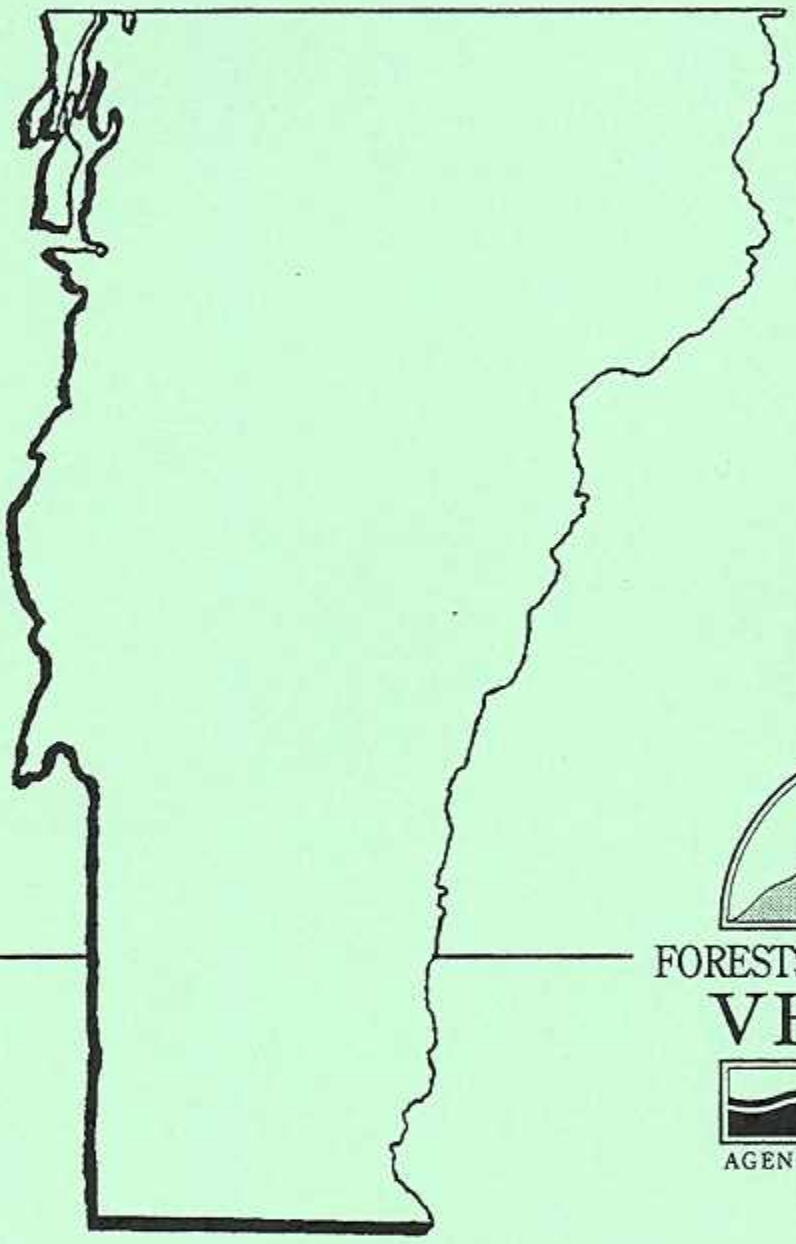
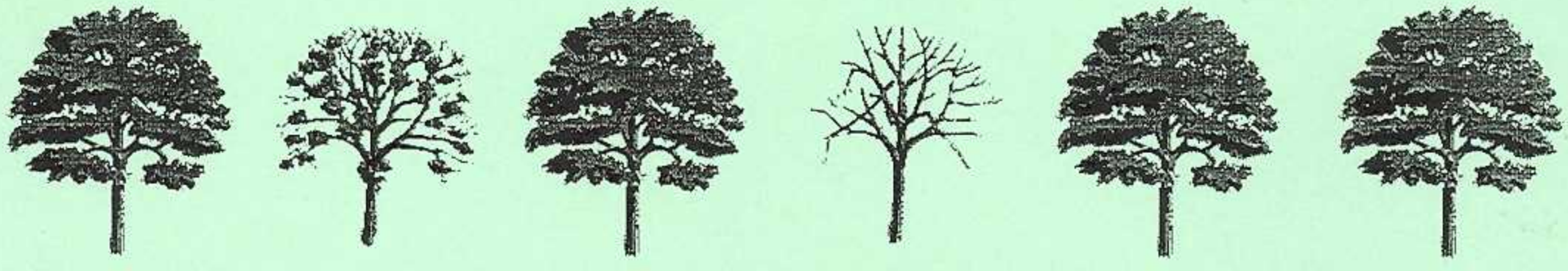
FOREST INSECT AND DISEASE CONDITIONS IN VERMONT 1999



VERMONT
FOREST RESOURCE PROTECTION
FIRE INSECTS DISEASE

FORESTS, PARKS & RECREATION
VERMONT
AGENCY OF NATURAL RESOURCES

AGENCY OF NATURAL RESOURCES
DEPARTMENT OF FORESTS, PARKS & RECREATION
WATERBURY, VERMONT 05671-0601



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We gratefully acknowledge the financial and technical support provided by the USDA Forest Service, Northeastern Area State & Private Forestry that enables us to conduct the surveys and publish the results in this report.

FOREST INSECT AND DISEASE CONDITIONS IN VERMONT

CALENDAR YEAR 1999

1999 Drought Impact: Hemlock Borer Galleries

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AGENCY OF NATURAL RESOURCES

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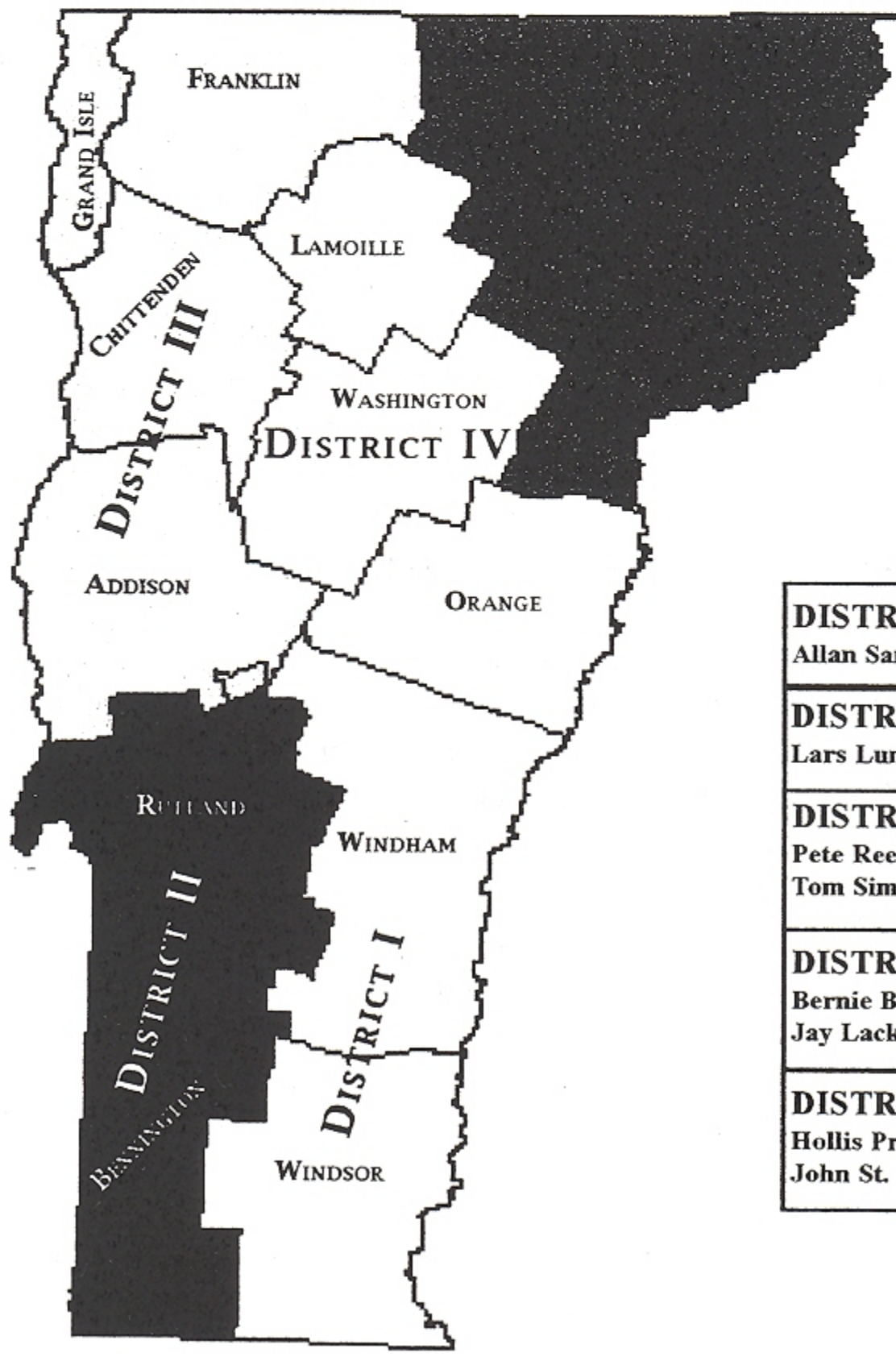

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1999 Vermont Forest Insect and Disease Highlights

Anthracnose on sugar maple and other hardwoods occurred at much lower levels than 1998. Dry spring conditions reduced the opportunity for infection.

Balsam Twig Aphid damage decreased statewide, with scattered light damage observed.

Balsam Shootboring Sawfly populations dropped to the lowest levels seen in many years. Emergence studies indicated that most have a two-year life cycle, with highest populations in even years. Heavy damage is expected in 2000.

Balsam Gall Midge populations remained high in Christmas trees and stands of wild balsam fir. Damage should be much lighter in 2000.

Bark Beetles were collected during a Vermont survey for the pine shoot beetle. A total of ten genera were captured.

Beech Bark Disease caused chlorosis and dieback that was more conspicuous than normal due to drought, and was mapped on 4,004 acres. Beech scale levels declined in monitoring plots.

Birch Defoliation, caused by birch leaf miners and anthracnose on paper birch, declined from previous levels. Only 7,667 acres were mapped from the air, compared to 21,283 acres in 1998.

Birch Decline occurred in scattered locations. Dieback improved or stayed the same in seven of the nine monitoring plots. Decline is expected to increase, since paper birch is sensitive to drought.

Brown Spot Needle Blight led to widespread white pine needle browning and drop of previous year needles. Infection took place during the wet summer of 1998. This disease has been reported on Scots pine in Vermont, but had not been identified on white pine prior to 1999.

Diplodia (Sphaeropsis) Tip Blight was the most common disease detected in Christmas trees. Infection was generally more frequent on pines, especially Scots pine.

Drought Conditions led to widespread symptoms, especially on shallow, wet, or excessively well-drained soils, and along roadsides. Hardwood foliar symptoms attributed to drought were mapped on 84,727 acres. There was also scattered conifer needle drop or mortality. Above average dieback, thinner crowns, and a build-up of secondary insects and pathogens, are expected over the next few years.

Forest Tent Caterpillar populations continued to be very low this year. A few moths were caught in pheromone traps in two locations. This may signal a small population increase.

Gypsy Moth caused no significant defoliation, and populations remained very low. Although individual egg masses have been observed, and may be more abundant than usual, no visible defoliation is expected in 2000.

Hardwood Decline and Mortality symptoms were mapped on 21,223 acres, an increase from 5,675 acres mapped during 1998 when water availability was greater.

Ice Storm Damage from 1998 remained visible during aerial surveys, with 18,847 acres mapped. Damaged stands continued to recover.

Invasive Plants were identified in a 1997 inventory of floodplain forests by the Nongame and Natural Heritage Program. Thirty-seven non-native plant species, ten considered to be highly invasive, were occurring in Vermont's riverine or lakeside floodplain forests.

Larch Decline leading to mortality continues in scattered Northeast Kingdom locations, and in southwestern Vermont where larch casebearer defoliation occurred in 1995.

Locust Leaf Miner caused scattered heavy damage. Mortality of black locust caused by previous defoliations was observed.

Maple Leaf Cutter caused some moderate to heavy defoliation with 14,479 acres mapped. Damage was more widespread than in 1998.

Non-Target Moths from eight families were identified in pheromone traps used in surveys for forest defoliators.

Oystershell Scale populations on American beech were light in most locations.

Pear Thrips populations in early spring appeared to be increasing. However, most thrips emerged before sugar maple buds opened, and damage was limited. Heavy damage was mapped on 10,921 acres, mostly in Windham County. Refoliation was sparse due to dry conditions. Soil samples collected in the fall show extremely low numbers of thrips. Noticeable damage is not likely in 2000.

Phytophthora Root Rot was the suspected cause of a large increase in balsam and Fraser fir Christmas tree mortality related to the extremely wet summer of 1998.

Pine Bark Adelgid levels were low in 1999. On white pine trees in an impact monitoring plot, there was no difference in foliage density between trees with and without heavy adelgid in 1995.

Pine Shoot Beetles were caught in Essex and Orleans County traps. This is an introduced pest that has been steadily moving eastward. No damage to pine has been detected in Vermont.

Saddled Prominent populations remain low. Light defoliation of sugar maple and beech was reported in scattered locations.

Scleroderris Canker has not been found in any new towns since 1986. All surveyed plantations in the quarantine zone were free of the disease.

Snow Breakage due to a late September storm was common in several sugarbushes in Franklin County.

Spring Hemlock Looper was not observed. An impact study showed some mortality within two years of the 1991 outbreak, with additional mortality in plots disturbed by logging. However, most defoliated trees recovered, maintaining wildlife habitat and other values.

Spruce Budworm, continued at low levels, with no visible defoliation detected. Trap counts were similar to 1998 levels.

Spruce/Fir Mortality and Dieback was observed mostly at high elevations, with 3,479 acres mapped during aerial surveys.

Spruce Spider Mite damage decreased. Overwintering egg numbers indicate that dry conditions have allowed populations to build up.

Ticks from animals or humans identified at the lab included deer ticks, American dog ticks, and a lone star tick.

Unthrifty Crowns Associated with Logging acres mapped were similar to 1998.

Wet Site conditions caused tree decline and mortality throughout the state, and damage was mapped on 10,334 acres. The previous years' wet growing seasons caused fine root mortality on these sites.

White Pine Weevil flagging occurred earlier than normal.

White Pine Blister Rust symptoms were more noticeable due to drought. In a survey of white pine, infection rates averaged 20% in Christmas tree plantations and 32% in pole-sized stands.

Wind Damage was widespread, particularly related to a July 6 wind storm and Hurricane Floyd. Especially hard hit were trees in wet areas, trees with defects, and roadside trees.

Vermont 1999 Forest Health Management Recommendations

The following recommendations summarize information in this report of particular importance to forest managers. Additional information can be found under specific pests mentioned. Separate summaries for sugarbush and Christmas tree managers are in the appendix.

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 (page 1) or your county forester.

All trees were affected by the **Drought** of 1999.

- Assume that food reserves, and growth, were reduced. Changes in water availability account for 90% of the variability in sugar maple diameter growth.
- Assume there was fine root mortality in the desiccated upper soil. Wet and ledgey sites will be hardest hit; upper soil is all they have. Don't disturb trees on these unforgiving sites.
- Also give a rest to: thinned hemlock, thin-crowned paper birch, sites with seasonal high water tables, residual trees where there's been blowdown (assume the wind broke a lot of roots on the standing trees as well), trees that have been defoliated.
- Expect an increase in dieback, cankers (bark under moisture stress is more susceptible to canker fungi), bark beetles, and root rot.
- Records from past droughts show that it may take as long as five years for trees to show symptoms, and ten years for them to recover.
- What if we get another dry season? We have no data to prove it works, but the Pennsylvania Bureau of Forestry asks, "Can you dance?" and recommends, " ...Then dance for slow, area-wide rainfall events to re-wet the soil"

Crowns are generally recovering in **Ice-damaged Areas**. Researchers at the Northeastern Forest Experiment Station suggests that sugar maple can compartmentalize most branch wounds. The presence of basal wounds, however, increases the impact of ice damage on timber quality. At the SUNY College of Environmental Science and Forestry, a study found insect-caused defects on 20% of the salvageable volume in ice-damaged stands. However, there had not been a significant build-up of secondary hardwood insects.

Keep looking for **Asian Longhorned Beetles**. Ask your friends and seasonal neighbors to get their firewood locally, rather than bringing it with them from areas that may be infested with this borer or other insects.

A variety of **Sugar Maple** defoliators were active in 1999. Half of the North American Maple Project plots had some feeding by thrips, maple leaf cutter, or saddled prominent. In most cases, significant impacts are not expected. However, some maple stands in southern Windham County did not successfully refoliate from thrips damage for the second year in a row. Monitor tree health closely in these stands. Where maple leaf cutter defoliation has been heavy, look for leaf mining by the tiny caterpillars this June to see if damage is continuing. If each leaf has several mines in it, there may be heavy defoliation.

And on **Oak**....Remember gypsy moths? Neighboring Massachusetts had 12,000 acres of defoliation, so we are reminded that this insect is still capable of building up to outbreak levels, in spite of the fungus that caused its population to crash region-wide in the early 1990's.

A lot of "primary" **Spruce-Fir** sites are shallow, and particularly prone to drought stress. Trees on "secondary" sites are vulnerable to shoestring root rot, and will be more so following the drought. After giving drought-stressed trees a rest, pre-commercial thinning may be a beneficial option. Research at the University of Maine suggests that there's less decay in root systems of thinned trees. This should help them get through the inevitable dry years.

The discovery of **Pine** shoot beetle will result in restrictions on shipping logs, trees, brush, and other pine products from Orleans and Essex Counties. These quarantine regulations should be finalized following additional trapping in the early summer.

Pine on shallow or excessively well drained sites may be susceptible to bark beetle attack following the drought of '99. Red pine is generally more severely affected, but eastern white pine is also susceptible. Woodpecker activity is a sign of likely beetle infestation.

If there's substantial shoot mortality on red pine, but not to other species, it may be worthwhile to rule out red pine scale. This insect isn't supposed to occur this far north, but it was associated with some mortality in Massachusetts in 1999. Drought may play a role there as well.

The smaller Japanese cedar longhorned beetle, another Asian import, feeds on **Cedar and Arborvitae**. It's in three counties in Connecticut, and has the potential to move here on plant material or cedar wood products. A highly cold-hardy insect, it causes calluses, cracking, splitting of the bark over the serpentine tunnels it excavates. Frass and pitch may be present.

Hemlock woolly adelgid is not known to occur in Vermont. However, in 1999, it moved further north in its range in both New York and Massachusetts. In Massachusetts, where it was first introduced ten years ago, one-third of the towns now have the insect. Additionally, it was found in locations in Maine, where it was introduced on nursery stock, and at one New Hampshire location, where the insect has been eradicated. We still don't recommend any management changes at this time, for several reasons:

- Although southern towns are at most risk, it's impossible to be sure where and when the insect will arrive. The natural northward spread in New York state has been slow. Most of the rapid movement of the insect has been caused by human introduction, which could occur anywhere in the state.
- Although hemlock woolly adelgid is clearly changing the landscape where it is established, hemlock mortality does not occur immediately. In fact, most trees survive the first outbreak in a new area.
- Natural controls may change the impact of the insect in Vermont forests. A tiny beetle which feeds on hemlock woolly adelgid is now being introduced from Asia. Early research data justifies optimism that this beetle, and other introduced natural enemies, may help lower adelgid populations.
- Ongoing research on the impact of hemlock woolly adelgid may provide managers with better information on how to manage threatened stands. For example, hemlocks on shallow soils appear to be most at risk.

Nonetheless, because this insect continues to advance, and our understanding of it is evolving, stay closely informed about its progress, and be ready to make changes if necessary

INTRODUCTION

The information in this report is based on aerial surveys to detect forest damage, as well as ground surveys and observations of Vermont Forestry Division staff.

One statewide aerial survey was flown in 1999, in late August to early September, to target drought symptoms, late-season defoliators, and general forest condition. An additional early summer survey was flown in Windham County and along the eastern side of the Green Mountains in Rutland and Windsor Counties to detect damage by pear thrips and pine needlecast. Special ground and aerial surveys were conducted to detect wind damage in Orleans and Essex Counties in late July and in late September.

A survey of Christmas tree plantations is conducted annually in North-Central Vermont as part of the Scleroderris quarantine. This year, 260 acres were surveyed. Observations are made on all pests during this survey. Acreages reported for Christmas tree problems refer to changes in these surveyed plantations, and are not statewide totals.

ACKNOWLEDGMENTS

Thanks to the many individuals who contributed to this report, including Jay Lackey, Tom Simmons, Hollis Prior, Pete Reed, Bernie Barton, John St. Arnauld, Allan Sands, Lars Lund, Tess Greaves, Judy Rosovsky, Phil Girton, and John Barrows from our Forest Resource Protection staff. Assistance in conducting aerial detection surveys and ground checks was provided by members of our Forest Management staff including Mike Johnson, Brad Greenough, Ron Wells, Dave Wilcox, Dick Greenwood, and Neil Monteith. Matt Mancini conducted surveys of Christmas tree plantations. Mary Burnham assisted in sorting and identifying moths. Amy Kearney assisted in data entry and Rose Levine with field surveys. Information on the Green Mountain National Forest was provided by Bob Burt and George Saufly. Diagnostic assistance and other data was provided by Dale Bergdahl, Shari Halik, Margaret Skinner, Don Tobi, and Ann Hazelrigg from the University of Vermont; Jon Turmel and Scott Pfister from the Vermont Department of Agriculture; and Dick Dearborn and Clark Granger from the Maine Forest Service. Assistance in processing map data was provided by Tom Luther and Bill Frament from the US Forest Service, Forest Health Protection and Laura Cadmus and Tom Merrifield from the Vermont Agency of Natural Resources.

A special thanks to Melissa Currier for preparing the manuscript.

We gratefully acknowledge the financial and technical support provided by the USDA Forest Service, Northeastern Area State & Private Forestry that enables us to conduct the surveys and publish the results in this report.

Finally, this document about current forest health, and the diagnostic and survey work required to produce it, would not be possible without support from the State of Vermont and from citizens who find the information useful.

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WEATHER AND PHENOLOGY

The winter of 1998-99 was much warmer and drier than normal, with December 1998 the 2nd warmest recorded in Vermont (Figure 1). Snow accumulation was modest, and some areas of the state developed a hard snow crust early in the season. There was little or no extreme cold.

Sugaring season was variable, with slightly below average yields. However, syrup quality was high.

Spring was warmer and drier than normal, with very little precipitation between late March and mid-May. April was the 6th driest on record for Vermont (Northeast Regional Climate Center). A statewide open burning ban was put into effect because of the dry conditions.

Mud season was very short. Spring development started early due to warm weather, but was prolonged due to dry conditions (Figures 2-3). Sugar maple budbreak was late, but quick; buds opened suddenly in the last week of April or first week of May (Table 1). Vegetative development was 2-3 weeks ahead of normal by full leaf-out. The rapid growth of many species from the warm weather allowed them to harden off quickly, perhaps making tissue less vulnerable to insects and disease. There were widely scattered light frosts in mid-May.

Summer continued the trend of warmer and drier than normal through early September, although there were no prolonged heat waves. There was significant rainfall on June 28, and some rain did come in July. High humidity and cool nights helped retain moisture. Although the soil appeared dry by late July, forest cover was generally still green .

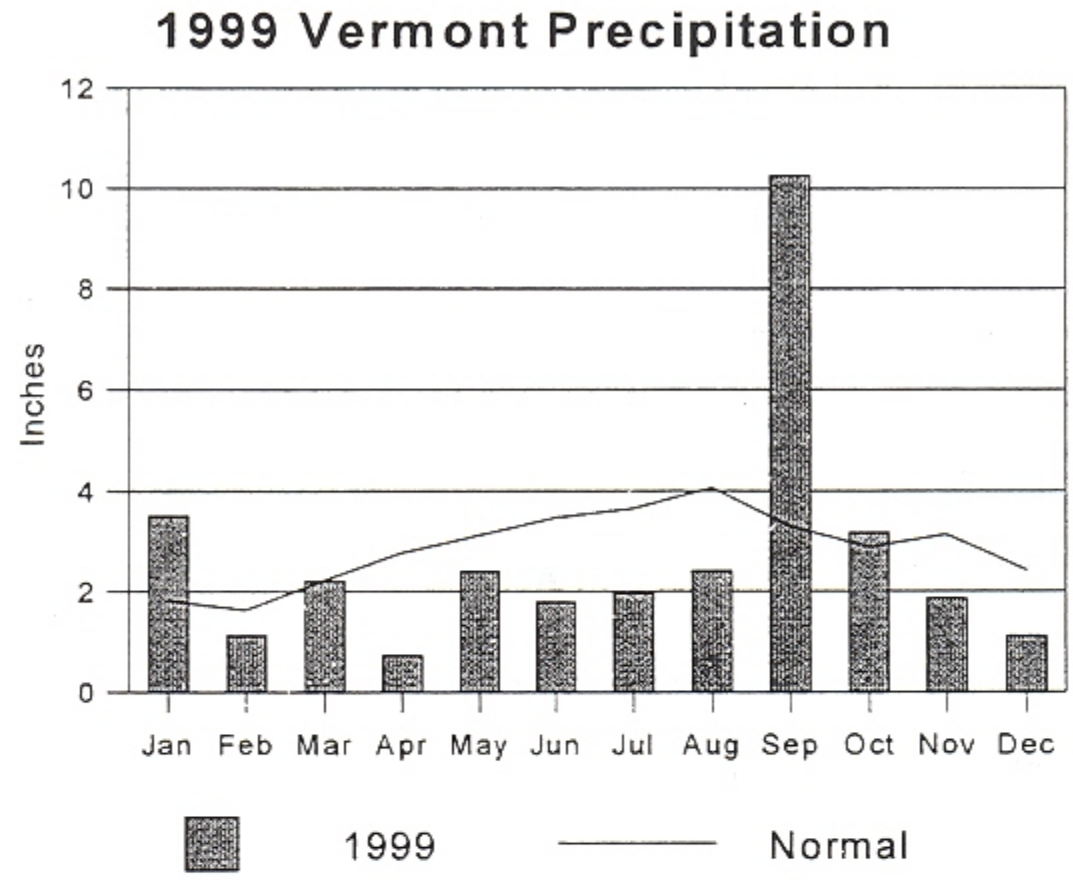
A severe windstorm on July 6th led to areas of blowdown. On September 16-17, winds associated with Hurricane Floyd caused additional damage to trees. During that storm, Mount Mansfield set a record for the most precipitation at that site in a 24-hour period with 9.92 inches. Autumn was generally warmer and wetter than normal, with September the wettest on record.

The onset of fall color was normal in most areas. Color was less brilliant along drought-stressed roadsides and upper elevation sites, where there was premature browning and leaf drop. Viewing in late September was also impaired by rain. However some foliage was spectacular. The red color of late turning foliage was more brilliant than average on oaks, ash, and shrubs. Generally, foliage stayed on the trees longer than normal, probably due to the absence of a killing frost.

Since 1997, fall color and leaf drop have been monitored at 8 study sites around Mount Mansfield. The results are used as a measure of forest health, and to inform foliage viewers on the timing, duration and "quality" of fall color. Locations represent high elevation birch forests, and northern hardwood forests at varying elevations and aspects. In 1999, sites varied widely in the timing and duration of fall color and leaf drop. Sites susceptible to drought conditions colored and dropped leaves early (50% color and leaf drop by September 10th). This was particularly true for high elevation ridgetops (Figure 4: site 4H). Other sites maintained good color into early October, as usual (Figure 4: sites 3, 5, and 6). Compared to other years, average color and leaf drop on all sites combined was a few days earlier in 1999.

Overall, this was the 5th warmest year on record for the state. Annual precipitation averaged only 5% below normal, mainly due to the large amount of rain in September, but much of the growing season received below normal precipitation.

Seed and berry development was generally less than normal because of the lack of moisture, and lower than average flowering. There was little seed production on beech, oak, or maple. Sugar maple flower production was very light. Dry spring conditions did allow good fruit set of apples, and they developed well, but often dropped quickly following maturation. Ash also had heavy seed production, but seeds often dropped early. Not spending energy on seed production may be beneficial to trees whose food reserves were lower than average because of the dry growing season.



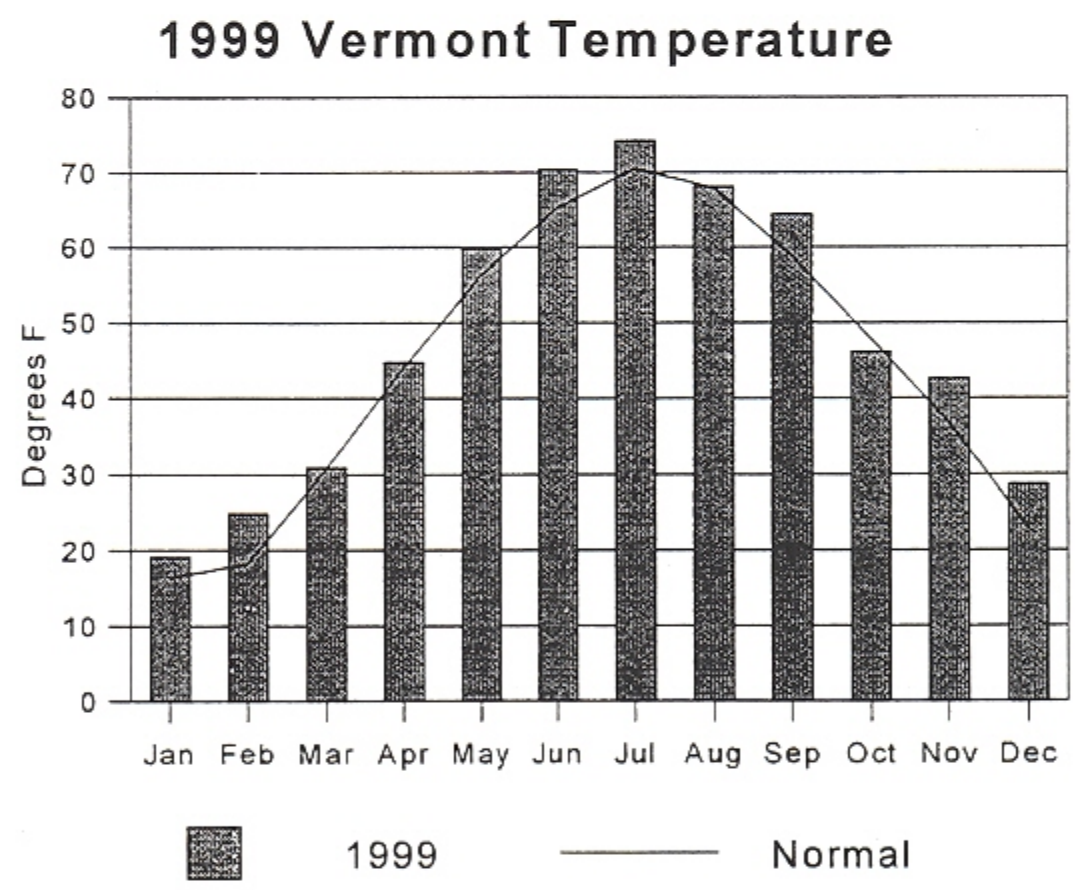
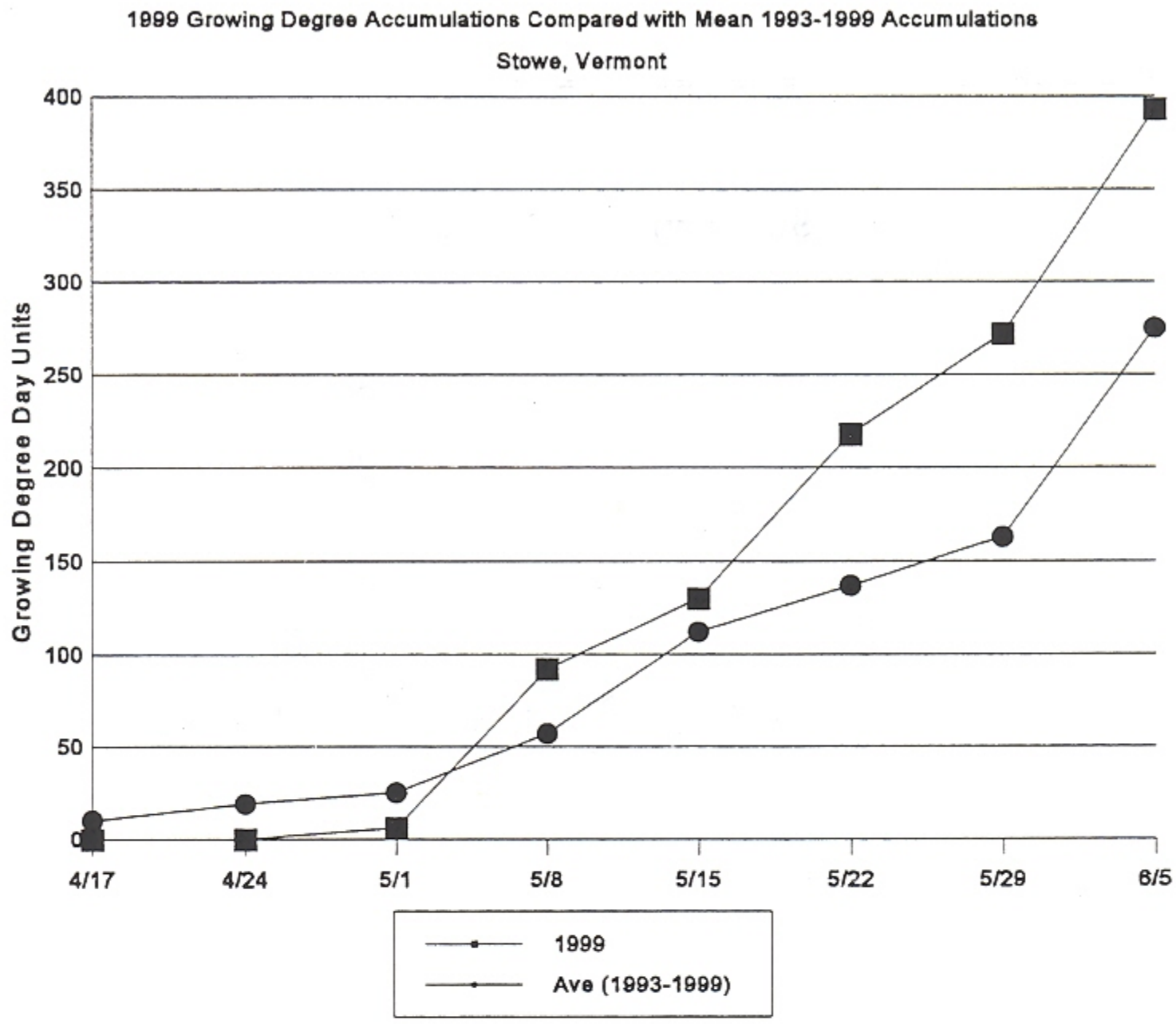
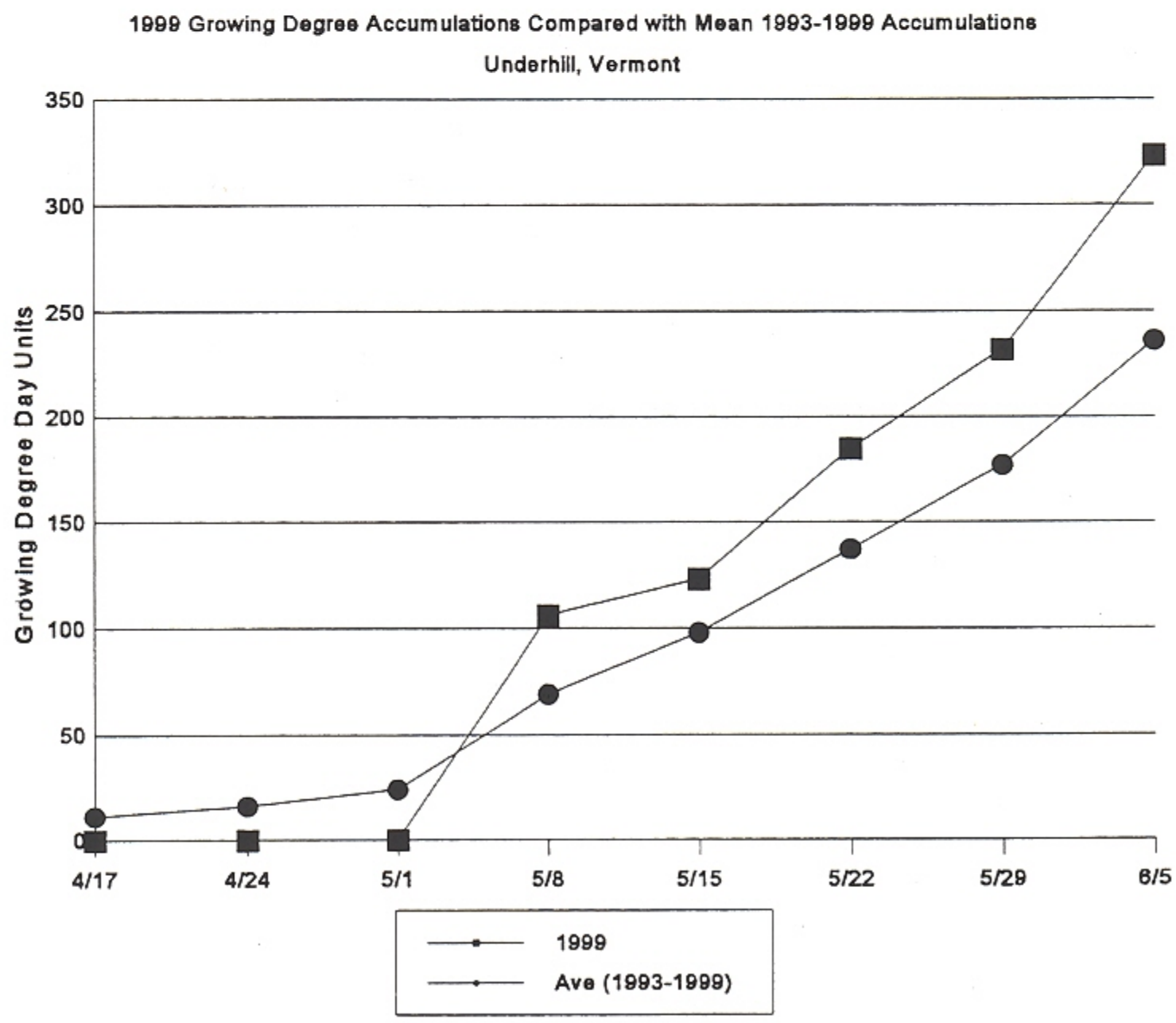


Figure 1. Monthly 1999 total precipitation and average temperature compared to normal monthly values in Burlington. Data from the NOAA National Weather Service.


1999 Growing Degree Accumulations Compared with Mean 1993-1999 Accumulations
Stowe, Vermont
Growing Degree Day Units
400
350
300
250
200
150
100
50
0
4/17
4/24
5/1
5/8
5/15
5/22
5/29
6/5
1999
Ave (1993-1999)


1999 Growing Degree Accumulations Compared with Mean 1993-1999 Accumulations
Underhill, Vermont
Growing Degree Day Units
350
300
250
200
150
100
50
0
4/17
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5/22
5/29
6/5
1999
Ave (1993-1999)

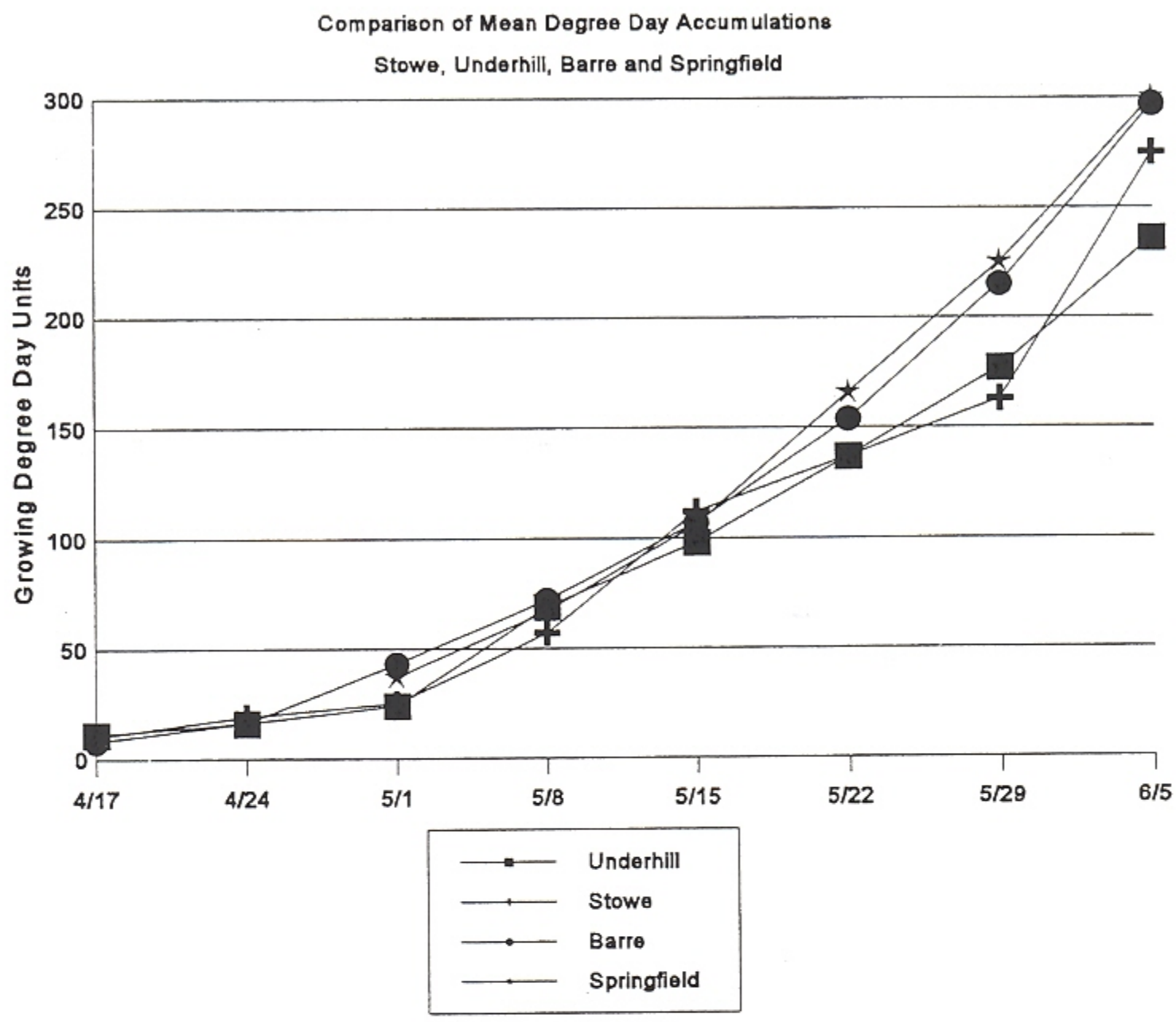


Figure 2. Weekly spring cumulative growing degree days at four locations, through 1999. Data are based on the following: Underhill and Stowe, 1993-1999, Barre, 1993-1998, and Springfield 1992-1998. 50 degrees F is used as the threshold of development.

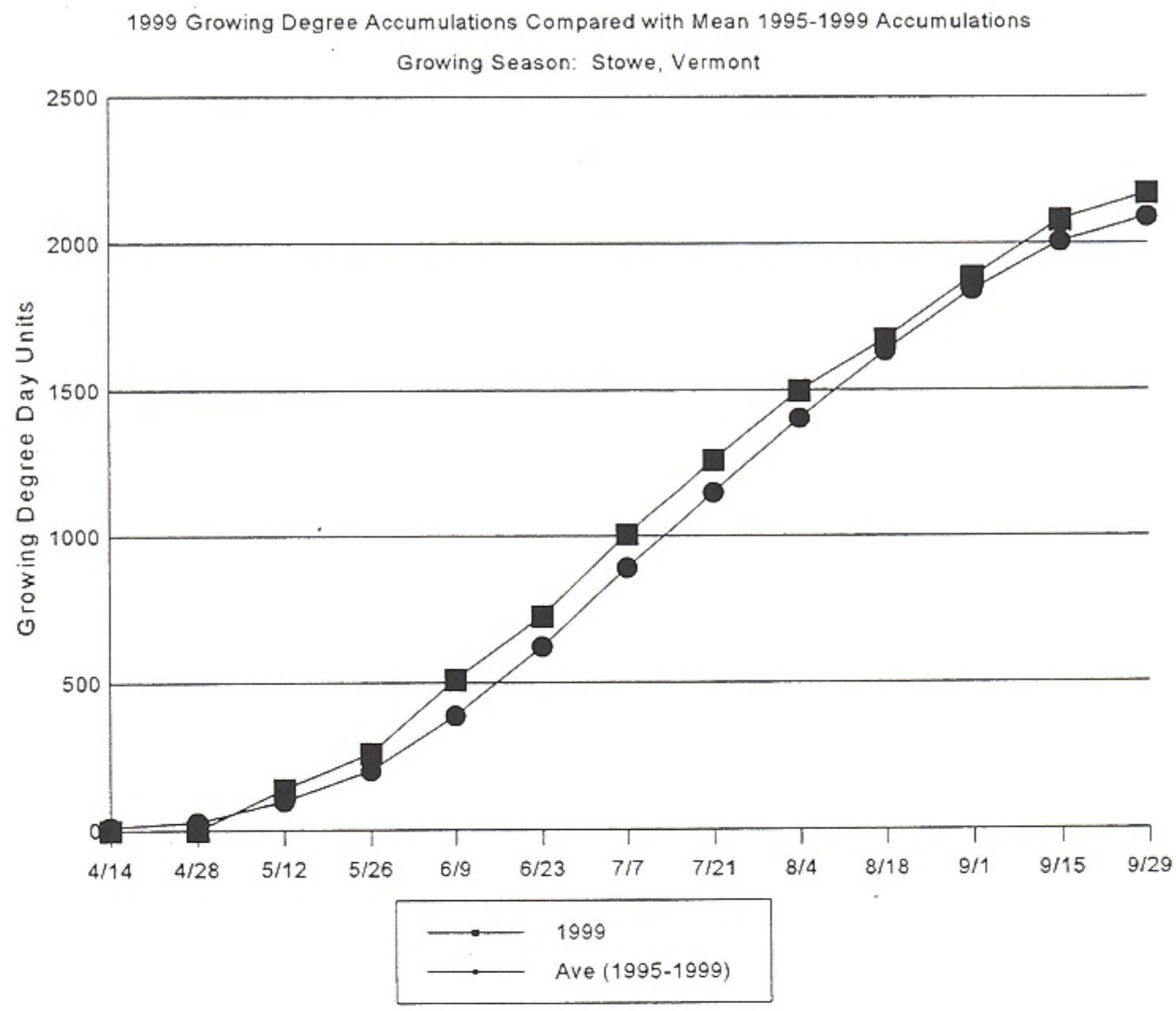


Figure 3. Weekly cumulative growing season degree days for Stowe in 1999, compared to average 1995-1999. 50 degrees F is used as the threshold of development.

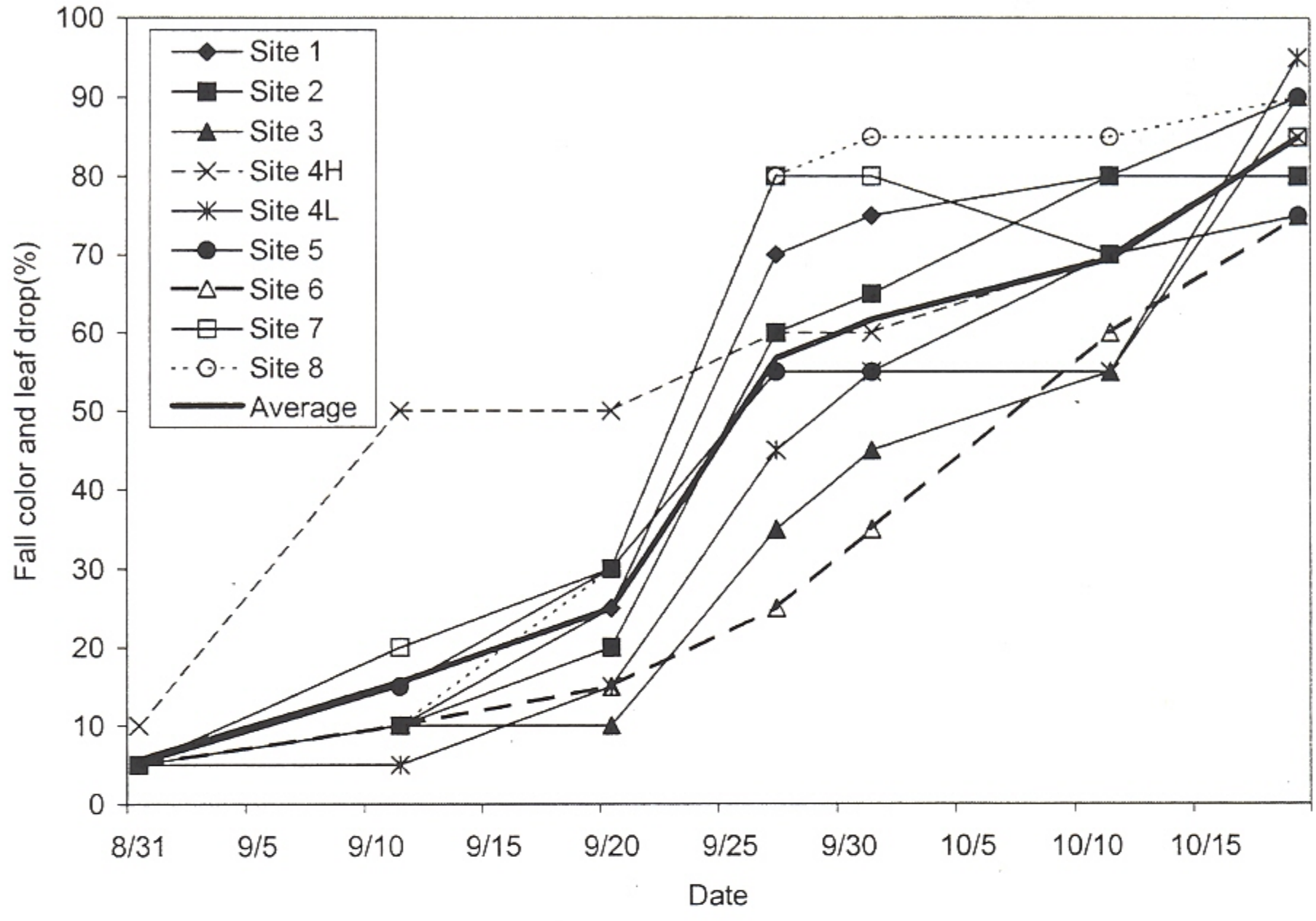


Figure 4. Comparison of the timing and duration of fall color and leaf drop on 8 hillsides near Mount Mansfield.

Table 1. 1999 Growing degree day accumulations and first observation dates of phenological development in 3 sites in Vermont. 50 degrees F used as the threshold of development.

Biological Indicator	Springfield	Stowe	Underhill
PLANT DEVELOPMENT			
Showing Green			
Balsam Fir		37 (5/3)	95 (5/7)
Fraser Fir		93 (5/7	
Budbreak			
Balsam Fir		46 (5/4)	111 (5/10)
Cherry	0 (4/15)		
Fraser Fir		130 (5/15)	
Hemlock	133 (5/22)	173 (5/18)	163 (5/18)
Red Maple	0 (4/8)		
Sugar Maple	2 (4/25)	0 (4/17)	54 (5/4)
Tartarian Honeysuckle		206 (5/21)	
White Ash			54 (5/4)
Flower Budbreak			
Lilac		190 (5/19)	
Flowers			
Black Cherry		76 (5/6)	
Dandelion	0 (4/19)		
Dolgo Crab		117 (5/9)	
Lilac	101 (5/17)		172 (5/21)
Lilac (full bloom)		240 (5/24)	
Popple/Aspen	0 (4/3)	0 (4/9)	
Red Maple	0 (4/8)	0 (4/15)	0 (4/13)
Red Maple (petal fall)		0 (4/18)	
Shadbush	83 (5/10)		95 (5/7)
Sugar Maple		0 (4/17)	54 (5/4)
Full Green Up	88 (5/15)		
INSECT DEVELOPMENT			
Balsam Gall Midge (adults)		60 (5/5)	
Balsam Shootboring Sawfly (adults)		11 (4/27)	
Balsam Shootboring Sawfly (laying eggs)		93 (5/7)	
Balsam Shootboring Sawfly (larval drop)		272 (5/29)	
Maple leafcutter (adults)		117 (5/9)	163 (5/18)
Maple leafcutter (first cuts complete)		750 (6/29)	
Pear Thrips (adults)	0 (4/7)	0 (4/9)	0 (4/9)
OTHER OBSERVATIONS			
Light frost damage to butternut		119 (5/10)	
Spring Peepers calling		0 (4/11)	

OZONE SUMMARY FOR 1999

The maximum ozone levels at both Vermont stations were higher this year than in 1998, but below the National Ambient Air Quality Standard of 0.124 ppm for 1 hour, a level set for the protection of human health. The Bennington station, which represents ozone concentrations for southern Vermont, peaked at 107.8 parts per million on July 16th. The Underhill Station, which represents ozone concentrations for northern Vermont peaked at 96.7 on July 31st. This national air quality standard is being changed to an index that uses daytime ozone levels over a series of days, and should better reflect sensitive plant and animal species.

Currently, we express ozone data in various ways that are more meaningful to plant health. Minimum ozone levels that adversely affect sensitive plant and tree species (i.e. black cherry and white ash) are from 0.060 to 0.080 ppm. The number of hours greater than 0.060 or 0.080 ppm, the SUM06, and the SUM08 are all indices used to relate ozone levels with potential plant injury. These indices reflect a cumulative exposure to ozone levels that are known to cause damage to sensitive plant species.

Ozone reached concentrations in 1999 than in 1998, and there were more hours above 80 ppm, as reflected by the indices in Table 2 below. SUM06 and number of hours above .06 ppm at Underhill were below 1998 levels, indicating that ozone exposure times were shorter, but more intense in 1999. Ozone concentrations are usually higher at the Bennington station than at Underhill, but plant exposure time above .06 ppm (threshold for injury) tends to be shorter.

Table 2. Ozone levels recorded during the 1999 growing season (April through August) at the two Vermont stations. Data provided by the Vermont Air Pollution Control Division.

Monitor Site	Total Number of Hours with		Maximum Level		SUM06 (ppm-hr)	SUM08 (ppm-hr)
	≥0.060 ppm	≥0.080 ppm	ppm	Date		
Bennington	276	47	107.8	7/16/99	26.36	5.37
Underhill	301	28	96.7	7/31/99	21.06	2.4

Ozone injury symptoms were observed on sensitive plant species at 33% of the 21 locations surveyed throughout the state (Figure 5). The severity of foliage symptoms was light (1-2) on 5 plots and moderate on two plots [using a rating system of 0 (no injury) to 5 (>75% injury on affected leaves]. No locations had heavy injury this year. Drought conditions likely prevented uptake of ozone, thereby reducing the severity of injury this year. The overall effect of ozone injury to forest health is not currently known, but may include reductions in growth and vigor. No ozone damage was detected on forest trees from aerial and ground surveys in forests.

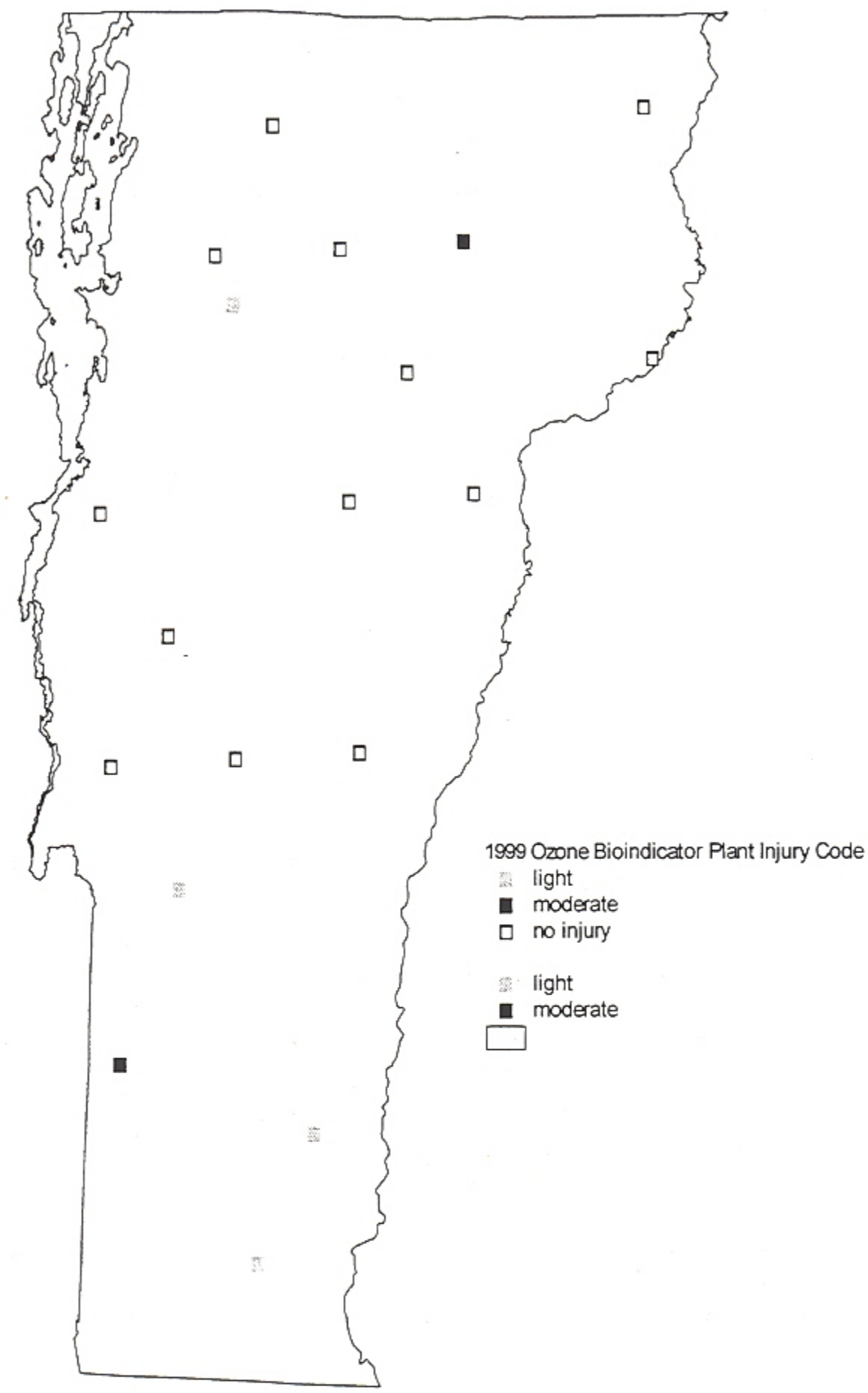


Figure 5. Approximate locations where ozone injury to sensitive plants was evaluated in 1999. Ozone injury is based on evaluations of 30 individuals per species, with 1 to 5 species evaluated at each site. The rating system is based on severity of injury as a percent of leaf surface area with symptomatic injury:: none, light (<25%), moderate (25-75%), heavy (>75%). Most locations showed no injury in 1999, 3 locations showed light injury, and 2 locations showed moderate injury. Ozone bioindicator evaluations are conducted as part of the National Forest Health Monitoring program.

HARDWOOD DEFOLIATORS

Birch Defoliation, caused by **Birch Leaf Miners**, *Fenusa pusilla* and *Messa nana,* and **Birch Anthracnose** (caused by *Marsonnina betulae* and *Septoria sp.*) on paper birch, declined from previous levels. Only 7,667 acres were mapped from the air, compared to 21,283 acres in 1998 (Table 3, Figure 6). Leaf dessication from the drought may have reduced larval survival in the mines, while dry conditions prevented infection by the anthracnose fungi.

Table 3. Mapped acres of birch defoliation in 1999.

County	Acres
BENNINGTON	231
CALEDONIA	854
CHITTENDEN	21
ESSEX	220
LAMOILLE	162
ORANGE	1,195
ORLEANS	840
RUTLAND	37
WASHINGTON	172
WINDHAM	675
WINDSOR	3,261
Statewide Total	**7,667**

Forest Tent Caterpillar, *Malacosoma disstria*, populations continued to be very low. Although larvae were occasionally observed statewide, no forest defoliation was observed. A few moths were caught in pheromone traps at sites in Lamoille and Washington Counties (Figure 7-8). This is the first time since 1991 that moths have been caught at more than one location. This may signal a small population increase. A Luminoc light trap in Hyde Park, with a black light plus pheromone for four hours per night, caught 2 moths compared to 0 moths in 1998.

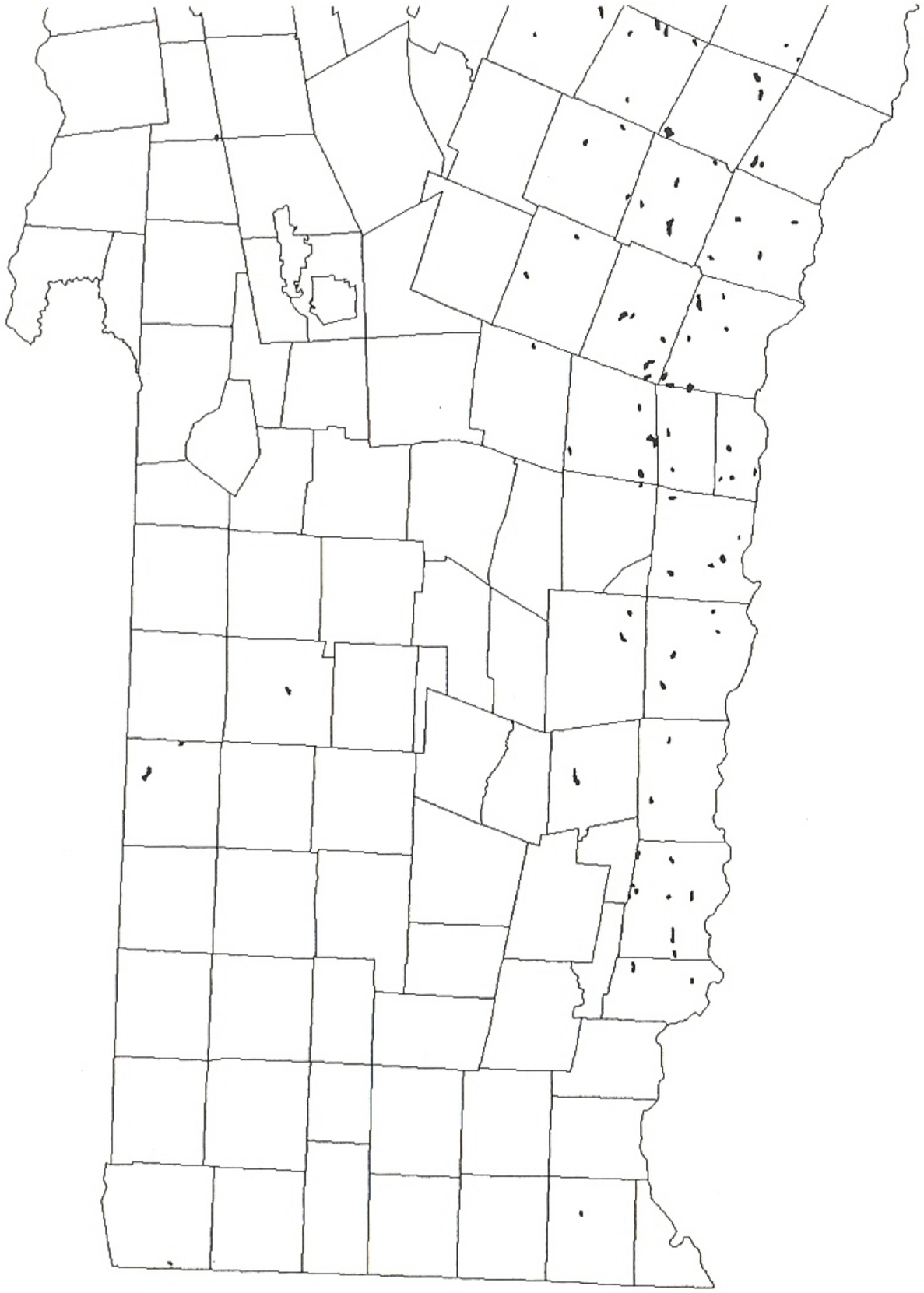


Figure 6. 1999 Damage by birch leaf miner. Mapped area is 7,667 acres.

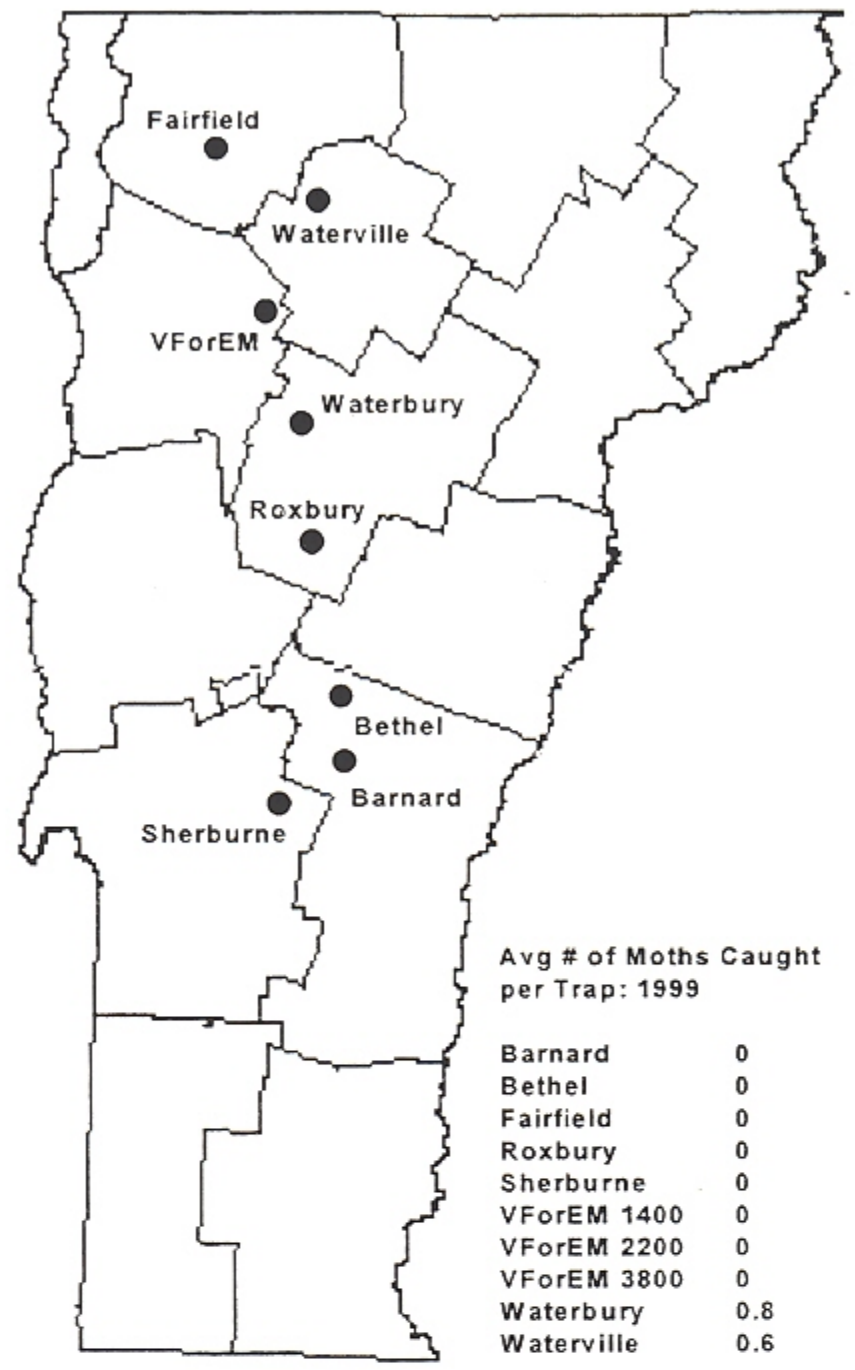


Figure 7. Average number of forest tent caterpillar moths caught in pheromone traps, 1999. Average of 5 traps per location.

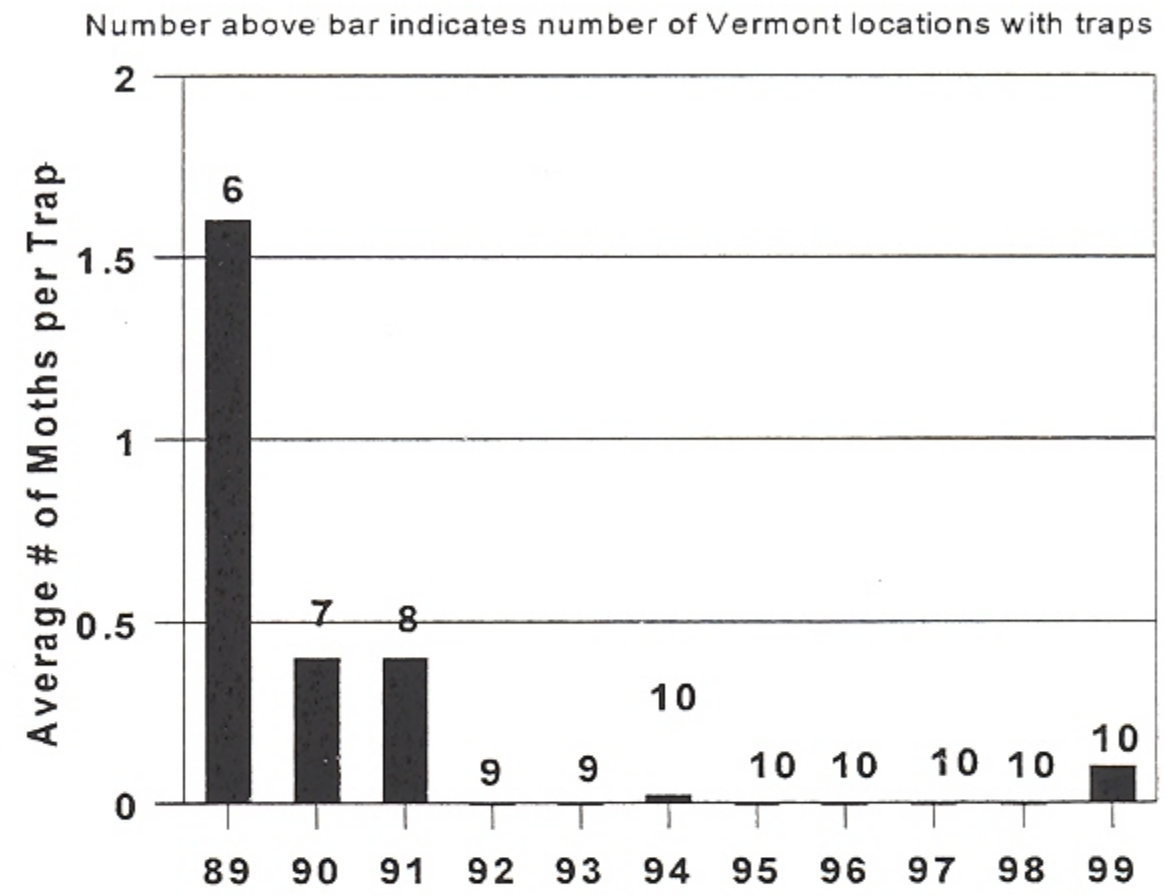


Figure 8. Average number of forest tent caterpillar moths caught in pheromone traps 1989-1999. Five multi-pher traps baited with RPC-2 component lures per location.

Gypsy Moth, *Lymantria dispar*, caused no significant defoliation, and populations remained very low. Although individual egg masses have been observed in widely scattered locations, and may be more abundant than usual, no significant defoliation is expected in 2000.

Egg mass counts in focal area monitoring plots remain low, with counts similar to 1998 (Figures 9-10). Some egg predation has occurred, and occasional dead larvae and pupal skins were observed. A few egg masses were found in the more mesic control plots associated with focal areas. These plots are located outside the normally heavily infested zones.

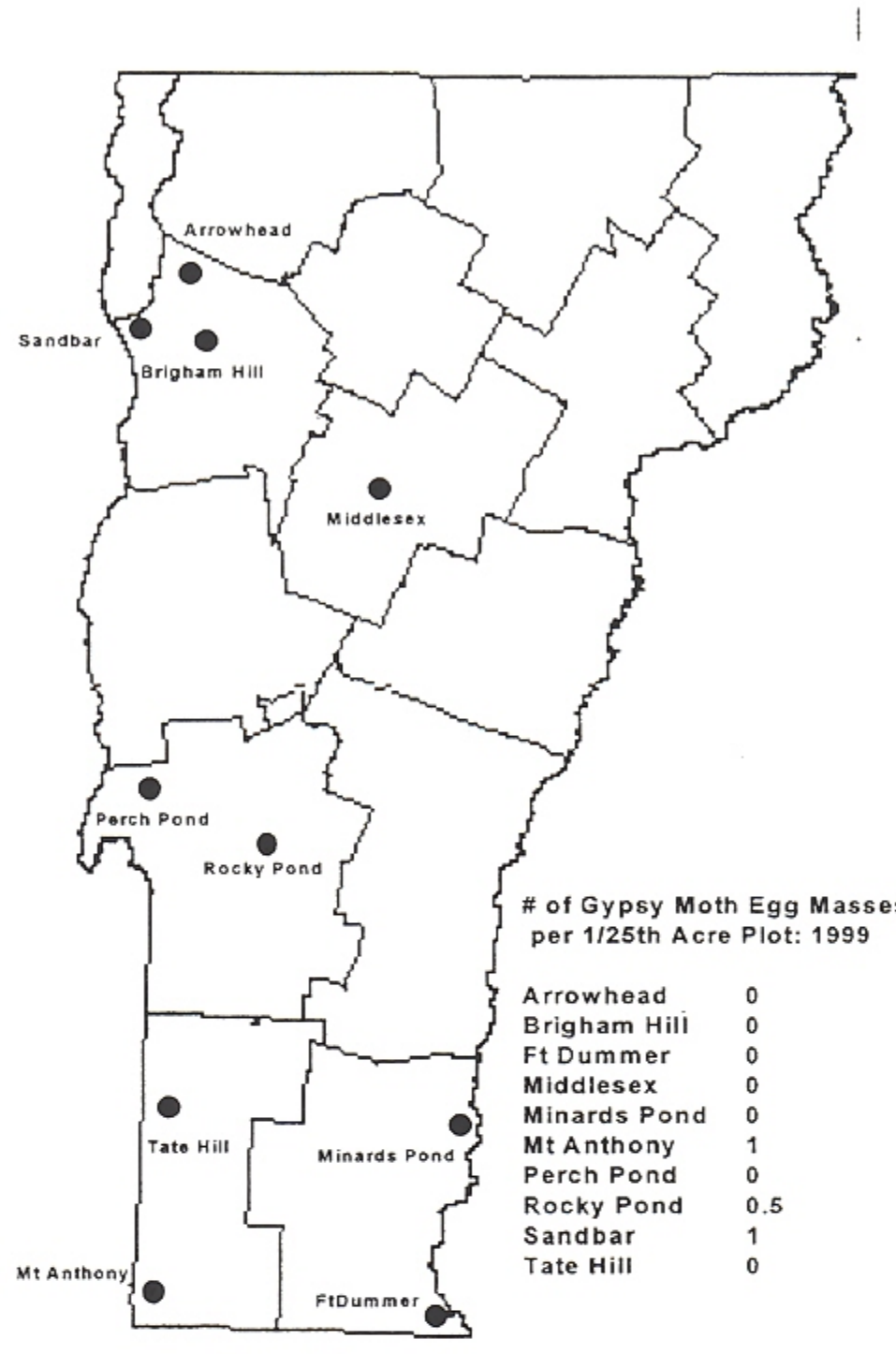


Figure 9. Gypsy moth egg mass counts from focal area monitoring plots, 1999. Average of two 15 meter diameter burlap-banded plots per location.

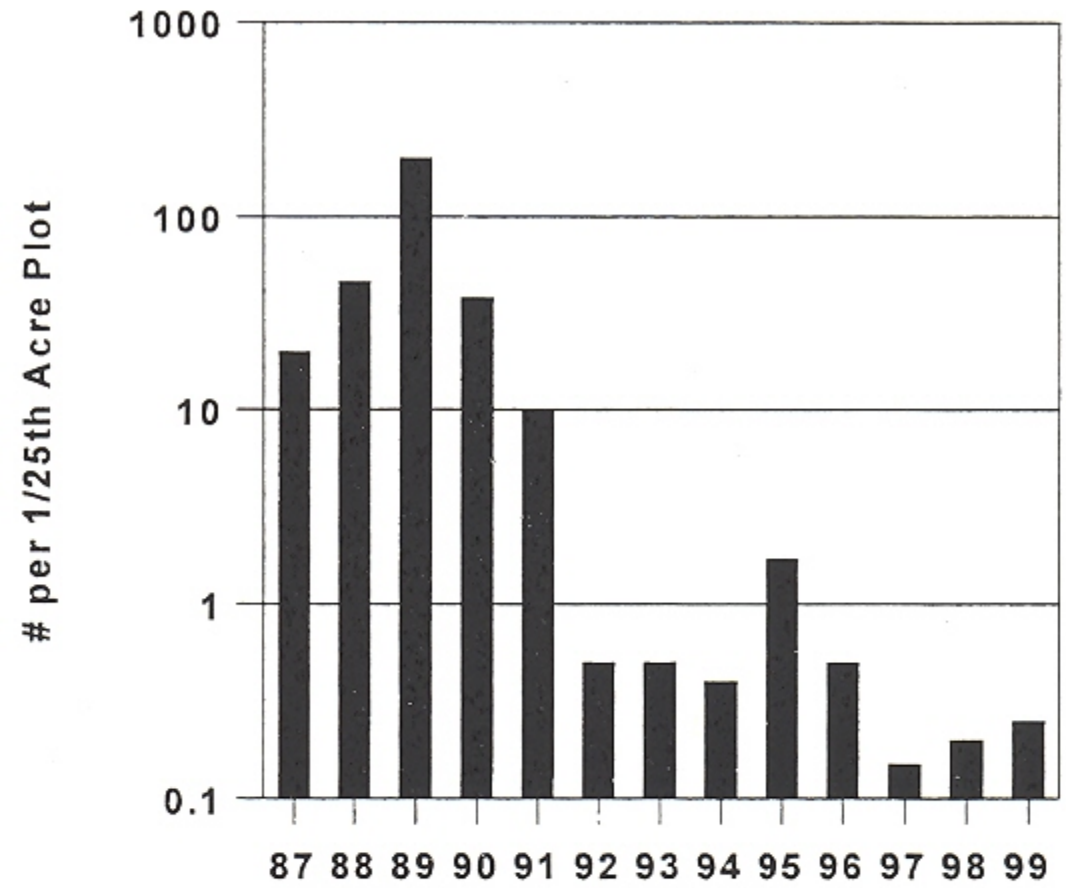
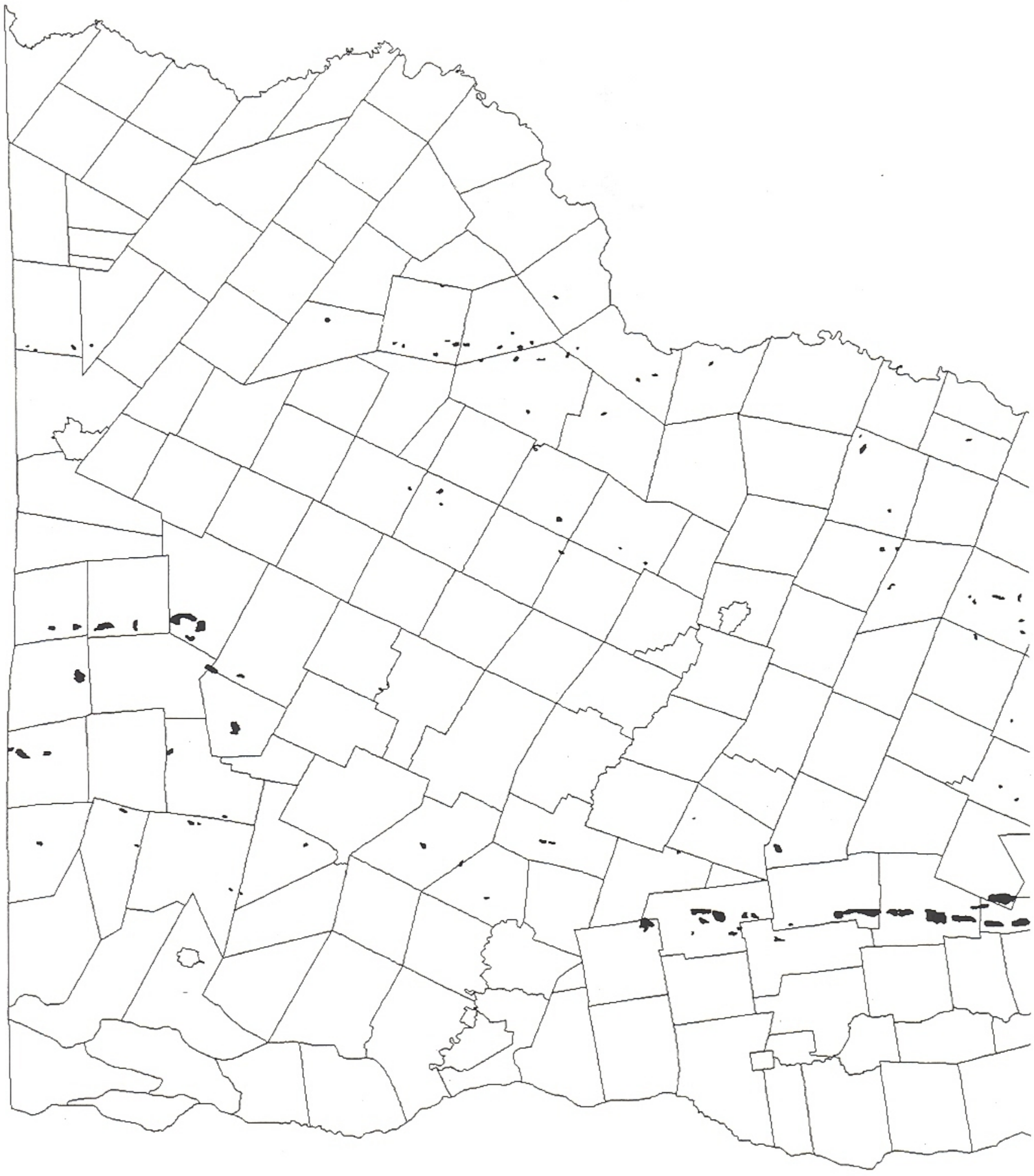


Figure 10. Gypsy moth egg mass counts from focal area monitoring plots, 1999. Average of ten locations, two 15m diameter burlap-banded plots per location .

Locust Leaf Miner, *Odontata dorsalis,* caused scattered heavy damage. During the aerial survey, 190 acres of defoliation were mapped in Chittenden, Windham, and Windsor Counties. Repeated heavy defoliations occurred in Putney due to multiple generations of the leaf miner, and the indeterminant growth habit of black locust. Mortality of black locust, caused by previous defoliations, was observed in Hartland.

Maple Leaf Cutter, *Paraclemensia acerifoliella*, caused some moderate to heavy defoliation in scattered locations with 14,479 acres mapped during aerial surveys (Table 4, Figure 11). Damage was more widespread than in 1998. One sugarbush in Hartford was sampled during the leaf mining stage, and averaged 0.92 live larvae per leaf.



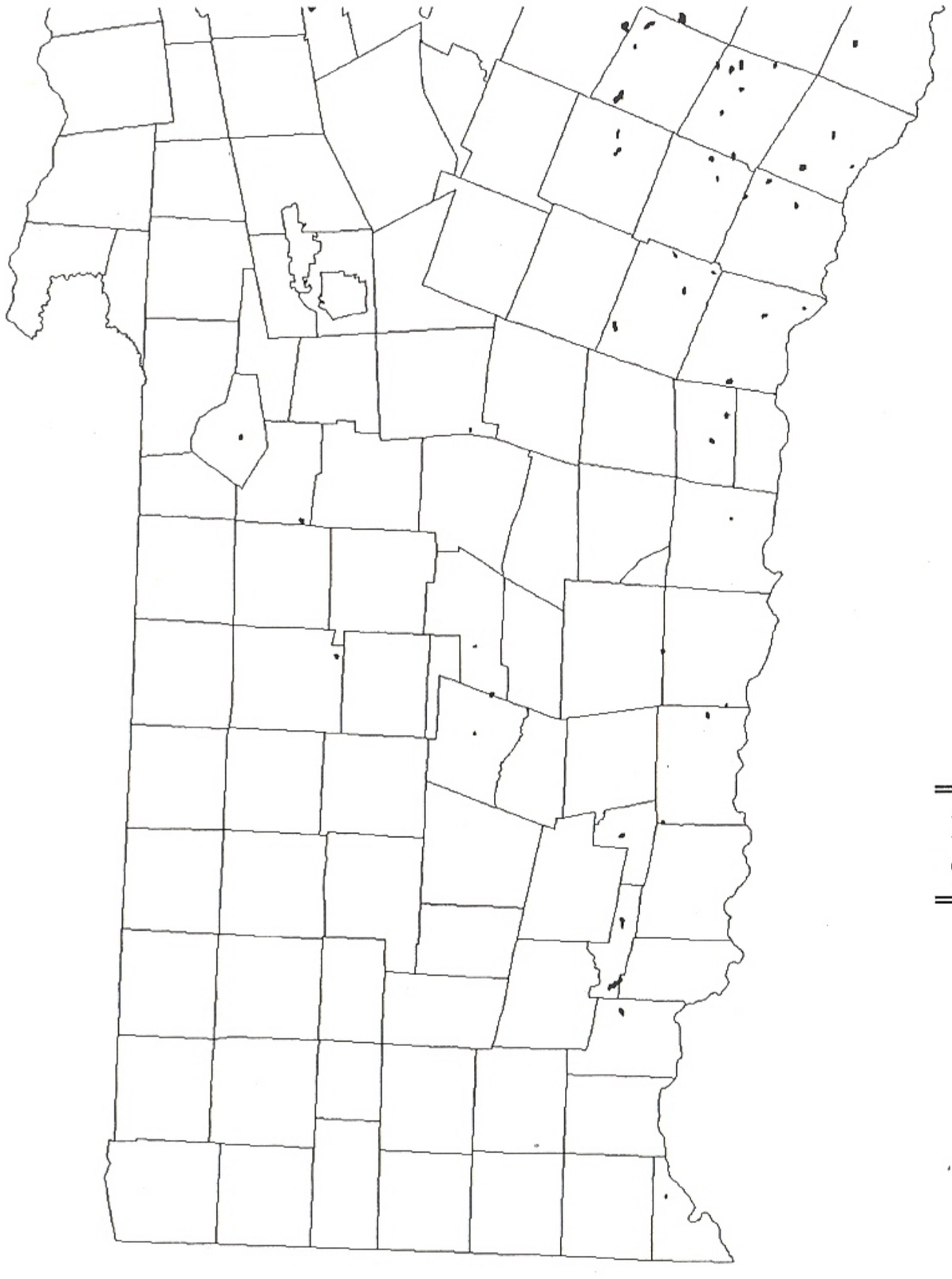


Figure 11. 1999 Damage by maple leaf cutter. Mapped area is 14,479 acres.

Table 4. Mapped acres of maple leaf cutter damage in 1999.

County	Acres
ADDISON	5,875
BENNINGTON	35
CALEDONIA	934
CHITTENDEN	635
ESSEX	0
FRANKLIN	1,252
GRAND ISLE	0
LAMOILLE	545
ORANGE	812
ORLEANS	1,892
RUTLAND	85
WASHINGTON	341
WINDHAM	462
WINDSOR	1,611
Statewide Total	**14,479**

Saddled Prominent, *Heterocampa guttivata*, populations remain low. Light defoliation of sugar maple and beech was reported in scattered locations statewide including Rupert/Danby, Shrewsbury/Plymouth/ Killington, and Westmore/Groton. Pheromone traps (Multi-Pher) deployed in five locations (three traps per location) caught an average of 0.7 moths per trap (Table 5).

Table 5. Average number of saddled prominent moths caught in pheromone traps in 1999.

Location	Number of Moths per Trap
Groton State Forest	1
Honey Hollow (Camel's Hump SF)	2
VMC1400	0
Ward	0.7
Westmore	0
Average	**0.73**

OTHER HARDWOOD DEFOLIATORS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Alder Leaf Beetle *Altica ambiens alni*	Speckled Alder	Northeast Kingdom	Present in wet areas but not heavy. Light populations present on wet sites.
American Dagger Moth *Acronicta americana*			Not reported.
Azalea Sawfly *Amauronematus azalae*	Azalea	Chester Montpelier	Ornamentals.
Birch Leaf Folder *Ancylis discigerana*	Yellow Birch Paper Birch	Northeast Kingdom Lamoille County Rutland County	Widely scattered but very light.
Birch Leaf Miner *Fenusa pusilla*			See narrative on Birch Defoliation.
Birch Skeletonizer *Bucculatrix canadensisella*		Essex, Caledonia, Chittenden Counties	Light damage.

OTHER HARDWOOD DEFOLIATORS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Bruce Spanworm *Operophtera bruceata*			Not reported.
Bud Moths, General *Family Tortricidae, Olethreutine (part)*	Paper Birch	Barre	Significant number of leaves were rolled.
Cecropia *Hyalophora cecropia*	Sugar Maple	Montpelier	Occasional caterpillars found.
Cherry Scallop Shell Moth *Hydria prunivorata*	Black Cherry	Widely scattered	Nests and light damage common statewide this year.
Cherry Sphinx *Sphinx drupiferarum*	Cherry	Danville	Occasional caterpillars found.
Cigar Casebearer *Coleophora serratella*	Apple	Montpelier	Scattered individuals.
Dogwood Sawfly *Macremphytus tarsatus*	Flowering Dogwood	Barre	Light damage.
Early Birch Leaf Edgeminer *Messa nana*			See narrative on Birch Defoliation.
Eastern Tent Caterpillar *Malacosoma americanum*	Cherry Apple	Throughout	Very light populations continue.
Elm Leaf Beetle *Pyrrhalta luteola*			Not reported.
Elm Leaf Miner *Fenusa ulmi*			Not reported.

OTHER HARDWOOD DEFOLIATORS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Euonymous Caterpillar *Yponomeuta cagnagella*			Not reported.
European Snout Beetle *Phyllobius oblongus*	Butternut Sugar Maple	Stowe Hyde Park	Only a few seen.
Fall Cankerworm *Alsophila pometaria*			Not reported.
Fall Webworm *Hyphantrea cunea*	Many	Throughout	Widespread with some heavy damage. Increasing in northern Vermont, continued high populations in southern Vermont.
Forest Tent Caterpillar *Malacosoma disstria*			See narrative.
Great Ash Sphinx Moth *Sphinx chersis*	Ash	Hardwood	Scattered individuals.
Green Pug *Chloroclystis rectangulata*	Apple		Insect from Eurasia found in Vermont by Chris Maier, Connecticut Agricultural Experiment Station.
Green Striped Mapleworm *Anisota rubicunda*	Sugar Maple	Groton Peacham	Abundant.
Gypsy Moth *Lymantria dispar*			See narrative.
Half Winged Geometer *Phigalia titea*			Not reported.

OTHER HARDWOOD DEFOLIATORS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Imported Willow Leaf Beetle *Plagiodera versicolora*	Black Willow	Addison, Chittenden, Franklin, Caledonia & Orleans Counties	Some moderate defoliation.
Japanese Beetle *Popillia japonica*	Many	Throughout	Remains a common complaint. Scattered heavy skeletonizing of ornamentals. Populations increasing and spreading northward in the state.
Large Aspen Tortrix *Choristoneura conflictana*			Not reported.
Leaf Beetles *Family Chrysomelidae*	Ornamentals	Hardwick	Light damage.
Linden Looper *Eranis tilaria*			Not reported.
Locust Leaf Miner *Odontata dorsalis*			See narrative.
Maple Leaf Cutter *Paraclemensia acerifoliella*			See narrative.
Maple Leaf Roller *Cenopsis (Sparganothis) acerivorana*	Sugar Maple	Windsor County	Damage widely scattered.
Maple Leafblotch Miner *Cameraria aceriella*			Not reported.
Maple Trumpet Skeletonizer *Epinotia aceriella*	Sugar Maple	Throughout	Very common. Heaviest in the Northeast Kingdom but overall damage lighter than in 1998. Moths frequently observed in the spring.

OTHER HARDWOOD DEFOLIATORS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Maple Webworm *Tetralopha asperatella*	Sugar Maple	Washington County	Light damage.
Mountain Ash Sawfly *Pristiphora geniculata*	Mountain Ash	Barre	Ornamentals.
Oak Leaf Tier *Croesia semipurpurana*			Not reported.
Oak Skeletonizer *Bucculatrix ainsliella*	Red Oak	Throughout	Heavy localized damage in Addison County. Elsewhere, some light damage. Populations lighter than expected based on counts of overwintering pupae. Dry spring conditions, known to affect birch skeletonizer cocoons, may have led to population decline.
Oak Slug Sawfly *Caliroa fasciata*	Red Oak	Stowe	Same ornamental as in past years. Heavier this year.
Orange-humped Mapleworm *Symmerista leucitys*	Sugar Maple	Concord	Solitary feeders in NAMP plot.
Pale Tussock Moth Caterpillar *Halysidota tessellaris*	Crabapple	Barton	Caterpillars common, but less so than last year.
Pear Sawfly *Caliroa cerasi*	Hawthorn Pear	Johnson Walden	Heavy defoliation.
Poplar Defoliation *Unidentified Coleoptera*	Popple	Bennington County	Gregarious larvae skeletonizing foliage.

OTHER HARDWOOD DEFOLIATORS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Red-humped Caterpillar *Schizura concinna*	Crabapple	Grand Isle	Scattered individuals.
Red-humped Oakworm *Symmerista canicosta*			Not reported.
Rose Chafer *Macrodactylus subspinosus*	Ornamentals	Caledonia, Orleans & Washington Counties	Not as heavy as in 1998.
Saddled Prominent *Heterocampa guttivata*			See narrative.
Satin Moth *Leucoma salicis*	White Poplar Cottonwood	Lamoille, Orleans, Rutland & Windsor Counties	Scattered heavy defoliation of ornamental and roadside trees. Moths numerous in late June. Increasing.
Spiny Ash Sawfly *Eupareophara parca*	White Ash	Dummerston	Regeneration.
Spiny Elm Caterpillar *Nymphalis antiopa*			Not reported.
Spring Cankerworm *Paleacrita vernata*			Not reported.
Uglynest Caterpillar *Archips cerasivoranus*	Cherry	Northern Vermont	Widely scattered light damage.
White Marked Tussock Moth *Orgyia leucostigma*	Pin Cherry Paper Birch	Franklin County Marshfield	Light populations.
Willow Flea Beetle *Rhychaenus rufipes*			Not reported.

SOFTWOOD DEFOLIATORS

Spring Hemlock Looper, *Lambdina athasaria*, was not observed. A study of the impact of the 1991 outbreak was completed. Although some mortality occurred within two years after defoliation, and additional mortality occurred in plots which were subsequently disturbed by logging, most defoliated trees recovered (Figure 12). Twenty-four percent of the trees with 90% defoliation, and 43% with 100% defoliation were dead by 1999. Trunk and root collar wounds in logged areas were more common on dead or unhealthy trees (Figure 13). Overall, tree crown condition improved. In the spring of 1993, only 14% of trees in heavily defoliated plots were in good condition. Six years later, 73% were rated as good. Trees with dead tops usually recovered, maintaining wildlife cover and other values, but the defect may affect timber quality. Three categories of risk were suggested by this study: <50% defoliation (mortality not expected), 50-80% defoliation (light risk of mortality), and 90-100% defoliation (moderate risk of mortality). Stand assessment two years after defoliation by spring hemlock looper provides an accurate picture of expected mortality, as long as no additional disturbance occurs.

Spruce Budworm, *Choristoneura fumiferana*, continued at low levels, with no visible defoliation detected. The number of moths captured in pheromone traps in northern Vermont has been fluctuating at low levels. Trap counts this year were similar to 1998 levels (Figure 14 and 15).

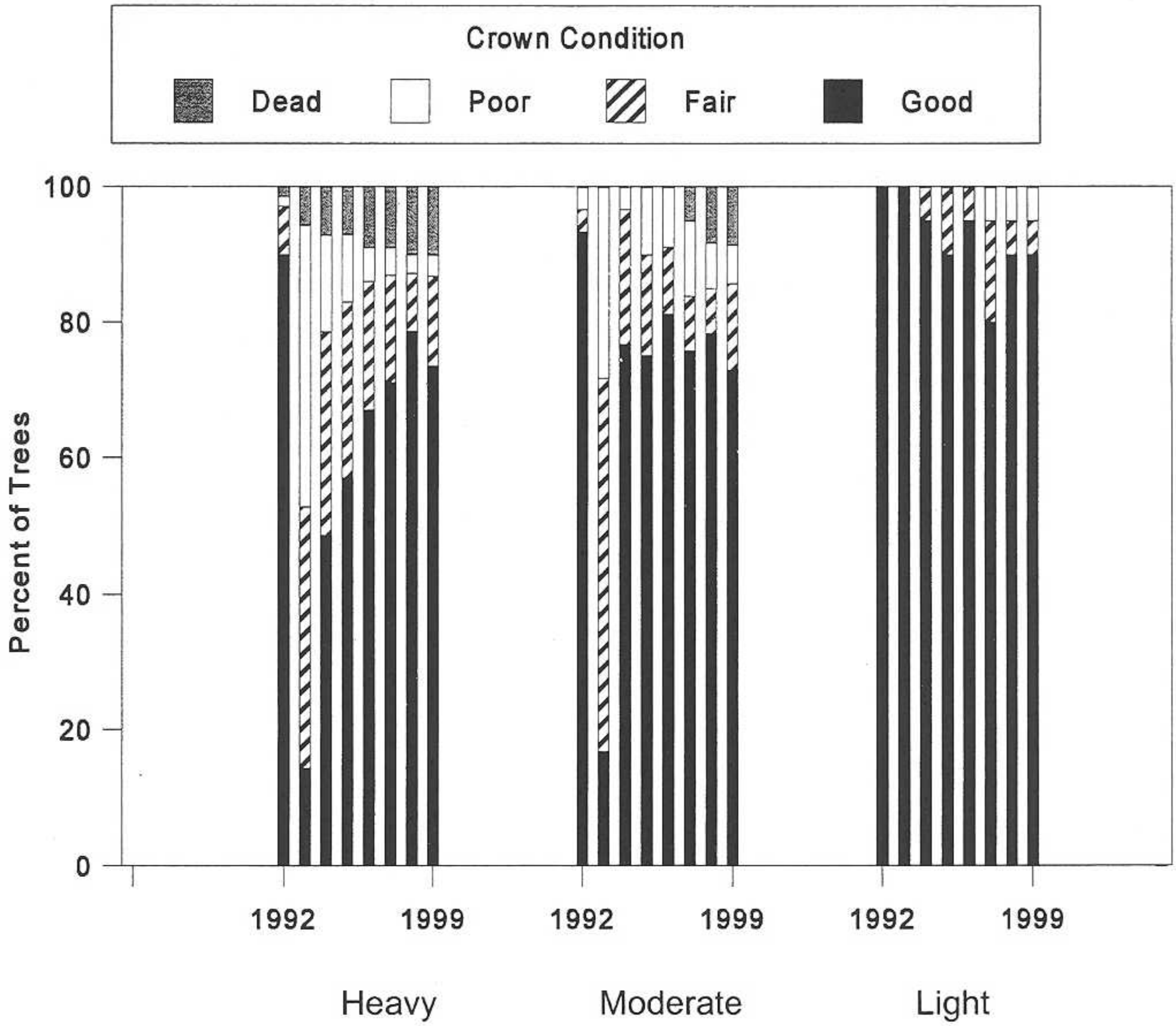


Figure 12. Annual rating of hemlock condition as percent of trees in each of five crown condition classes, evaluated in spring 1992-1999. Results are grouped by the general severity of the 1991 spring hemlock looper defoliation in the stand. Data are from ten trees in each of seven stands which had heavy defoliation, six which had moderate defoliation, and two which had only light defoliation.

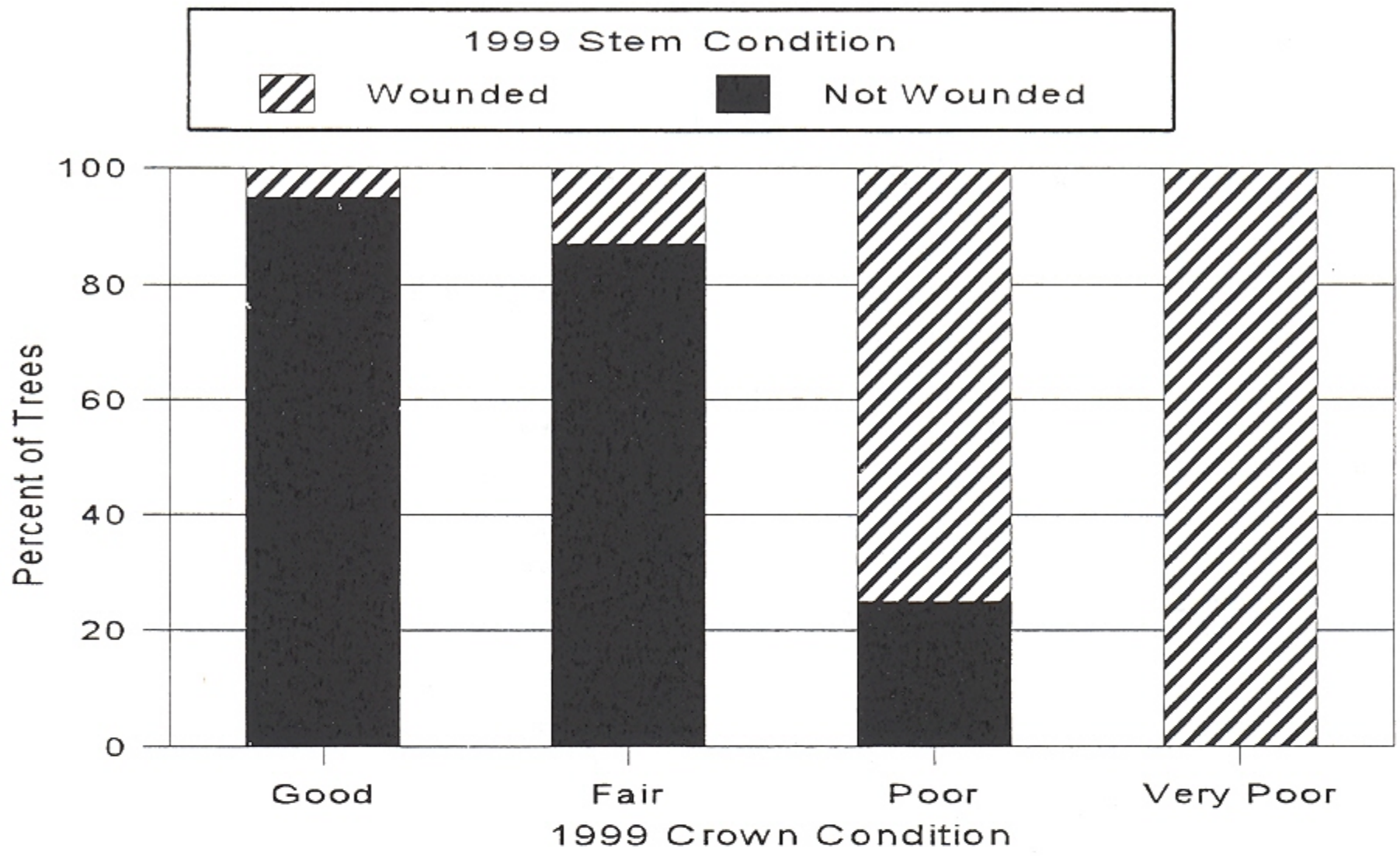
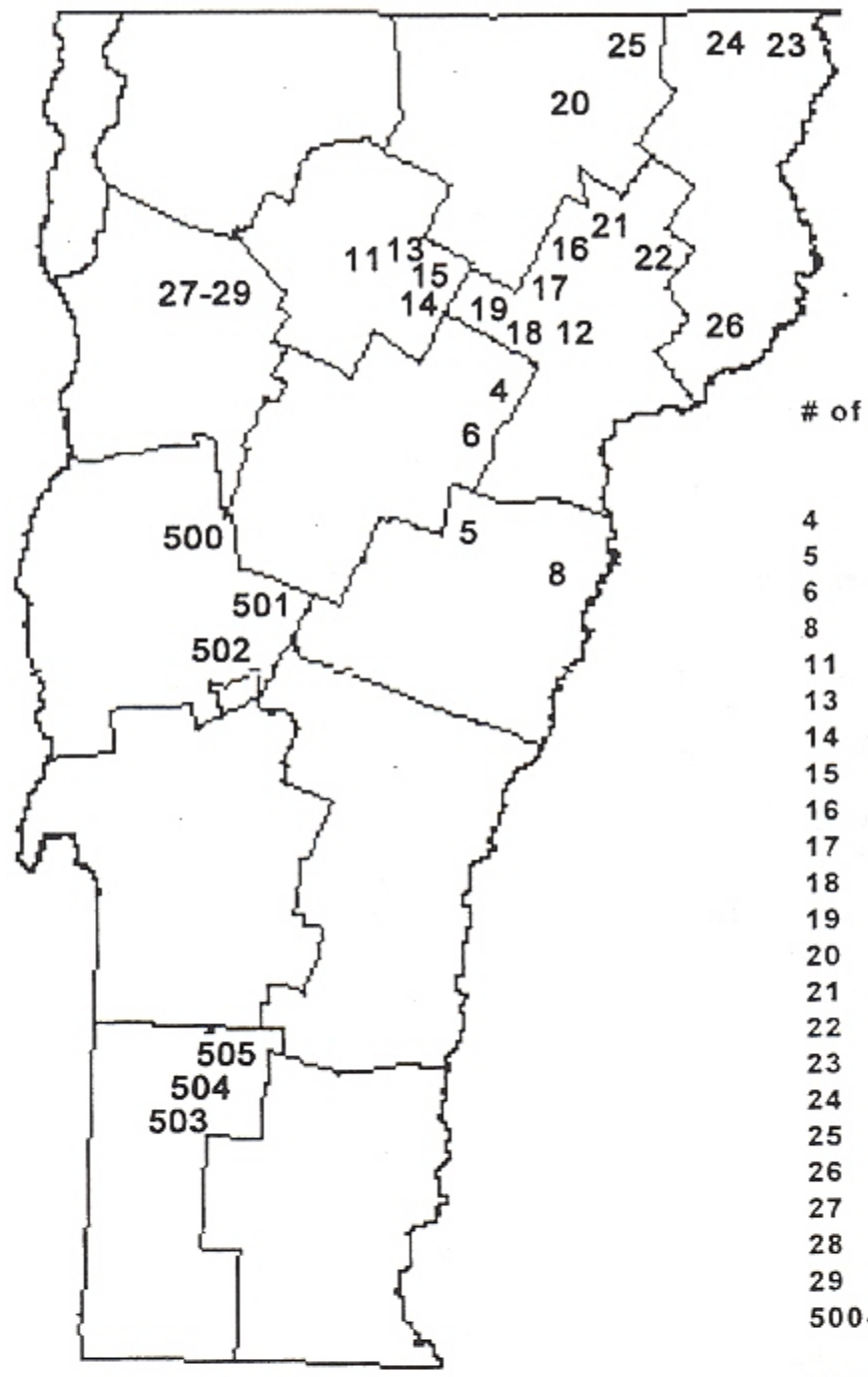


Figure 13. Percent of hemlocks, in 1999, with and without wounds to the stem or root collar, by crown condition. Data are from fifteen spring hemlock looper impact monitoring plots, with 113 trees in good condition, 18 in fair condition, 5 in poor condition, and 2 in very poor condition.



# of Spruce Budworm Moths per Trap: 1999

4	Danville Hill	2.0
5	Reservoir	0.6
6	Marshfield Pond	0.3
8	Scotch Hollow	0.3
11	Centerville	16.7
13	Diggins	Discontinued
14	Wolcott F&G	2.0
15	Bear Swamp	8.7
16	Withers	3.0
17	Mason	3.3
18	Star School	5.0
19	Beagle Club	6.7
20	Brownington Pond	3.3
21	Calendar Brook	9.3
22	Chieppo	6.0
23	Bunnel Brook	4.3
24	Norton Cemetary	34.7
25	Holland Pond	4.7
26	Victory Bog	9.3
27	VForEM 1400	13.3
28	VForEM 2200	2.6
29	VForEM 3800	6.0
500-505	GMNF	Discontinued
Average (excluding 28 & 29)		6.8

Figure 14. Spruce budworm pheromone plot locations and average number of moths caught per trap in 1999.

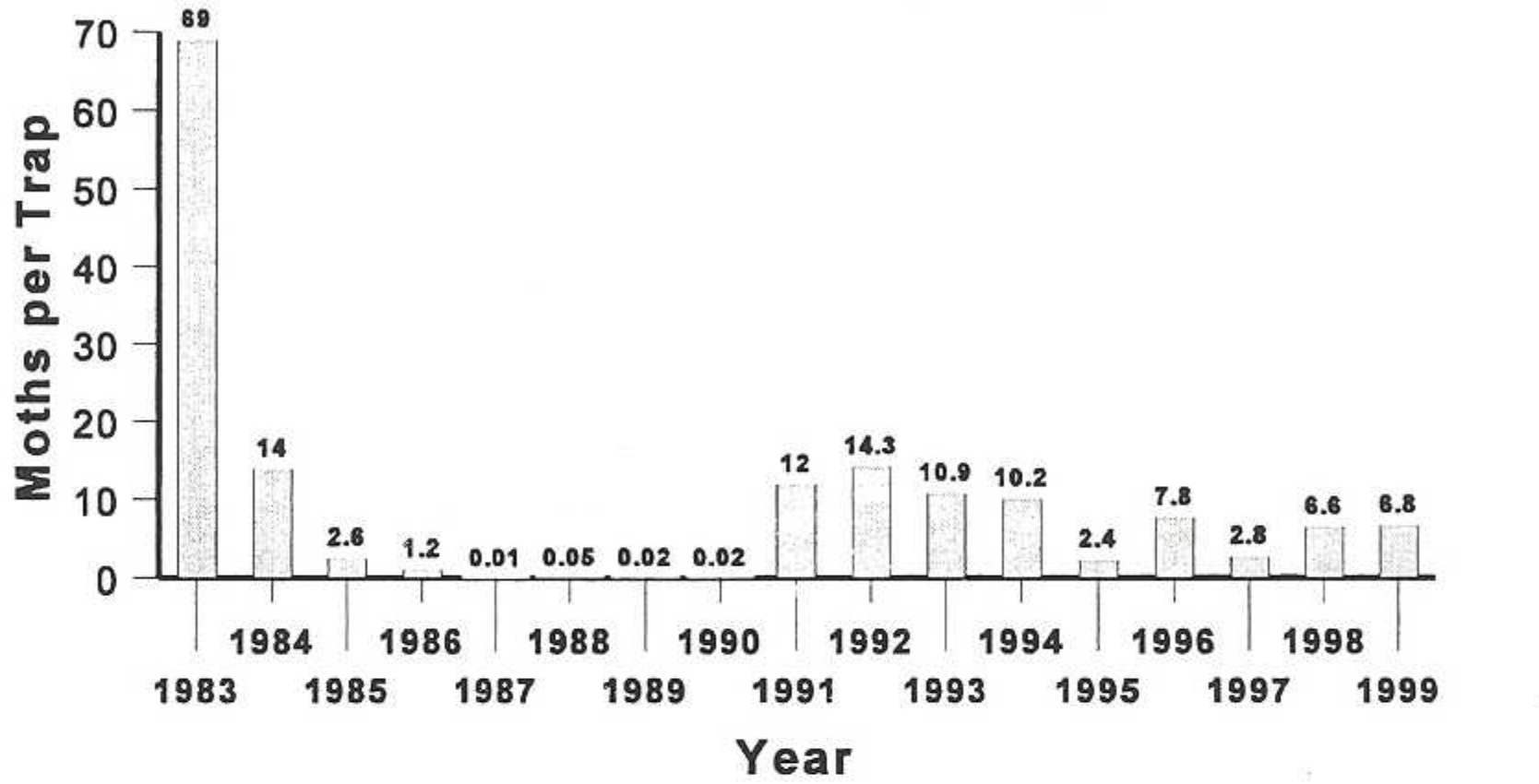


Figure 15. Average number of spruce budworm moths caught in pheromone traps, 1983-1999, based on 3 to 5 multi-pher traps per site for 15 to 23 sites.

OTHER SOFTWOOD DEFOLIATORS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Arborvitae Leaf Miner *Argyresthia thuiella*	Northern White Cedar	Chittenden, Caledonia & Rutland Counties	Heavy damage throughout Caledonia County. Elsewhere, damage to ornamentals.
Balsam Fir Sawfly *Neodiprion abietis*			Not reported.
European Pine Sawfly *Neodiprion sertifer*	Scots Pine	Chittenden County	Increasing. [Found on a Christmas tree in Bristol that had been inside for weeks.]

OTHER SOFTWOOD DEFOLIATORS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
European Spruce Needle Miner *Taniva albolineana*	Spruce	Northeast Kingdom	Only light damage.
Fall Hemlock Looper *Lambdina fiscellaria*	Hemlock	Washington & Windsor Counties	Moths commonly seen in early September.
Fir Coneworm *Dioryctria abietivorella*	Balsam Fir	Scattered in northern Vermont	Built up following heavy cone crop of '98.
Introduced Pine Sawfly *Diprion similis*	White Pine Scots Pine	Orleans, Washington, Orange & Windsor Counties	Light damage. Detections in surveyed Christmas tree plantations increased by 20%. Pupal cases common in pine tops in Springfield.
Larch Casebearer *Coleophora laricella*	Eastern Larch	Caledonia, Chittenden & Rutland Counties	Moderate damage in a Danville stand. Elsewhere light. Some larch mortality in Rutland County where casebearer was heavy in 1995.
Larch Sawfly *Pristophora ericksonii*			Not reported.
Nursery Pine Sawfly *Diprion fruteorum*			Not reported.
Pine False Webworm *Acantholyda erythrocephala*			Not reported.
Pine Webworm *Tetralopha robustella*			Not reported.
Red-Headed Pine Sawfly *Neodiprion lecontei*	Red Pine Ponderosa Pine Pitch Pine Jack Pine	Chittenden County	First reports of this insect in many years.

OTHER SOFTWOOD DEFOLIATORS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Shoot Moth *Pyralidae*	Red Pine	Rutland	Pupal cases on trees with dieback and bud proliferation. Identified by the Maine Forest Service.
Spring Hemlock Looper *Lambdina athasaria*			See narrative.
Spruce Bud Moth *Zeiraphera canadensis*		Essex, Caledonia & Orleans Counties	Light damage.
Spruce Budworm *Choristoneura fumiferana*			See narrative.
Tussock Moths *Orgyia sp.*	Balsam Fir White Spruce	Whitingham Canaan	Egg mass. Scattered larvae.
White Pine Sawfly *Neodiprion pinetum*			Not reported.
Yellow-Headed Spruce Sawfly *Pikonema alaskensis*	White Spruce	St. Johnsbury Concord	Heavy on individual trees.

SAPSUCKING INSECTS, MIDGES, AND MITES

Balsam Gall Midge, *Paradiplosis tumifex*, populations remained high. Occasional heavy damage was observed in southern Vermont in stands of wild balsam fir, but damage was less noticeable, compared to 1998, in northern Vermont. Damage should be much lighter in 2000.

Some heavy damage was reported by Christmas tree growers. However, unlike 1998, none of the balsam fir Christmas trees visited in the northern Vermont survey received heavy damage. Light damage was reported for 126 acres and moderate damage for 105 acres. Control effectiveness was variable in Christmas trees, even when the timing seemed correct.

Balsam Twig Aphid, *Mindarus abietinus*, damage decreased statewide again this year, with scattered light damage observed. Damage in the balsam fir Christmas tree plantations surveyed was mostly light (121 acres), with 55 acres of moderate damage. Moderate populations of stem mothers were seen in early spring beating surveys, but warm weather and steady shoot flush kept overall damage low.

Oystershell Scale, *Lepidosaphes ulmi*, populations on American beech were light in most locations, and dieback was not heavy enough to be detected by aerial survey. Populations of the scale insect in our survey plot in Huntington decreased from 1998 levels and remained low (Table 6, Figure 16).

Table 6. Number of oystershell scales on current year beech twigs in Camel's Hump State Forest, 1993-1999.[1]

	Average Number of Mature Viable Scales per:													
	Twig							Millimeter						
	1993	1994	1995	1996	1997	1998	1999	1993	1994	1995	1996	1997	1998	1999
Suppressed	1.2	2.1	9.0	0.6	2.1	4.0	0.7	0.03	0.07	0.15	0.06	0.15	0.10	0.50
Intermediate	1.4	8.4	16.8	1.2	2.6	3.3	2.8	0.05	0.16	0.31	0.12	0.10	0.25	0.14
Codominant	4.8	3.4	11.3	0.2	4.5	4.2	2.7	0.11	0.08	0.71	0.17	0.17	0.18	0.11

[1]Average for 10 branches from one tree per crown class, collected in Autumn, each year.

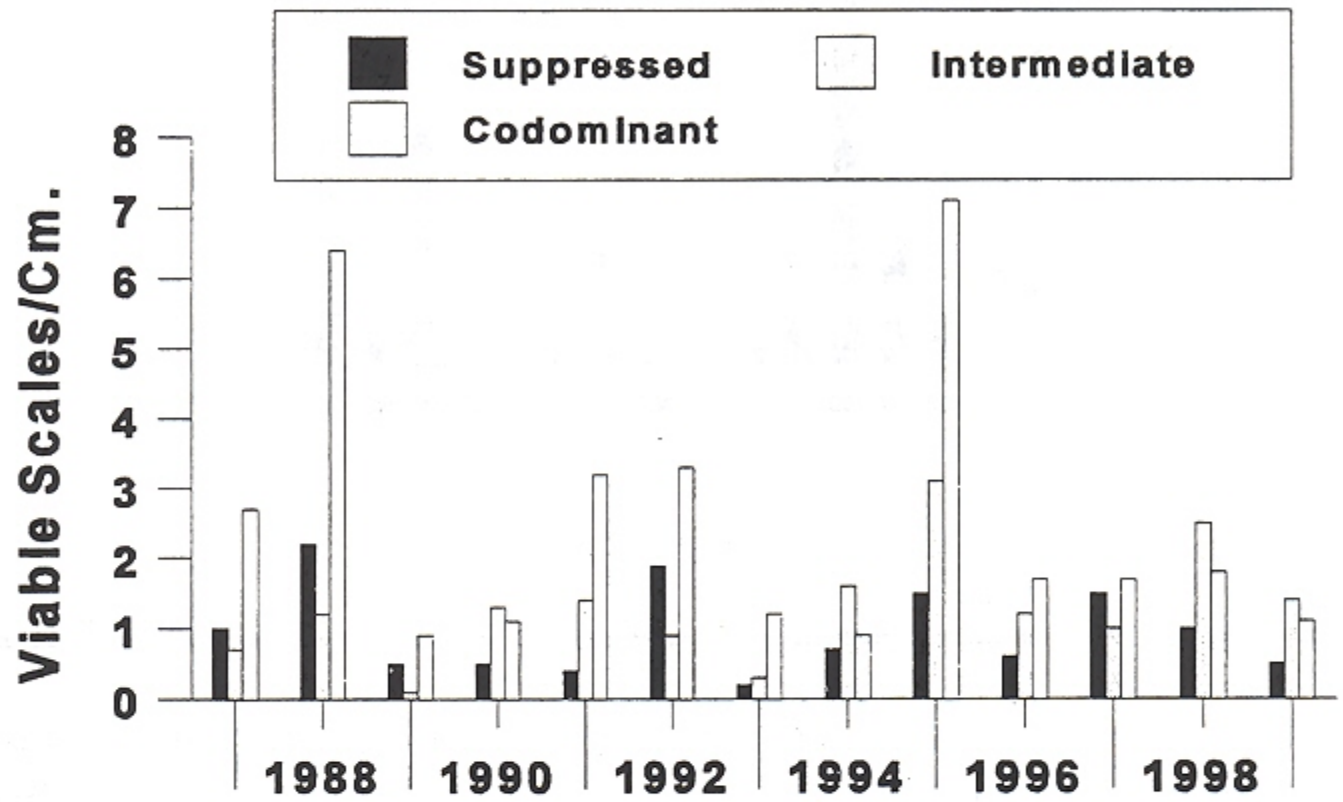


Figure 16. Oystershell scale populations in three tree canopy levels in Camel's Hump State Forest, 1987-1999[1]. Average for 10 current year twigs/tree per crown class, collected in autumn.

Pear Thrips, *Taeniothrips inconsequens*, populations in early spring appeared to be increasing. Bud counts in southern Vermont averaged 6.05 adult thrips per sugar maple bud, the highest since the 1988 outbreak (Figure 17). In a sugarbush in Stowe, counts averaged 1.0 thrips per one bud.

Thrips generally came out of the ground about two weeks earlier than normal. In Dummerston, they were first seen on April 4 - the earliest known date of emergence in Vermont. However, sugar maple buds were still tightly closed at that time, and early emerging thrips fed and laid eggs in other species such as cherry and red maple. Others did enter the buds of later breaking species once they started to open. However, in most of the state, sugar maple budbreak was rapid, and the chance for damage was minimal.

Very little damage by thrips was observed in most locations. Heavy damage to sugar maple occurred only in southern Windham County, where damage was mapped during the aerial survey (Figure 19, Table 7), with some moderate damage occurring in the Pittsfield/Stockbridge area.

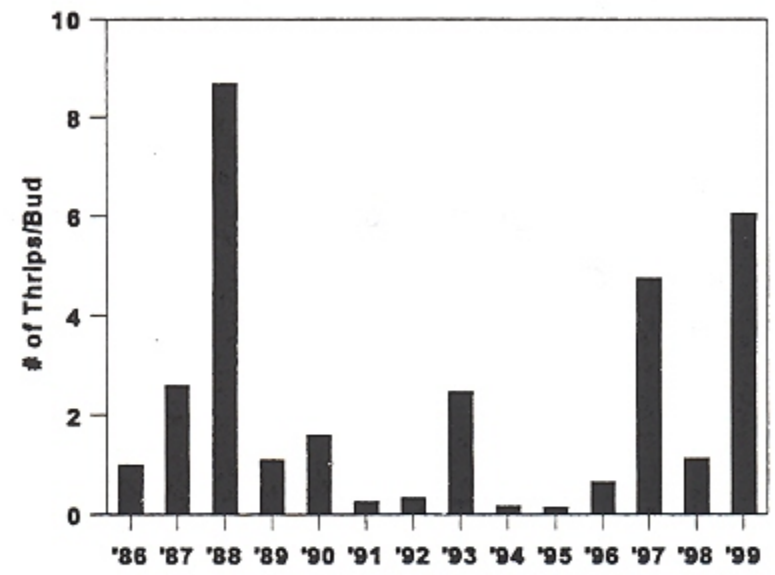


Figure 17. Spring thrips counts in buds of sugar maple in southern Vermont 1986-1999. This survey consisted of an average of 2 sugarbushes in 1986 and 5-6 sugarbushes in 1987-1999 (100 understory buds were sampled/sugarbush).

Table 7. Mapped acres of pear thrips damage in 1999.

County	Acres
ADDISON	0
BENNINGTON	3,274
CALEDONIA	0
CHITTENDEN	0
ESSEX	0
FRANKLIN	0
GRAND ISLE	0
LAMOILLE	0
ORANGE	0
ORLEANS	0
RUTLAND	0
WASHINGTON	0
WINDHAM	7,609
WINDSOR	38
Statewide Total	**10,921**

Yellow sticky traps were placed in nine locations to determine adult emergence patterns and numbers (Figure 18). Peak emergence occurred during mid to late April and thrips numbers averaged 3.2 per square inch. The one location that was also trapped in 1998 showed a 26 percent increase in numbers of thrips.

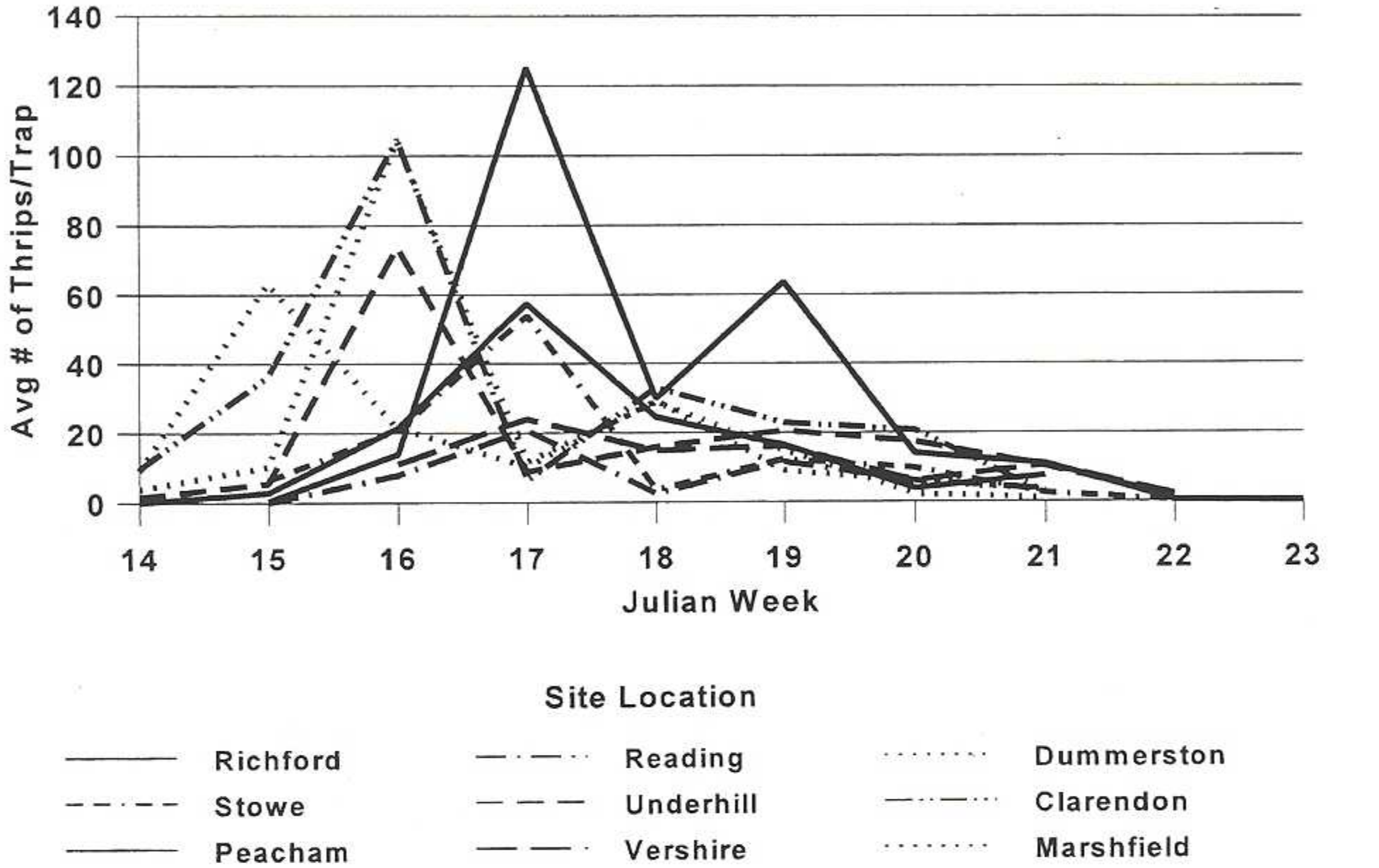


Figure 18. Pear thrips caught on sticky traps in 1999 at nine sites, by week. Number is average of 4 traps per site. Traps were changed and counted weekly.

In addition to sugar maple, damage was observed on cherry and red maple in parts of Windham County. Cherry leaves damaged by thrips usually drop off, and some trees were defoliated in May. Red maple crowns looked thin, with tufted foliage. Scattered throughout southern Vermont, there was light damage to late bud breaking species (i.e. red oak and white ash) and sugar maple, with heavier damage to sugar maple regeneration.

Where sugar maple damage was moderate or heavy in Windham County, deteriorating tree health is of concern. This is the second year in a row of defoliation in some stands. In 1998, the damage had been compounded by wet conditions, which allowed anthracnose to build up on damaged leaves, and on the refoliation. In 1999, dry conditions compounded the impact. Damaged leaves did not expand fully, often browned up over the course of the summer, and sometimes dropped. Most significantly, refoliation was sparse, and trees remained thin crowned all growing season. The acreage of damage mapped in August was greater than that mapped in late June.

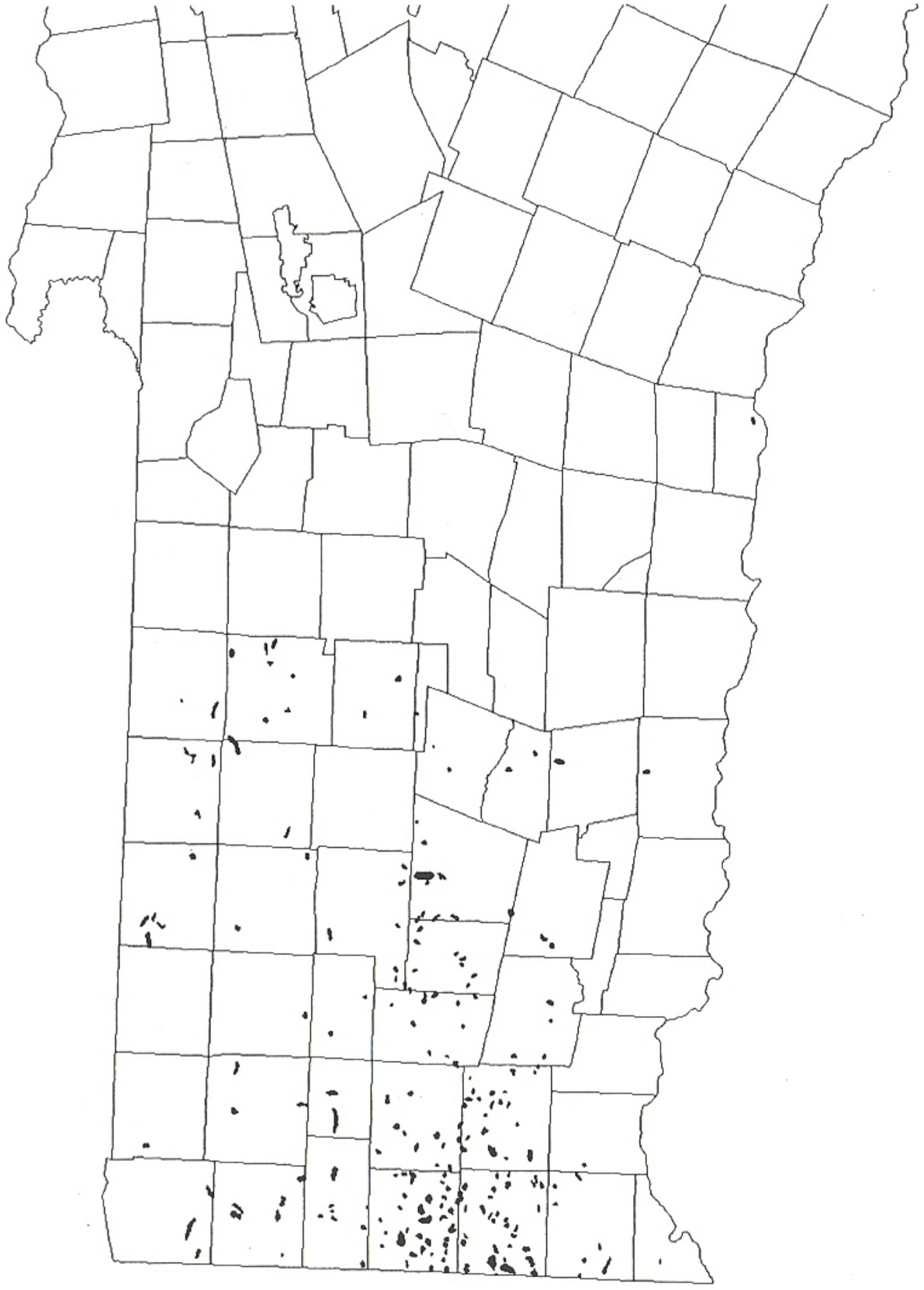


Figure 19. 1999 Damage by pear thrips. Mapped area is 10,921 acres.

Soil samples collected in the fall of 1999 show extremely low numbers of thrips (Figure 20). Although thrips were found in 77% of the 43 sites, populations were lower than the previous fall in 91% of the sites. Noticeable damage is not likely in 2000.

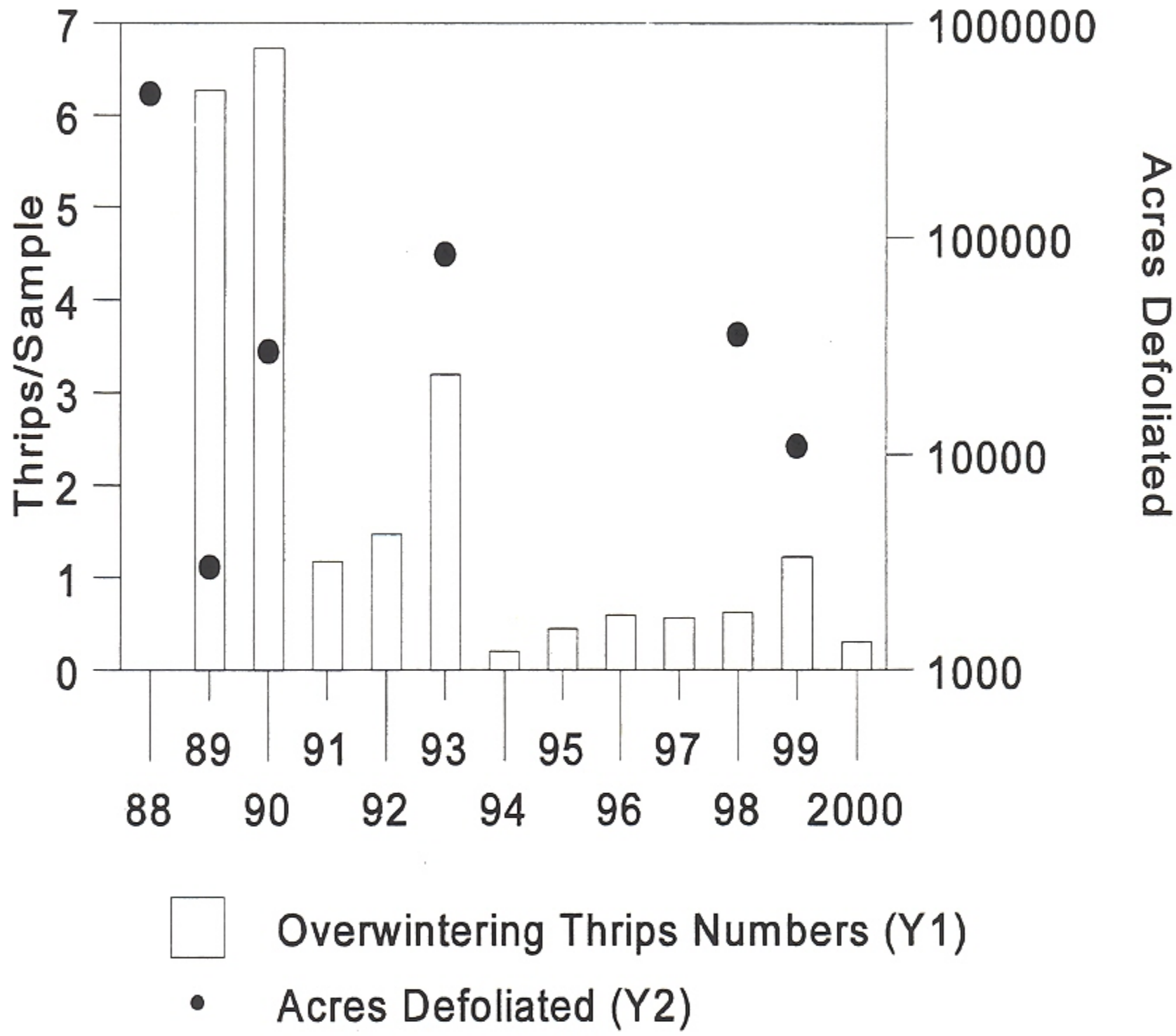
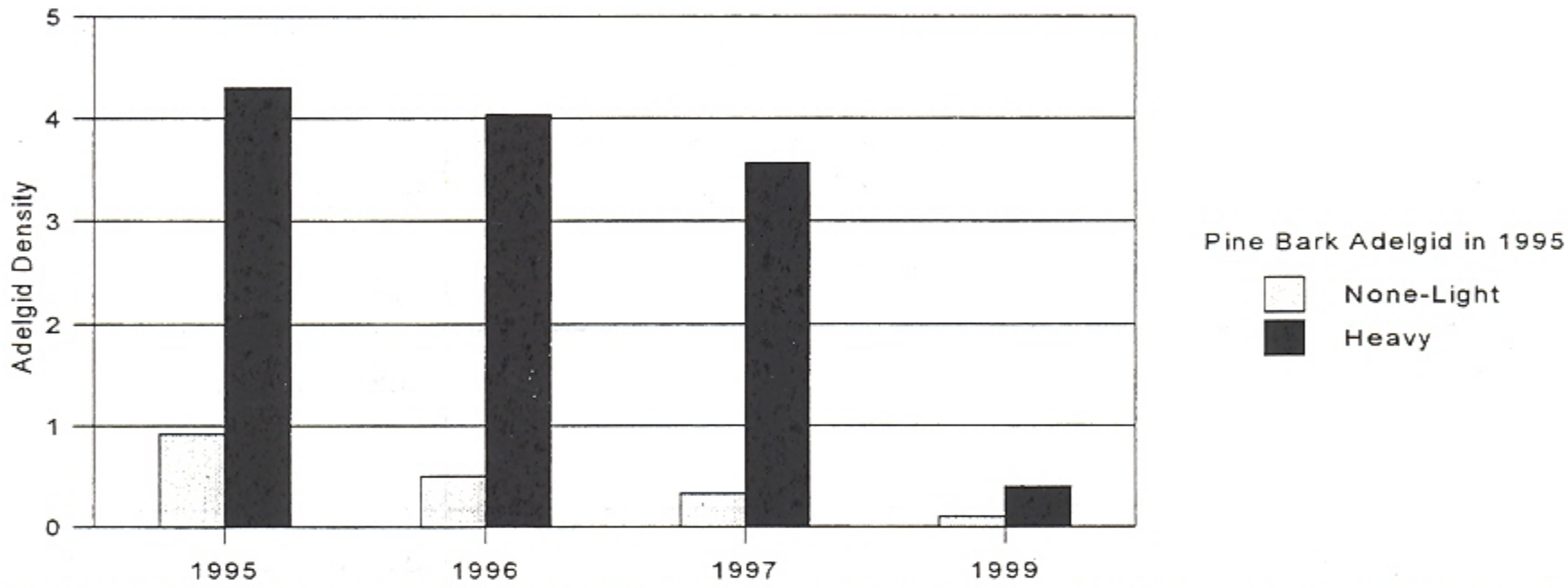


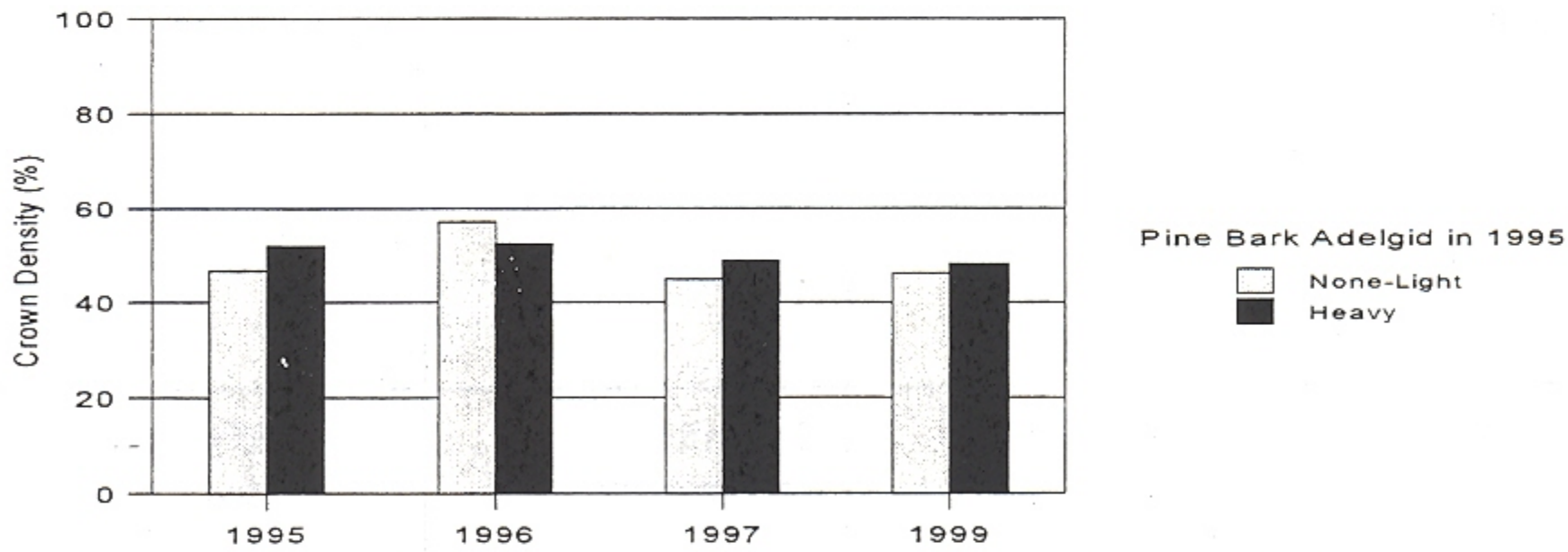
Figure 20. Average counts of overwintering pear thrips in soil samples (# of insects/16 cubic inches of soil) compared to acres of thrips damage mapped statewide the following summer. Overwintering thrips numbers determined by extraction in 1989-93, and by forced emergence in 1994-1999. 43 sites were sampled in fall 1999.

Pine Bark Adelgid, *Pineus strobi*, population levels were low in 1999. Monitoring was completed on 36 eastern white pine trees in Rupert, where the adelgid was heavy in 1995 (Figure 21). These were co-dominant, forest-grown trees 10-20" in diameter. The adelgid density had been evaluated based on the amount of white woolly material on the stem, using a zero to five scale. Pine bark adelgid levels dropped gradually on both heavily infested and lightly infested trees between 1995 and 1997. By 1999, the adelgid population was negligible. Heavy rains in the spring of 1998, when crawlers were active, may have been responsible for this population decline.

Tree health was also evaluated over the four-year period. There was no significant difference in the density of foliage in the tree crowns between trees with and without pine bark adelgid in any of the years of the study, although some fluctuations did occur. There was also no relationship between the amount of twig dieback, the percent of the total tree height with live branches (live crown ratio), or the overall tree condition and the amount of adelgid present. Pine bark adelgid infestations do not appear to have caused tree injury. Additional monitoring would help assess the impact of this noticeable pest.



Adelgid Density: 0-none, 1-some white visible, 2-obvious whiteness limited to one internode, 3-obvious whiteness more extensive, 4-more white than grey, 5-flocculent, white over most of smooth stem



Crown Density: A measure of foliage thickness measured as the percent of crown area without light coming through

Figure 21. 1995-1999 pine bark adelgid density and tree crown density ratings on twelve white pine trees in Rupert with generally low levels of adelgid in 1995 (none-light), and 23 with generally heavy levels. Adelgid density was rated on the worst face. Crown density was rated using national Forest Health Monitoring standards.

Spruce Spider Mite, *Oligonychus ununguis*, damage decreased in 1999, in spite of the hot, dry weather. Mostly light damage was observed on Christmas trees and ornamentals. Moderate damage was observed on 15 acres of white and blue spruce in the northern Vermont Christmas tree survey. Overwintering egg numbers indicate that dry conditions have allowed populations to build up on Christmas trees. More damage may occur in 2000.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Aphids *Cinara sp.*	Balsam Fir White Pine Scots Pine	Widely scattered	Mostly light populations. Very heavy infestation on a large stressed ornamental fir in Morrisville. Became active on a cut Christmas tree indoors.
Aphids *Periphyllus sp.*	Sugar Maple	Danby	Sugarbush.
Ash Plant Bug *Tropidosteptes amoenus*	Ash	Brattleboro.	Nymphs feeding on lower leaf surface, producing spotting on upper surface.
Balsam Gall Midge *Paradiplosis tumifex*			See narrative.
Balsam Twig Aphid *Mindarus abietinus*			See narrative.
Balsam Woolly Adelgid *Adelges piceae*			Not reported.
Beech Scale *Cryptococcus fagisuga*			See Beech Bark Disease.
Birch Budgall Mite *Aceria rudis*	Paper Birch	Granville Rockingham	Scattered proliferation of buds on infested trees.
Birch Lace Bug *Corythucha pallipes*	Birch	Johnson	Light damage.
Boxelder Bug *Leptocoris trivittatus*	Boxelder	Widespread	Common and numerous in late summer, often invading homes in search of shelter.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Cooley Spruce Gall Adelgid *Adelges cooleyi*	Blue Spruce White Spruce Norway Spruce	Scattered	Fewer than normal reports of damage, but remains common on ornamentals and Christmas trees.
Cottony Maple Scale *Pulvinaria innumerabilis*	Sugar Maple	North Danville	One call.
Eastern Spruce Gall Adelgid *Adelges abietis*	White Spruce Red Spruce Norway Spruce	Widespread	Damage to white spruce Christmas trees increased slightly. One plantation in Bennington County with heavy damage in spite of treatment. Also common on ornamentals throughout.
Elm Cockscomb Gall Aphid *Colopha ulmicola*	Liberty Elm	Castleton	Ornamental.
Elongate Hemlock Scale *Fiorinia externa*	Balsam Fir	Westminster	Isolated infestation on ornamentals imported from out-of-state nursery.
Eriophyid Mites *Family Eriophyidae*	Butternut	Townshend	Causing considerable leaf distortion at this site.
European Elm Scale *Gossyparia spuria*	Chinese Elm	Champlain Valley	Ornamental.
Fletcher Scale *Parthenolecanium fletcheri*			Not reported.
Gall Mites *Family Eriophyidae*	Silver Maple Red Pine	Duxbury Rutland	Ornamental. Associated with bud proliferation.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Hemlock Woolly Adelgid *Adelges tsugae*	Hemlock		Not detected or known to occur in Vermont (although on two different occasions, visitors from out-of-state brought in samples to be identified... which were quickly destroyed). Trap trees at eradication site were checked in May and October.
Honeylocust Plant Bug *Diaphnocoris chlorionis*	Honeylocust	Montpelier	Common.
Lacebugs *Corythucha sp.*	Elm Yellow Birch	Scattered	Some.
Leafhoppers *Cicadellidae*	Many	Northeast Kingdom	Observed but no damage.
Leafhoppers *Erythroneura sp.*	Hardwood	Dummerston	Common on sticky traps in early May.
Maple Spindle Gall Mites *Vasates aceris-crumena*	Sugar Maple Red Maple	Widespread	Common, especially on regeneration, but light. Down from 1998.
Oystershell Scale *Lepidosaphes ulmi*			See narrative.
Pear Thrips *Taeniothrips inconsequens*			See narrative.
Pine Bark Adelgid *Pineus strobi*			See narrative.
Pine Cone Gall Midge *Rhabdophaga strobiliodes*	Willow	Waterbury	Brought to lab by curious homeowner.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Pine Fascicle Mite *Trisetacus alborum*	White Pine	Widespread	More noticeable than in 1998. Light damage on 91 acres of Christmas trees and moderate damage on 20 acres.
Pine Leaf Adelgid *Pineus pinifoliae*	White Pine	Widely scattered	Damage to Christmas trees decreased. Light damage to 70 acres compared to 114 acres in 1998.
Pine Needle Midge *Contarinea baeri*			Not reported.
Pine Needle Scale *Chionapsis pinifoliae*	Scots Pine Mugo Pine	Vernon, Pawlet Springfield, Castleton & Barton	Light populations. Sometimes causing chlorosis, browning, and tufting.
Pine Spittlebug *Aphrophora parallela*	White Pine Scots Pine	Widespread	Increase from 1998. Light populations on 102 acres of Christmas trees.
Pine Thrips *Gnophothrips sp.*	Scots Pine Mugho Pine	Widely scattered	Increasing. Light damage to 32 acres of Scots Pine Christmas trees. Severe damage to Mugho Pine in Stowe.
Ragged Spruce Gall Aphid *Pineus similis*	Red Spruce	Widespread	Remains common.
Spittle Bugs *Family Cercopidae*	Paper Birch	Barre	Ornamentals.
Spruce Gall Aphid *Adelges lariciatus*			Not reported.
Spruce Gall Midge *Mayetiola piceae*	White Spruce	Elmore	Heavy damage to one tree.
Spruce Spider Mite *Oligonychus ununguis*			See narrative.

OTHER SAPSUCKING INSECTS, MIDGES, AND MITES			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Whiteflies *Family Aleyroidae*	Rhododendron	Rutland	Feeding on terminal leaves.
Woolly Alder Aphid *Prociphilus tessellatus*	Silver Maple Sugar Maple	Danville Champlain Valley Poultney Danby	Some moderate damage from heavy populations on ornamentals.
Woolly Elm Aphid *Eriosoma americana*			Not reported.

BUD AND SHOOT INSECTS

Balsam Shootboring Sawfly, *Pleroneura brunneicornis*, populations dropped to the lowest levels seen in many years. Only one fir plantation (15 acres in Waterville) examined during the regular northern Vermont Christmas tree survey received moderate damage this year compared to 202 acres of moderate to heavy damage in 1998. Most adults emerged during the last week in April through the first week in May. The number of adults caught on sticky cards in Lamoille County dropped dramatically from 1998 (Figure 22).

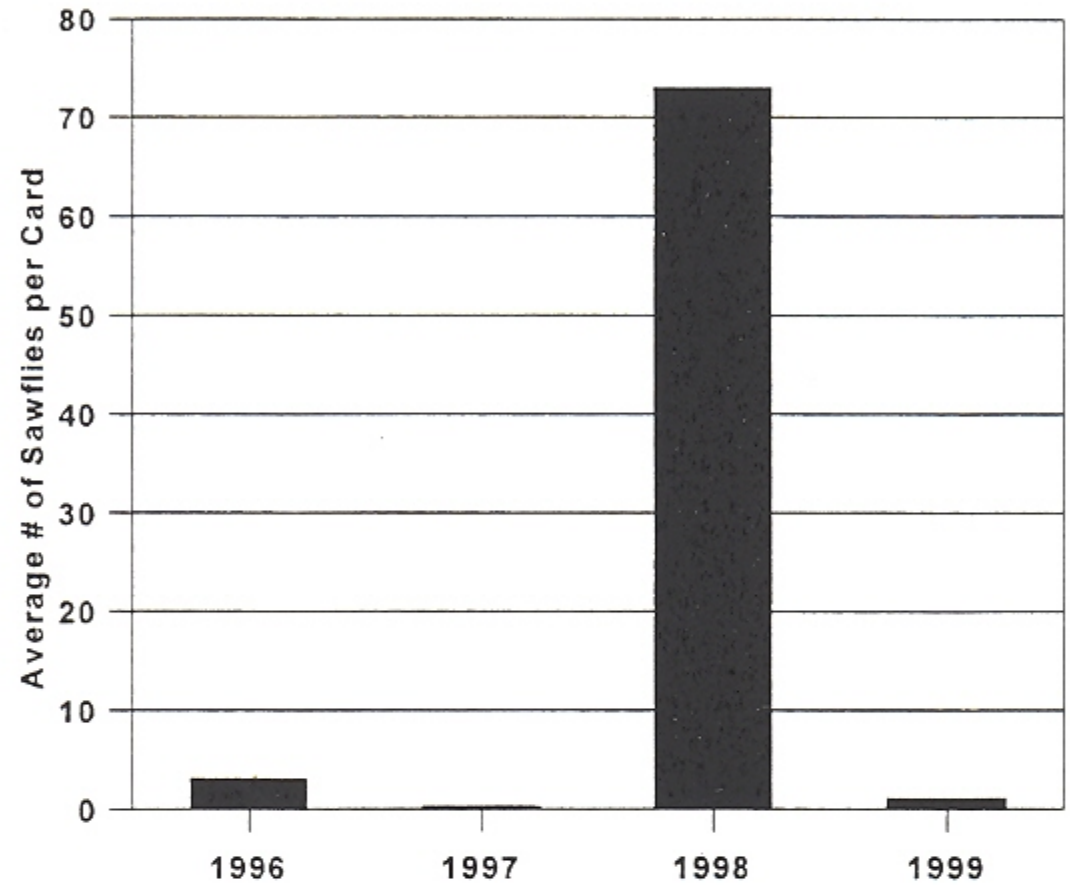


Figure 22. Average number of balsam shootboring sawfly adults caught per 3x5" yellow sticky card placed in mid-crowns of balsam fir trees in Lamoille County, 1996-1999.

We have long observed that the heaviest populations and damage occur in even years, indicating that most of the sawflies may have a two-year life cycle. This year some additional information was obtained to support that theory. In May, 1998, 10 mature larvae were placed in each of five nylon sleeves and buried about one foot deep in the soil to determine how many would emerge as adults in 1999. On May 3, 1999, after natural adult emergence had occurred, these were removed from the soil and survivors counted. Four adults and 7 prepupae were recovered, indicating that the majority of sawflies, at least in this small sample, spend more than one year in the soil before emerging.

Since damage is heaviest in even years and 1998 was the worst year yet seen, growers should expect heavy damage in 2000, particularly if we have a warm spring when adults are emerging.

Pine Shoot Beetle, *Tomicus piniperda*, was confirmed as present in Essex and Orleans Counties. Adults were captured in traps placed in red pine plantations by the Vermont Department of Agriculture. Nine pine shoot beetles were trapped in Essex County, and one in Orleans County (see Table 8 under Bark and Wood Insects). This is an introduced pest that has been steadily moving eastward in New York state. The source of our introduction is believed to be from Quebec which received infested logs from New York. Infested logs were shipped to an area of Quebec not far from the northeastern Vermont border. The insect kills pine shoots during the summer by boring into them. So far, no infested pine trees have been detected in Vermont, but have been observed in Quebec.

White Pine Weevil, *Pissodes strobi*, remains common throughout. Flagging on white pine occurred several weeks earlier than normal, starting in late June, due to early phenology and dry conditions. Moderate damage to white spruce Christmas trees was observed in Brookfield. Stunting of mugho pine shoots was observed in Barton.

OTHER BUD AND SHOOT INSECTS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Balsam Shootboring Sawfly *Pleroneura brunneicornis*			See narrative.
Birch Petiole Borer *Pseudanthonomus validus*	Yellow Birch	Lamoille County	Very noticeable on Mt. Mansfield State Forest. First incidence in many years.
Boxelder Twig Borer *Proteoteras willingana*	Boxelder	Throughout	Associated with shoot blight.
Butternut Curculio *Conotrachelus juglandis*	Walnut	Townshend	
Dioryctria Shoot Moths *Dioryctria spp.*	Eastern White Pine Balsam Fir	Waterbury Addison	Isolated trees within stand.
Eastern Pine Shoot Borer *Eucosma gloriola*	Scots Pine	Widespread	Increasing. Light damage on 80 acres of Christmas trees and moderate damage on 50 acres.
European Pine Shoot Moth *Rhyacionia buoliana*			Not reported.

OTHER BUD AND SHOOT INSECTS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Gall Wasps *Family Cynipidae*	Hawthorn (wild spp.)	Burlington	Causing knots on twigs, dieback follows.
Maple Petiole Borer *Caulocampus acericaulis*			Not reported.
Pine Gall Weevil *Podapion gallicola*	Red Pine	Chittenden County	Increasing.
Pine Shoot Beetle *Tomicus piniperda*			See narrative.
Pitch Nodule Maker *Petrova albicapitana*			Not reported.
Twig Pruner *Elaphidionoides villosus*			Not reported.
Whitespotted Sawyer *Monochamus scutellatus*	Balsam Fir	Burlington	Occasional red tips.

BARK AND WOOD INSECTS

Bark Beetles were collected during a Vermont survey for the pine shoot beetle, *Tomicus piniperda*. Because of the discovery of the pine shoot beetle, in nearby areas of Quebec, ten Lindgren funnel traps baited with alpha pinene lure were deployed in Essex and Orleans Counties in Vermont. Trap placement was within 40 miles of the Vermont/New Hampshire/Quebec border intersection point. All but one trap was placed in mature red pine plantations; the final trap was situated in white pine slash near a receiving mill. All traps were in place by the first week of April and inspected bi-weekly until July.

Traps were screened for *Tomicus piniperda* by University of Vermont personnel and suspect beetles sent to PPQ for species verification. At the Forest Biology Lab, the non-target bark beetles retrieved from the traps were identified. A total of 39 bark beetles were captured, and, counting *Tomicus*, ten genera were represented (Table 8).

Table 8. Bark beetles caught in traps in Orleans and Essex Counties baited for *Tomicus*. Traps were placed on site 4/6/99. Final collections were made 6/8/99.

County	Town	Type of Property	Host Type	*Cryophalus sp.*	*Dendroctonus valens*	*Dryocetes autographus*	*Hylastes sp.*	*Hylastes opacus*	*Hylastes porculus*	*Hylurgops ruginpennispinifex*	*Pityogenes sp.*	*Pityogenes hopkins*	*Polygraphus rufipennis*	*Tomicus piniperda*	*Tryodendron lineatum*	*Xyleborus sp.*	Total
Essex	Guildhall	Tree Farm	red pine	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Essex	Guildhall	Woods/ Slash	white pine	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Essex	Maidstone	Tree Farm	red pine	0	5	0	0	2	0	2	0	0	0	0	1	0	**10**
Essex	Brighton	Tree Farm	red pine	0	0	1	0	0	0	0	1	1	0	0	0	0	**3**
Essex	Brighton	Tree Farm	red pine	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Essex	Brighton	Tree Farm	red pine	0	0	0	0	0	0	0	0	0	0	2	1	0	**3**
Essex	Canaan	Tree Farm	red pine	0	0	0	0	0	1	0	0	0	0	7	1	0	**9**
Orleans	Morgan	Tree Farm	red pine	1	0	0	0	2	0	0	0	0	0	1	0	0	**4**
Orleans	Morgan	Tree Farm	red pine	0	0	0	0	0	1	0	0	0	0	0	2	0	**3**
Orleans	Derby	Tree Farm	red pine	0	0	1	1	0	1	0	0	0	1	0	1	1	**6**
				1	**5**	**2**	**1**	**4**	**4**	**2**	**1**	**1**	**1**	**10**	**6**	**1**	**39**

OTHER BARK AND WOOD INSECTS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Allegheny Mound Ant *Formica exsectoides*	Balsam Fir	Starksboro Orleans	Killed 12 Christmas trees within two plantations.
Ambrosia Beetle *Scolytidae*	Hardwoods	Widespread	Common in ice-damaged white birch.
Asian Longhorned Beetle *Anoplophora glabripennis*			Remains undetected in Vermont.
Balsam Fir Bark Beetle *Pityokteines sparsus*	Balsam Fir	Albany	Christmas trees.
Bronze Birch Borer *Agrilus anxius*	Paper Birch European Birch	Groton Randolph Bennington County	Current and old infestation present. Causing dieback. Causing mortality.
Cedar Tree Beetle *Semanotus ligneus*		East Hardwick	Infesting cedar logs being used to build a house.
Eastern Larch Beetle *Dendroctonus simplex*	Tamarack	Rutland Hyde Park	Associated with larch mortality following larch casebearer. Attacking a drought-stressed ornamental.
Elm Bark Beetles *Hylurgopinus rufipes* *Scolytus multistriatus*			See Dutch Elm Disease.
Hemlock Borer *Melanophila fulvoguttata*	Hemlock	Widely scattered	Associated with drought-stressed trees.
Locust Borer *Megacyllene robiniae*	Black Locust	Windsor and Windham Counties	More common than normal in 2-8" trees. Associated with locust mortality in Hartland.

OTHER BARK AND WOOD INSECTS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Northeastern Sawyer *Monochamus notatus*			Not reported.
Northern Pine Weevil *Pissodes approximatus*			Not reported.
Pigeon Tremex *Tremex columba*	Sugar Maple	Scattered throughout	Adults more commonly observed than normal. Holes in maple, on declining trees or in dead spots in the bark, often reported because of concern for Asian longhorned beetle.
Pine Engraver *Ips pini*	White Pine Red Pine Scots Pine	Scattered throughout	Attacking drought-stressed trees, often on wet or ledgey sites.
Pine Root Collar Weevil *Hylobius radicis*			Not reported.
Pitted Ambrosia Beetle *Corthylus punctatissimus*	Sugar Maple	Orwell	Light damage to scattered seedlings in a sugarbush.
Red Turpentine Beetle *Dendroctonus valens*	White Pine	Springfield	Associated with pine mortality on ledgey site, attributed to drought.
Round-headed Apple Tree Borer *Saperda candida*	Apple Mountain Ash	Chittenden & Caledonia Counties	Attacking many newly-planted (1-2 yrs.) trees in Caledonia County.
Sawyer *Monochamus sp.*	Conifer Balsam Fir	Throughout Craftsbury	Although numbers are down, samples and requests for identification continue to come in in response to concern about Asian Longhorned Beetle. Damage detected in one 15-acre Christmas tree plantation.

OTHER BARK AND WOOD INSECTS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Sugar Maple Borer *Glycobius speciosus*	Sugar Maple	Throughout	Remains a common cause of defect on slow growing maples. Trees with exit holes, but without the typical "catface" scar often resulting from sugar maple borer injury, were occasionally reported in response to concern about Asian Longhorned Beetle.
Teeny Weeny White Pine Beetle *Pityogenes hopkinsi*	Eastern White Pine	Shelburne	Found in trees infected with blister rust.
Zimmerman Pine Moth *Dioryctria zimmermanni*			Not reported.

ROOT INSECTS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Asiatic Garden Beetle *Autoserica castanea*	Many	Barre Burlington Waterbury	Scattered reports.
Conifer Swift Moth *Korsheltellus gracilis*			Not reported.
White Grub *Phyllophaga spp.*	Many	Essex	Larvae from soil.

FRUIT AND FLOWER INSECTS			
INSECT	**HOST(S)**	**LOCALITY**	**REMARKS**
Acorn Plum Gall *Amphibolips prunus*	Oak	Bennington	Numerous galls found on ground.
Rose Chafer *Macrodactylus subspinosus*	Roses	Widespread	Decreasing. Few seen this year.
Pyralid Moths *Family Pyralidae*	Sumac	Barre	Larvae found consuming sumac heads.
Western Conifer Seed Bug *Leptoglossus occidentalis*	Balsam White and Other Pines White Spruce Hemlock	Statewide	Readily entering homes and other structures for overwintering; Not reported feeding on scales or seed pulp of conifer seeds.

MISCELLANEOUS INSECTS: LEPIDOPTERA

Non-Target Moths were identified in pheromone traps used in surveys for forest tent caterpillar, saddled prominent, and spruce budworm. Results are in Tables 9-11.

Table 9. Non-target moths caught in 1999 in pheromone traps baited with lure for forest tent caterpillar. Data are from 9 locations statewide.

Family	Species (Author)	UVM Species Identification #	Total Number Caught
Arctiidae	*Halysidota tessellarius* (J.E. Smith, 1797).	238	1
Drepanidae	*Drepana arcuata* Wlk., 1855.	10	1
Geometridae	*Campaea perlata* (Gn., 1857).	221	1
	Caripeta divisata Wlk., 1863.	220	1
	Homochlodes lactispargaria (Wlk., 1861)	15	64
	Lambdina fiscellaria (Gn., 1857).	191	46
Lymantriidae	*Lymantria (=Porthetria) dispar* (L., 1758).	352	114
Noctuidae	*Syngrapha rectangula* (W. Kby., 1873).	407	1
	Zanclognatha pedipilalis (Gn., 1854)	325	1
Notodontidae	*Nadata gibbosa* (J.E. Smith, 1797).	93	1
	Phlogophora iris Gn., 1852.	210	1
Tortricidae	*Choristoneura fumiferana* (Clem., 1865).	498	1

Table 10. Non-target moths caught in 1999 in pheromone traps baited with lure for saddled prominent. Data are from 5 locations in northern Vermont.

Family	Species (Author)	UVM Species Identification #	Total Number Caught
Arctiidae	*Halysidota tessellaris* (J.E. Smith, 1797).	238	12
Geometridae	*Lambdinia fiscellaria* (Gn.., 1857).	191	6
Lymantriidae	*Lymantria (=Porthetria) dispar* (L., 1758).	352	74
Noctuidae	*Bomolocha baltimoralis* (Gn., 1854).	161	1
	Polia nimbosa Gn., 1852.	360	1
Tortricidae	*Clepsis persicana* (Fitch, 1856).	179	1

Table 11. Non-target moths caught in 1999 in pheromone traps baited with lure for spruce budworm. Data are from 21 locations in northern Vermont.

Family	Species (Author)	UVM Species Identification #	Total Number Caught
Geometridae	*Cabera erythemaria* Gn., 1857.	88	1
	Campaea perlata (Gn., 1857).	221	2
	Caripeta divista Wlk., 1863:	220	5
	Cyclophora pendulinaria (Gn., 1857).	86	1
	Hydria prunivorata (Fgn., 1955).	266	1
	Lambdina fiscellaria (Gn., 1857).	191	117
	Mesoleuca ruficillata (Gn., 1857).	165	1
	Nepytia canosaria (Wlk., 1863).	276	1
	Prochoerodes transversata (Drury, 1770).	417	1
Lymantriidae	*Lymantria (=Porthetria) dispar* (L., 1758).	352	6
Noctuidae	*Calyptra canadensis* (Bethune, 1865).	676	3
	Nephelodes minians Gn., 1852.	482	1
	Parallelia bistriaris Hbn., 1818.	199	1
	Phlogophora periculosa G., 1852.	502	1
	Xestia bicarnea (Gn., 1852).	408	1
Thyatiridae	*Pseudothyatira cymatophoroides*	291	1
Tortricidae	*Olethreutes trinitana* (McD., 1931).	934	1

MISCELLANEOUS INSECTS

DIPTERA: FLIES

INSECT	HOST	LOCALITY	REMARKS
Blowflies Family Calliphoridae	Household	Springfield Craftsbury Burlington	Associated with dead animals in attics.
Dark-winged Fungus Gnats *Sciara* sp. Family Sciaridae	Household	Middlesex	Aggregations reported in windows.
Deer Flies *Tabanidae*	Human	Throughout	Very high numbers.
Drain Flies Family Psychodidae	Household, in drain	Burlington	Tremendous numbers found in clogged drain pipe.
Fungus Gnats Family Fungiovoridae (formerly Mycetophilidae)	Household	Barre	Associated with houseplants.

MISCELLANEOUS INSECTS

HYMENOPTERA: ANTS, BEES AND WASPS

INSECT	HOST	LOCALITY	REMARKS
Baldfaced Hornet *Dolichovespula maculata*	At large, annoying humans	Jericho	Concern about stings to human.
Carpenter Ants *Camponotus* sp.	Household	All counties	Roaming individuals and swarms reported.

MISCELLANEOUS INSECTS

HYMENOPTERA: ANTS, BEES AND WASPS

INSECT	HOST	LOCALITY	REMARKS
Ichneumonid Wasps Family Ichneumonidae	Observed in a variety of habitats	Statewide	Common parasitoids of a variety of insects. Associated with various plants, some found in homes.
Paper Wasps *Polistes* sp. Family Vespidae	At large	All counties	Usual number of inquiries about nests in worrisome locations.
Pavement Ants *Tetramorium caespitum*	At large in buildings	Burlington Montpelier	Found foraging in heated buildings.
Sphecid Wasps Family Sphecidae	On ceilings and wall of old building	Bristol	Inquirer was curious about biology of these wasps.

MISCELLANEOUS INSECTS

LEPIDOPTERA: BUTTERFLIES AND MOTHS

INSECT	HOST	LOCALITY	REMARKS
Armyworms Family Noctuidae	Various	Statewide	Caterpillars associated with a variety of host plants.
Cecropia Moth *Hyalophora cecropia*	Many hardwoods	Waterbury Corinth Essex	Interested individuals called for information about these showy moths.
Indian Mealmoth *Plodia interpunctella*	In stored products	Burlington	Common, general feeders in grain and grain products.
Paddle Caterpillar *Acronicta funeralis*	Christmas tree plantation	St. Johnsbury	Unusual, uncommon caterpillar drew attention. Crawled onto a boot.

MISCELLANEOUS INSECTS

LEPIDOPTERA: BUTTERFLIES AND MOTHS

INSECT	HOST	LOCALITY	REMARKS
Sphinx Moth Caterpillars Family Sphingidae	Roaming on various host plants	Statewide	Usual number of calls about these large, sometimes showy caterpillars.
Tiger Swallowtail *Papilio glaucus*	Hardwoods	Throughout	Adults numerous.
Virginia Ctenucha Moth *Ctenucha virginica*	At large in sedges	Berlin	Identification request for these showy, metallic blue moths.

MISCELLANEOUS INSECTS

COLEOPTERA: BEETLES

INSECT	HOST	LOCALITY	REMARKS
Bostrichid Beetles Family Bostrichidae	Wood products	Berlin	Of concern to homeowner.
Carpet Beetles, including *Attagenus megatoma*, *Anthrenus scrophulariae*, *Dermestes lardarius*, *Trogoderma* sp. and others Family Dermestidae	Stored food and textiles	Dummerston Montpelier Chester Morrisville Burlington	Usual number of requests about dermestids that were found feeding on a variety of plants and animal products.
Carrion Beetles *Necrodes surinamensis*	At large in home	Waterbury	Associated with a dead animal.
Clover Weevils *Trachyphloesoma* sp.	At large in homes	Stowe Waterbury	Homeowners concerned about numbers of weevils and potential damage.

MISCELLANEOUS INSECTS

COLEOPTERA: BEETLES

INSECT	HOST	LOCALITY	REMARKS
Lampyrid Beetles Family Lampyridae	Various substrates	Statewide	Regularly seen on tree trunks, in sap buckets, etc.
Lily Leaf Beetle *Lilioceris lilii*	Lilies	Franklin Co.	Numerous specimens collected on daylilies.
Mealworms Family Tenebrionidae	In homes	Barre Waterbury	Larvae found in several homes; occupants concerned.
Multicolored Asian Lady Beetle *Harmonia axyridis*	In homes	Statewide	Still receiving questions about fall aggregations of these beetles.
Prionid Beetles (Tile-horned and Brown) *Prionis laticollis* and *Orthosoma brunneum*	At large	Colchester Waterbury	Large beetles generated curiosity in those who found them.
Sawtoothed Grain Beetle *Oryzaephilus surinamensis*	Stored food products	Essex	Heavy infestation in stored products in home.

MISCELLANEOUS INSECTS

HEMIPTERA: TRUE BUGS

INSECT	HOST	LOCALITY	REMARKS
Assassin Bugs Family Reduviidae	Feeding on insect	Starksboro	Common predators drew attention of onlookers.
Chinch Bugs *Blissus* sp.	Lawns	Springfield Reading	Discolored, scattered patches of lawn.
Giant Water Bug Family Belostomatidae	Ponds	Waterbury Montpelier Bristol	Attracted to lights.
Western Conifer Seed Bug *Leptoglossus occidentalis*	On and in buildings	Statewide	See Fruit, Nut and Flower Insects.

MISCELLANEOUS INSECTS

OTHER MISCELLANEOUS INSECT ORDERS

INSECT	HOST(S)	LOCALITY	REMARKS
Bark Lice Order Psocoptera	Huge aggregations on a variety of trees	Statewide	These lichen and algal feeders were especially numerous this year.
Camel Crickets Family Gryllacrididae Order Orthoptera	Found on patio	Springfield	Crickets in this group appeared hump-backed.
Cicadas Family Cicadidae Order Homoptera	Found resting on various substrates	Montpelier	Adults and castings from last nymphal molt submitted to lab.
Dobsonflies *Corydalus cornutus* Order Neuroptera	Aquatic	Montpelier Bristol	A few specimens are received each year from people who wonder if these insects are as fierce as they look.

SPIDERS AND TICKS

As usual, this year we received specimens or inquiries at the Forest Biology Lab about a variety of arachnids. Spiders included the typical line-up: black-and-yellow and silver argiopes (*Argiope trifasciata* and *A. argentata*), barn spiders (*Araneus cavaticus*), crab spiders (family Thomisidae), fishing spiders (*Dolomedes tenebrosus*), grass spiders (family Agelenidae), jumping spiders (family Salticidae), and wolf spiders (family Lycosidae).

Ticks that were found on or taken from animals or humans in Vermont or nearby states and sent to the Forest Biology Lab for identification included deer ticks (*Ixodes scapularis*), American dog ticks (*Dermacentor variabilis*) and a lone star tick, (*Amblyomma americanum*).

STEM DISEASES

Beech Bark Disease, caused by *Cryptococcus fagisuga* and *Nectria coccinea var. faginata* caused chlorosis and dieback that was more conspicuous than normal due to drought. Damage was mapped on 4,004 acres during the aerial survey (Table 12, Figure 23).

Although tree condition in monitoring plots was stable, there was less beech scale than in recent years, as indicated by wax cover (Figure 24). This may be due to the heavy rains in 1998.

Table 12. Mapped acres of beech bark disease damage in 1999.

County	Acres
BENNINGTON	298
CALEDONIA	102
CHITTENDEN	28
ESSEX	523
FRANKLIN	198
ORLEANS	27
RUTLAND	511
WINDHAM	1,382
WINDSOR	936
Statewide Total	**4,004**

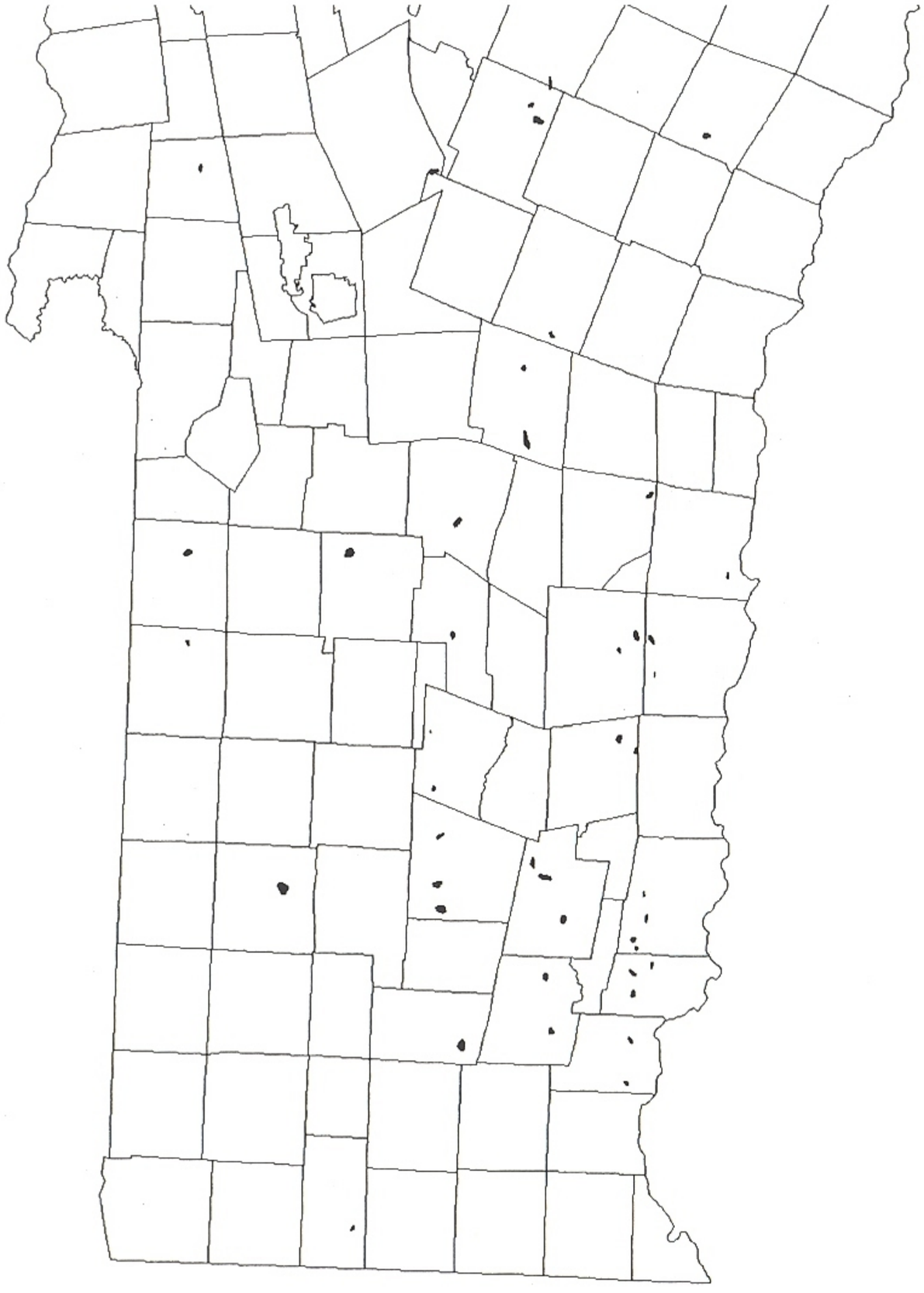
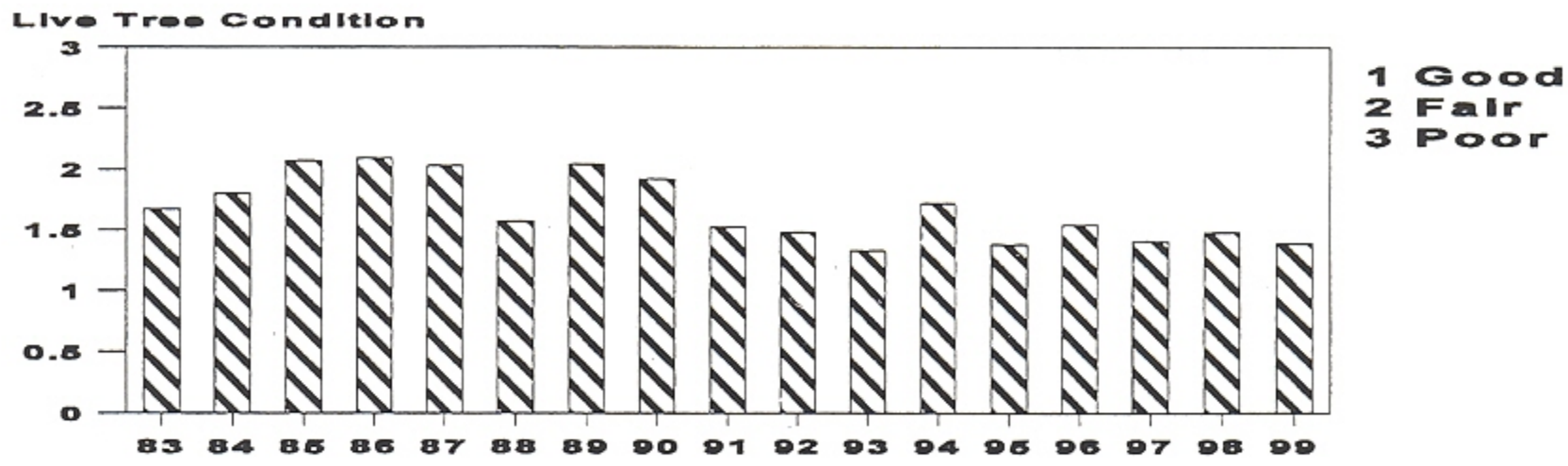
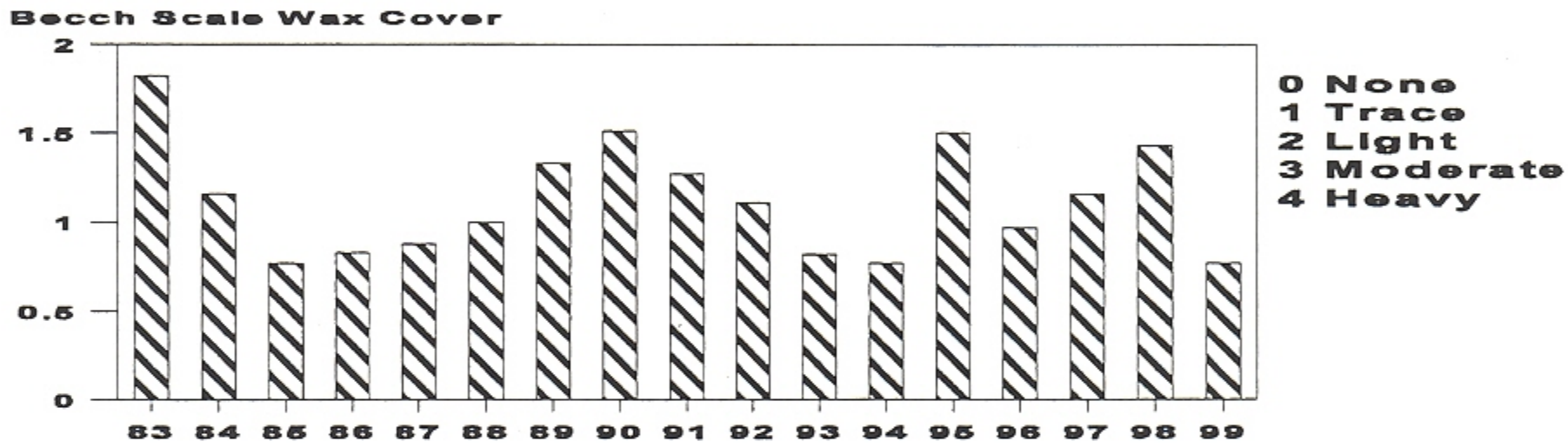


Figure 23. 1999 Damage by beech bark disease. Mapped area is 4,004 acres.





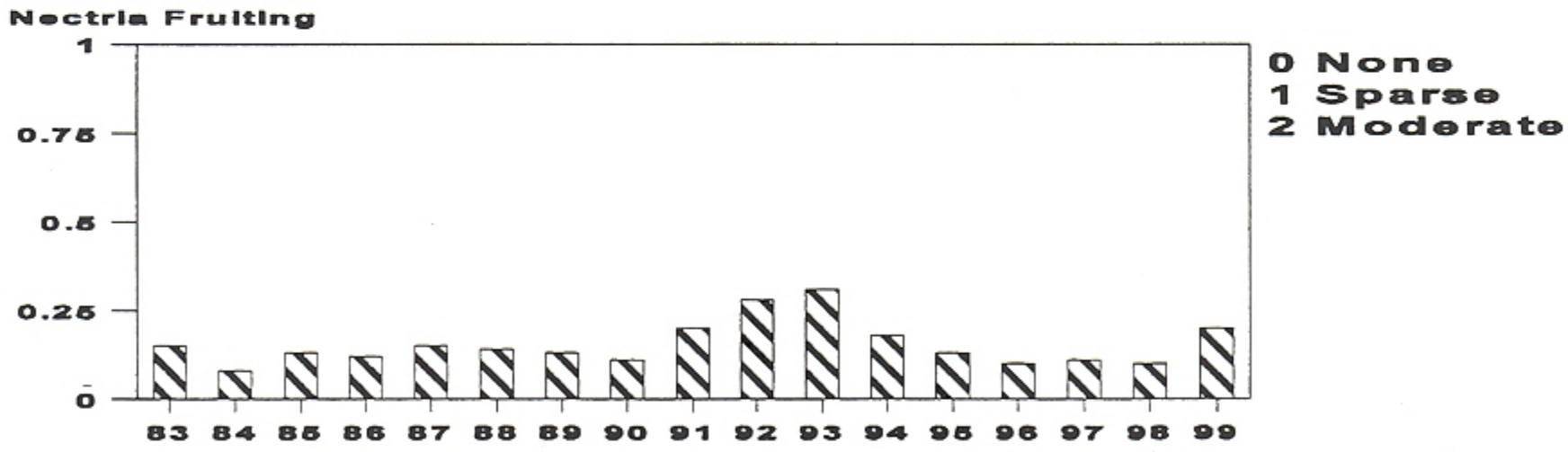


Figure 24. Average live tree condition, beech scale wax cover, and Nectria fruiting ratings, 1983-1999. Average of three southern Vermont locations, 1983-1992, and six to eight locations statewide, 1993-1999.

Diplodia (Sphaeropsis) Tip Blight caused by *Sphaeropsis sapinea*, was the single most common disease detected in Christmas trees this year. A total of 231 acres with light infection from this disease were detected in the northern Vermont survey. In mixed plantations of pine and fir, infection was generally more frequent on pines, especially Scots pine.

Scleroderris Canker, caused by *Ascocalyx abietina*, has not been found in any new towns since 1986. Fifteen pine Christmas tree plantations within the quarantine zone (Figure 25), were surveyed for the presence of the disease this year and all were found free of the disease.

White Pine Blister Rust, *Cronartium ribicola*, symptoms were more noticeable due to drought. Levels of infection may also have been higher because of preceding wet years. During the annual northern Vermont Christmas tree survey, 136 acres were reported to have light infection, 25 acres had moderate infection and 15 acres had heavy infection.

A more intensive survey was conducted in six Christmas tree plantations in northern Vermont and eight pole-sized stands in Rutland County to document the type and extent of infection. In the Christmas tree plantations, blister rust infection rates per plantation ranged from 10% to 42%, averaging 20% of the 721 trees examined. In the Rutland County pole-sized stands, infection levels ranged from 12-46%, averaging 32%, with mainstem infections present on 76% of infected trees. In these stands, 98% of Ribes plants had white pine blister rust fruiting structures (Figure 26). These surveys indicate an extremely high rate of infection in both natural stands and Christmas tree plantations. The Forestry Division in cooperation with Dr. Dale Bergdahl at UVM will re-examine these and inspect other stands in 2000.

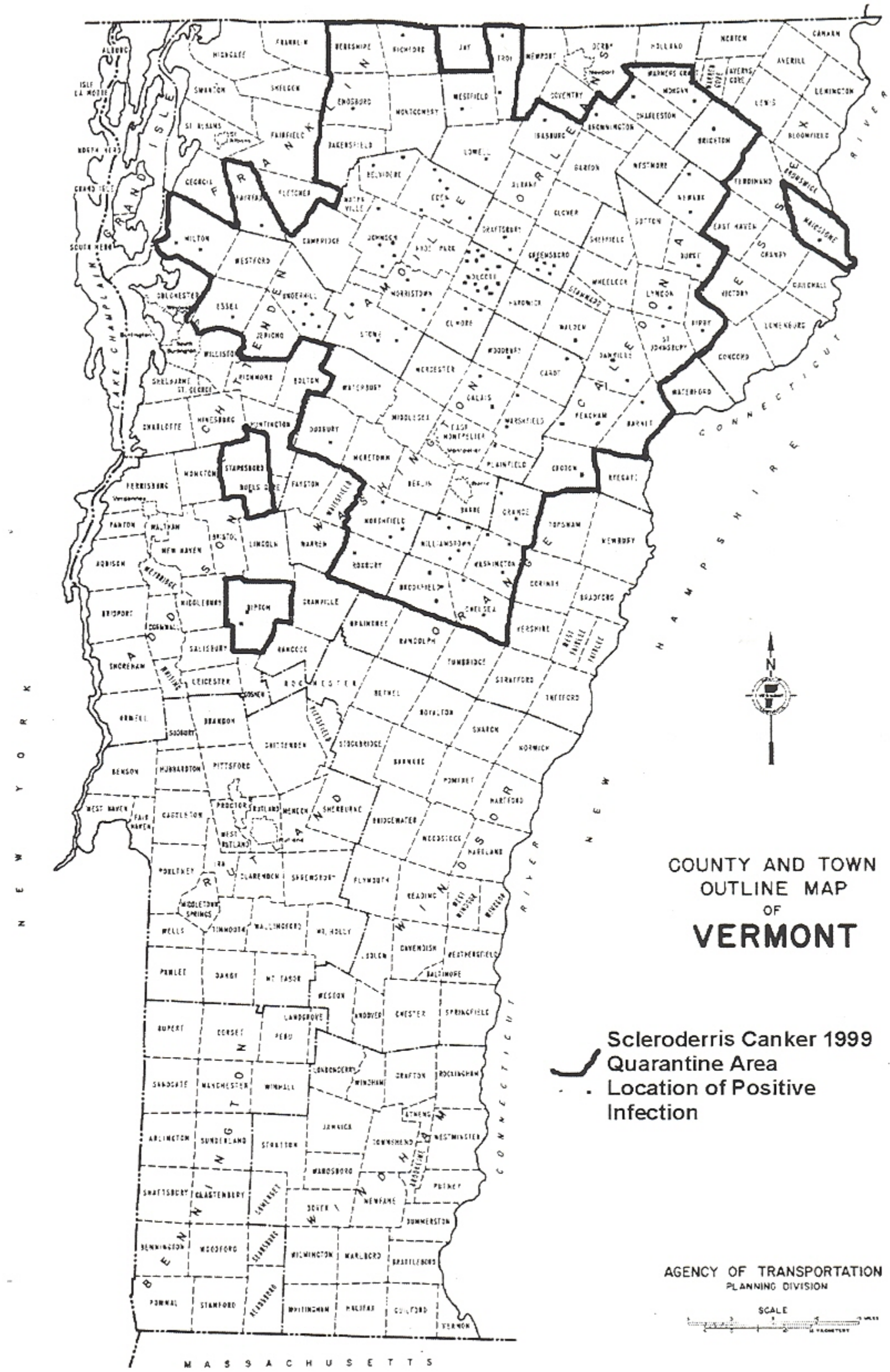


Figure 25. 1999 Scleroderris Canker quarantine area and location of positive infections.

1999 White Pine Blister Rust Infection Rates

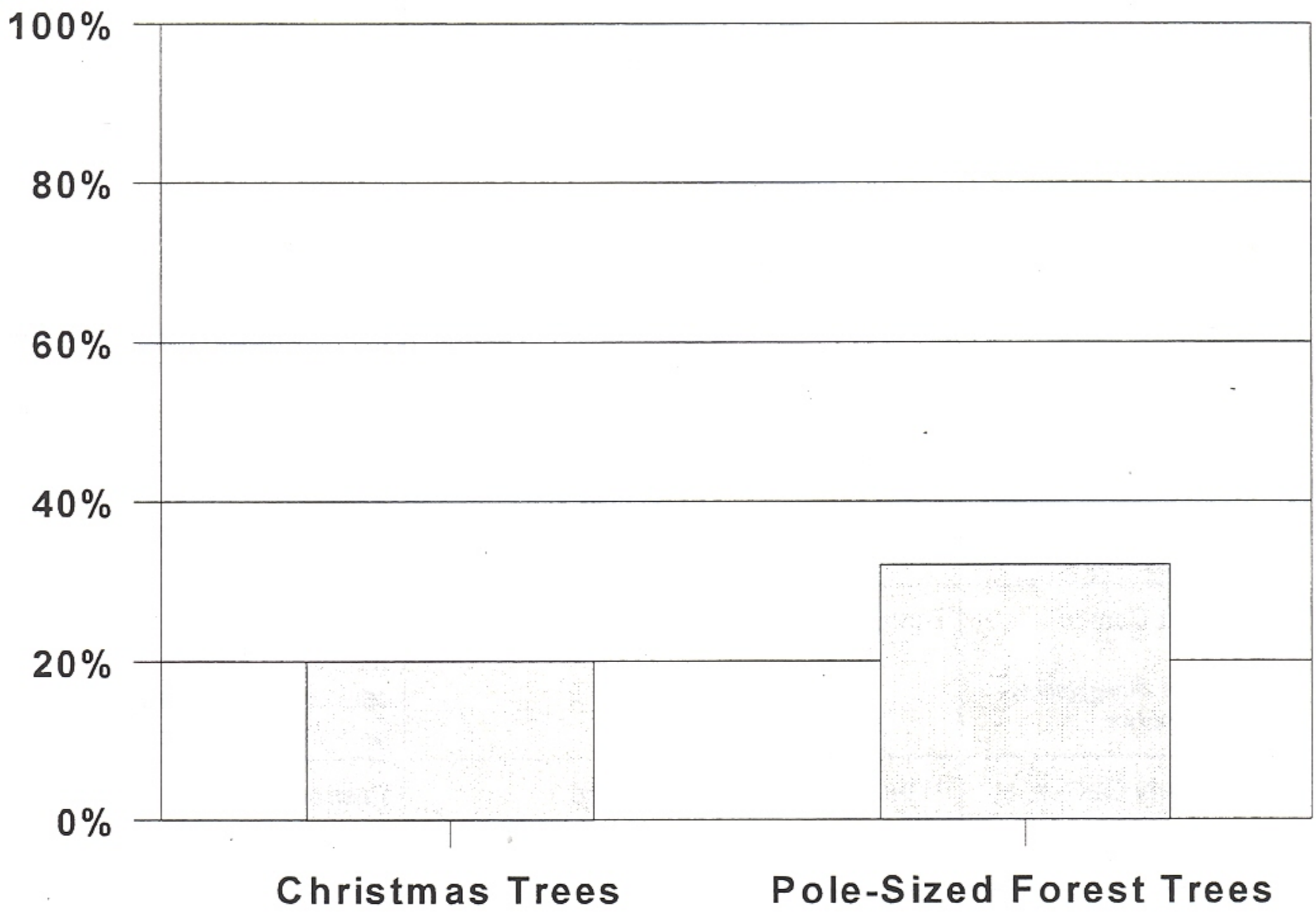


Figure 26. Percent of white pine trees infected with white pine blister rust in a survey of six Christmas tree plantations in northern Vermont and eight pole-sized stands in Rutland County.

OTHER STEM DISEASES			
DISEASE	**HOST(S)**	**LOCALITY**	**REMARKS**
Annual Canker *Fusarium sp.*	Sugar Maple	Dummerston	On thin, ledgey soils.
Ash Yellows *Mycoplasma-like organism*	White Ash	Southern Vermont Champlain Valley	Mortality continues. Levels generally appear stable, possibly increasing in Rutland County.
Beech Bark Disease *Cryptococcus fagisuga* and *Nectria coccinea var. faginata*			See narrative.
Black Knot *Dibotryon morbosum*	Black Cherry	Throughout	Commonly seen.
Botryosphaeria Canker *Botryosphaeria spp.*	Pear	Norwich	Foliage discolored, blister-like formations. Bark rough.
Butternut Canker *Sirococcus clavigignenta-juglandacearum*	Butternut	Throughout	Remains a common cause of mortality. Trees without cankers occasionally observed in heavily-infected stands.
Caliciopsis Canker *Caliciopsis pinea*	White Pine	Scattered	Less common than a few years ago but still noticeable in the Connecticut River Valley.
Chestnut Blight *Cryphonectria parasitica*	American Chestnut	Throughout	Observed on previous "escape" in Stockbridge.
Coral Spot Nectria *Nectria cinnabarina*	Sugar Maple Pear	Throughout Montpelier	Fruiting extensively on young dying ornamental in Rutland. Remains common in ice-damaged stands. Twigs exhibiting cankers on branches, some associated with injuries or bud scars, but some evident without any wound or natural opening.

OTHER STEM DISEASES			
DISEASE	**HOST(S)**	**LOCALITY**	**REMARKS**
Cytospora Canker *Leucostoma kunzei*	Blue Spruce Concolor Fir Norway Spruce	Rockingham Northeast Kingdom	Ornamentals.
Delphinella Tip Blight of Fir *Delphinella balsamae*	Balsam Fir	Danville Wolcott East Montpelier	Light to moderate infection in three Christmas tree plantations. Decreasing.
Diplodia Shoot Blight *Diplodia pinea (Sphaeropsapinea)*			See narrative.
Dutch Elm Disease *Ceratocystis ulmi*	American Elm	Throughout	Appears stable. Mortality of young roadside elms common.
Eastern Dwarf Mistletoe *Arceuthobium pusillum*			Not reported.
Fireblight *Erwinia amylovora*	Apple Pear Peach Crabapple	Chittenden, Caledonia, Orleans & Washington Counties	Several calls on ornamentals. Some heavy damage.
Hypoxylon Canker *Hypoxylon pruinatum*	Aspen	Throughout	Breakage of cankered trees common following summer windstorms.
Maple Canker *Steganosporium ovatum*	Sugar Maple	Burlington	Wilting and dieback on ornamentals.
Oak Wilt *Ceratocystis fagacearum*			Not detected. No suspects seen during aerial surveys.
Red Ring Rot *Phellinus pini*	White Pine	Canaan Springfield	Heavy losses. Extensive in high-activity recreation area.

OTHER STEM DISEASES			
DISEASE	**HOST(S)**	**LOCALITY**	**REMARKS**
Sapstreak *Ceratocystis coerulescens*	Sugar Maple	Putney Londonderry	Wounded trees in a recently-opened stand. Logging wounds.
Scleroderris Canker *Ascocalyx abietina*			See narrative.
Sirococcus *Sirococcus strobilinius*	Blue Spruce White Spruce	Widely scattered	Increasing, with 45 acres of light infection in Christmas trees compared to trace levels on 30 acres in 1998.
Sugar Maple Canker *Unknown*	Silver Maple	Coventry	Dead patches in bark.
Tomentosus Butt Rot *Inonotus tomentosus*			Not reported.
Verticillium Wilt *Verticillium albo-atrum* or *V. dahliae*	Sugar Maple	Northeast Kingdom	One call.
White Pine Blister Rust *Cronartium ribicola*			See narrative.
Woodgate Gall Rust *Endocronartium harknessii*	Scots Pine	Throughout	Remains common in Scots pine Christmas tree plantations. Lighter than in 1998. Also observed on ornamentals.
Yellow Witches Broom Rust *Melampsorella caryophyllacearum*	Balsam Fir	Widespread	Increasing in northern Vermont. Light infection on 92 acres and moderate infection on 15 acres of Christmas trees. Increasing in some southern Vermont Christmas tree plantations, decreasing in others.

FOLIAGE DISEASES

Anthracnose on sugar maple and other hardwoods, caused by *Gloeosporium spp.*, occurred at much lower levels than 1998. Dry spring conditions reduced the opportunity for infection. Damage was occasionally observed in southern Vermont on roadside trees, associated with thrips damage, or on regeneration. There was some heavy defoliation along roadsides in Guilford and Halifax. In northern Vermont, very little anthracnose was observed.

Brown Spot Needle Blight, caused by *Scirrhia acicola,* AKA *Mycosphaerella dearnessii*, led to widespread white pine needle browning, and drop of previous year needles, in many locations during early summer. Infection of affected needles took place during the extremely wet summer of 1998. New growth developed normally, and, by mid-summer, trees were green, with thinner than normal foliage.

Damage was especially noticeable in Lamoille, Orange, Washington, Windsor, and Windham Counties but was present elsewhere. Needle blight was difficult to detect from the air, as symptoms were most severe in the lower crown. However, some of the pine browning mapped during the aerial survey (Table 13) was due to brown spot. Brown spot was also observed in a planting of Austrian pine on heavy soils in Shelburne associated with needle and twig necrosis.

This disease has been reported on Scots pine in Vermont in the past but had not been identified on white pine prior to 1999.

Table 13. Mapped acres of white pine browning and other pine symptoms in 1999.

County	Acres
BENNINGTON	44
CHITTENDEN	2
FRANKLIN	9
RUTLAND	251
WINDHAM	204
WINDSOR	66
Statewide Total	**577**

OTHER FOLIAGE DISEASES			
DISEASE	**HOST(S)**	**LOCALITY**	**REMARKS**
Anthracnose *Gloeosporium spp.*			See narrative.
Anthracnose *Glomerella spp.*	American Elm	Brattleboro	Liberty elm with leaf spot.
Anthracnose *Gnomonia ulmea*	Camperdown Elm	Montpelier	Black spots on foliage.
Apple Scab *Venturia inaequalis*	Apple	Throughout	Common at mostly moderate levels.
Balsam Fir Needlecast *Lirula nervata*	Balsam Fir	Montpelier Rockingham	Light infection in Christmas tree plantations.
Black Rot *Guignardia bidwell*	Grape	Guilford	Spots on foliage.
Boxelder Shoot Blight Possibly *Leptosphaeria sp.*	Boxelder	Southern Vermont	Most severe on lower and inside branches in riparian areas. Common in late June.
Brown Spot Needle Blight *Scirrhia acicola* *Mycosphaerella dearnessii*			See narrative.
Cedar-Apple Rust *Gymnosporangium juniperi-virginianae*	Apple	Newfane	Spotting on foliage.
Coccomyces Leaf Spot *Blumeriella jaapii*	Black Cherry	Lamoille & Caledonia Counties	Very light, unlike 1998, when it was unusually heavy.
Crabapple Leaf Spot Unidentified fungus	Crabapple	Westminster Brattleboro Newfane	Causing defoliation of ornamentals.

OTHER FOLIAGE DISEASES			
DISEASE	**HOST(S)**	**LOCALITY**	**REMARKS**
Cyclaneusma Needlcast (formerly Naemacyclus) *Cyclaneusma minus*	Scots Pine	Throughout	Back down to light levels, after severe damage in 1998.
Fir Fern Rust *Uredinopsis mirabilis*	Balsam Fir	Widespread	Decreasing. Light infection in 167 acres of Christmas trees in survey.
Fir-Fireweed Rust *Pucciniastrum epilobii*	Balsam Fir	Danville	
Giant Tar Spot *Rhytisma sp.*	Norway Maple	Southern Vermont	Present, but much less than 1998.
Horsechestnut Leaf Blotch *Guignardia aesculi*	Horsechestnut	Rutland	Street tree.
Lophodermium Needlecast *Lophodermium seditiosum*	Scots Pine	Throughout	Decreasing. Light damage to Christmas trees.
Phyllosticta Leaf Spot *Phyllosticta spp.*	Japanese Maple	Brattleboro	Foliar spotting.
Poplar Leaf Blight *Marssonina spp.*	Balsam Poplar	Franklin, Chittenden & Addison Counties	Present but at much lighter levels than in 1998.
Powdery Mildew *Eryiphaceae*	Flowers Lilac, etc.	Widespread	Decreasing. At light levels.
Rhabdocline Needlecast *Rhabdocline pseudotsugae*	Douglas Fir	Widely scattered	Stable at light to moderate levels on Christmas trees.

OTHER FOLIAGE DISEASES			
DISEASE	**HOST(S)**	**LOCALITY**	**REMARKS**
Rhizosphaera Needlecast *Rhizosphaera kalkhoffii*	Blue Spruce White Spruce	Throughout	Increasing on ornamentals and Christmas trees. Scattered heavy defoliation of lower branches. 100 acres of light damage and 20 acres of moderate damage to Christmas trees in survey.
Rhizosphaera Needle Blight *Rhizosphaera pini*	Balsam Fir	Throughout	Remains common but reduced to mostly light levels. Light infection of 117 acres and moderate infection of 10 acres in Christmas trees surveyed.
Septoria Leaf Spot *Septoria sp.*	Sugar Maple	Shrewsbury	Light spotting on foliage.
Spruce Cushion Rust *Chrysomyxa weirii*	Blue Spruce	Rutland Craftsbury	On yard trees. In one site, heavier infection on the smaller (pole sized) tree. Orange fruiting bodies on 1st and 2nd year needles.
Spruce Rusts *Chrysomyxa spp.*	White Spruce	Starksboro Danville	Light infection.
Swiss Needlecast *Phaeocryptopus gaeumanni*	Douglas Fir	Widespread	Remains common wherever Douglas fir is planted.
Tar Spots *Rhytisma acerinum* *Rhytisma punctatum*	Sugar Maple Red Maple	Widely scattered	Light damage, down from 1998 levels. See Giant Tar Spot.
White Pine Needle Blight *Canavirgella banfieldii*	White Pine	Throughout, especially Windsor County	Brown or straw-colored foliage in early to late June. Symptomatic foliage has dropped by July. In northern Vermont survey, detected on only 25% of acreage infected in 1998.

ROOT DISEASES

Phytophthora Root Rot, by *Phytophthora spp*., was the suspected cause of a large increase in balsam and Fraser fir Christmas tree mortality related to the extremely wet summer of 1998. Of the northern Vermont plantations annually surveyed, two plantations (14 acres) had moderate losses and one (20 acres) had light losses. Elsewhere, many calls were received and a number of other plantations scattered throughout Vermont were visited. Some of these had losses in the thousands of dollars.

OTHER ROOT DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Annosus Root Rot *Heterobasidion annosum*			Not reported.
Phytopthora Root Rot *Phytophthora spp.*			See narrative.
Shoestring Root Rot *Armillaria spp.*	Many Hemlock	Throughout Springfield Grafton Royalton	Remains common on stressed trees. Associated with scattered mortality, following logging or unknown stress.

DIEBACKS, DECLINES AND ENVIRONMENTAL DISEASES

Birch Decline occurred in scattered locations, and was mapped in Addison (68 acres) and Orange (26 acres) counties during aerial survey. Since last evaluated in 1997, birch dieback in monitoring plots improved or stayed the same in seven of the nine stands surveyed. Although the general trend was towards improvement, the statewide average remains similar to 1997 (Figure 27), because of a substantial dieback from ice damage, and impacts from logging, in the Barnard plot. Birch decline is generally expected to increase over the next few years, since white birch is sensitive to drought.

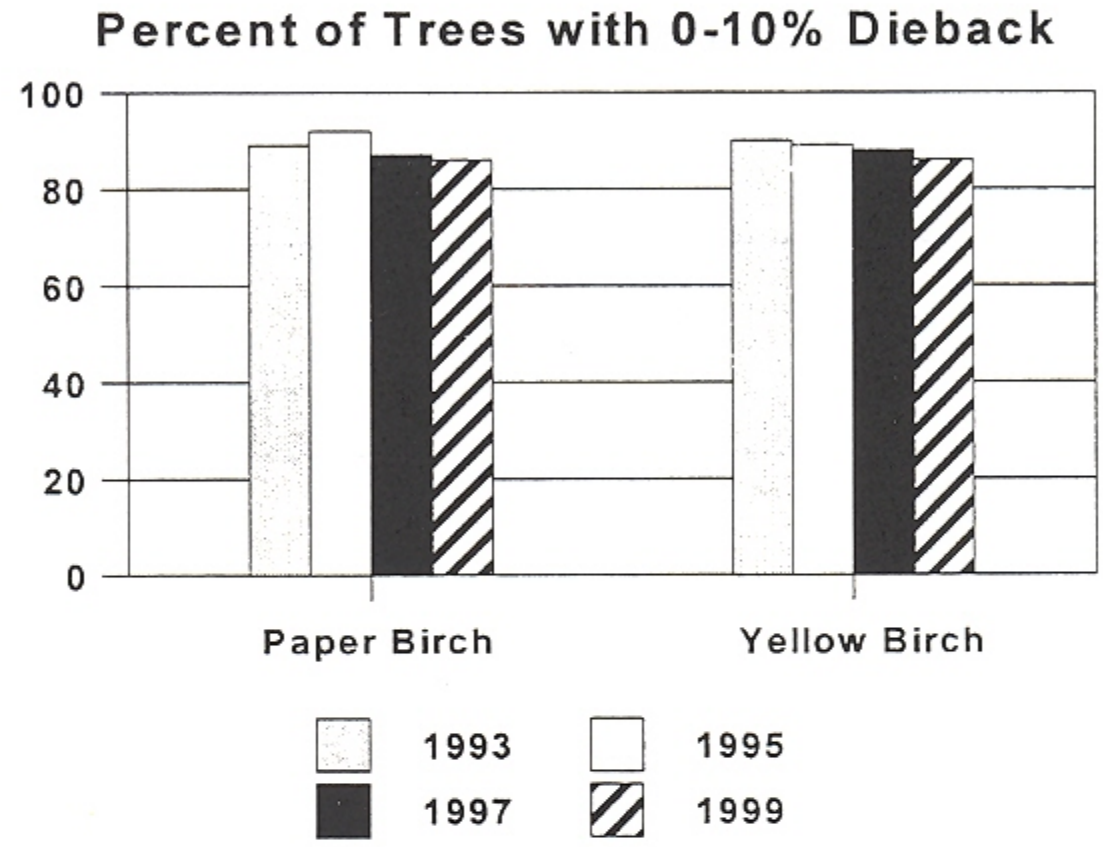


Figure 27. Average percent of live birch trees (≥ 5" DBH) with ≤ 10% dieback in 9 birch monitoring plots 1993-1999.

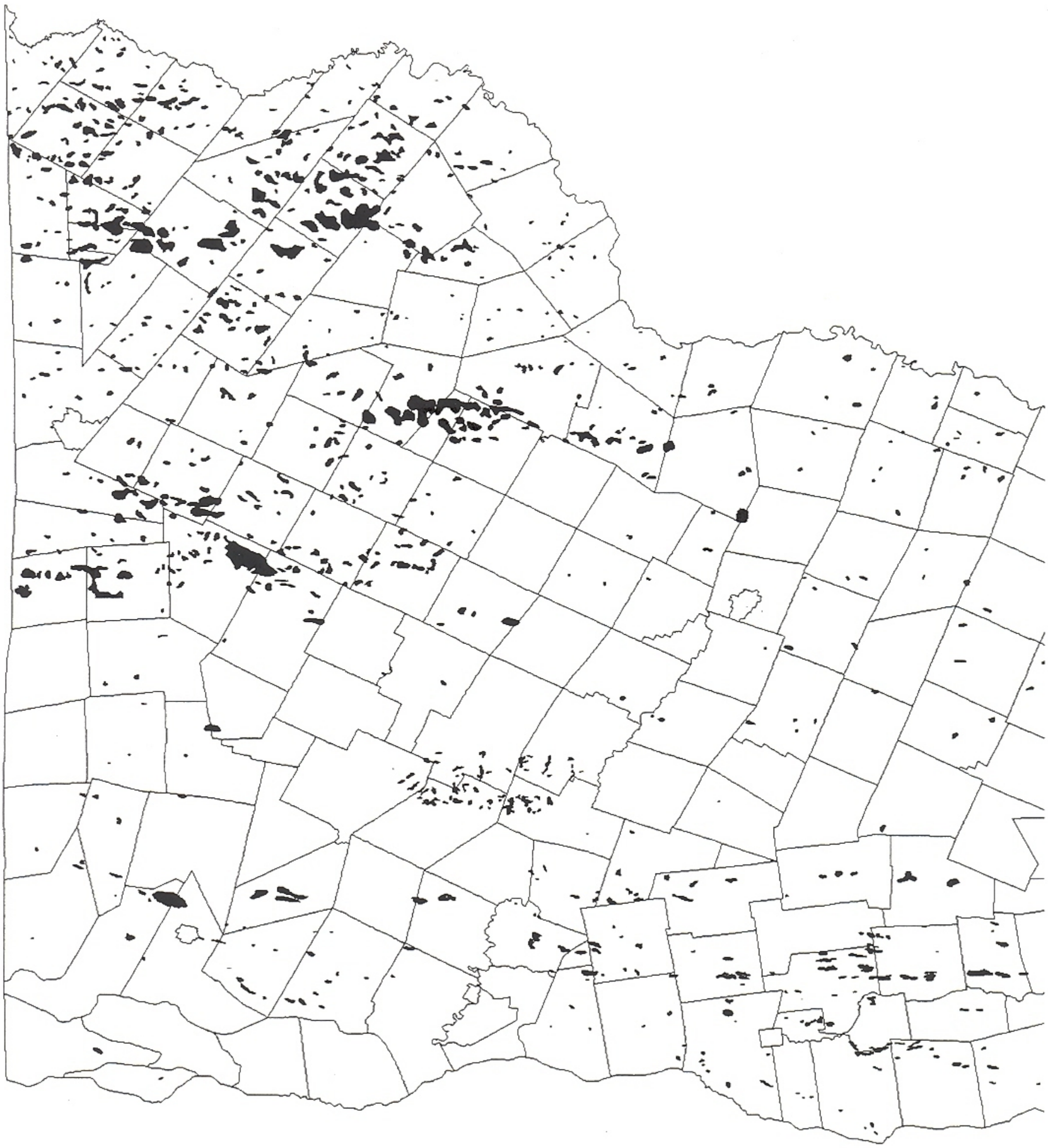
Drought Conditions led to widespread leaf scorch, yellowing and browning on hardwoods. Some symptoms were visible by late June, but most became more severe and widespread as the season progressed. Foliar symptoms attributed to drought were mapped on 84,727 acres (Figure 28, Table 14).

Table 14. Mapped acres of browning from drought in 1999.

County	Acres
ADDISON	7,495
BENNINGTON	0
CALEDONIA	14,075
CHITTENDEN	4,836
ESSEX	33,173
FRANKLIN	4,011
GRAND ISLE	146
LAMOILLE	3,034
ORANGE	0
ORLEANS	16,763
RUTLAND	248
WASHINGTON	435
WINDHAM	0
WINDSOR	510
Statewide Total	**84,727**

Visible drought impacts observed in 1999 included:

- Scattered patches of severe damage to trees on rocky ledges statewide, including mortality of white and red pine, and scorch, defoliation and refoliation of red oak.
- Trees along village greens in the Northeast Kingdom dropped some of their leaves in late June to early July.
- Various drought symptoms on shallow, ledgy, wet, or excessively well-drained soils.
- Beech leaves on large and small trees appeared to be freeze dried.
- Hardwoods on well-drained sites, especially yellow birch, turned yellow, then brown, and dropped their leaves by mid-September.
- Wilting of forest and roadside basswood, white ash, and hobblebush.
- Scorch on roadside sugar maple and other hardwoods starting by late June, and worsening through mid-summer.
- Dieback more visible than other years on sugar maple and other hardwoods.
- Heavy infestations by hemlock borer on hemlock and bark beetles on pine, particularly on shallow or disturbed sites.



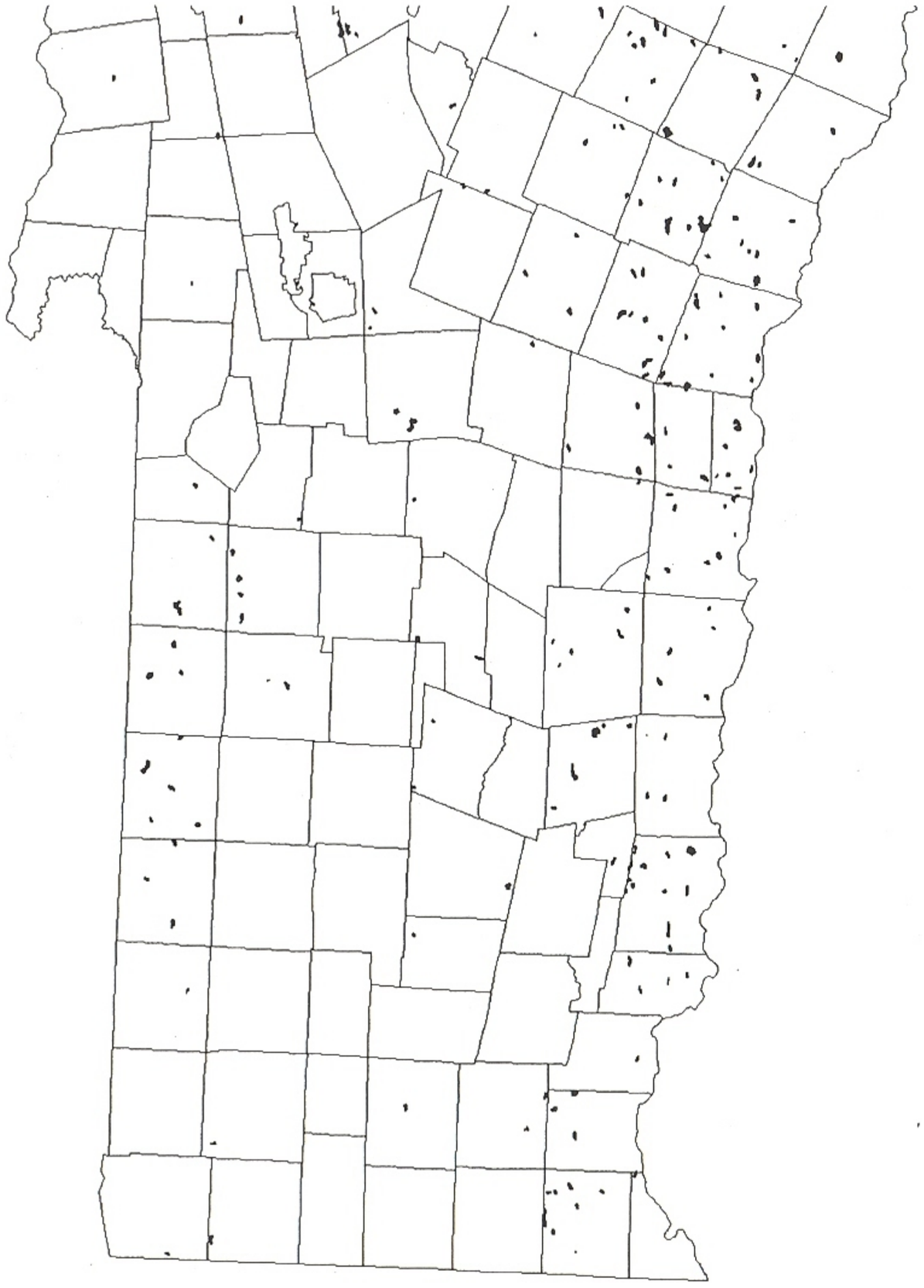


Figure 28. 1999 Symptoms associated with drought. Mapped area is 84,727 acres.

- Some early fall color, especially on drought-susceptible sites.
- Transplant mortality common in Christmas trees and ornamentals.
- Christmas tree current growth shorter than normal.
- Interior needle drop of conifers.
- Symptoms more visible on trees infected with white pine blister rust and beech bark disease, or with wounds to the trunk or roots.
- Poor refoliation after damage by pear thrips.

Even trees which did not show symptoms were impacted by low water availability. In general, trees will have produced less carbohydrates than normal, wood and shoot growth will be reduced, and they will be vulnerable to other stressors. Above average dieback and thinner crowns are expected in many locations over the next few years.

Hardwood Decline and Mortality symptoms were mapped on 21,223 acres during the aerial survey (Table 15, Figure 29). This is an increase from the 5,675 acres mapped during 1998, when water availability was greater (Figure 30).

Table 15. Mapped acres of thin crowns, chlorosis, early fall color, mortality, and dieback of hardwoods in 1999.

County	Acres
ADDISON	10
BENNINGTON	787
CALEDONIA	3,793
CHITTENDEN	29
ESSEX	0
FRANKLIN	30
GRAND ISLE	34
LAMOILLE	2,028
ORANGE	1,188
ORLEANS	4,800
RUTLAND	2,958
WASHINGTON	1,798
WINDHAM	1,965
WINDSOR	1,804
Statewide Total	**21,223**

Ice Storm Damage from 1998 remained visible during aerial surveys, with 18,847 acres mapped, but damaged stands continued to recover. Many recovering maples had small leaves, but most damaged trees had better foliage density and color than in 1998.

In ice-damaged Vermont Hardwood Health Survey plots revisited in 1999, there was little overall change in tree health compared to 1998. This reflects a dramatic improvement for ice-damaged sugar maple in the Green Mountains (Roxbury) and a reduction in tree health for most other species. Many of these, which escaped ice damage but were under severe drought stress, were in the Champlain Valley. Additional information about the recovery of damaged trees is in the section "Trend in Forest Condition", and in the report on "Ice Damage to Vermont Sugarbushes" in the appendix.

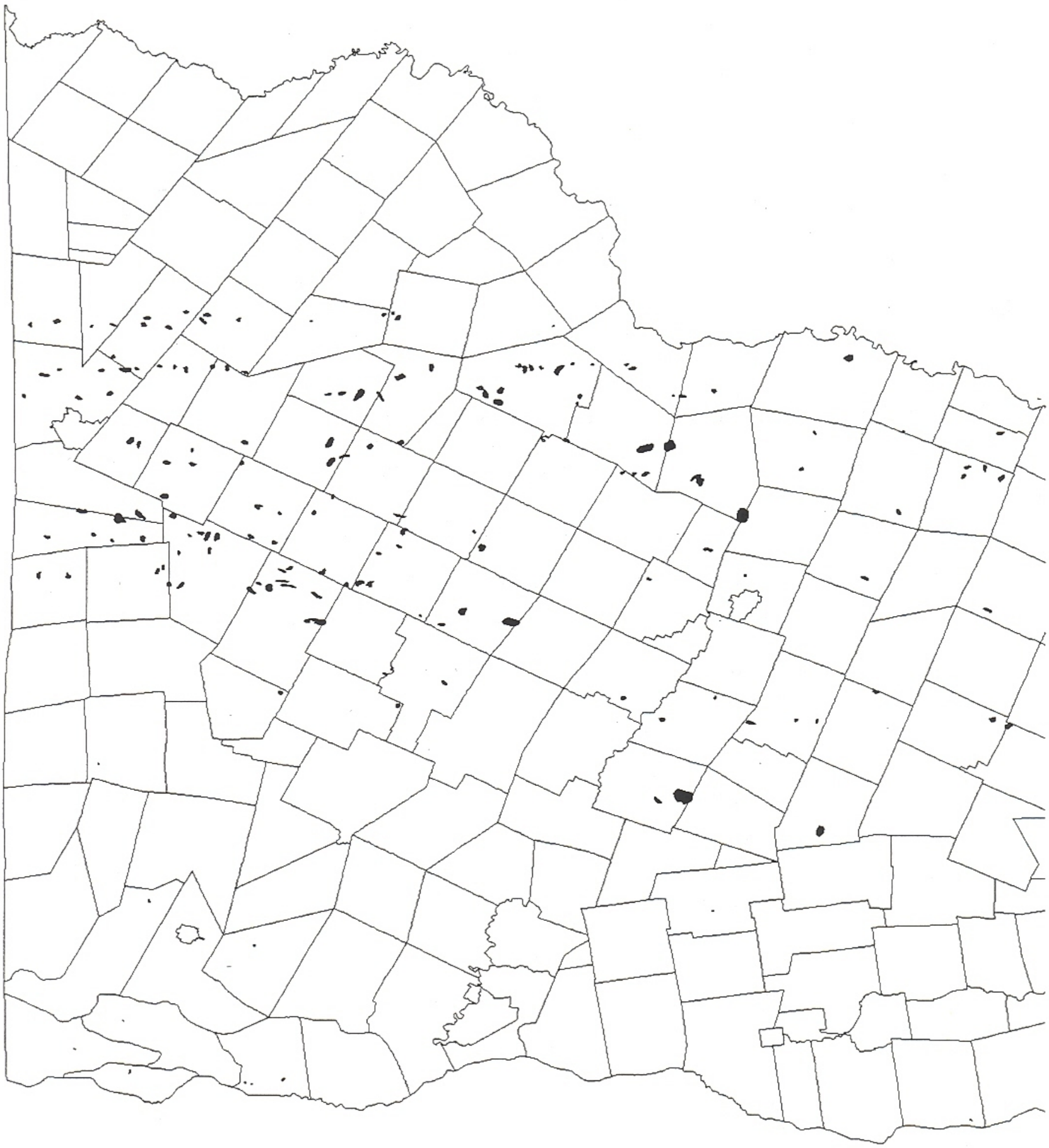
Larch Decline leading to mortality continues in scattered Northeast Kingdom locations, where 92 acres with symptoms were mapped during aerial surveys. New areas of mortality have developed in stands in Rutland and Bennington Counties where larch casebearer defoliation occurred in 1995. Larch beetle can be found in dying trees.

Snow Breakage due to a late September storm was common in several sugarbushes in Franklin County. Many branches were broken and some trees downed along a narrow band in Sheldon, Fairfield and Fletcher.

Spruce/Fir Mortality and Dieback was observed mostly at high elevations, with 3,479 acres mapped during aerial surveys (Table 16). This is an increase from the 784 acres mapped in 1998. Fir mortality on wet sites, which appeared in the spring, developed in new locations in 1999, especially in Windham County.

Table 16. Mapped acres of spruce/fir mortality and dieback in 1999.

County	Acres
ADDISON	162
BENNINGTON	312
CALEDONIA	22
CHITTENDEN	0
ESSEX	273
FRANKLIN	1,509
GRAND ISLE	0
LAMOILLE	0
ORANGE	0
ORLEANS	324
RUTLAND	363
WASHINGTON	286
WINDHAM	223
WINDSOR	5
Statewide Total	**3,479**



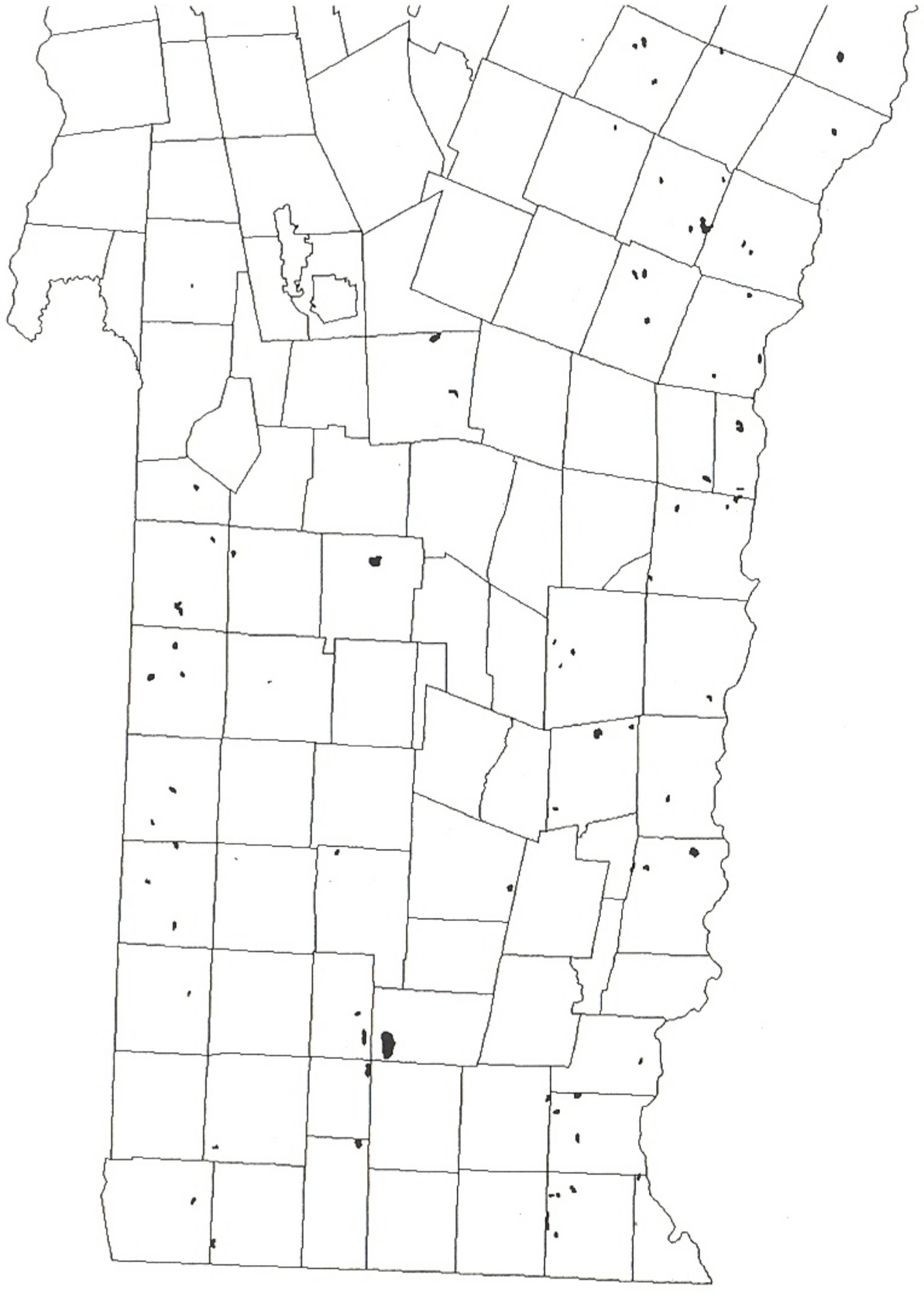


Figure 29. 1999 Hardwood thin crowns, chlorosis, early fall color, mortality, and dieback. Mapped area is 21,223 acres.

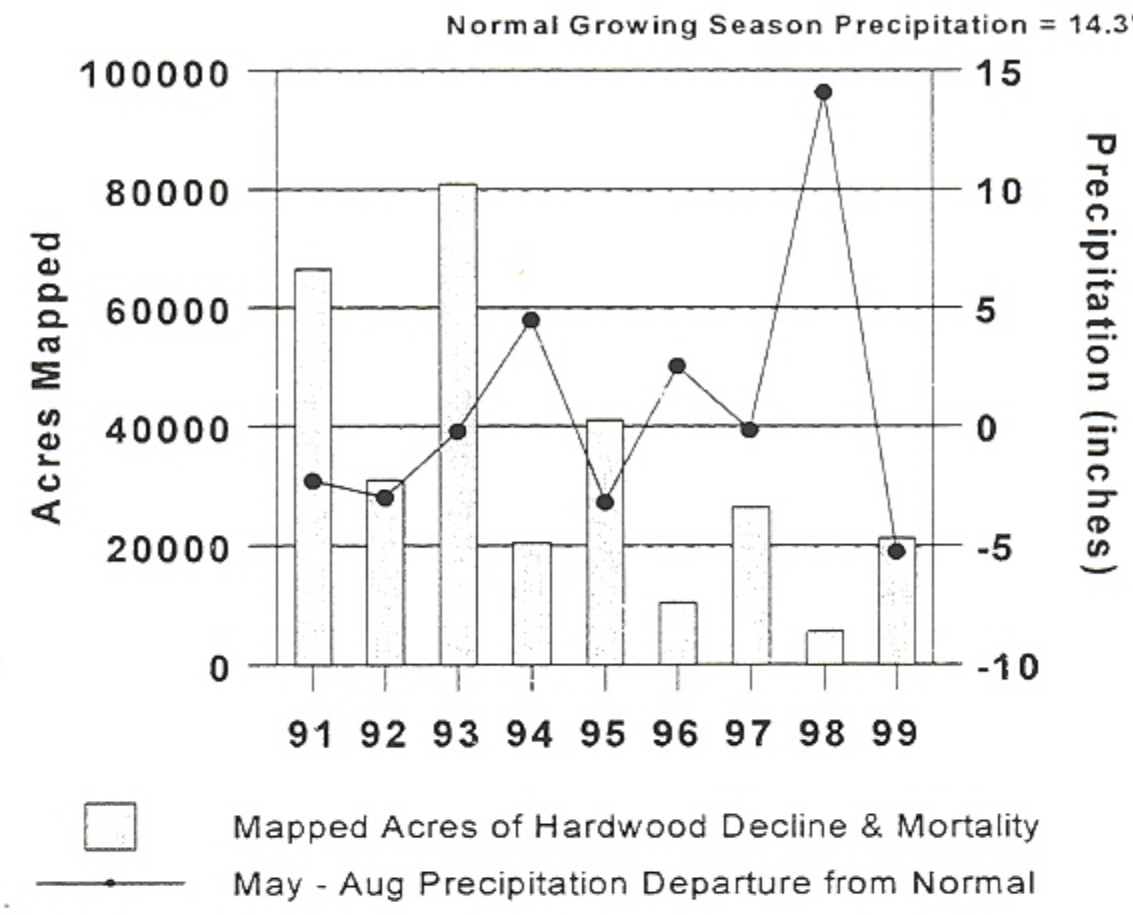


Figure 30. Acres mapped of hardwood decline and mortality during annual aerial survey, compared to growing season precipitation, 1991-1999. Precipitation data from National Weather Service, Burlington.

Unthrifty Crowns Associated with Logging were observed in scattered locations and mapped during the aerial survey (Table 17). Acres mapped were similar to 1998.

Wet Site conditions caused tree decline and mortality throughout the state, and was mapped on 10,334 acres (Table 18, Figure 31). The previous wet growing seasons caused fine root mortality on these sites. Affected root systems were often inadequate in the dry 1999 conditions. Wet sites were also associated with widely scattered Christmas tree mortality early in the season, where Phytophthora root rot frequently played a role.

Table 17. Mapped acres of unthrifty crowns associated with logging in 1999.

County	Acres
ADDISON	0
BENNINGTON	136
CALEDONIA	196
CHITTENDEN	0
ESSEX	0
FRANKLIN	0
GRAND ISLE	0
LAMOILLE	0
ORANGE	0
ORLEANS	211
RUTLAND	72
WASHINGTON	0
WINDHAM	176
WINDSOR	79
Statewide Total	**870**

Wind Damage was very common this year, related to a number of different storms, but particularly a July 6 wind storm and Hurricane Floyd (September 16-17). Especially hard hit were trees in wet areas, trees with defects, and roadside trees.

Damage from the July 6 storm occurred in scattered locations statewide, with ground reports indicating that damage was much more extensive than what was mapped during aerial surveys. Over 1000 acres in the Northeast Kingdom were detected from the air (Table 16), with most mapped areas having 30-100% of trees uprooted, snapped, or tipped. Most of the damage extended from west to east along a line running from Derby to Lemington. A large area of blowdown also occurred in the Rupert/Dorset region.

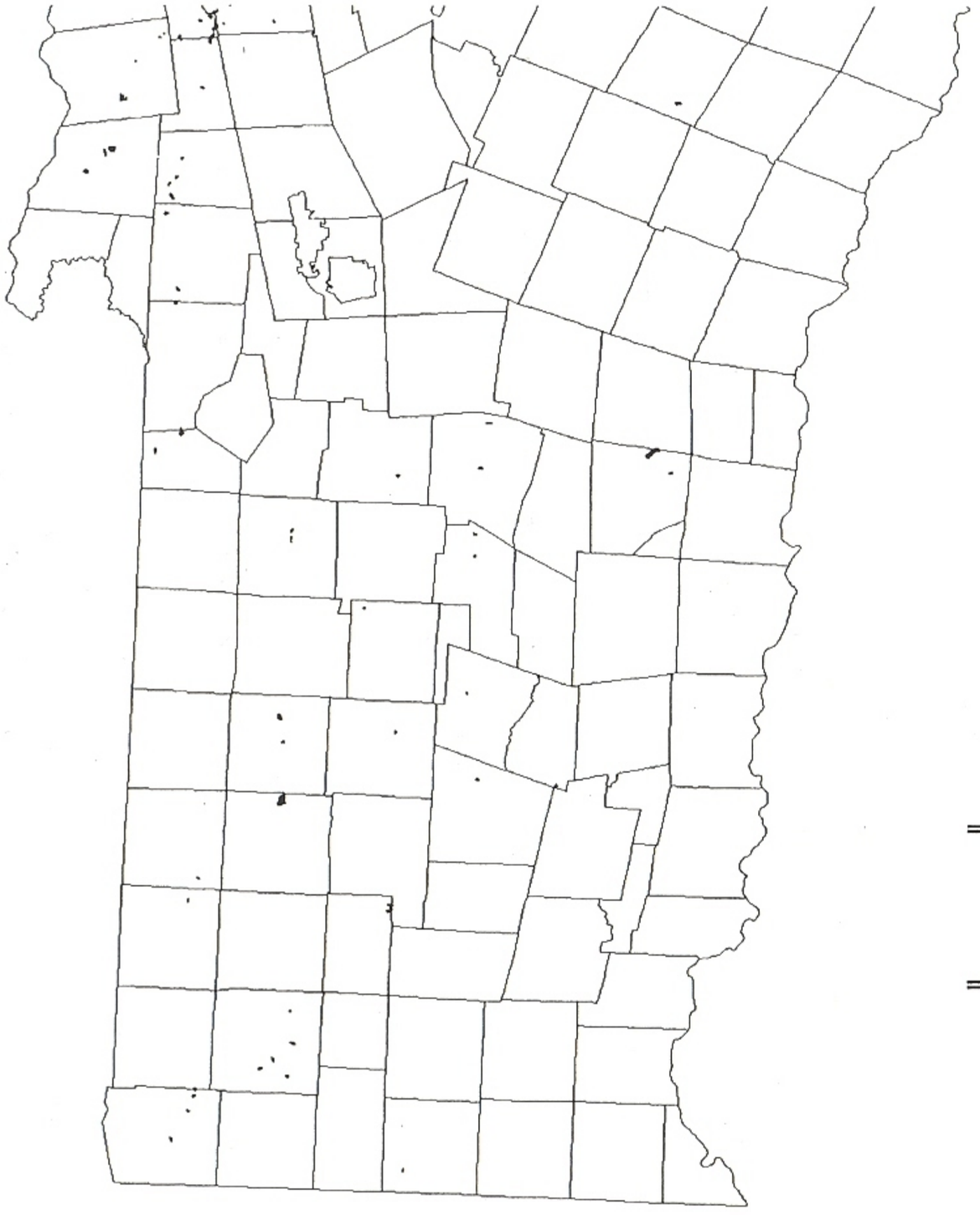


Figure 31. 1999 Dieback and mortality associated with wet site conditions. Mapped area is 10,334 acres.

Table 18. Mapped acres of dieback and mortality associated with wet site conditions in 1999.

County	Acres
ADDISON	2,928
BENNINGTON	399
CALEDONIA	1
CHITTENDEN	952
ESSEX	20
FRANKLIN	2,397
GRAND ISLE	2,463
LAMOILLE	24
ORANGE	227
ORLEANS	34
RUTLAND	491
WASHINGTON	81
WINDHAM	96
WINDSOR	223
Statewide Total	**10,334**

Table 19. Mapped acres of blowdown from wind storms in 1999.

County	Acres
CALEDONIA	21
ESSEX	592
ORLEANS	502
Statewide Total	**1,116**

Hurricane Floyd winds, combined with saturated soils from record-setting rainfall in September, uprooted many trees in scattered locations, particularly in Lamoille, Washington, Windsor, and Orleans counties. A special aerial flight in late September detected only a very small percentage of the known damage, including 65 acres in Washington and Lamoille Counties, plus an area about 1¼ miles long in the Worcester Range. The most severe damage was to paper birch that was previously damaged by the 1998 ice storm. Some spruce-fir was also blown down. County Forester reports estimate about 2000 acres of damage in Lamoille County and 5000 acres in Orleans County.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES			
DISEASE	**HOST(S)**	**LOCALITY**	**REMARKS**
Ash Defoliation	White Ash	Jamaica Winhall	No symptoms on ash in stands defoliated in 1997 by unknown cause.
Ash Dieback	White Ash	Throughout	See Ash Yellows.
Birch Decline			See narrative.
Bud Proliferation	Red Pine	Rutland	Widespread in a natural stand at an exposed location of Aiken State Forest. Some dieback present. Similar damage is known to be caused by *Trisetacus* mites.
Cherry Gummosis	Black Cherry	Northwestern Windsor County	Attributed to trees growing at higher elevations at the edge of the range of cherry.
Compaction Injury	Ornamentals	Throughout	Common.
Drought			See narrative.
Fading Out	Balsam Fir	Throughout	Above normal interior needle drop on Christmas trees in the fall attributed to drought.
Frost Damage	Maple	Lamoille, Caledonia, Washington & Orleans Counties	Very light damage to balsam fir and white spruce Christmas trees
Hardwood Decline and Mortality			See narrative.
Heavy Seed			None.
Ice Storm			See narrative.
Improper Planting	Many	Throughout	Girdling roots and trees planted too deep are often cause of dieback or mortality. Symptoms exacerbated by drought. Dessication also caused by exposed burlap left on root balls wicking away soil moisture.
Larch Decline			See narrative.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES			
DISEASE	**HOST(S)**	**LOCALITY**	**REMARKS**
Logging Related Decline			See narrative: Unthrifty Crowns Associated with Logging.
Maple Decline	Sugar Maple	Throughout	See Hardwood Decline and Mortality. Exacerbated by drought. In Shrewsbury, root breakage from past windstorms is thought to be the cause of decline in a small sawtimber-sized stand.
Mechanical Injury	Many	Throughout	Widespread cause of tree decline. Symptoms exacerbated by drought.
Nutrient Deficiency	White Spruce	Scattered	Drought led to chlorosis of needles on current shoots.
Ozone Injury			See Ozone Summary.
Pesticide Injury	Sugar Maple	Rutland	2, 4-D on ornamental.
Salt Damage	White Pine Red Pine	Throughout	Foliage damage from airborne salt less than normal.
Snow Breakage			See narrative.
Spruce/Fir Decline and Mortality			See narrative.
Spruce Needle Drop	Red Spruce	Grafton	Defoliation of current years growth of understory trees.
Wet Site			See narrative.

OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES			
DISEASE	**HOST(S)**	**LOCALITY**	**REMARKS**
White Pine Dieback	White Pine	Londonderry Wardsboro	Unexplained scattered shoot dieback continues, although less severe than 1998. Scattered mortality observed during aerial flights. Samples were examined at the FPR Forest Biology lab at the UVM Forest Pathology lab and by the Maine Forest Service. No pathogens were isolated from symptomatic shoots. Shoot tips often resin soaked. Increment growth of symptomatic trees had slowed down since 1995.
White Pine Needle Blight			See Other Foliage Diseases.
Wind Damage			See narrative.
Winterburn	Conifers	Throughout	Very little winterburn compared to other years.

ANIMAL DAMAGE			
ANIMAL	**SPECIES DAMAGED**	**LOCALITY**	**REMARKS**
Beaver	Many	Throughout	Population increasing. Many new ponds, particularly in Green Mountains.
Deer	Sugar Maple White Ash Other Hardwoods	Throughout, especially outside of the Green Mountains in southern Vermont.	Population increasing. Mild winters past 5-7 years have allowed them to roam greatly in the winter. Heavy browse pressure, invasive exotic plants, and fern invasion preventing adequate regeneration in many areas.
	White Pine	Brattleboro	Stripping bark on sapling and pole-sized trees.
	Beech	Newfane	All seedlings on 10-acre woodlot heavily browsed.
Moose	Many	Widely scattered	Stripping of bark in winter becoming more common.
Mouse	Ornamentals	Rutland St. Johnsbury	Girdling at base.
Pileated Woodpecker	Hemlock White Pine	Chittenden County	Numerous calls on stressed trees being worked by these woodpeckers following invasion by bark beetles, hemlock borers, and other insects.
Porcupine	Many	Scattered	Observed occasionally. Little damage, similar to recent years.
Sapsucker	Birch Sugar Maple	Londonderry Franklin	Heavy damage and mortality throughout a small, young stand.
Squirrel	Sugar Maple	Castleton	Tooth wounds.
	Norway Spruce Red Spruce	Throughout	Shoot clipping heavy late summer through winter.
	Tubing	Scattered	Appears stable.

INVASIVE PLANTS

Contributed by Bob Popp, Vermont Nongame and Natural Heritage Program

Biological pollution is a term that many are unfamiliar with. Unfortunately, we'll get used to it because it isn't going away. In fact it probably already resides, or soon will, in a forest near you. Most folks are already familiar with the problem by its other name; invasive non-native plants and animals. Many of these species have been with us for quite awhile, but we are only recently beginning to comprehend the magnitude of their impact on natural systems and native species. Admittedly, artificial habitats receive the most attention, but forested habitats and natural systems are also heavily impacted.

In 1997 the Nongame and Natural Heritage Program conducted an inventory of floodplain forests throughout the state. All of the best, known examples of this natural community type were visited. The resultant report identifies 37 non-native plant species occurring in Vermont's riverine or lakeside floodplain forests. Ten of these are considered to be highly invasive. Many of our best remaining floodplain forests now have serious infestations of honeysuckle (*Lonicera* spp.), and their ground layers are dominated by goutweed (*Aegopodium podagraria*), garlic mustard (*Alliaria petiolata*), dames' rocket (*Hesperis matronalis*), and Japanese knotweed (*Polygonum cuspidatum*). The composition of this community has been radically altered with many of the native species becoming crowded out, and a few becoming rare, because of competition from non-native species. This, in turn, impacts the birds and mammals that utilize floodplain forests. A recent study documented higher rates of predation for robin nests in Amur honeysuckle (*Lonicera maackii*) and common buckthorn (*Rhamnus cathartica*) than nests built in native shrubs. We can only hazard a guess at the impact of exotics on insects and soil micro-organisms which formerly depended upon these now reduced or displaced natives.

Of the approximately 4,000 exotic plant species and 2,300 non-native animals species in the U.S., most cause few problems. So what makes an exotic plant invasive and potentially damaging to natural systems? The following criteria have been developed for plants in New England: being non-native, having high seed production, being capable of rapid dispersal, having the ability to establish easily, displaying rapid growth, being an aggressive competitor, and being persistent on the landscape. The New England Plant Conservation Program, a volunteer monitoring program overseen by the New England Wildflower Society, has recently begun documenting the spread of invasive exotics in natural areas in Massachusetts. They hope to extend the program into Vermont next year.

The New England Wildflower Society has produced a booklet titled *Invaders* that documents the problem of invasive plants. Limited copies are available through the Nongame and Natural Heritage Program. DEC and Fish & Wildlife in cooperation with The Nature Conservancy have produced an *Invasive Exotic Plant Fact Sheet* booklet that is available at no charge. It lists some of the most serious offenders and provides fact sheets that help to identify many of them. In forested communities, the most invasive species include the morrow and tartarian honeysuckles (*Lonicera morrowii* and *L. tatarica*) and the common and glossy buckthorns (*Rhamnus cathartica* and *R. frangula*) in addition to the herbaceous species occurring in floodplain forests. The booklet also lists a second category of exotics that have the potential to disrupt native plants communities. In forested communities these would include Russian and autumn olive (*Elaeagnus angustifolia* and *E. umbellata*) and Japanese, Amur, and bush honeysuckle (*Lonicera japonica, L. maackii,* and *L. xylosteum*) among others.

It may seem like a daunting task to stem the flow of these exotics. The first step is to learn to recognize them. In the future, we may begin documenting their impact and even begin some attempt at control. In the meantime eradicate any new or small infestations before they have time to get established and spread. The smaller and more recent an infestation is the easier it is to eradicate.

TRENDS IN FOREST CONDITION

This information on forest condition is from North American Maple Project plots in Vermont. Four indicators of tree condition have been used to determine trends over the last 12 years: tree vigor, crown dieback, foliage transparency and mortality. Low values for all these indicators show good or improving tree condition. In the NAMP, 5 tree species are represented in sufficiently large numbers to monitor over time: sugar maple, beech, yellow birch, white ash and red maple. In addition to information on current conditions of trees, data is collected on injuries to trees that might affect their long-term health (e.g. insect defoliation, ice storm damage). Regeneration has been measured on 5 milacre plots at each site for the past two years to help assess forest changes due to the 1998 ice storm.

Sugar Maple Condition

Average overstory sugar maple condition varied little from previous years, with 94% of sugar maples in NAMP plots in a healthy condition (≤15% dieback). On a statewide basis, the only indicator that showed significant change was mortality (Figure 32). Average annual mortality of overstory trees from 1989 to 1997 was between 0.1 and 0.9%, but rose to 1.7% in 1998 and 1.3% in 1999.

However, when considered on a site by site basis, one-fifth of the NAMP sites have less than 90% of trees in a healthy condition. Half of these sites were affected by significant ice damage from the 1998 ice storm.

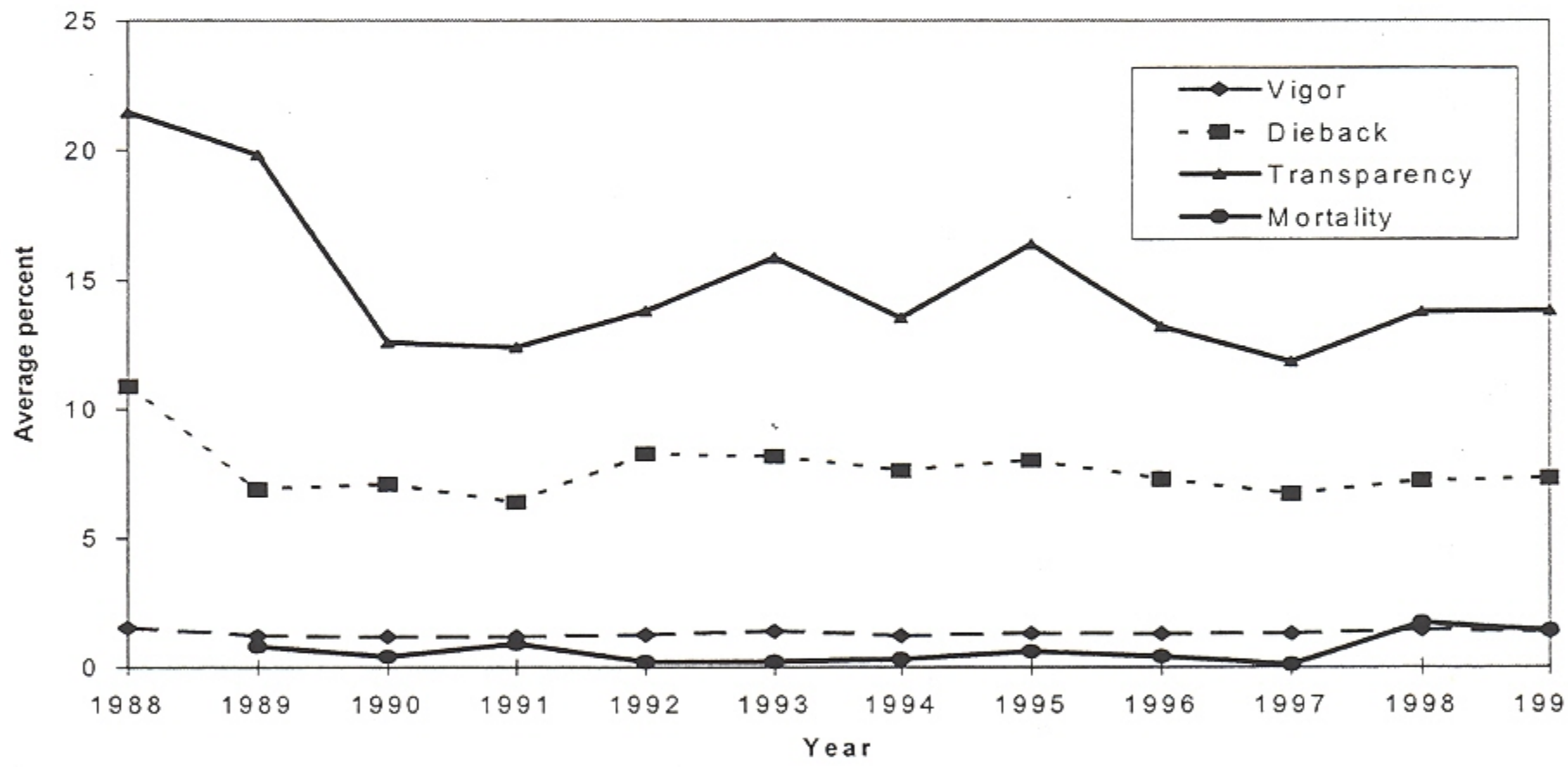


Figure 32. Trend in overstory sugar maple condition on NAMP plots.

Drought conditions were present throughout Vermont during the spring and summer months. Sites with shallow soils or ledgy sites were particularly susceptible to water deficits. While some symptoms of drought stress were visible on NAMP plots in July and early August in the form of wilted understory plants, the long-term effects on tree conditions are expected to be more obvious next year.

Most sugar maples had very little, if any seed production this year, and only one NAMP plot had moderate seed production.

Defoliation of Sugar Maple

Sugar maple trees with moderate and heavy defoliation by pear thrips in 1999 showed higher dieback and foliage transparency than other sugar maples surveyed (Figure 33). Many of these trees (18%) had been defoliated two years in a row. Refoliation was not successful on some trees in 1998, because of anthracnose injury, and in 1999, because of drought stress. Recovery may be compounded by drought stress.

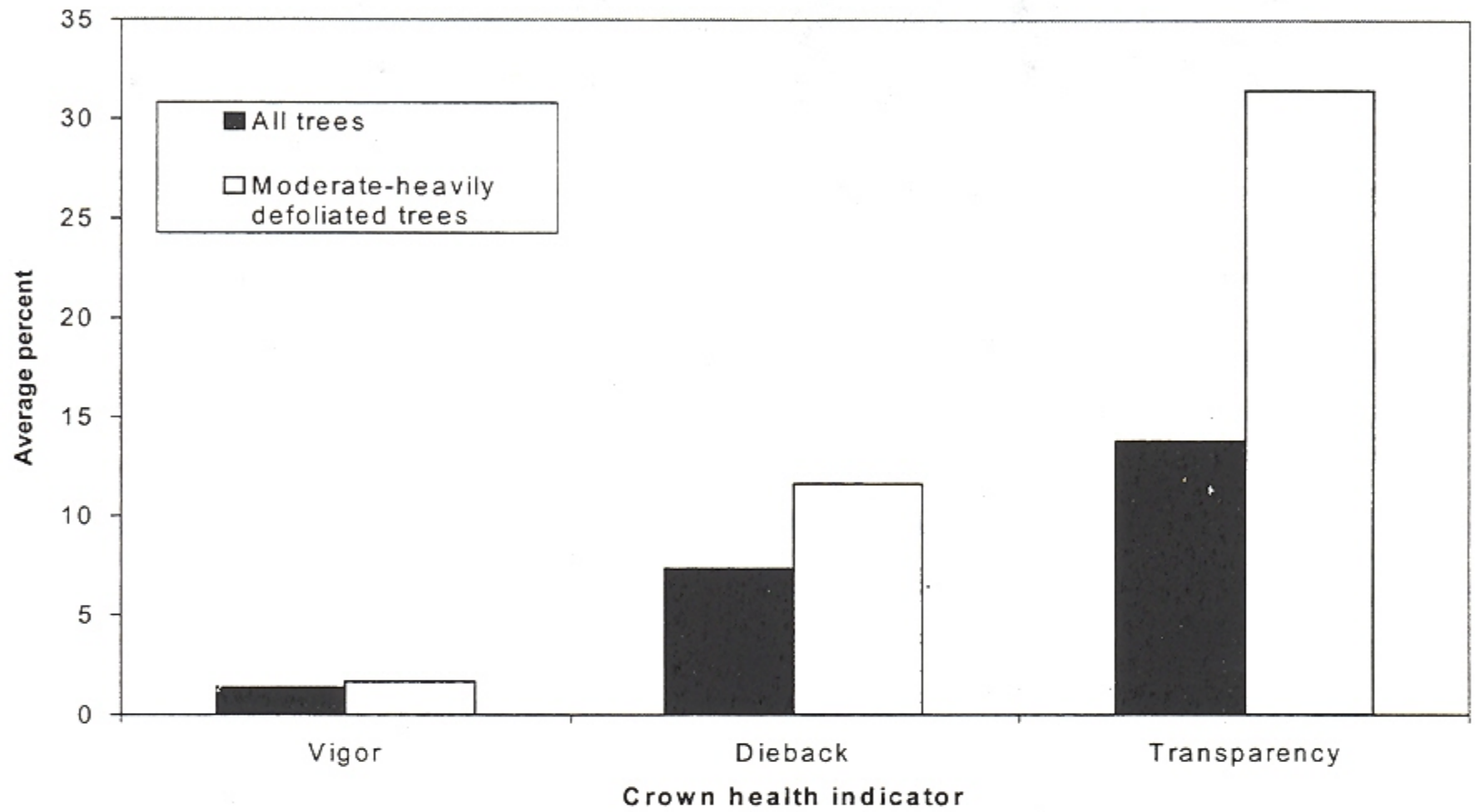


Figure 33. Health of trees defoliated by pear thrips compared to non-defoliated trees on NAMP plots.

Ice Effects

The 1998 ice storm was a major disturbance in those forests affected by heavy ice loads. Eighteen percent of NAMP plots received light to heavy ice damage. Although initial damage was significant in some sites, trees are showing signs of recovery (Figures 34-36). Initial crown damage categories used to evaluate ice injury were based on the percent of crown loss: none=0, trace=1-10%, light=11-25%, moderate=26-50%, heavy=51-75% and severe=>76%. Tree vigor decreased dramatically in 1998 as tree decline followed initial ice injury. In 1999, some improvements were seen, but trees in the moderate to severe crown damage categories continue to exhibit signs of decline. Foliage transparency improved dramatically in 1999, as trees began the recovery process. Dieback trends were more variable, with increased dieback in the none and trace categories. This may be a result of other stress factors occurring (e.g. leaf diseases in 1998, defoliation in 1999, drought effects in 1999).

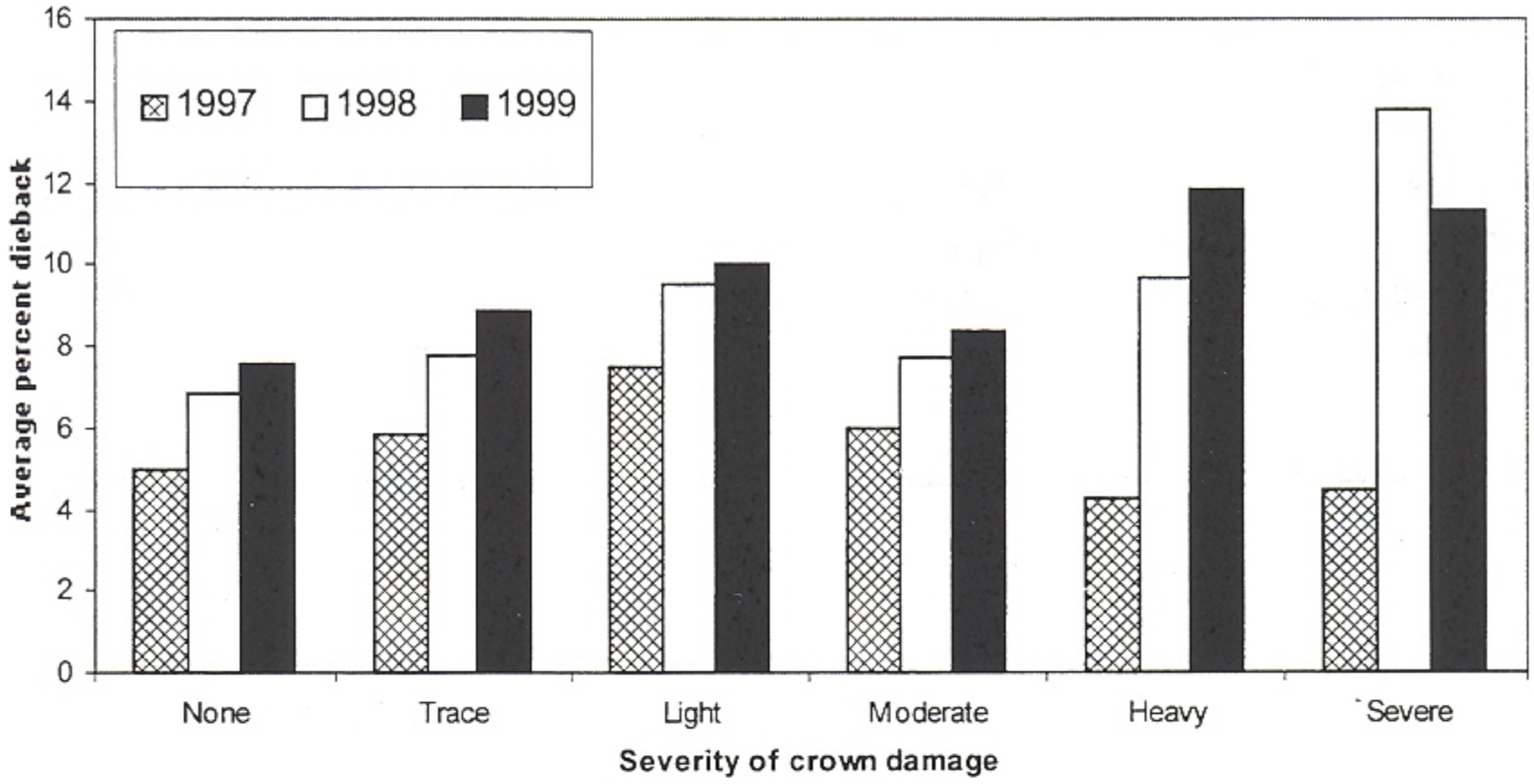


Figure 34. Trend in dieback of trees with no ice damage (none) compared to different amounts of ice injury (trace to severe). 1997 dieback is before the ice storm, 1998 is initial damage, and 1999 is the second growing season.

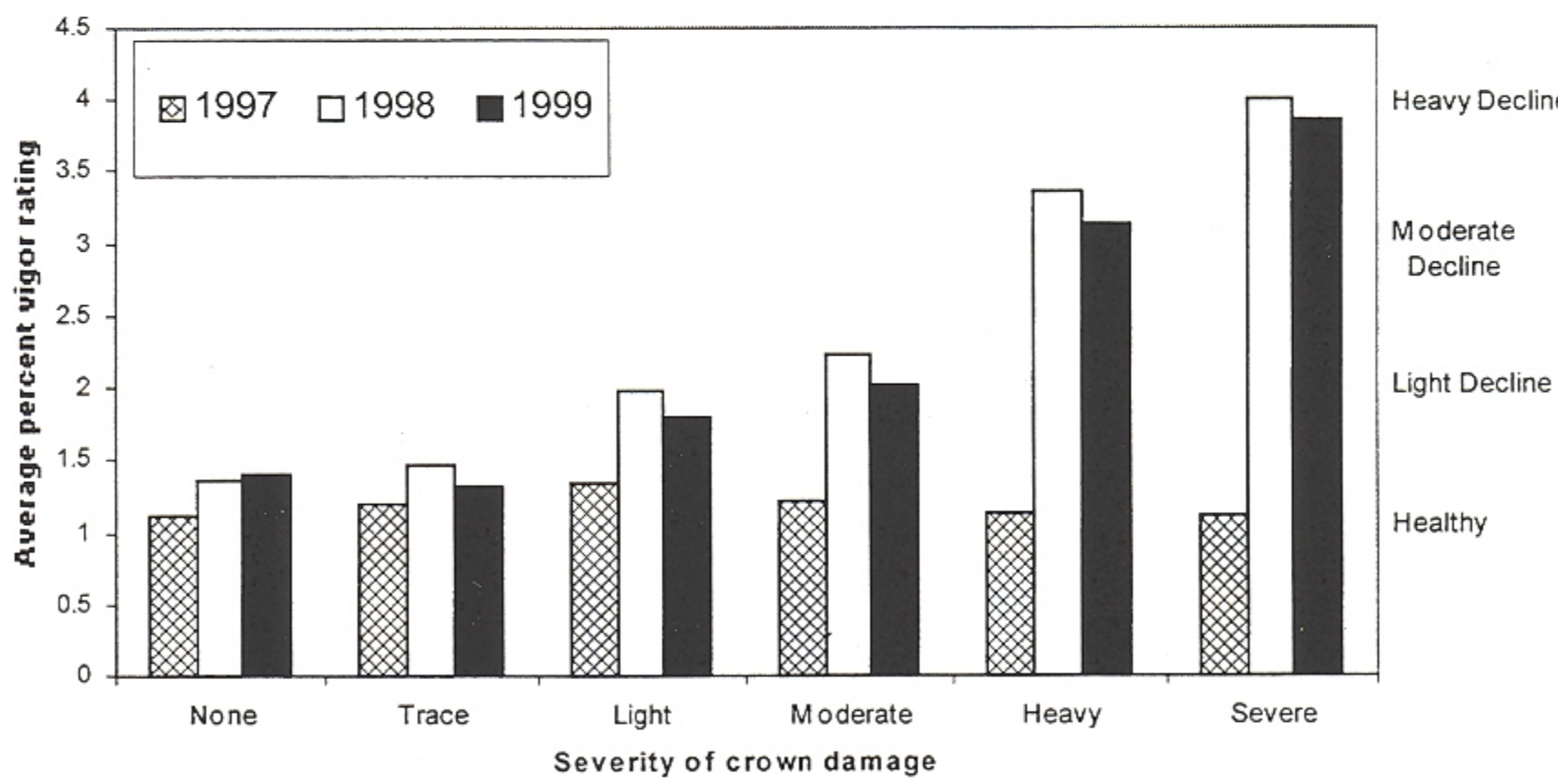


Figure 35. Trend in vigor of trees with no ice damage (none) compared to different amounts of ice injury (trace to severe). 1997 vigor is before the ice storm, 1998 is initial damage, and 1999 is the second growing season.

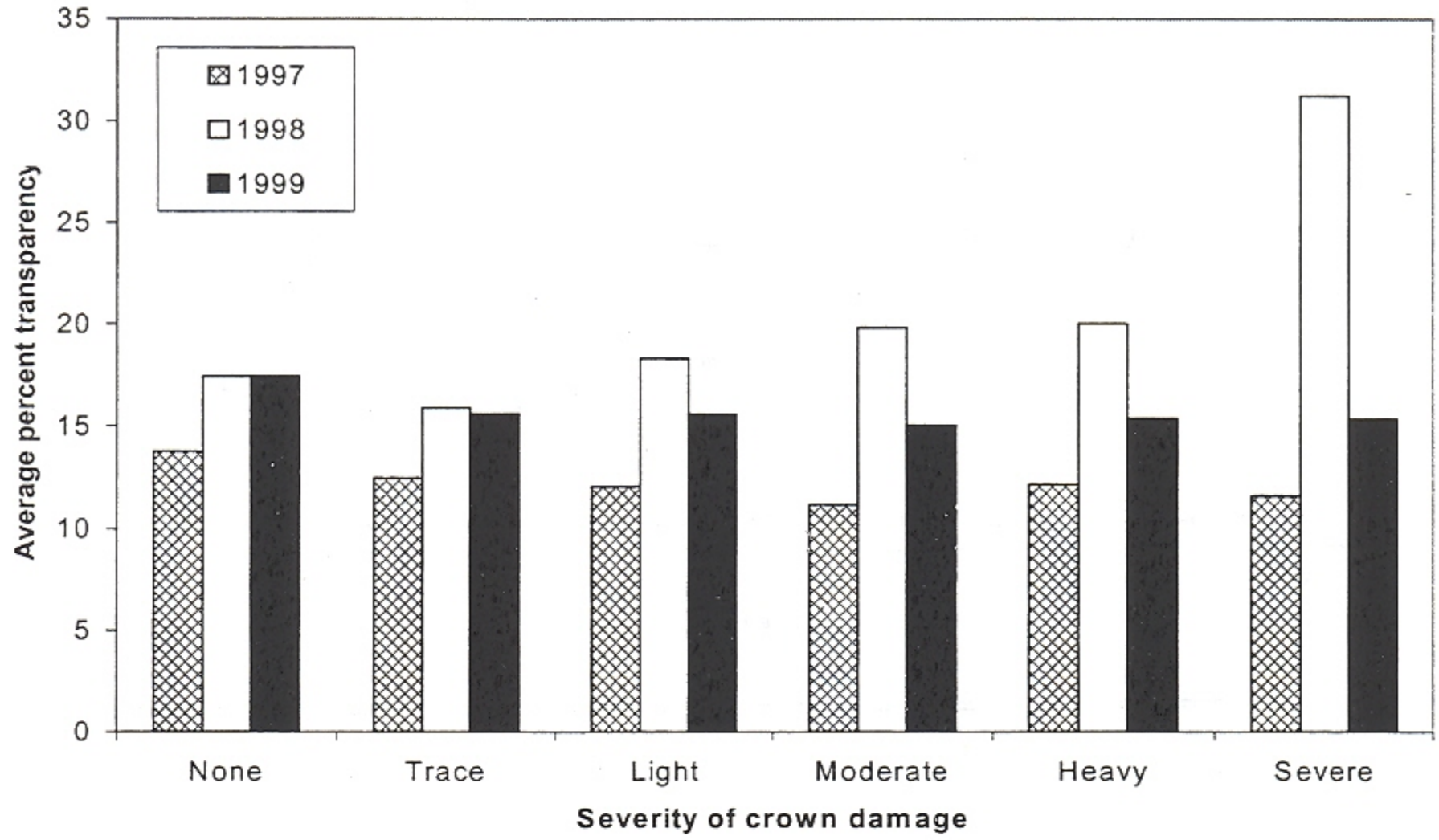


Figure 36. Trend in foliage transparency of trees with no ice damage (none) compared to different amounts of ice injury (trace to severe). 1997 transparency is before the ice storm, 1998 is initial damage, and 1999 is the second growing season.

Other Hardwood Species

Indicators of tree condition for 1999 show that red maple (Figure 37) on NAMP plots remained in stable condition, while white ash continues a 3 year trend of increasing foliage transparency and dieback (Figure 38). Yellow birch foliage transparency improved this year, following a sharp increase in 1998 (Figure 39). Beech likewise shows signs of improving following a sudden decline in 1998 brought on by the ice injury and significant foliar diseases (Figure 40).

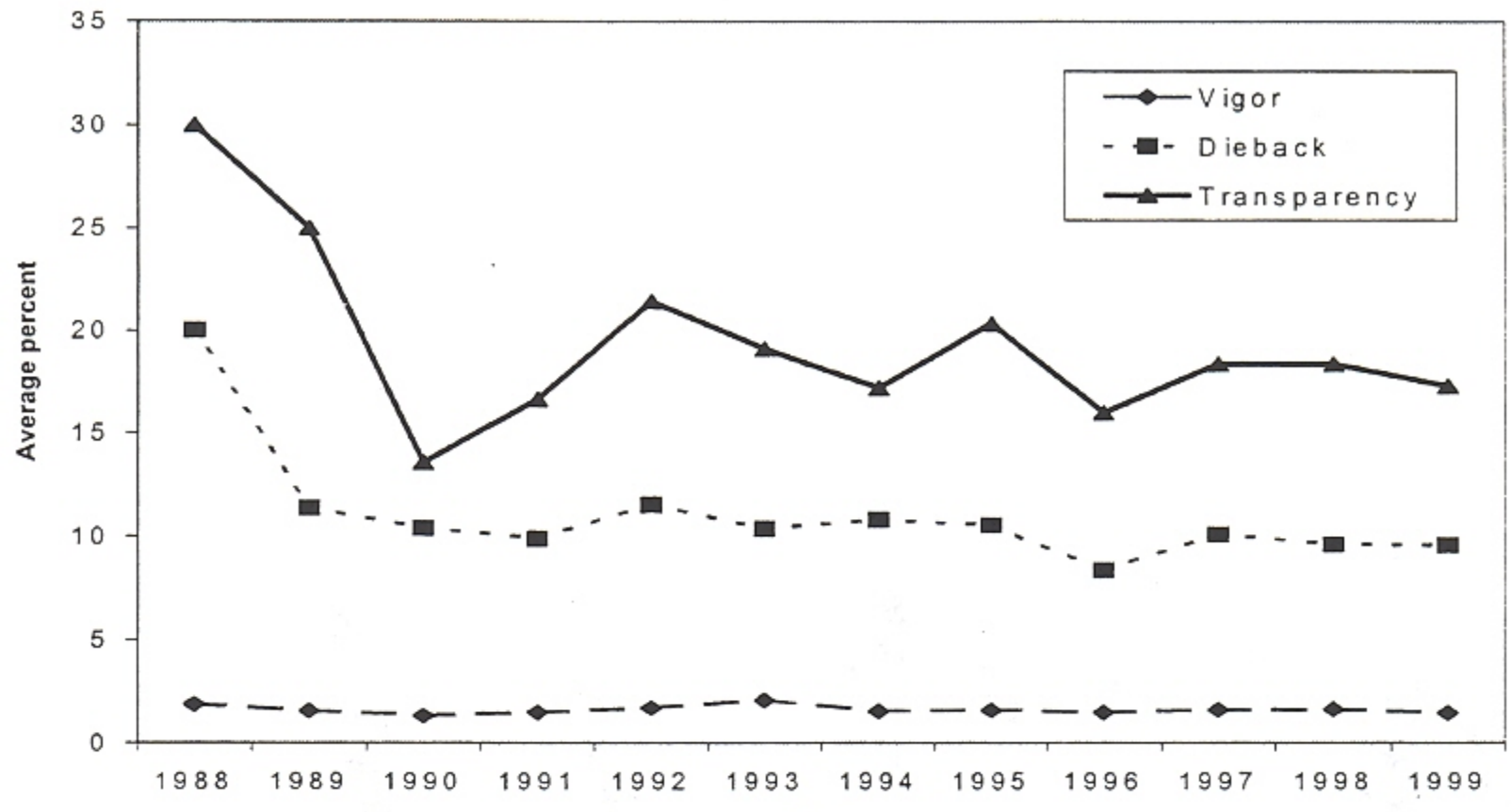


Figure 37. Trend in the condition of red maple on NAMP plots.

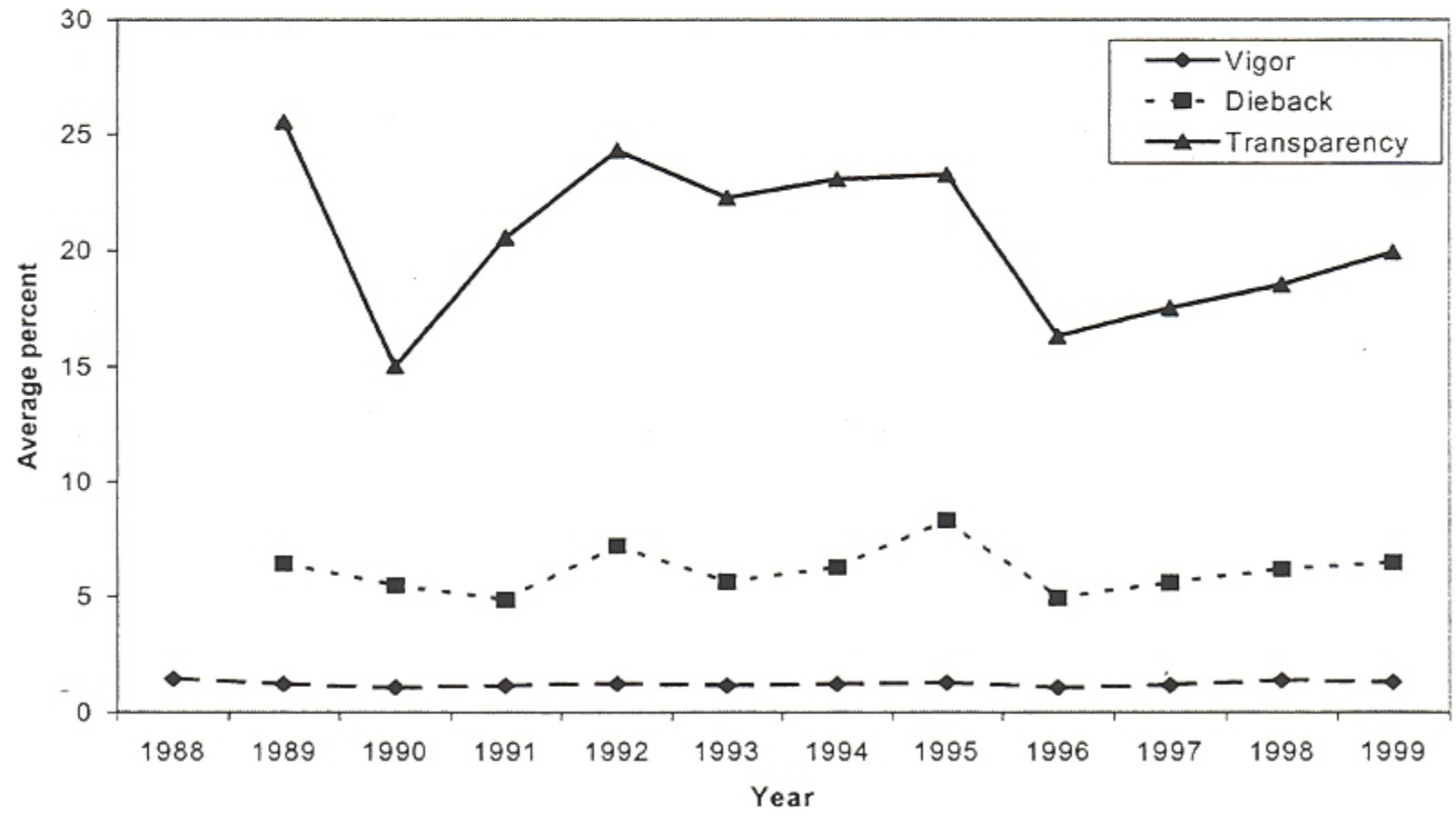


Figure 38. Trend in the condition of white ash on NAMP plots.

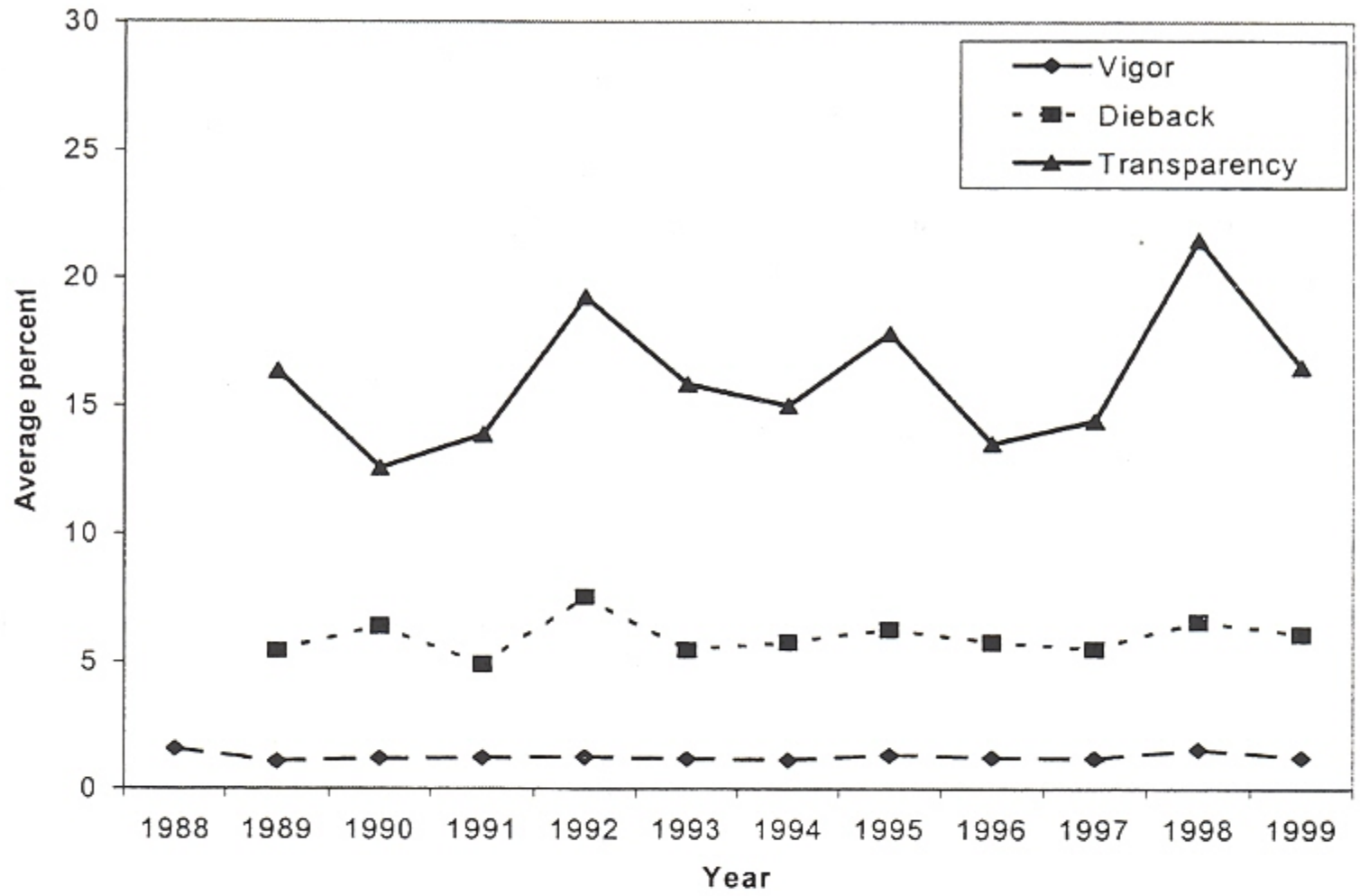


Figure 39. Trend in the condition of yellow birch on NAMP plots.

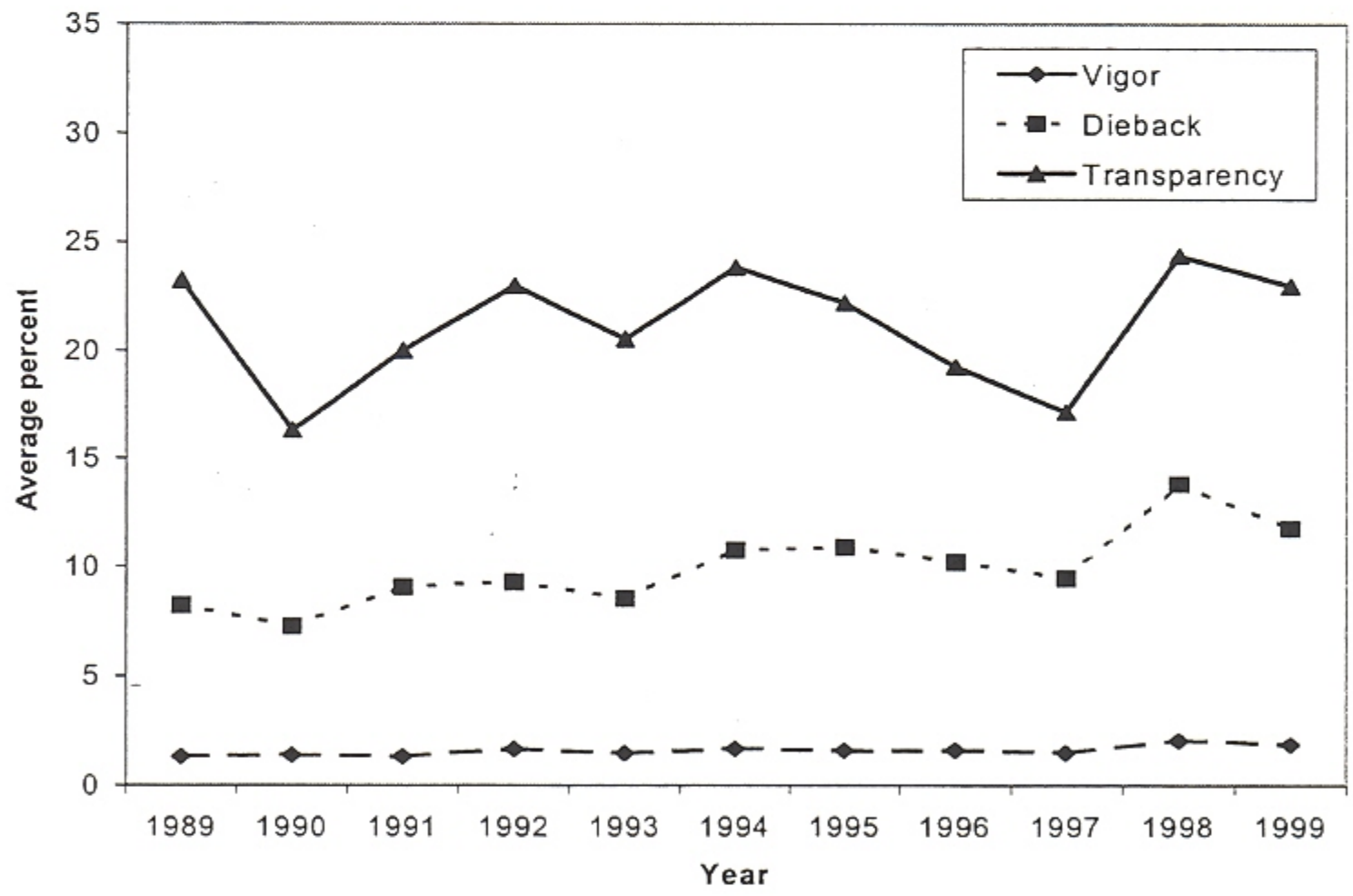


Figure 40. Trend in the condition of beech on NAMP plots.

Regeneration

In 1998, there was an abundance of sugar maple regeneration on NAMP plots. Seedlings less than 30 cm in height (seedlings class 1) with more than 2 leaves (cotyledons) were most abundant, with an average of 20 seedlings per milacre plot. Only 2 plots had no seedlings. By 1999, significant changes were measured in sugar maple regeneration. On non-ice injured sites, there was a decrease in class 1 seedlings on 88% of sites (Figure 41). Increases in more mature regeneration (seedlings 30 cm to 1 meter height (class 2 seedlings) and saplings less than 10 cm DBH) were measured on 38% and 25% of sites, respectively. On ice-injured sites, there was a higher number of sites with increases in class 2 seedlings and saplings (Figure 42). On 86% of sites, there was an increase in more mature seedlings (class 2 seedlings), and an increase of saplings on 43% of sites. Trends in regeneration will continue to be measured to determine long-term effects of the ice storm.

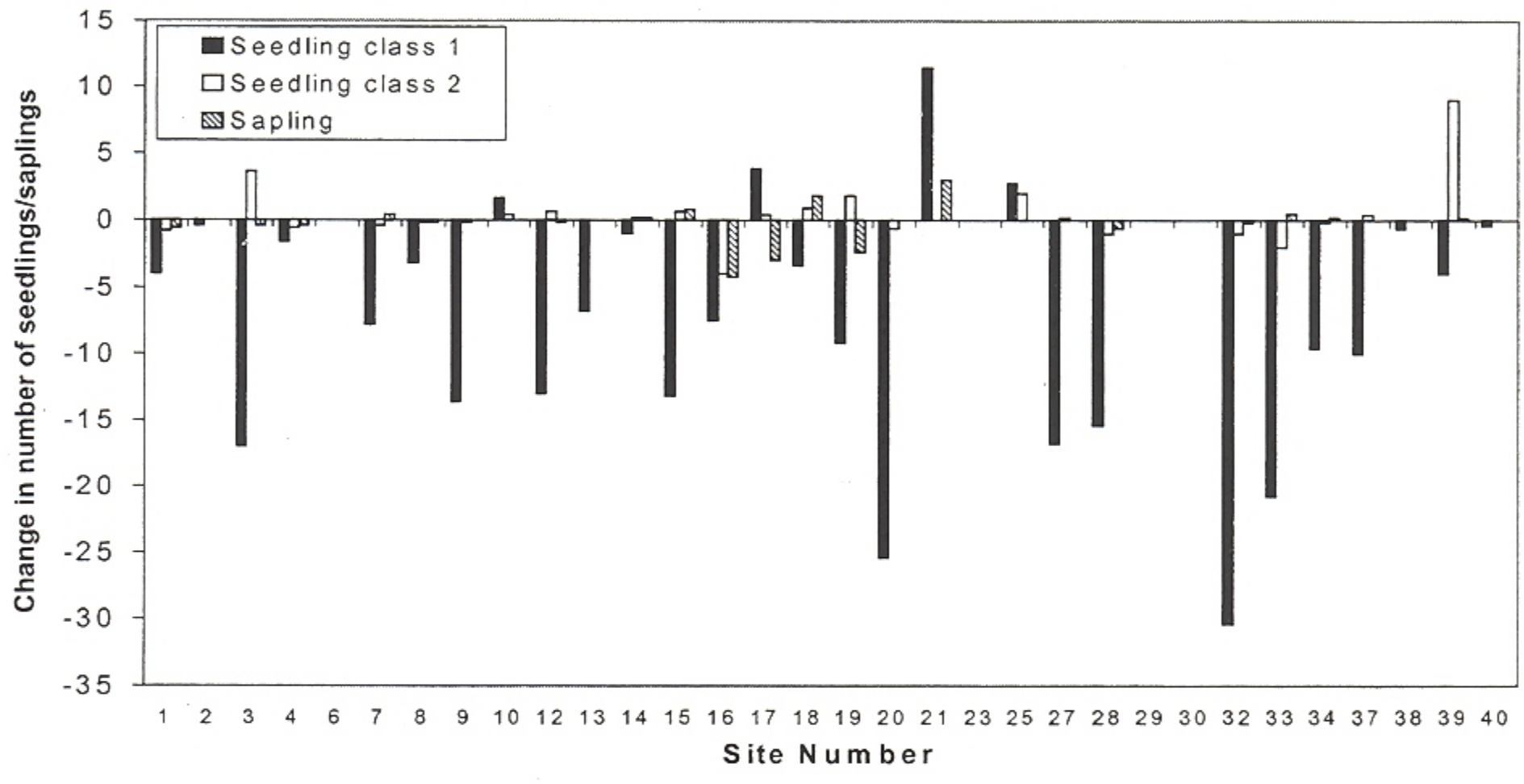


Figure 41. Change in regeneration on non-ice injured NAMP plots, 1998 to 1999.

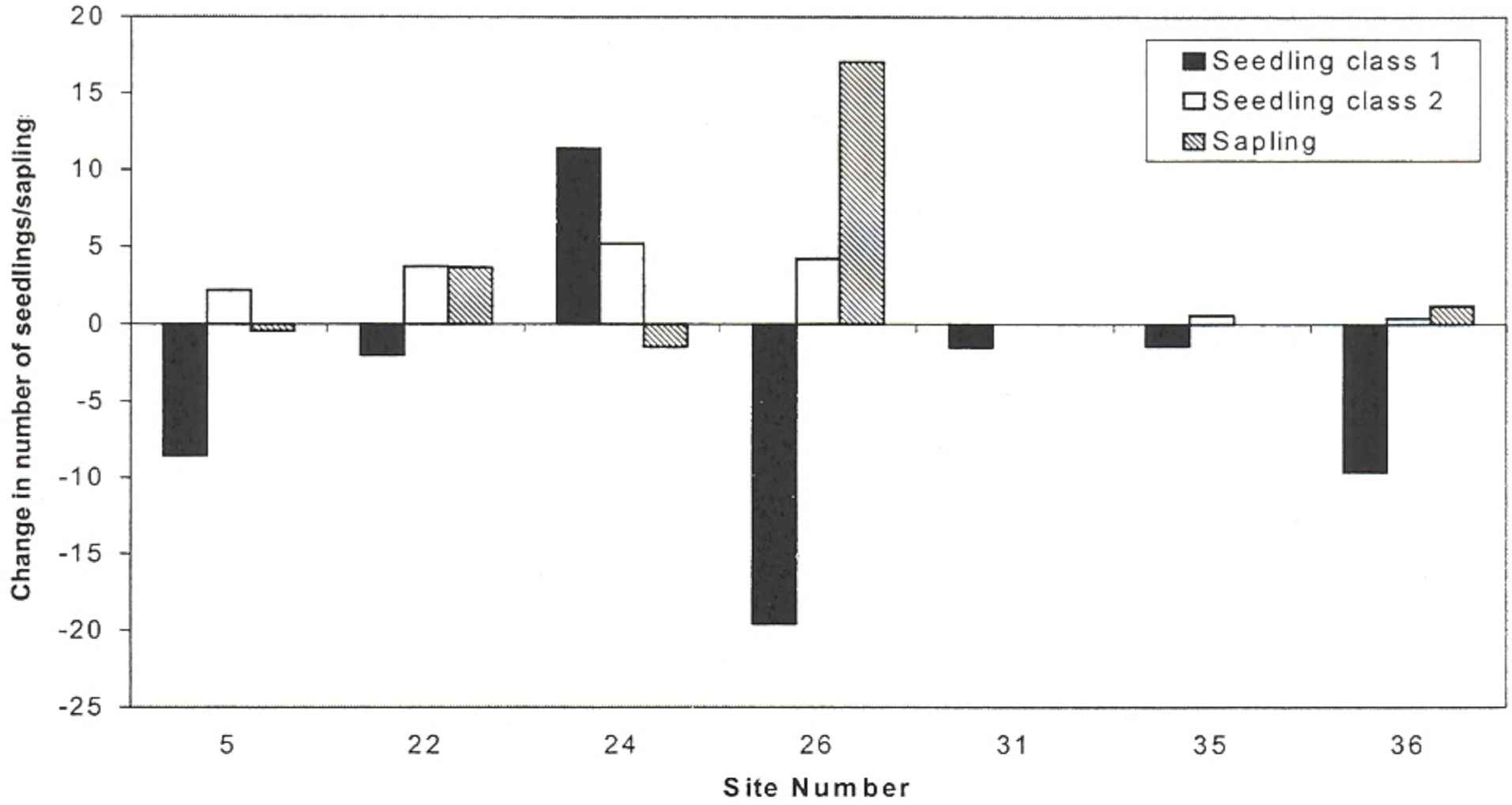


Figure 42. Change in regeneration on ice-injured NAMP plots, 1998 to 1999.

ICE DAMAGE TO VERMONT SUGARBUSHES

Introduction

The ice storm of January 1998 wreaked havoc on forests in the northeast. Forest products, including maple syrup, represent an important part of the Vermont economy. To assess the effect of the storm damage on the maple sugar industry, ground crews surveyed 17 sugarbushes from areas where ice damage had been reported.

Methods

The protocol for this survey was similar to the Regional Polygon Characterization Survey. Clusters of 5 plots were established at the center of each sugarbush, and data were collected on tree species, tree size (diameter and height), crown position, tree position (bent, leaning, uprooted), crown damage (in 10% increments). Data on percent dieback and transparency were taken from 12 of the 17 sites, and at each plot information on aspect, elevation and fire hazard was recorded.

Crown damage was assessed in 10% increments and categorized as follows: no damage, 0; light to moderate, 1 to 49 % of the crown damaged; heavy, 50 to 79% of the crown damaged; and severe, 80-100% crown damage. Trees with heavy damage may see growth impairment, and severely damaged trees are unlikely to survive.

Stands were grouped into three categories based on crown damage: 0-10%, lightly damaged stand; between 10-20%, medium damage; and greater than 20%, severe.

Results

Overall Damage: Approximately 44% of the 710 trees in this survey were undamaged. Only 12% received heavy or severe crown damage.

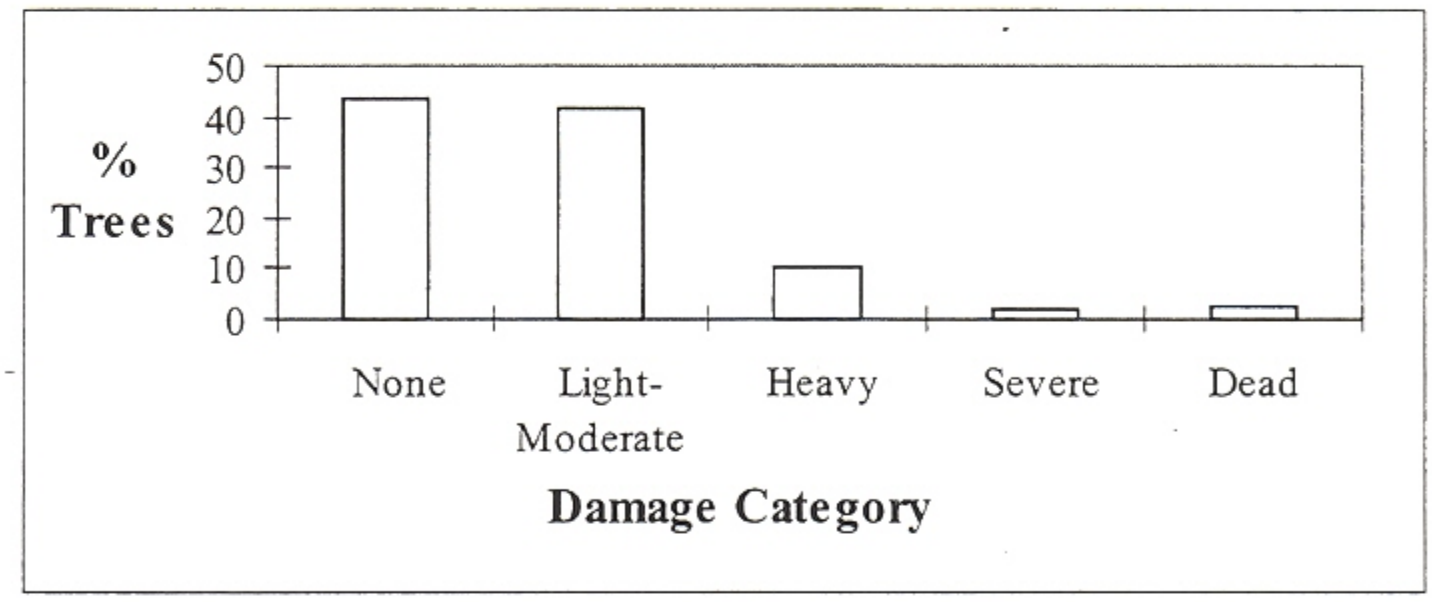


Figure 1.
Percent Trees In Crown Damage Categories

Stand Damage: There were five lightly (L) damaged sugarbushes, five with medium (M) amounts of damage and 7 in the severe (S) damage category. Overall average crown damage in the three stand damage types was low. Even the most heavily damaged stands had an overall mean crown damage of less than 30%.

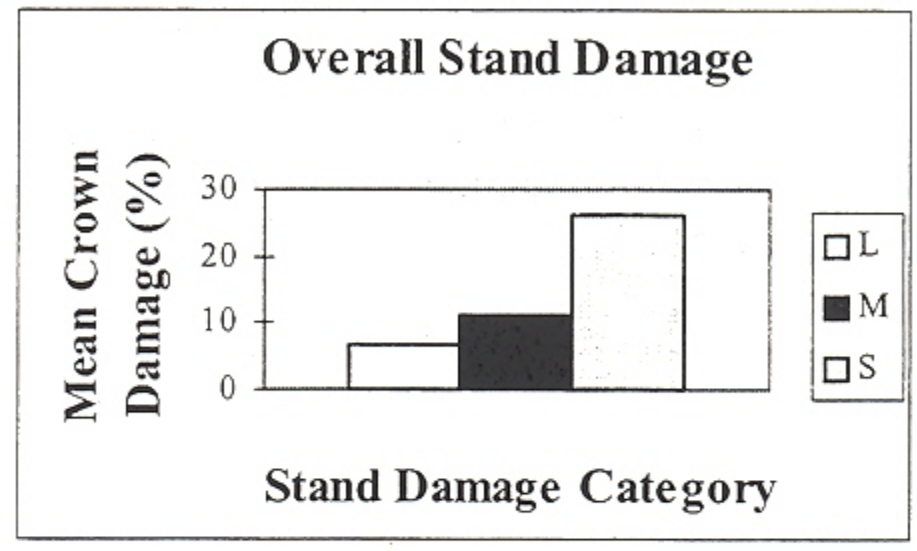


Figure 2. Overall Stand Damage

But crown damage ranged widely within individual sugarbushes. The mean crown damage on any individual site was less than 50%, but even in the lightly damaged stands crown damage on particular trees could range from 0-100%.

Maple trees represent 81% of the trees surveyed, and on average received slightly more damage to their crowns than the other tree species. Average crown dieback and transparency were slightly lower on sugar maples.

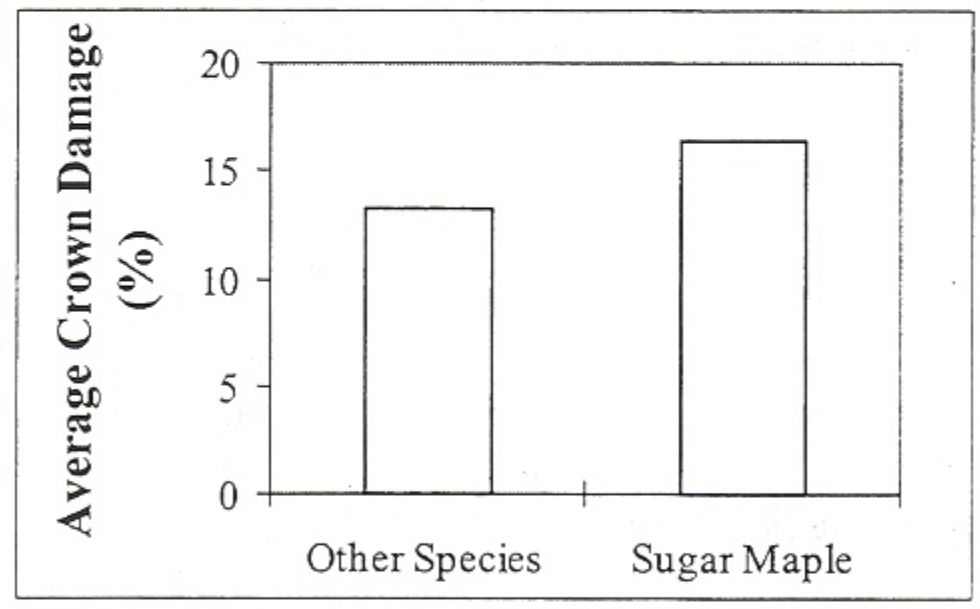


Figure 3. Comparison of Crown Damage on Sugar Maple and Other Species

Fire Hazard: Mean crown damage was twice as high in plots given a moderate fire hazard rating than in light fire hazard plots (34% compared to 14%). Dieback and tranparency were higher on moderate plots too.

Size Class: There were only minor differences between size class groups. Saplings received slighly less crown damage than pole or sawtimber size trees, but dieback and transparency were lower on sawlogs compared to poles and saplings.

Size Class	Mean Dieback (%)	Mean Transparency (%)
Sapling	6.76	16.69
Pole	6.33	15.34
Sawtimber	3.92	9.08

Elevation: A bimodal pattern of crown damage was seen, with peaks at 850 feet (mean crown damage of 35%) and at 1820 (mean crown damage of over 45%). Damage from dieback and transparency showed a similar pattern.

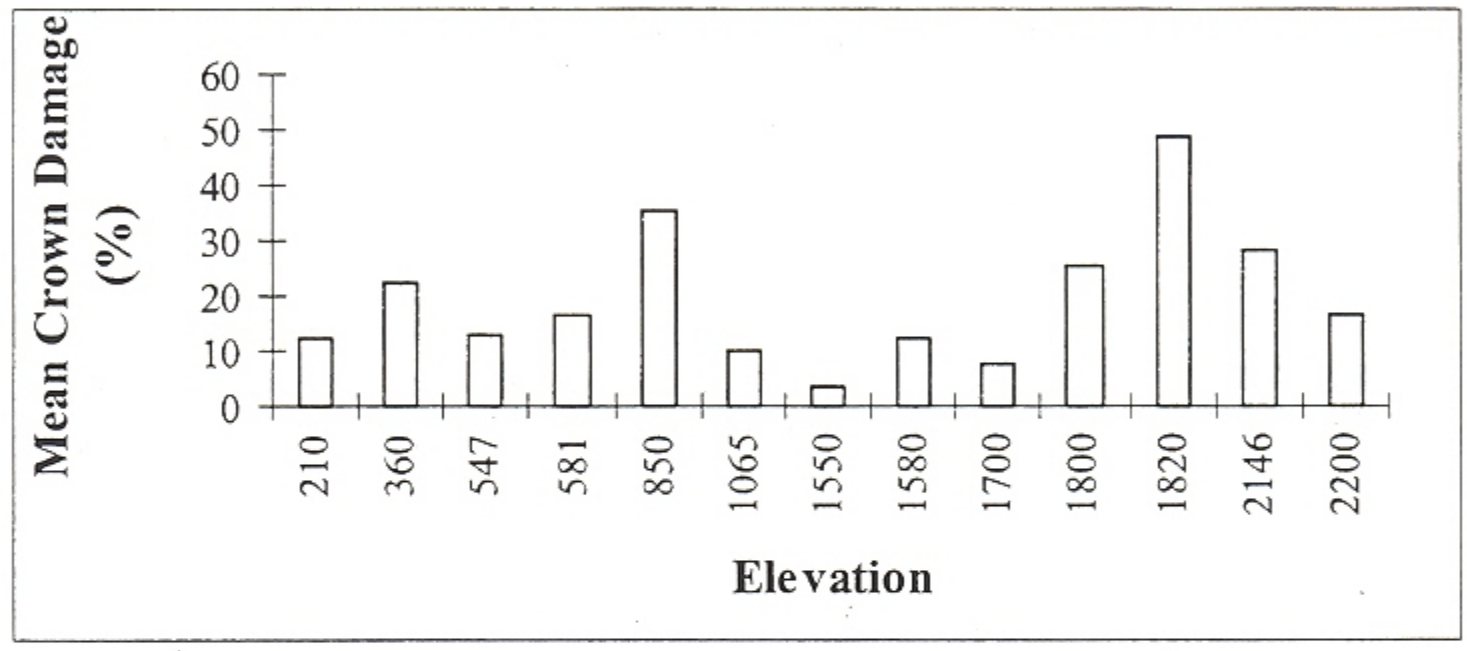


Figure 4. Crown Damage at Different Elevations

Aspect: Sugarbushes with an aspect between 180 and 360 degrees (south to north) had noticably higher amounts of crown transparency than those that faced the opposite direction.

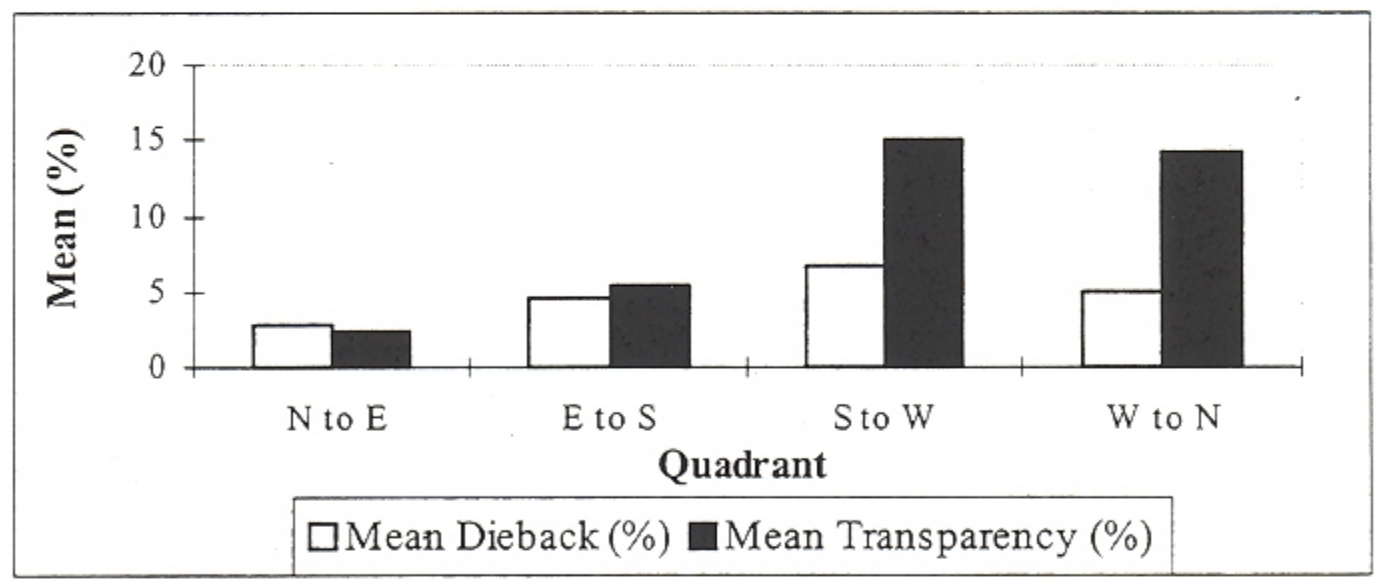


Figure 5.
Stand Aspect and Damage

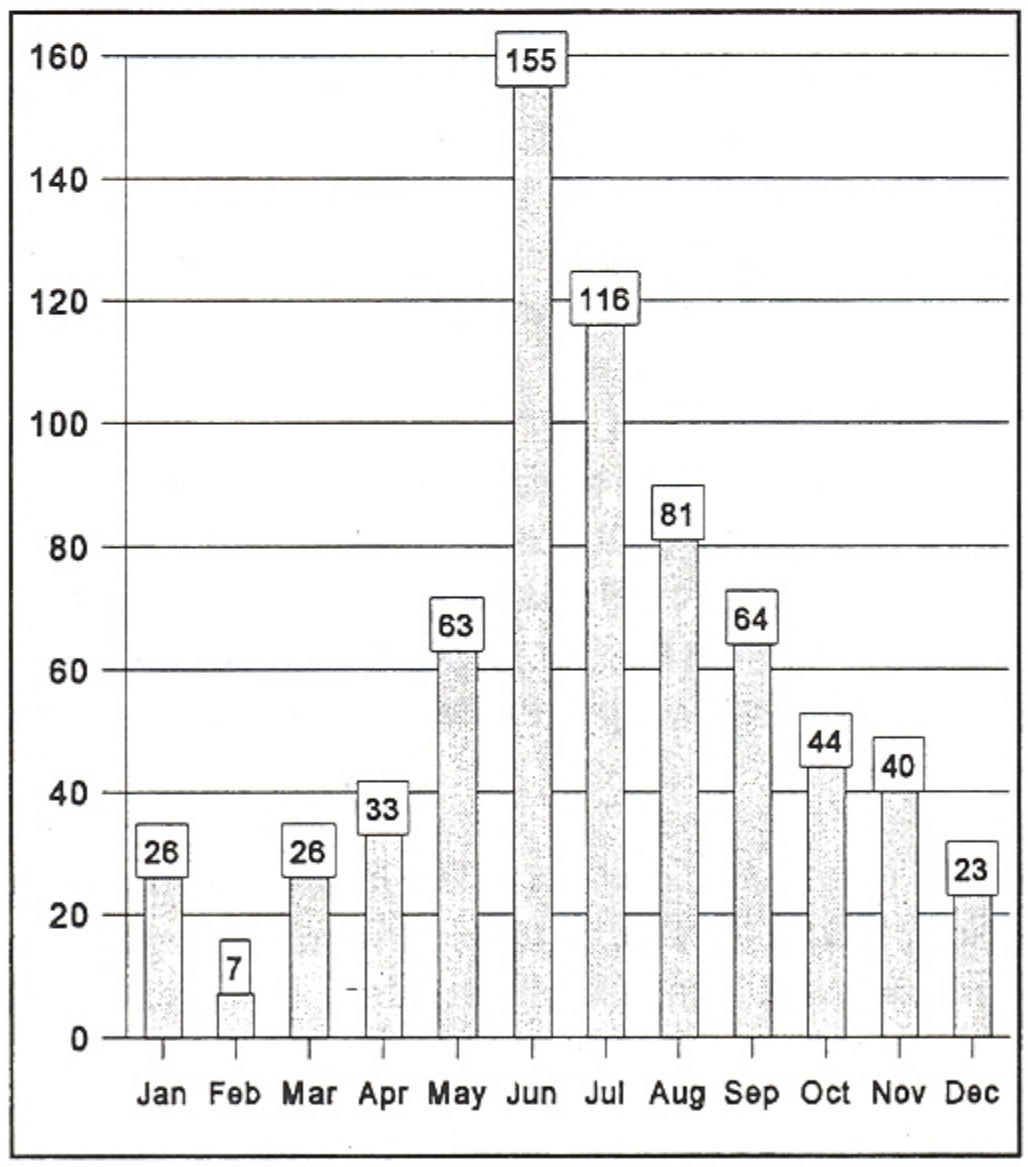
Conclusion: Sugar maple as a Vermont resource remains stable, but it may take 3-5 years for the fate of ice damaged trees to be determined.

FOREST BIOLOGY LABORATORY -1999

Laboratory Diagnostic Services

A primary function of the Forest Biology Laboratory is to provide diagnostic and laboratory services to a variety of user groups for forest insect and disease questions. Throughout the year, we respond to requests for identification and diagnosis of tree insect and diseases, and provide control recommendations and other information. We received 678 requests for identifications, advice and information in 1999.

Numbers of inquiries were highest in June (155 requests) and July (116) (Figure 1).



We received inquiries from all counties in Vermont (Figure 2). The highest number of requests came from people in Washington County (172), while Grand Isle inquiries numbered 3. We had 47 out-of-state inquiries, and 14 requests that involved state-wide observations.

County	Number of Requests
Addison	53
Bennington	19
Caledonia	37
Chittenden	115
Essex	6
Franklin	20
Grand Isle	3
Lamoille	20
Orange	22
Orleans	20
Rutland	37
Washington	172
Windham	59
Windsor	34
Total	**617***

*Out of state and statewide inquiries brought the total to 678.

User Groups

The majority of requests in 1999 (62%) came from the general public, either directly or through FPR personnel. These requests involved a large variety of insects and diseases, mostly from trees and shrubs, but occasionally from herbaceous plants, wood products, and other hosts. We categorized about 20% of our requests as "educational". In

these situations, no specimen was brought in or sent to the lab. Rather, the inquirer needed information or resources about a known condition. This included control recommendations for various insects and diseases, life cycle information or descriptive materials of one sort or another. We provided information and/or specimens (3% of total requests) to the media, including newspaper and television reporters and journalists. This category includes three artists who have used our specimens for technical or abstract drawings or paintings. Another 4% of requests were received directly from nurseries, growers, golf course managers or arborists. Three percent of our calls came from other labs in the Northeast, and 2% came from pest control operators involved with pests in buildings. Veterinarians, Fish and Wildlife personnel, and other people concerned with animal and human parasites made up about 1% of the inquiries. The final 5% was made of a variety of miscellaneous categories.

Types of Information Requested

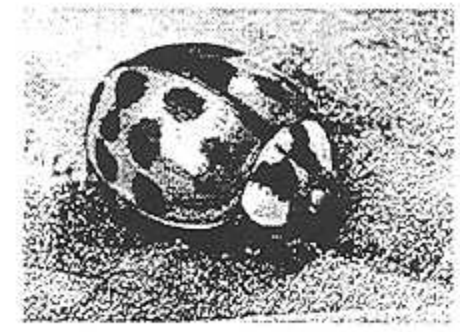
Fifty-seven per cent (388) of the requests received at the Forest Biology Lab were for identification of insects and diseases, while 33% (221) were specifically for information, such as biology and management. Six per cent (41) of the requests involved needs for reference material, slides, photos, or equipment. About 1% (10) of our calls were from people who were curious about tree health conditions and the status of particular insects or diseases in Vermont. The final 3% (18) of requests involved a variety of topics.

Categories of Organisms

Though the majority of requests (75%) involved insects and diseases, we also received inquiries about spiders, ticks, and other invertebrates, as well as weeds.

Host Types

About 52% of the specimens submitted to the lab for identification came from trees. Sixty species of hardwood and softwood hosts were included, with sugar maple, balsam fir, white pine and Colorado blue spruce most commonly involved. Other specimens came from households/buildings (15%), herbaceous plants (5%), and humans/animals (5%). As usual, a number of insects were collected "at large" (18%). The remaining specimens were associated with soil or snow, wood products or vegetables.



The household/building category included insects, such as the multicolored Asian lady beetle (*Harmonia axyridis*) and the western conifer seed bug (*Leptoglossus occidentalis*) that enter homes in the fall.

Other Lab Activities

Lab personnel were involved in a number of educational programs. In addition to our regular workshops, presentations were made for the Vermont Leadership Center, Forest Watch Program, the Department of Fish and Wildlife's "Becoming an Outdoors Woman" Program, and several other groups. In 1999, we produced five issues of our lab newsletter, *Bug Bytes*, which is distributed to 475 people.

We've continued to improve and maintain our database which contains yearly pheromone, sticky, and light trap catch data, occurrence of pest and non-pest insects and fungi, phenological records and data, and slide, photograph, and bibliographic catalog.

Our *Guide to Common Bark Beetles (Coleoptera: Scolytidae) Endemic to the Northeastern United States* became available in June, 1999, and about 2000 of these have been distributed. Contact us if you need a copy. Our instructional kit, *Forest Insect Discovery Program: The Small-Sized Big Players of Forest Ecology*, is scheduled for completion in spring of 2000.

Forest Biology Lab
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COMMON PESTS OF CHRISTMAS TREES IN VERMONT 1999
REPORTED BY THE
DEPARTMENT OF FORESTS, PARKS AND RECREATION

INTRODUCTION

Information in this report is based largely on a systematic annual survey of Christmas trees in northern Vermont as part of the Scleroderris quarantine. This year 260 acres were surveyed in northern Vermont. Observations by Forestry Division personnel throughout the state are also incorporated. Acreage trend information reported refers to changes in surveyed plantations in northern Vermont and is not statewide totals.

INSECTS

Balsam Gall Midge populations remained high this year but damage levels were down compared to 1998. Unlike last year, none of the balsam fir Christmas trees visited in the northern Vermont survey received heavy damage. Light damage was reported for 126 acres and moderate damage for 105 acres. Moderate damage was also reported for plantations in or near the Green Mountains in southern Vermont. Some heavy damage was reported by Northern growers. Control effectiveness was variable. Damage was less noticeable on wild trees statewide compared to 1998. Damage should be much lighter in 2000.

Balsam Shootboring Sawfly populations dropped to the lowest levels seen in many years. Only one fir plantation (15 acres in Waterville) examined during the regular northern Vermont Christmas tree survey received moderate damage this year compared to 202 acres of moderate to heavy damage in 1998. This year, most adults emerged during the last week in April through the first week in May. Adults caught on 3 x 5 yellow sticky cards placed in mid-crowns of trees in Lamoille County averaged only 1.1 per card compared to 73 per card in 1998, 0.30 in 1997 and 3.1 in 1996.

We have long observed that the heaviest populations and damage occur in even years, indicating that most of the sawflies may have a two-year life cycle. This year some additional information was obtained to support that theory. In May, 1998, 10 mature larvae were placed in each of five nylon sleeves and buried about one foot deep in the soil to determine how many would emerge as adults in 1999. On May 3, 1999, after natural adult emergence had occurred, these were removed from the soil and survivors counted. Four adults and 7 prepupae were recovered, indicating that the majority of sawflies, at least in this small sample, spend more than one year in the soil before emerging.

Since damage is heaviest in even years and 1998 was the worst year yet seen, growers should expect heavy damage in 2000, particularly if we have a warm spring when adults are emerging.

Balsam Twig Aphid damage decreased slightly statewide again this year. Damage in the balsam fir Christmas tree plantations surveyed was mostly light (121 acres), with 55 acres of moderate damage. All damage observed in southern Vermont was reported to be light. Moderate populations of stem mothers

were seen in early spring beating surveys, but warm weather and steady shoot flush kept overall damage low.

Cinara Aphids were detected in only one plantation this year where they were lightly infesting 20 acres of pine and balsam fir. This is a slight decrease from last year.

Eastern Spruce Gall Adelgid damage to white spruce increased slightly, with 35 acres of light damage and 45 acres of moderate damage detected during the northern Vermont survey. This compares to 57 acres of mostly moderate damage detected in the same plantations last year.

Fir Coneworm damage to balsam and fraser fir was reported in two plantations totaling 235 acres. All damage was light, restricted to chewing of young bark.

Pales Weevil damage to Fraser fir was reported for one 20-acre plantation in Barre, but damage was limited to scattered branch mortality.

Pine Leaf Adelgid damage to white pine decreased this year. Light damage was detected in 70 acres compared to 114 acres in 1998.

Pine Needle Midge damage to Scots pine was not detected this year.

Introduced Pine Sawfly injury to white and Scots pine increased by about 20 percent from last year. 129 acres received light damage by this pest. In the hot, dry conditions of this summer, multiple generations were observed.

Mound Ants killed about twelve trees within plantations in Starksboro and Orleans. All affected trees were in the vicinity of the mounds.

A Pine Fascicle Mite on white pine was more noticeable this year, lightly damaging 91 acres and moderately affecting 20 acres. This mite causes scattered small spots of yellow

discoloration on shoots of white pine. These spots darken and become less noticeable by the time trees are harvested.

Pine Shoot Moth damage to Scots and white pine leaders increased this year. Light damage was detected on 80 acres and moderate damage on 50 acres. Populations are more abundant in hot, dry summers like the summer of 1999. Look for slightly wilted shoots in the upper crowns. Infested shoots have a chewed entrance hole and the end of the shoots are packed with frass.

Pine Spittlebugs were observed in 102 acres of the survey. Populations were light and no damage was recorded. This is an increase by 40 acres from last year. Light populations were also observed throughout southern Vermont.

Pine Thrips damage increased this year, lightly affecting 32 acres of Scots pine. This is almost three times the acreage detected last year. One specimen of Mugho pine was collected that had severe damage, including shoot stunting and malformation.

Sawyer Beetle damage to balsam fir was reported in one 15-acre plantation in Craftsbury. This site is a natural regeneration plantation; damage was limited to scattered branch mortality.

Spruce Bud Moth was reported lightly attacking blue spruce in two plantations (35 acres). Look for full-length shoots with bud sheaths still attached with fine webbing. Damage is confined to needle browsing at shoot tips.

Spruce Spider Mite damage decreased this year despite the hot, dry conditions that usually promote a population buildup. Balsam and Fraser fir received moderate damage on 15 acres. However, an evaluation of overwintering eggs on Christmas trees in southern Vermont indicates that dry conditions have allowed populations to build. So growers should check for mite populations early in the year 2000 growing season.

White Pine Weevil damage to pine and spruce trees remained common throughout the survey area with most damage at light levels (127 acres). A 10-acre, mixed plantation of white pine, blue and white spruce in Brookfield received moderate damage. Interestingly, the white spruce suffered the most damage in this plantation.

DISEASES

Armillaria Root Rot was associated with the death of 3 to 5 trees at each of two locations - in Craftsbury and Bakersfield.

Cyclaneusma and **Lophodermium Needlecast** of Scots pine remains very common. Light infection was detected within 107 acres of Christmas trees.

Delphinella Tip Blight continues to be fairly common in northern Vermont balsam fir plantations. Three plantations were found with infection this year. One plantation in Danville (10 acres) had light infection. Two plantations in Wolcott and East Montpelier received moderate infection totaling 15 acres. Trees can be protected by applying Cleary's Protect T/O fungicide shortly after budbreak and again 10 days later.

Diplodia (Sphaeropsis) Tip Blight, was the single most common disease detected in Christmas trees this year. A total of 231 acres were detected with light infection from this disease. In mixed plantations of pine and fir, infection was generally more frequent on pines, especially Scots pine.

Fir-fern Rust infection decreased this year. It was detected at light levels in 167 acres of fir plantations. A few farms that had experienced heavy infection in the past saw little or no damage this year. Control of sensitive fern within some plantations is helping to reduce this problem.

Lirula Needlecast on balsam fir was reported in three northern plantations totaling 30 acres. All infection was light. These locations were all found within the natural zone of fir. Another plantation in Rockingham had light damage. Commonly, infection was restricted to edge trees and lower, inner branches of older trees.

Phytophthora Root Rot was the suspected cause of a large increase in balsam and Fraser fir mortality related to the extremely wet summer of 1998. Of the northern Vermont plantations annually surveyed, two plantations (14 acres) had moderate losses and one (20 acres) had light losses. Elsewhere, many calls were received and a number of other plantations scattered throughout Vermont were visited. Some of these had losses in the thousands of dollars.

Rhabdocline and **Swiss Needlecast** of Douglas fir continue their presence wherever Douglas fir is planted in Vermont. Levels of infection were light to moderate, similar to 1998 levels.

Rhizosphaera Needle Blight of Fir, caused by *Rhizosphaera pini*, remained common but mostly at light infection levels on 117 acres. One 10-acre plantation in Wolcott still had heavy damage. Trees can be protected by an application of Cleary's Protect T/O plus sticker just after complete budbreak, followed by a second application two weeks later.

Rhizosphaera Needlecast of spruce increased from last year, with 100 acres of light infection and 20 acres of moderate infection. This compares to 92 acres of mostly light infection in 1998.

Scleroderris Canker has not been found in any new towns since 1986. Fifteen Christmas tree plantations within the quarantine zone were inspected this year and found free of the disease.

Sirococcus Shoot Blight of spruce increased, with 45 acres of light infection to blue and white spruce compared to trace infection levels in 30 acres in 1998. Most infection was limited to crowded trees where drying was poor.

Spruce Needle Rust was reported on 65 acres of blue and white spruce. All infection was light and limited to a few needles per shoot.

White Pine Blister Rust damage remains common throughout the survey area. 136 acres received light infection, 25 acres had moderate infection and one plantation in Waterbury was heavily infected (15 acres). A major factor at this site is tree age; trees here have been held back and thus have had more exposure to spores of the blister rust. An intensive survey of six plantations showed that blister rust infection was present on 20% of the 721 trees examined. Infection rates per plantation ranged from 10% to 42%.

White Pine Needle Blight infection levels decreased this year. 112 acres of pine were lightly infected and 60 acres were moderately infected. The total area of infection this year is about 25 percent that of last year.

Woodgate Gall Rust damage to Scots pine decreased from last year, with 112 acres of light damage compared to 127 acres of light damage and 2 acres of heavy damage in 1998.

Yellow Witches Broom Rust of balsam fir increased slightly. 92 acres of fir received light infection and one farm in Waterville experienced moderate infection (15 acres). It was also observed on balsam and Fraser fir in Rockingham and Bennington.

Frost Damage to balsam fir and white spruce was light on 112 acres this year, compared to almost no detections last year. Most locations experienced only one or two episodes of freezing conditions after budbreak.

Deer injury to balsam fir was reported for one plantation in Craftsbury. Damage to the main stem killed about 20 trees here.

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ACKNOWLEDGMENTS

We thank Matt Mancini, Christmas Tree Pest Surveyor, for his keen observations and detailed reports that form the basis for much of this information.

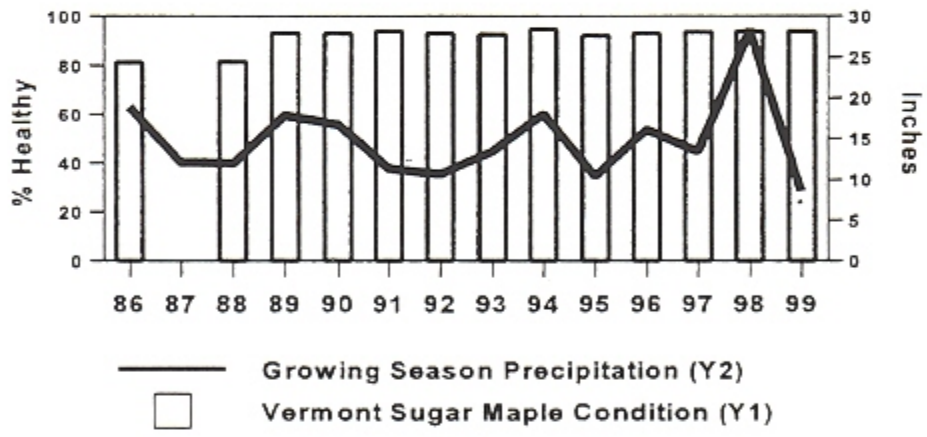
HEALTH OF SUGAR MAPLE IN VERMONT - 1999

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

This information on health of sugar maple is based on aerial surveys and field observations by the VT Dept of Forests, Parks, and Recreation, the University of Vermont and the U.S. Forest Service. Every year, the Department of Forests, Parks, and Recreation looks at tree health from the ground and from the air. In 1999, all 4.7 million acres of forestland were evaluated from an airplane at least once, with a second survey for pear thrips in southern Vermont, and for wind damage in the Northeast Kingdom. In addition, survey crews walked to monitoring plots on the ground to rate tree condition.

To assess the **General Condition** of sugar maples in 1999, 2000 sugar maples were evaluated for the North American Maple Project. Their health remained similar to previous years (see figure), in spite of the fact that noticeable defoliator activity was reported in half of the plots. Only 3% of the trees were unhealthy, based on how many dead twigs they had.

Foliage stayed on trees longer than normal in the fall, probably because killing frosts were rare. There was very little sugar maple flowering.

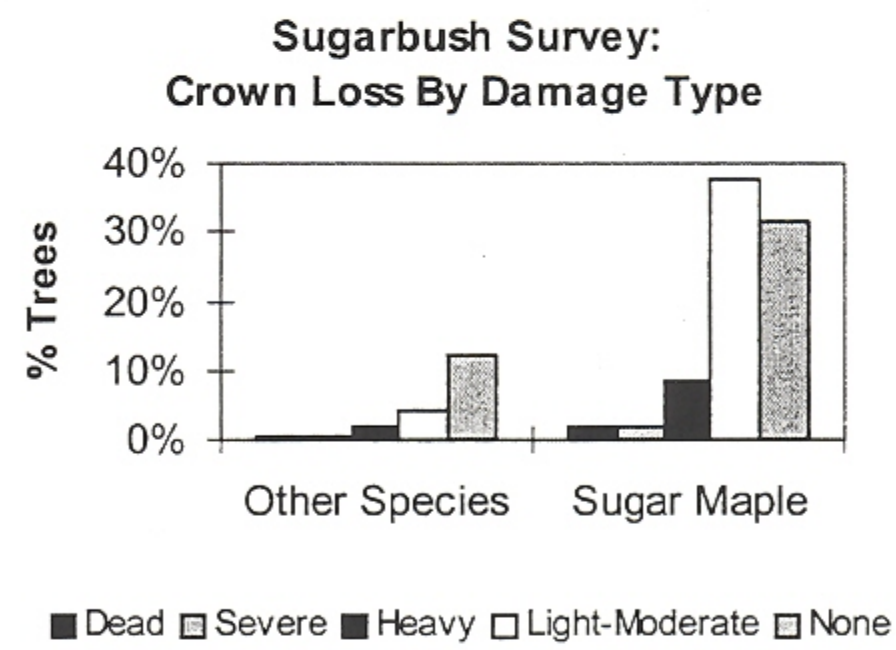


Impacts of Weather....

Drought Conditions led to widespread leaf scorch, leaf browning and leaf yellowing on sugar maple by late summer. Particularly noticeable were symptoms on roadside trees and on high elevation ridges.

In most stands, however, foliage remained green throughout most of the summer. There were no prolonged heat waves, and cool nights helped retain moisture. Nonetheless, the lack of water will affect sugar maple health over the next few years. Lower food reserves mean that trees will have thinner foliage in 2000. They are expected to close tapholes more slowly, with less energy available for wood production, and are also likely to produce a lot of seed, a normal response to stress. Many fine roots have died from lack of water, so the trees are going into this year with less than normal ability to absorb soil water. Although recovery is expected, limit additional disturbance where trees are already stressed: avoid major thinning cuts and road construction. Where trees were defoliated by pear thrips or grow on wet or ledgey sites, limit tapping in spring 2000.

1998 Ice Storm damaged areas continued a process of recovery, but remained visible during aerial surveys. In many areas, recovering maples had small leaves, and have produced large numbers of stress shoots, called "epicormics". A survey was conducted on sugarbushes which were known to have sustained damage in the storm (See figure). On average, 10% of the sugar maples in these sugarbushes sustained heavy damage.



1999 Storms resulted in widespread breakage and blowdown. On July 4, storms blew down trees in Orleans and Essex counties just south of the Canadian border. Just over 1,000 acres of damage were mapped. In southern Vermont, severe damage was caused by a July 6 storm. Winds associated

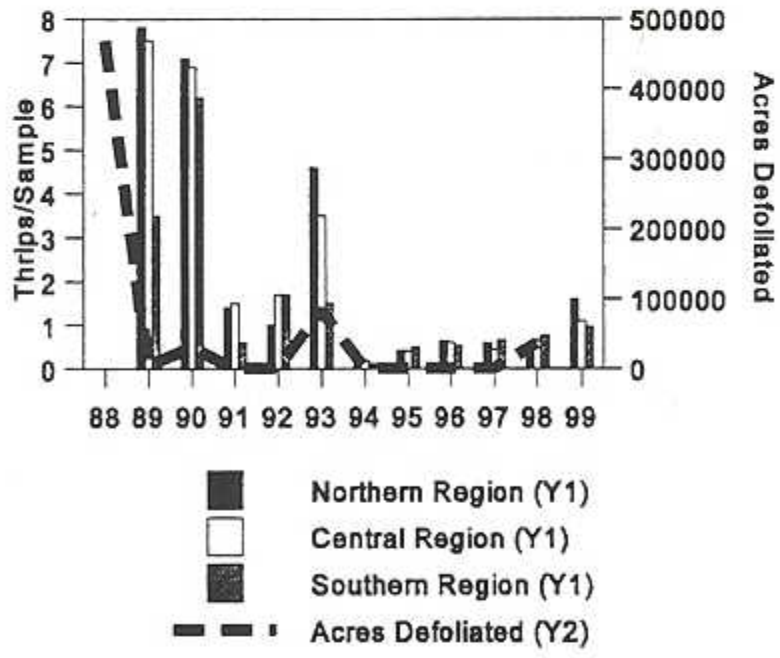
with Hurricane Floyd in mid September blew down a lot of trees in scattered locations. A Snowstorm in late September caused a lot of crown breakage in several sugarbushes in Franklin County, particularly in the Sheldon area.

Whether the damage is from ice, wind, or snow, trees with heavily damaged crowns should be given time to recover. Trees with no symptoms now may decline in the future where heaving by storms broke roots underground. To prevent additional breakage in the future, examine the branch structure of all trees. When thinning, remove those with large wounds, obvious decay, or V-shaped forks.

Impacts of Insects...

Pear Thrips damage was down from 1998, but some heavy defoliation did occur in the southeastern tier of towns, where bud counts in spring were the highest since the 1988 outbreak. Refoliation was limited, and browning increased over the course of the summer, due in part to the dry growing season.

Thrips came out of the ground early. In Dummerston, they were first seen on April 4 - the earliest known date of emergence in Vermont. However, sugar maple buds were still tightly closed at that time, and early emerging thrips fed and laid eggs in other species such as cherry and red maple. In most of the state, sugar maple budbreak was rapid, and the chance for damage was small.



Where sugar maple damage was moderate or heavy in Windham County, tree health is of concern. This is the second year in a row of defoliation in some sugarbushes. In 1998, the damage had been compounded by wet conditions, which allowed fungus diseases to build up on damaged leaves, and on the refoliation. In 1999, dry conditions compounded the impact. Damaged leaves did not expand fully, often browned up over the course of the summer, and sometimes dropped. Most significantly, refoliation was sparse, and trees remained thin all growing season. Trees in Guilford, Halifax, and Whitingham, or elsewhere which have been heavily damaged two years in a row should not be tapped in spring 2000.

Maple Leaf Cutter increased somewhat but not dramatically. Damage was heaviest in Orange and Windsor Counties. **Maple Trumpet Skeletonizer** damage remained heavy, although down from 1998. Tree health may be affected by these insects where drought caused damaged leaves to brown up in mid-summer. Normally, their damage does not become severe until later in August, when the impact on tree health is limited.

Asian Longhorned Beetle has spread to new locations in the New York and Chicago metropolitan areas. Sugar maple is a favored host species, and it sometimes kills trees in less than three years. This insect has not been found in New England. However, look out for round holes (about 1/2" in diameter) on trunks and branches, and for coarse, excelsior-like sawdust.

For More Information: Insect and disease reports, and requests for identification, publications, and information on control, should be directed to the County Forester or Forest Resource Protection personnel at our district or county offices.

Addison	388-4969/879-6565
Bennington	375-1217
Caledonia	751-0110
Chittenden	879-6565
Essex	751-0110
Franklin	524-6501/879-6565
Grand Isle	524-6501/879-6565
Lamoille	888-5733
Orange	479-3241/476-0170
Orleans	334-7325/751-0110
Rutland	483-2314
Washington	476-0170
Windham	257-7967/885-8855
Windsor	296-7630/885-8855

Vermont Roadside Tree Health Survey - 1999

INTRODUCTION

In 1994, a roadside tree health survey was conducted to evaluate trees along one paved and one unpaved road in each of 25 Vermont towns. In 1999, a new survey was conducted by randomly selecting 20 percent of the roads originally surveyed and evaluating trees along these roads in the same manner as in 1994. Tree data from these roads were compared with 1994 data from the same roads.

RESULTS

In 1999, nearly 83 percent of roadside trees were healthy compared to 71 percent in 1994 (Figure 1). Roadside trees are generally less healthy than forest trees, but tree condition in 1999 was not far below the average of 89 percent healthy for a statewide forest tree health survey conducted in 1996. Health of forest trees has steadily improved over the past 15 years and roadside trees appear to be following the same trend.

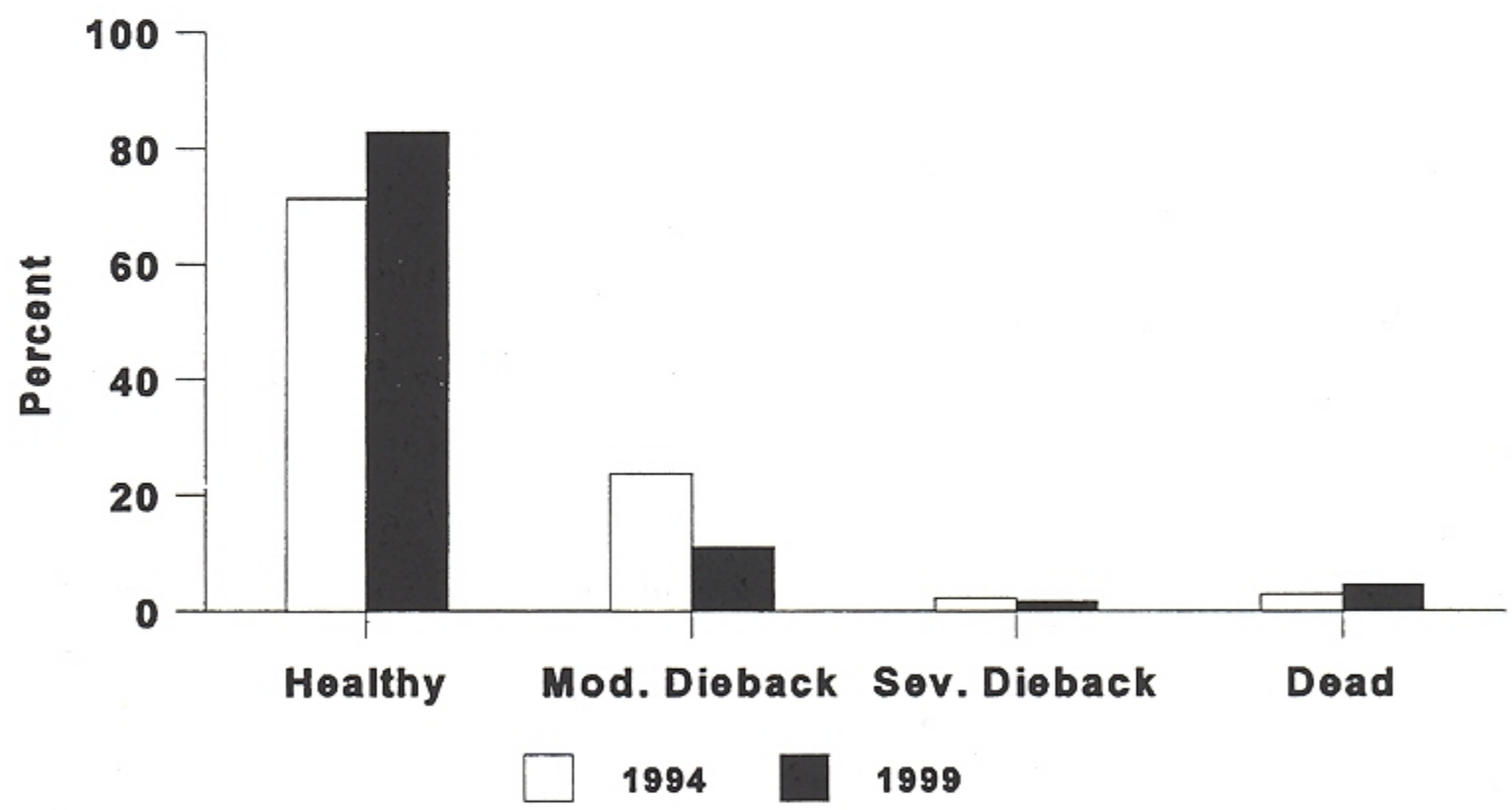


Figure 1. Crown dieback ratings of trees 5 inches dbh or greater along Vermont roads in 1994 and 1999. Healthy = 0-10% crown dieback; Mod. Dieback = 11-50% crown dieback; Sev. Dieback = >50% crown dieback.

Most species improved in crown condition between 1994 and 1999 (Figure 2). The only exceptions were red maple, which didn't change, and the birches, which had more dieback. Birch condition may be related to their greater sensitivity to the drought conditions that occurred during 1999.

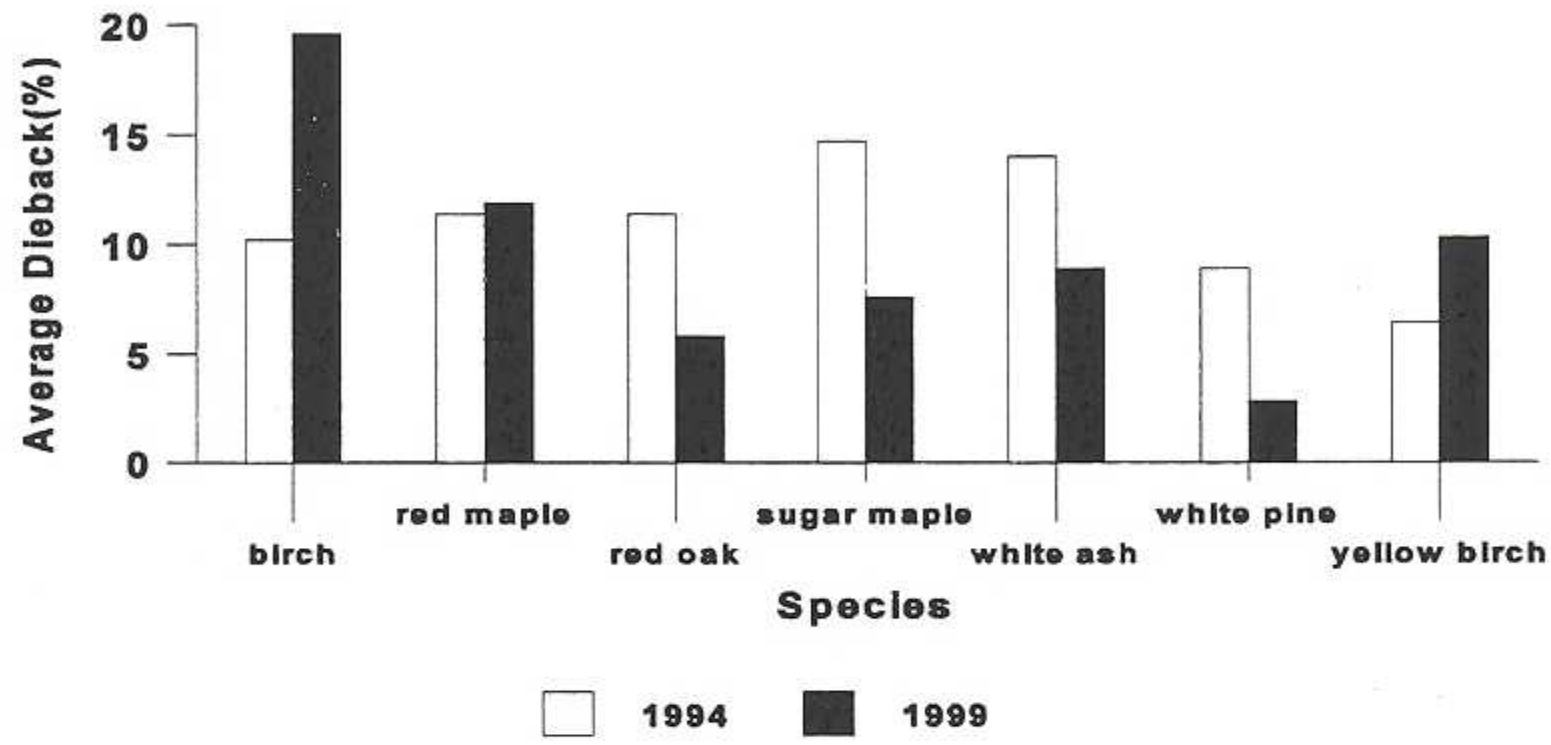


Figure 2. Average crown dieback by species in 1994 and 1999.

As in 1994, trees along paved roads had slightly more crown dieback and greater foliage transparency (light visible through the foliated portion of the crown) than trees along dirt roads (Figure 3). This may be due to winter applications of salt to paved roads and its effect on adjacent trees.

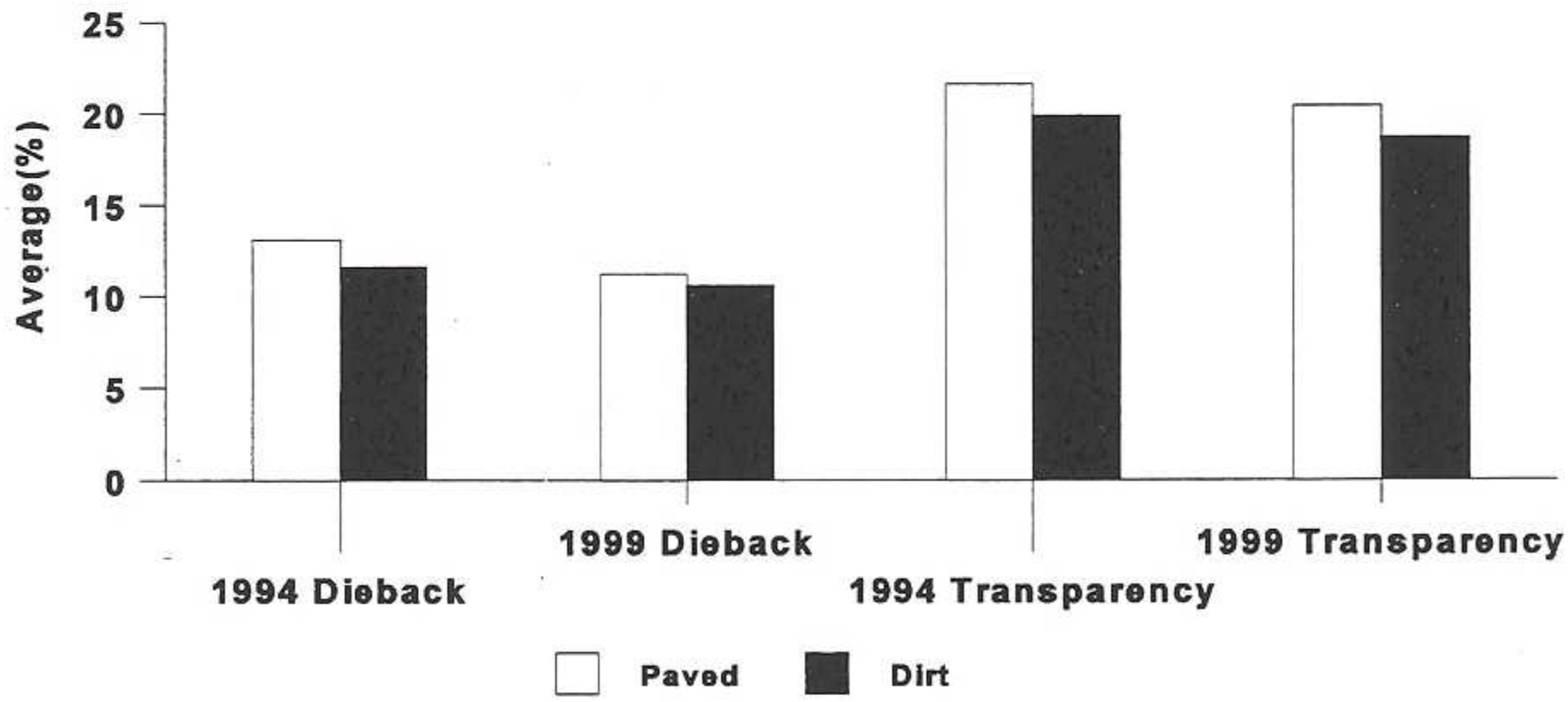


Figure 3. Average crown dieback and transparency in 1994 and 1999 along paved and unpaved (dirt) roads.