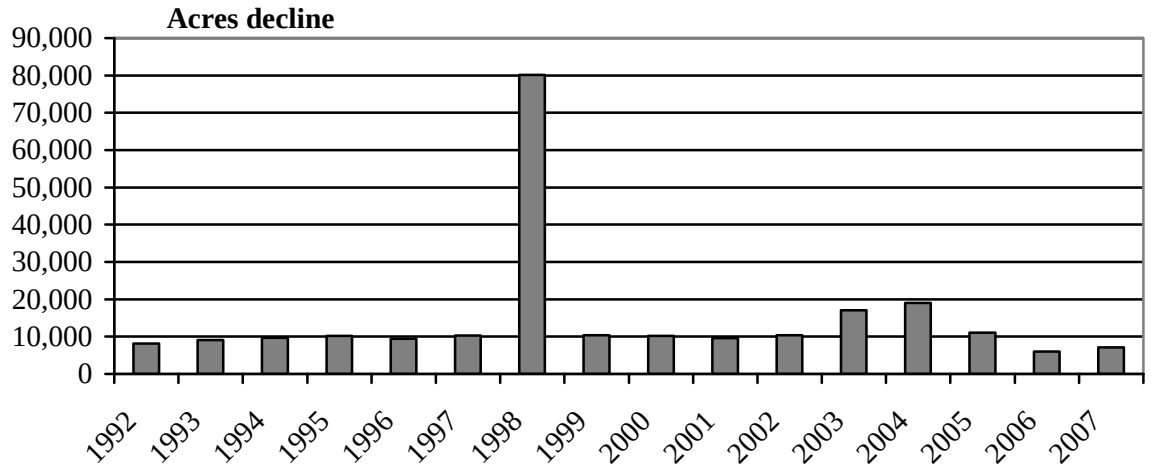


Figure 25. Trend in declines associated with wet site conditions showing stable levels in 2007.

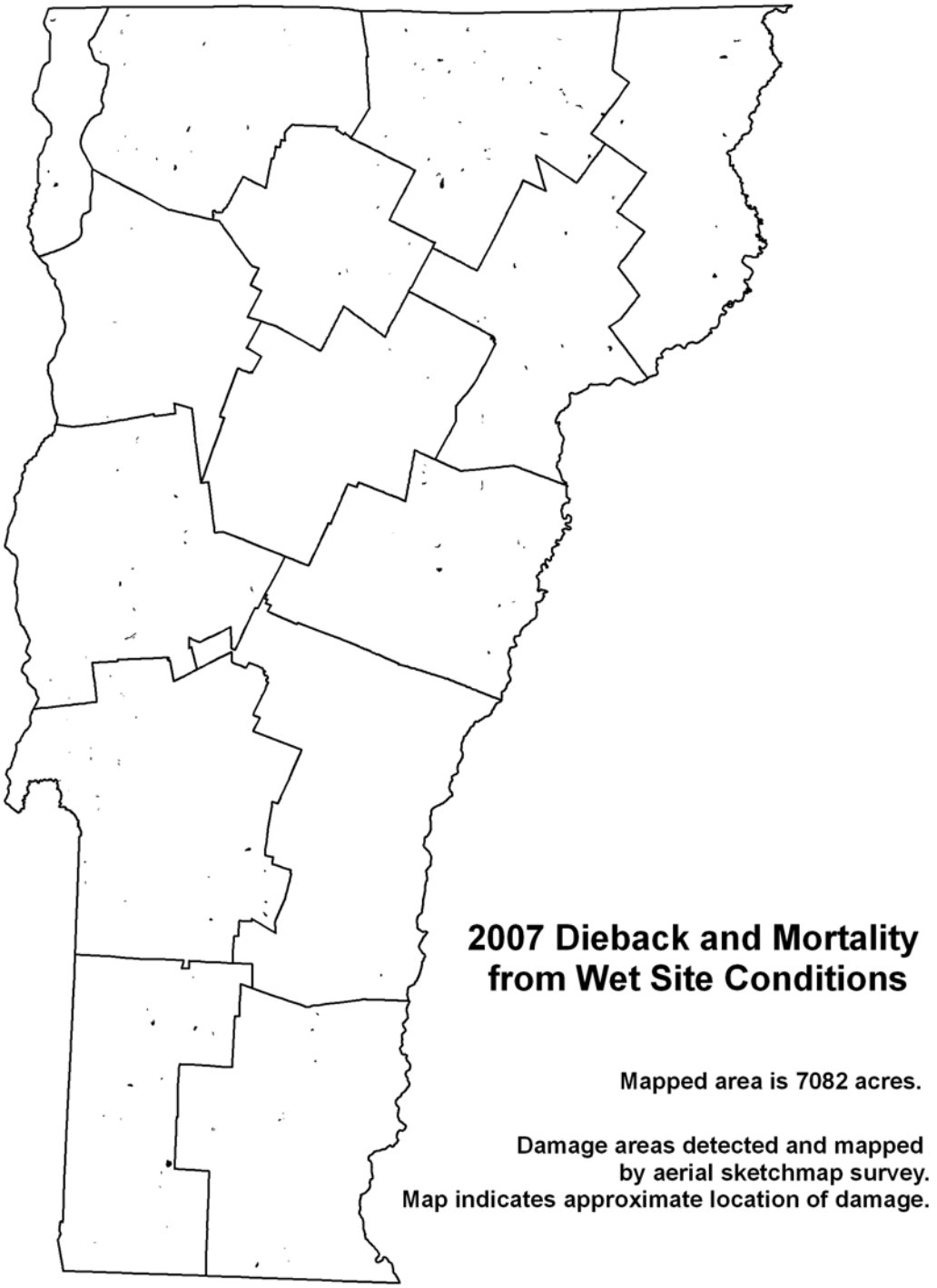


Figure 26. Wet sites with dieback and mortality mapped in 2007. Mapped area is 7,082

Wind Damage

Wind Damage was sometimes severe as a result of a windstorm, dubbed a "nor'icane" by the media, on April 16th. The heaviest damage was in the City of Rutland and in parts of the Northeast Kingdom. Although many species were affected, conifers were particularly likely to be either windthrown or snapped. In addition to ornamental trees, some forested areas were flattened. Elsewhere in Rutland County, as well as northern Bennington County and south-central Windsor County, scattered damage was reported, especially on southeast-facing slopes. Tree damage led to power outages in much of the region.

A couple of strong summer storms caused relatively small, but conspicuous blowdowns including spots in Proctor, Pittsford, Rutland and Hartford. Hartford Village was without power and access until broken trees could be removed. An August 27th storm caused tree damage in Georgia and on the Lake Champlain islands, as well as the Northeast Kingdom.

A special aerial survey was flown in May to map wind damage in the Rutland area and the Northeast Kingdom. Additional damage was mapped during routine surveys in late summer. In all, 6,090 acres of damage were mapped (Table 23, Figure 27).

Table 23. Mapped acreage of wind damage in 2007.

County	Acres
Addison	32
Bennington	32
Caledonia	1,628
Essex	3,262
Franklin	172
Lamoille	142
Orleans	323
Rutland	390
Windham	90
Windsor	18
Total	**6,090**

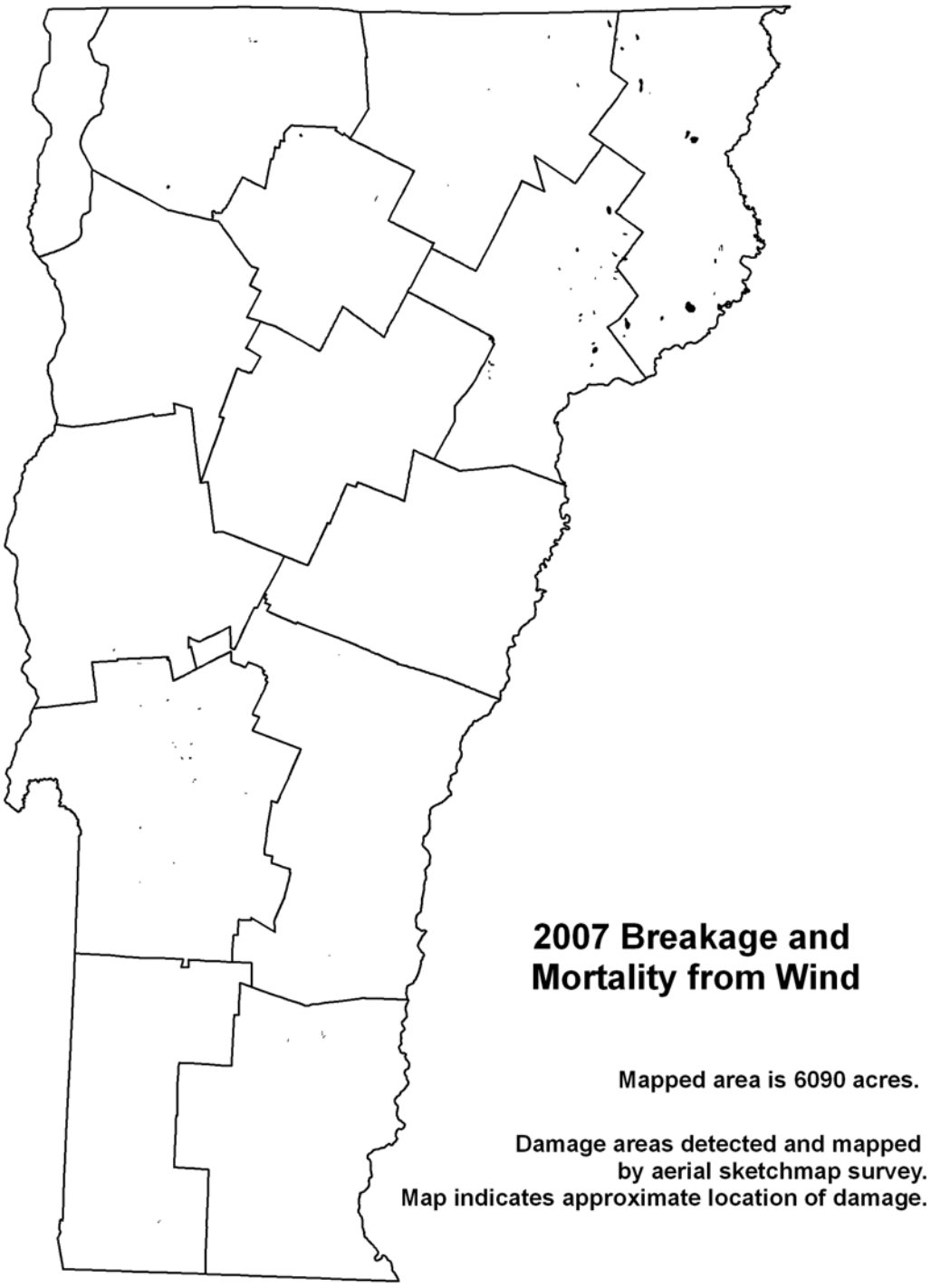


Figure 27. Breakage and Mortality from Wind 2007.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Air Pollution Injury	Sensitive plants	Localized areas	See narrative (Ozone Injury)
Ash Dieback	White Ash	Scattered throughout	Generally stable
Birch Decline			See narrative.
Drought			See narrative.
Fire Damage	Many	Townshend	Root damage from a persistent ground fire.
Frost Damage	Fruit trees	Champlain Valley	Due to the late budbreak, and lack of late season frosts.
Girdling Roots	Many	Scattered throughout.	Frequent cause of planted tree failure.
Hardwood Chlorosis			See narrative.
Hardwood Decline and Mortality			See narrative
Hemlock Needlecast	Hemlock	Rutland, Windham and Windsor Counties	Reported from seven towns. Noticeable green needle drop in July. Cause unknown.
Larch Decline			See narrative.
Logging-related Decline	Many	Widely scattered	See narrative.
Maple Decline			See hardwood decline.
Salt Damage			Generally light again in 2006-2007.
Snow Breakage			Only scattered damage reported.
Spruce/Fir Dieback and Mortality			See narrative.
Wet Site			See narrative.
White Pine Mortality	White Pine	Widely scattered	White pine decline and mortality were mapped on 2,013 acres statewide. Causes include wet sites, needle blight, and white pine blister rust.
Wind Damage			See narrative.
Windburn	Sugar Maple, White Ash, Red Maple, Red Oak	Dorset, Shaftsbury	Wind is thought to be the cause of marginal foliar scorch on the east-facing sides of tree crowns. Damage was detected in late June. Some trees refoliated. See also Maple Anthracnose.

Heavy seed, Ice and Winter damage not reported this year.

ANIMAL DAMAGE

ANIMAL	SPECIES DAMAGED	LOCALITY	REMARKS
Beaver		Common	Damage similar to recent years
Deer	Hardwood regeneration	Common, especially in the Connecticut River Valley.	Damage similar to recent years. Heavier damage expected with increasing deer population.
Moose		Northeastern and central Vermont	Damage seems stable
Mouse and Vole	Various shrubs	Northeast	Occasional damage to shrubs
Porcupine	Sugar maple Yellow birch	Widespread	More damage than in the past in north-central Vermont. Elsewhere, damage similar to recent years.
Sapsucker	Black walnut	Barre	Severe damage to a few trees.
	Apple Paper birch	Scattered throughout	Remains common on the usual hosts.
Squirrel	Sugar Maple	Springfield	Scattered mortality of large branches in upper crowns scattered through an urban neighborhood.
Woodpecker	Balsam Fir Hemlock	Northeast	Damage by woodpeckers seeking borers in dead and dying trees.

TRENDS IN FOREST CONDITION

North American Maple Project (NAMP) Plots

Sugar Maple Health

Sugar maple condition on NAMP plots improved in 2007, with the decline of forest tent caterpillar populations. Over 92% of overstory sugar maple trees had healthy crowns (Figure 28), average foliage transparency (19.9%) and dieback (7%) improved (Figure 29) and the percent of trees with high foliage transparency decreased to 8.3% (Figure 30). The Crown Condition Index, a composite of crown health measurements, also reflected an improvement, but indicates that stress agents are still affecting sugar maple trees (Figure 31). Mortality was 1.6% of overstory sugar maples. A separate, comprehensive 20 year report is underway.

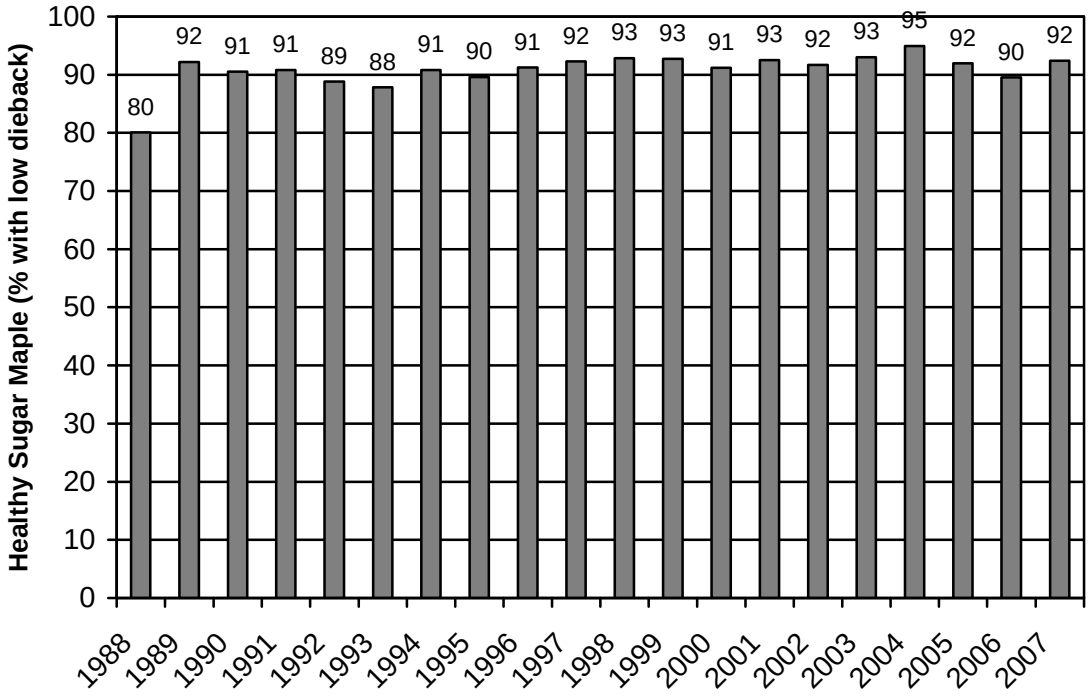


Figure 28. Trend in healthy overstory sugar maple trees on NAMP plots. Health based on trees with less than 15% dieback.

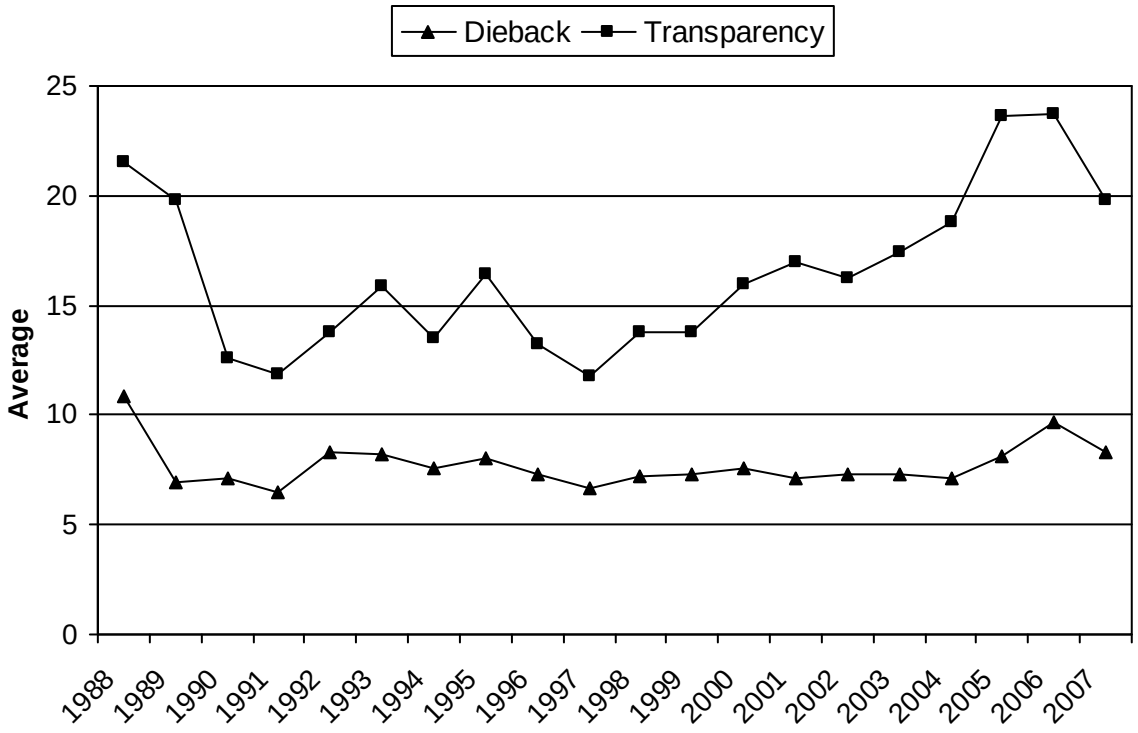


Figure 29. Trend in overstory sugar maple tree condition from 1988 to 2007, showing some improvements in average foliage transparency and dieback in 2007.

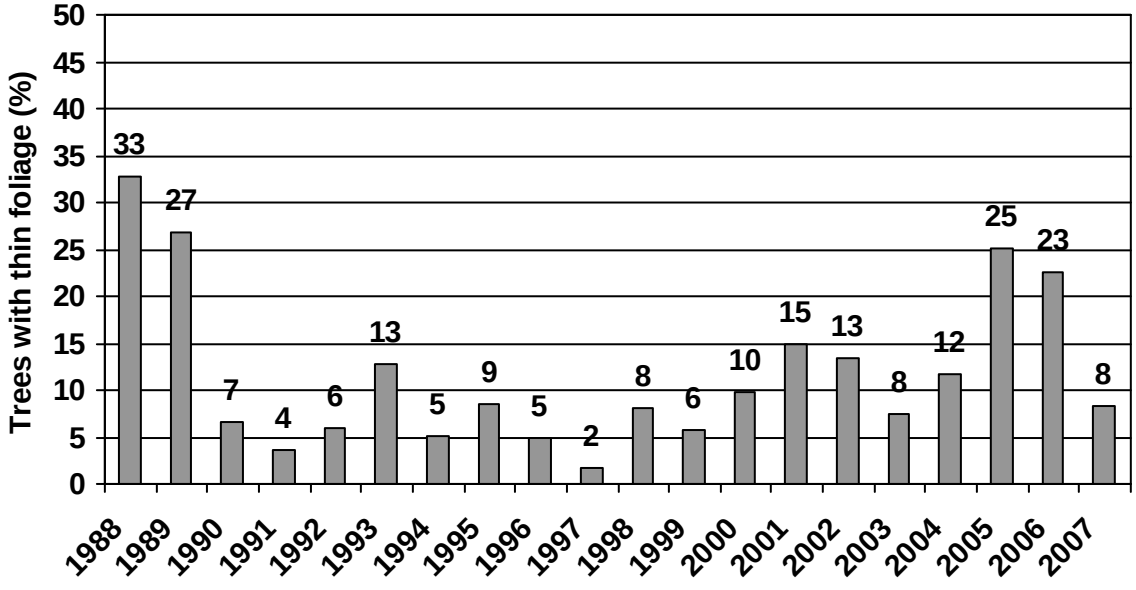


Figure 30. Percent of overstory sugar maple trees with thin foliage (foliage transparency >25%) showing improvement in 2007 following 3 years of forest tent caterpillar defoliation.

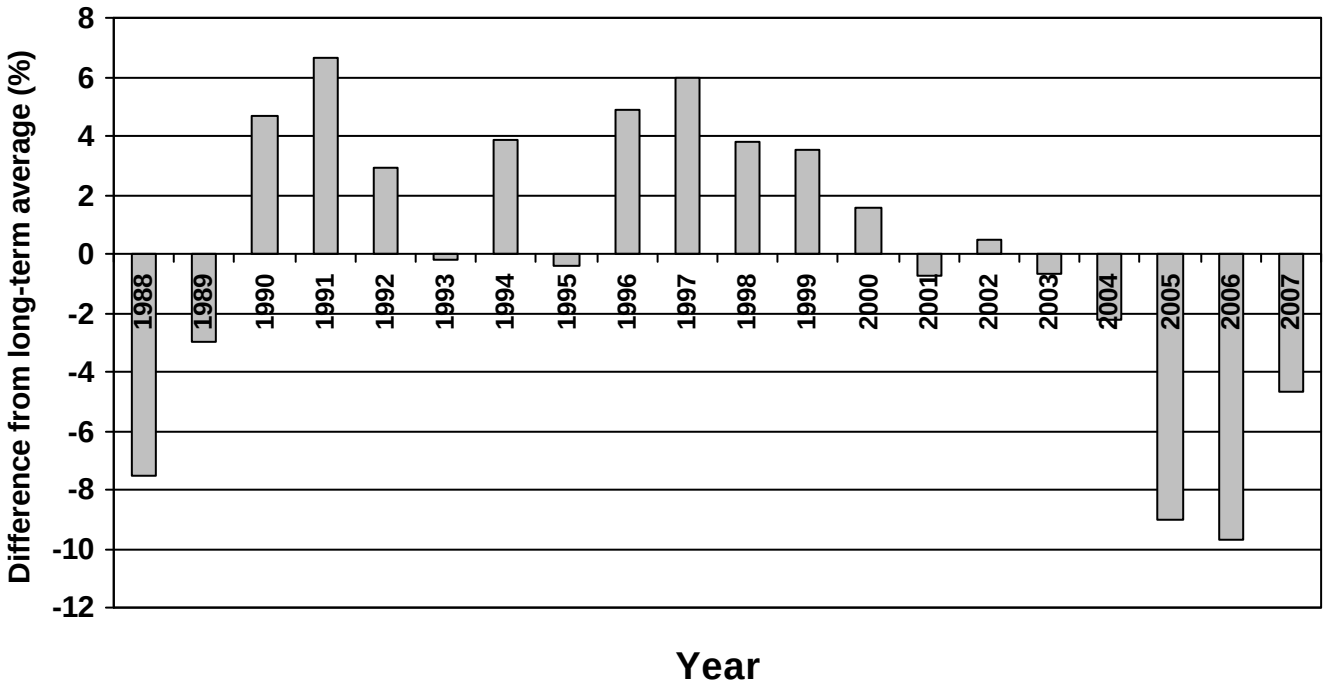


Figure 31. Crown Condition Index showing the percent difference from the long-term average for overstory sugar maple trees. Crown Condition Index includes dieback and transparency. Negative Crown Condition Index values indicate poorer than average crown condition.

Vermont Monitoring Cooperative Tree Health

Trends in tree health on Mount Mansfield

In 2007, 14 forest health monitoring plots were evaluated, 6 on the east slope and 8 on the west slope of Mount Mansfield. The 8 west slope plots have been monitored for 15 years, and a separate, comprehensive report is underway.

Poor tree health on east slope plots has continued since 2002 (Figure 32). A complex of biotic and abiotic stress agents has been involved. Conversely, tree condition on low elevation plots on the west side of the mountain has remained good (Figure 33). Balsam fir on summit plots trees (3,800 feet on the west slope) have been steadily declining over this same time period, and in 2006 over 40% of trees had high dieback (Figure 33).

A Crown Condition Index applied to all plots on Mount Mansfield combines four crown health indicators (dieback, foliage transparency, crown density and live crown ratio) (Figure 34). Following crown health problems resulting from drought in 1999 and 2001, trees have generally recovered and experienced the fullest crowns on record in 2006.

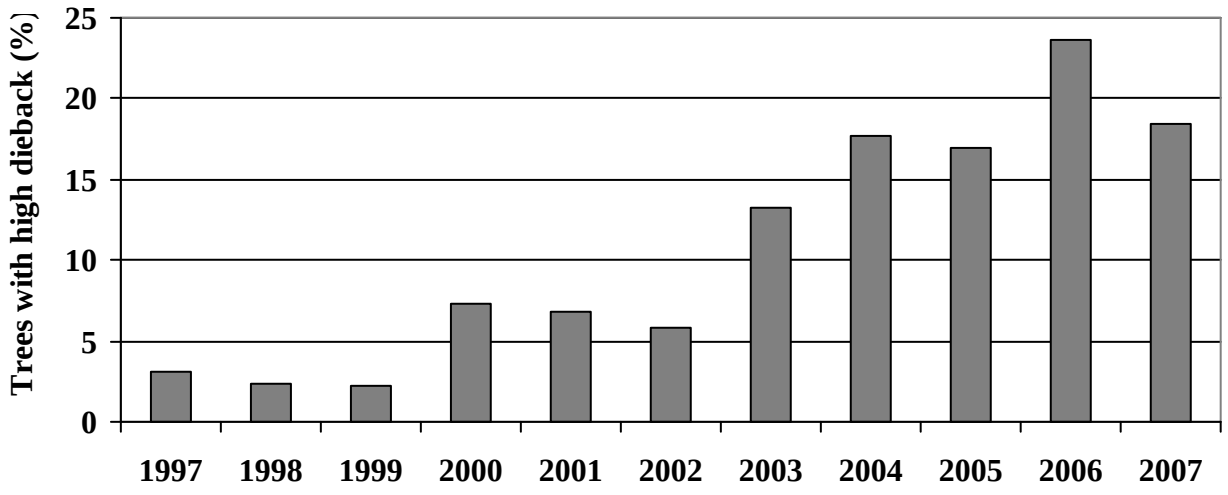


Figure 32. Trend in overstory trees with high dieback at 2 elevations (4 plots at 1400 & 2200 feet) on the east slope of Mt. Mansfield, showing increase in poor health trees since 2002. Basked on trees with greater than 15% dieback.

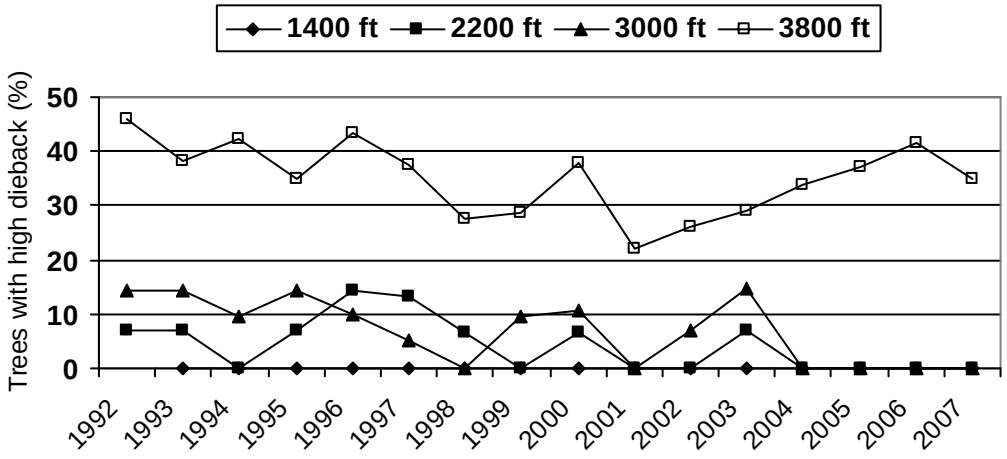


Figure 33. Trend in overstory trees with high dieback at 4 elevations on the west slope of Mt. Mansfield, showing increases in poor health trees only on high elevation plots (3800 feet). Based on trees with greater than 15% dieback.

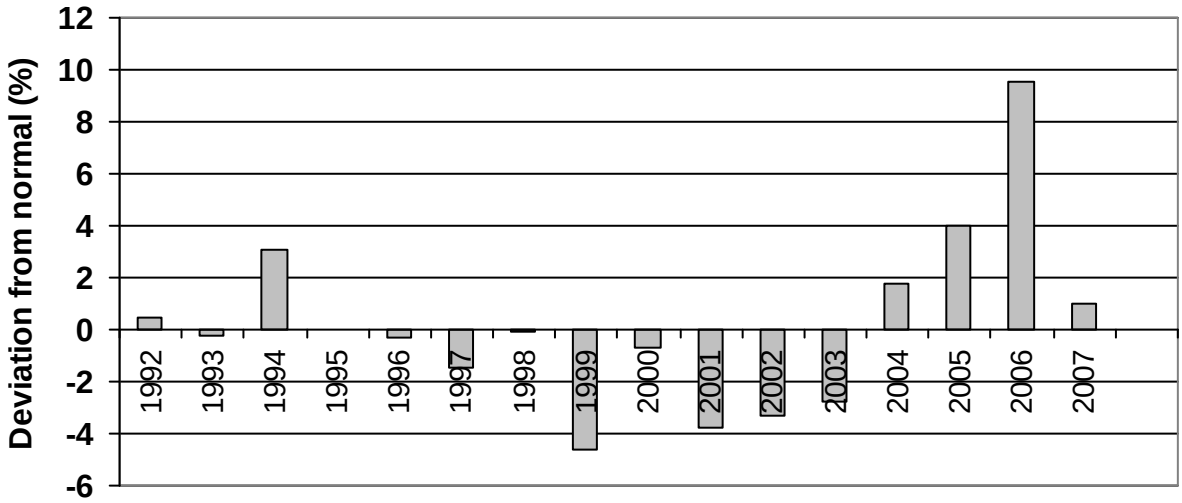


Figure 34. Crown condition index, showing deviation from normal (long-term average) for all plots on Mount Mansfield, indicates an improvement in crown condition over the last few years. Crown Condition Index includes dieback, transparency, density and crown ratio.

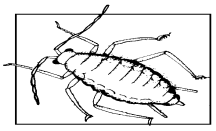
COMMON PESTS OF CHRISTMAS TREES IN VERMONT 2007

REPORTED BY THE

DEPARTMENT OF FORESTS, PARKS AND RECREATION

INTRODUCTION

Information in this report is based largely on observations made by Forest Resource Protection personnel, including some spot-checks of key plantations. This was again an excellent growing season for Christmas trees, similar to the past two years, and many growers reported that their trees had few insect and disease problems.



INSECTS

Balsam Gall Midge populations are increasing, with light to moderate damage now common in many Christmas tree plantations. Damage remained heavy in a couple of Northeast Kingdom plantations that have been out of synchrony with other locations and there was heavy damage to scattered individual trees in several other northern plantations. Outbreaks are cyclical and about seven years apart. Heavy damage was last observed in 2001 so this insect is likely to be an increasing problem in 2008. Vermont is expected to regain its local use registration for Diazinon AG500 in 2008 so it, along with Lorsban, should be available for control of gall midge. Past trials have shown that Diazinon gave the best control for early spray timing (1 1/3 inch shoot length). Lorsban was equally effective for the later timing (2 inch shoot length). This is based on measuring terminal shoots in the upper third of tree crowns, concentrating on trees that had some galls in the previous year.

Balsam Shootboring Sawfly population levels were very low, this being an odd numbered year. Expect to see some increase in bud mining in 2008, but heavy damage is very unlikely.

Balsam Twig Aphid damage was mostly light with some moderate damage, similar to what was seen in 2005 and 2006. It's surprising that damage has remained light for three years in a row. Expect populations to increase in 2008.

Balsam Woolly Adelgid populations have increased on wild balsam fir trunks due to recent mild winters. This insect was not observed on Christmas trees but has the potential to become a problem if populations continue to build.

Eastern Spruce Gall Adelgid damage to white spruce remains common, at mostly light to moderate levels.

Japanese Beetle adults damaged balsam and Fraser fir Christmas tree shoots in Essex by feeding on the bark. Damage was heavier on previous year shoots than on current shoots.

Sawyer Beetle adults were sometimes seen, but damage was infrequent.

Spruce Spider Mite damage increased in some southern Vermont plantations but populations remained mostly low elsewhere.

White Pine Weevil damage to pine and spruce trees remained common throughout the state but damage remained mostly at light levels.

DISEASES

Armillaria Root Rot continues to be a problem associated with tree mortality in more and more plantations. This is particularly true for sites that are beyond their second rotation and plantations where trees are inter-planted near old stumps. Some Armillaria caused mortality was found on the majority of such plantations visited in northern Vermont this year. Fraser fir is much more susceptible to this root rot than balsam fir while balsam-Fraser crosses appear to be intermediate in susceptibility. Growers who are now converting to Fraser fir by planting them between mature balsam fir trees may be inviting a greater risk of loss due to Armillaria in the future.

Brown Spot Needle Blight was widespread and often heavy on white, red and Scots pines again this year. Some heavy damage was seen on Scots pine trees in Waterbury. Infected needles turn brown from the tips back and develop small black fruiting bodies.

Cyclaneusma Needlecast of Scots pine remains very common but mostly at light levels.

Delphinella Shoot Blight is becoming increasingly common on balsam fir in widely scattered locations. Needle and lateral shoot mortality due to this fungus cause heavily infected trees to be unmarketable.

Diplodia (Sphaeropsis) Tip Blight was occasionally seen this year at mostly light levels.

Fir-Fern Rust was widespread this year and was the heaviest seen in a long time. Although it was very noticeable on balsam fir nearly everywhere during the growing season, it was rarely heavy enough to impact marketability. Fruiting on the alternate fern hosts was observed on bracken fern as well as sensitive fern.

Lirula Needlecast continues to be increasingly common on balsam fir. Heavy damage to scattered individual trees was observed in several locations. Needles killed by this fungus maintain their orientation on the stems, with retention of dead two and three year needles. Mature trees that are crowded or partially shaded are most likely to be infected. Look for long narrow black fruiting bodies down the midrib of brown previous-year needles.

Lophodermium Needlecast remained common at mostly light levels.

Phytophthora Root Rot continues to be associated with the death of Fraser fir and occasionally balsam fir growing on poorly or somewhat poorly drained sites in more and locations. It appears that once the organism gets established during wet years, it persists and becomes more of a problem in years with average precipitation.

Rhizosphaera Needle Blight of fir, caused by *Rhizosphaera pini*, was increasingly common in Christmas tree plantations, along with the other fir diseases. This was especially true for crowded or shaded trees. Damage was heavy on individual trees in widely scattered locations. Harvesting of crowded trees and low pruning in plantations where this was a problem in the past seems to have helped alleviate the damage.

Rhizosphaera Needlecast of white and blue spruce remains very common with some heavy damage to blue spruce again this year.

Scleroderris Canker has not been found in any new towns since 1986.

Spruce Needle Rust was observed on individual blue spruce trees in a few scattered locations.

White Pine Blister Rust damage remains common throughout the state and continues to kill white pines at moderate levels in plantations that have had the problem in the past.

Winter Injury was observed but damage was minor.

Woodgate Gall Rust damage to Scots pine is decreasing as growers remove heavily damaged trees.

Yellow Witches Broom Rust of balsam fir appeared to be more noticeable this year than in previous years. Removal of these brooms during shearing is recommended.

ANIMAL DAMAGE

Moose Damage is becoming an increasing problem in remote northern plantations, including one in Craftsbury.

The following insects and diseases were not observed on Christmas trees this year.

Insects: Cinara Aphids, Introduced Pine Sawfly, Pine Leaf Adelgid, Pine Needle Midge, Pales Weevil, Pine Root Collar Weevil, Pine Thrips and Yellow-Headed Spruce Sawfly.

Diseases: Sirococcus Shoot Blight, Rhabdocline Needlecast, Swiss Needlecast and White Pine Needle Blight.

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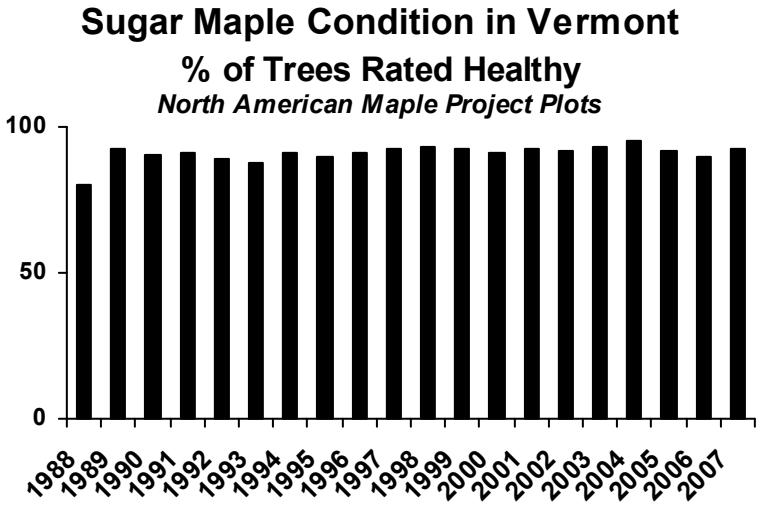
HEALTH OF SUGAR MAPLE IN VERMONT — 2007

Reported by the State of Vermont Department of Forests, Parks and Recreation

This information on sugar maple health is based on aerial surveys and field observations. Every year, the Department of Forests, Parks and Recreation looks at tree health from the ground and from the air. In 2007, all 4.7 million acres of forestland were evaluated from an airplane at least once. In addition, crews assessed monitoring plots on the ground to rate tree condition.

Weather Conditions in 2007 were generally good for sugar maple. Winter weather was not severe, and late spring frosts were uncommon. Maple budbreak was later than average. Moisture was adequate through most of the growing season, although lack of rain in mid-late summer affected trees on droughty sites. In most of the state, the weather stayed warm through mid-autumn, and fall leaf drop occurred later than normal.

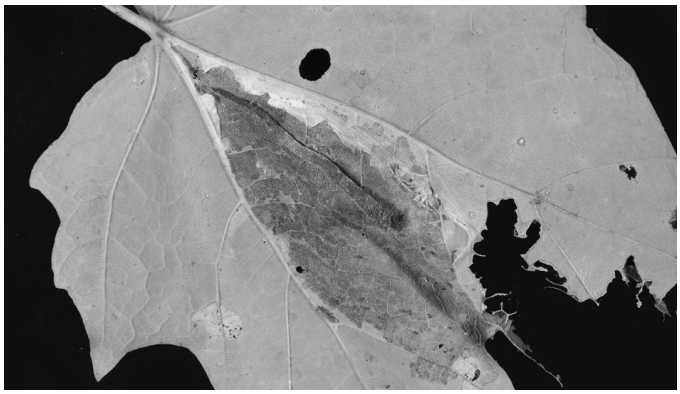
To assess the **General Condition** of maple stands, 2000 sugar maples were evaluated using North American Maple Project ratings. Over 90% of sugar maple trees on survey plots remained healthy in 2007, and mortality was low. On average, crown vigor improved from 2006, with much of the improvement attributed to tree recovery following the forest tent caterpillar outbreak.



Drought was responsible for late-season leaf browning of maple and other hardwoods that was mapped on 8,484 acres, statewide. It also contributed to yellow foliage that was mapped on 1,932 acres. Most of the damage was observed on ledgey sites.

Late-Season Sugar Maple Defoliation was common by September, and was mapped on 102,551 acres, mostly in the south-central and western Green Mountains. Because the damage occurred late in the growing season, the impact on tree health is not expected to be significant.

A number of defoliators played a role. The fungus disease, Maple Anthracnose was often present. Other agents were also significant, especially the caterpillar, Maple Trumpet Skeletonizer (picture below), and the fungus, Septoria Leaf Spot, in northern areas and the caterpillar, Saddled Prominent, in southern areas. In parts of Franklin and Grand Isle Counties, windburn also contributed to the damage.



Pear Thrips damage (picture below) was locally significant at higher elevations in the Taconics and in the central Green Mountains. The impact of this damage may be greater in sugarbushes that had been previously defoliated by forest tent caterpillar.

Squirrel Damage to sugar maple bark was locally significant. High squirrel populations likely resulted from a heavy crop of acorns in 2005 and of beechnuts in 2006.

Wind Damage was sometimes severe as a result of a windstorm, dubbed a "nor'icane" by the media, on April 16th. The heaviest damage was in the Northeast Kingdom and in the Rutland area. Sugar maple damage was much lighter than damage to conifers.

Several strong summer storms caused small, but locally conspicuous damage.

Wind is thought to be the cause of marginal browning of sugar maple leaves in widely scattered locations west of the Green Mountains. Damage was detected in late June. Symptoms were confined to the east-facing sides of tree crowns. Some trees refoliated.

Concern continues to grow about the impact of **Invasive Exotic Plants** on the regeneration of hardwood trees. Key species of concern are glossy buckthorn, exotic honeysuckles and oriental bittersweet, with Norway maple, winged euonymus, and multiflora rose becoming increasingly noticeable. High populations of deer and moose contribute to regeneration failures in some areas.

Forest Tent Caterpillar populations collapsed statewide. Caterpillar feeding was reported from central Vermont and the Champlain Valley, but no defoliation was mapped during aerial surveys.

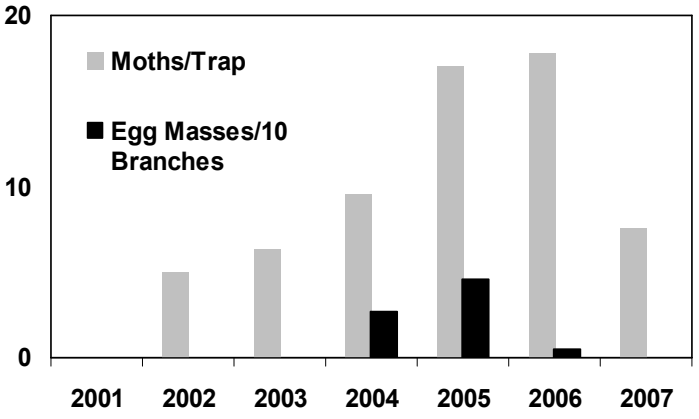
Defoliation was predicted in only two of the 116 sugarbushes where overwintering egg mass counts were made. In 2006-07, the statewide egg mass average was one-tenth of the previous year's average.
In sugarbushes that had not been sprayed in 2006, egg mass counts were three times as high as in sprayed sugarbushes.

We will continue to watch forest tent caterpillar populations in 2008. Although moth catches continue to decline, numbers remain high.

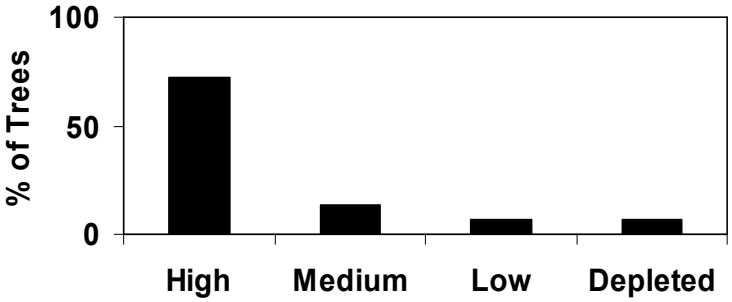
In some sugarbushes and forest stands, sugar maple health has declined following defoliation. Areas of severe decline and mortality are widely scattered, and often on dry or wet sites, or in areas that were recently thinned. Hardwood dieback and mortality attributed to forest tent caterpillar was mapped on 1,268 acres during aerial surveys.

Most often, trees are recovering well. Although defoliation was widespread in 2006, good growing conditions and adequate rainfall allowed the trees to refoliate quickly and replenish their carbohydrate reserves. In late fall 2006, assessments were made of starch reserves in sugar maples from 32 defoliated sugarbushes or forest stands Starch levels were "high" in 2/3 of the trees evaluated.

Forest Tent Caterpillar Counts



Fall 2006 Starch Ratings of Sugar Maples in Defoliated Stands



Sugarbush Management Recommendations

The condition of sugar maples in 2007 should determine whether or not past forest tent caterpillar defoliation remains a concern in sugarbush management. If there has been a noticeable increase in dead branches and twigs, or if leaves weren't as large or as green as normal, continue to postpone thinning and tap more conservatively than normal. If trees had a full crown of green leaves in 2007, it's probably safe to resume routine management activities.

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	Orange & Washington Counties……..	Barre (802) 476-0170
	Lamoille & Washington Counties……	Morrisville (802) 888-5733
	Caledonia, Orleans & Essex Counties……	St. Johnsbury (802) 751-0110

Research Highlights 2006-2007
Ongoing and Completed Projects
PROCTOR MAPLE RESEARCH CENTER

FOOD SAFETY / SAP & SYRUP CHEMISTRY

Effects of Air Injection on Syrup Chemistry, Quality, and Flavor: Air injection is a relatively new maple syrup manufacturing technique. We compared syrup produced in paired evaporators – one equipped with air injection and one without. In general, syrup produced with air injection was lighter in color, but did not differ in most respects from syrup produced without air injection. *van den Berg, Isselhardt, Perkins* USDA – Ongoing

Characterizing and Reducing "Metabolism" Off-Flavor in Maple Syrup: There is currently no identifiable cause for "metabolism", an off-flavor which occasionally develops in maple syrup, which reduces its marketability. Our research aims to identify the compounds in maple syrup that are responsible for metabolism off-flavors. Once identified, it may be possible to develop better strategies to cope with or reduce the occurrence of this problem. *Perkins, van den Berg, Isselhardt.* USDA – Ongoing

Adulteration and Contamination in Maple Syrup: Lead can be a contaminant of maple syrup. Our goal is to reduce lead levels in syrup by identifying the sources of lead in maple equipment and altering production practices to reduce contamination of sap and syrup where it occurs. We are also interested in identifying natural levels of paraformaldehyde in maple sap and the influence of PF use on the level of formaldehyde in the finished product. Finally, we are developing methods to detect various types of adulteration of pure maple syrup. *Perkins, Wilmot, van den Berg* USDA – Completed

PRODUCTION OF SAP AND SYRUP / MAPLE EQUIPMENT

Comparison of Tubing and Installation Methods in a Field Environment: This study compares the materials and methods of vacuum tubing installations of three equipment manufacturers. The participants were assigned approximately 200 taps within the sugarbush at The Proctor Center and asked to install a tubing system. Sap quantity, quality, longevity, maintainability, and costs are being recorded with the goal of deciding which is the most efficient and cost effective. The study is currently in its third year. *Perkins, Stowe, Isselhardt.* NAMSC, CCMSMA – Ongoing

Strategies for Maintaining High Sap Yields in Vacuum Tubing Operations: After high production rates for a few years, sap yield typically steadily decreases in maple tubing system operations. The reasons for this are not clearly understood. This project seeks to identify economical methods to maintain high sap yields over the lifetime of tubing systems using various equipment replacement and management strategies. *Perkins, Stowe, Wilmot* HATCH, EXT, NAMSC, CCMSMA – Ongoing

Sugar Sand, Scale, and Evaporator Cleaning: Strong chemicals (primarily acids) are being increasingly used to clean scale (niter) deposits from evaporators. This project is investigating the chemical nature of maple niter as well as developing and evaluating possible methods to reduce the use of chemicals in cleaning. *Isselhardt, van den Berg, Stowe, Perkins* USDA – Ongoing

High Vacuum Effects on Sap Production and Wounding: Sap production is linearly related to vacuum level: higher levels of vacuum yields higher sap production. Vacuum level (up to 21" Hg) does not significantly affect sugar content or sap chemistry, and does not increase the level of internal damage in trees. *Perkins, van den Berg, Stowe, Wilmot, Isselhardt* USDA – Completed

Effects of Forest Fertilization in Sugarbushes: "Fertilization of Sugarbushes" was published in October 2004 which describes fertilization research conducted by PMRC staff between 1988 and 2003, as well as offering instructions and recommendations for sugarmakers who wish to fertilize their land. The brochure contains information about the potential geographical range of nutrient-deficient soils, tips on evaluating stand nutrition by recognizing key indicator plants, and considerations for sugarmakers who wish to certify their syrup as organic. *Wilmot, Perkins* USDA, FREEMAN FDN, NAMSC – Completed

Evaluation of Small Spouts: This study compares sap production and wounding using normal and small spouts. Under most conditions, sap yield was roughly the same for either size spout using vacuum, but was slightly less for small spouts with gravity flow. In large trees under gravity or vacuum, wood discoloration from small taphole wounds was somewhat less than internal damage caused by large tapholes. *Perkins, Wilmot, Stowe, van den Berg, Isselhardt* CCMSMA, NAMSC – Completed

The Timing of Tapping under Gravity and Vacuum. During the last 2 decades, periods of above-freezing temperatures in January and February have caused many sugarmakers to consider abandoning their traditional March tapping date. Two separate studies, one with gravity sap collection and one with sap collection under high vacuum, were conducted to study the effects of differential timing of tapping on overall yields. Gravity collection showed similar seasonal yields for taps placed either February 1 or March 1 during the 2000-2002 seasons. Vacuum collection, studied for the first time in 2006, showed that sap could be collected for over 12 weeks from some tapholes. Yields from taps placed in late January exceeded those from taps placed in late February or mid-March during this unusually warm winter. Continued research in future years will again examine the effects of differential tapping dates using vacuum collection. *Wilmot* EXT, AES, NAMSC – Ongoing

- more project descriptions on reverse --

Vented versus Closed 5/16" Tubing: Venting of tubing systems was recommended early in the history of tubing development. While sap runs faster through vented compared to non-vented tubing systems, venting of tubing resulted in a 32% loss of sap production, probably due to faster drying of tapholes and loss of natural vacuum. *Stowe, Isselhardt* NAMSC – Completed.

Optimum Number of Spouts per 5/16" Line under Vacuum: We compared sap production from tubing installations with 1, 5, 10, and 15 spouts per 5/16" line. Single tap setups produced the greatest amount of sap, with lesser amounts from the 10 tap (20% reduction) and 15 tap (28% reduction) lines. Length of lateral line appears to have little effect on vacuum transfer as long as the number of taps on that line are kept within recommended levels. *Stowe, Isselhardt, van den Berg, Perkins* NAMSC – Completed

MAPLE PHYSIOLOGY & GENETICS

Meteorological Influences on Stem Pressure and Sap Flow in Sugar Maple: Cold nights and warm days will always provide the conditions necessary for good sap runs, but changes in global climate could affect the timing and success of sugaring in the Northeast. Using electronic sensors, we can measure air, wood and soil temperatures, as well as stem pressures and sap flow in sugar maple. Real time data are shown our web site each spring. Our collection of data contributes to our long term goal of constructing computer models relating sap flow to meteorological conditions. *Wilmot, Perkins* AES, EXT – Ongoing

Relationship Between Tapholes on Opposite Sides of a Tree: What Area of a Tree Contributes Sap to a Taphole? Using electronic sensors which can measure pressure in different parts of the trunk, we experimented with trees of various sizes to determine the timing and extent of sap movement toward an open taphole. Results have shown that the general behavior of sap movement is similar under both gravity and vacuum, but vacuum draws sap from a larger area of the wood, and affects areas of the trunk more rapidly than gravity. Results suggest that there is considerable sap movement in a horizontal direction, therefore tapholes on opposite sides of the tree may draw from the same area of wood depending on duration of the flow event. *Wilmot* UVM EXT AES – Ongoing

Fall Coloration in Sugar Maple: While important economically and scientifically, the process of fall coloration in sugar maple has not been widely studied. Our current research aims to improve the basic understanding of the process and identify factors that may be valuable in predicting the timing and quality of fall coloration. Specifically, anthocyanin pigments and their function and relation to physiological processes during fall senescence will be examined. *van den Berg* AES – Ongoing

FOREST ECOLOGY & HEALTH

Effects of Ice Storm Damage on Carbohydrate Reserves, Growth, and Survival in Sugar Maple: The Ice Storm of 1998 caused extensive damage to sugarbushes in New England, New York, and Canada. The loss of crowns resulted in depleted carbohydrate reserves in heavily damaged trees for two-three years after damage. The amount of carbohydrates stored in wood and root tissue was related to the amount of crown loss. This research is aimed at improving knowledge of how crown loss affects tree carbon reserves, sap production, growth, and survival in ice-storm-affected areas. *Perkins, Wilmot, van den Berg* VTFRP – Completed

Effects of Global Change on the Maple Sugaring Industry: This research examined the effects of global warming on timing of sap production in the northeast. Surveys of sugarmakers were used to determine changes in season open, season close, and duration of the sugaring season. Throughout the northeast U.S., the sugaring season is starting significantly earlier than it did 40 years ago, and the duration has decreased by an average of 10%. *Perkins, Wilmot* HATCH, NAMSC, DOE EPSCoR – Completed

Acid Rain Effects on Forested Ecosystems: Forest decline was a major concern throughout the 1980's and in the early 1990's. While the Clean Air Act of 1990 addressed some aspects of pollution, acid rain does continue to fall. Long-term vegetation plots on Camels Hump Mtn. are measured periodically to determine forest health and growth. *Perkins, van den Berg* EPA – Ongoing

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FUNDING SOURCE
NAMSC = North American Maple Syrup Council EPA = US Environmental Protection Agency
USDA = US Department of Agriculture CCMSMA = Chittenden Co. Maple Sugar Makers Association
HATCH = USDA Hatch AES = UVM Agricultural Experiment Station EXT = UVM Extension
VTFPR = Vermont Department of Forests, Parks & Recreation

INVASIVE PLANTS

Concern continues to grow about the impact of invasive plants on biodiversity and forest regeneration. Key species of concern are glossy buckthorn, exotic honeysuckles, Japanese barberry, and oriental bittersweet, with Norway maple, winged euonymus, and multiflora rose becoming increasingly noticeable.

The Agency of Natural Resources Task Force on Forest Sustainability made a number of recommendations related to invasive plants, including :

a) Create an Agency of Natural Resources-led Invasive Species Council to implement a rapid detection and aggressive management program. A sub-group should focus on forestry issues.
b) Act as a clearinghouse for research on best management practices. Work with research institutions to develop new strategies and monitor results.
c) Use state lands for demonstration of invasive plant management techniques, including post-sale monitoring of regeneration success.
d) Map invasive species that impact forest ecosystems statewide. Monitor for changes.
e) Update the Vermont Noxious Weed Quarantine. Require pre-testing of new plant species if their invasive potential is unknown.
f) Control invasive species seed sources on State lands and through cost-share programs. Require control on lands enrolled in the Use Value Appraisal program.
g) Assist other state agencies in identifying and managing invasive species. Require native species in state plantings. Encourage their use elsewhere.
h) Develop practices to curb invasive plants in transportation and recreation corridors.
i) Strengthen outreach, including public awareness and technology transfer.