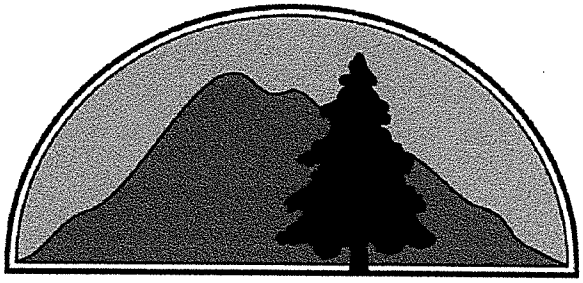
Vermont Publications on the 1998 Ice Storm and Related Forest Health Damage



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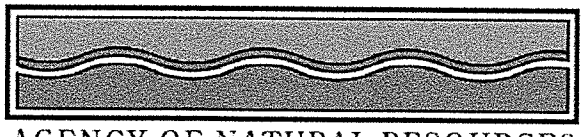
VERMONT



AGENCY OF NATURAL RESOURCES

Vermont Publications on the 1998 Ice Storm and Related Forest Health Damage

Prepared by the Vermont Department of Forests, Parks and Recreation
Forest Resource Protection Section

In cooperation with
The USDA Forest Service, State and Private Forestry

Vermont Publications on the 1998 Ice Storm and Related Forest Health Damage

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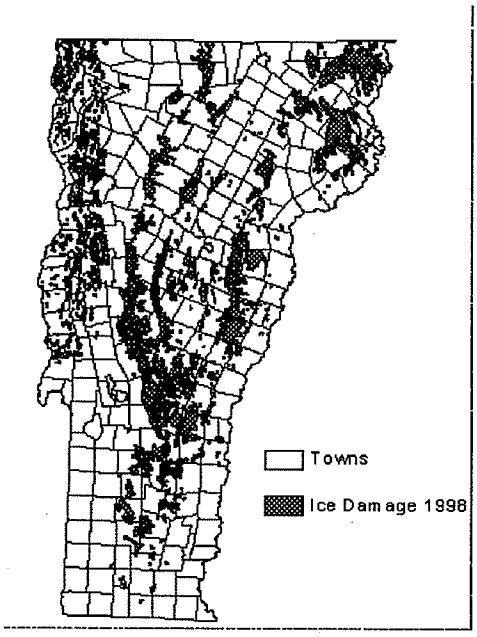

The 1998 Ice Storm: VT Assessment and Response

Ronald S. Kelley[1]

ABSTRACT

The January 1998 ice storm damaged trees in every county in the state. Damage was mapped on 260,000 hectares (about 20 percent of the forest area) by special aerial surveys. Guidelines based on crown loss were developed for landowners and foresters, recommending which trees to remove. Tapping guidelines for damaged sugarbushes were also developed. A sugarbush damage survey indicated that 14 percent of sugarbushes were damaged. Permanent plots used to collect forest health measurements were revisited and assessed for extent of damage.

INTRODUCTION

The January 7-9, 1998 ice storm was the worst ever in the experience of many Vermonters, causing severe damage to many trees and resulting in extended power outages. The initial response of the Department of Forests, Parks and Recreation was to provide personnel to help clean streets and provide emergency management needs. Following this, aerial surveys were conducted to determine extent of tree damage, and guidelines for managing damaged forest stands and sugarbushes were developed. Then ground surveys were conducted to determine the severity of damage.

AREA OF ICE DAMAGE

Damage was mapped on 260,000 hectares (about 20 percent of the state's forested area) by special aerial surveys (Figure 1). Initial surveys were conducted in January when many of the trees were encased in ice. This made damage severity very difficult to determine so additional aerial surveys were conducted for some areas after the snow had melted. The Champlain Valley received the most continuous, severe damage. Elsewhere, damage was scattered at higher elevations, generally above 1200 meters in and near the Green Mountains. East-facing slopes tended to have the heaviest ice loading. There was little or no damage in the Taconic Mountains and the Connecticut River Valley.

[1]Forestry Protection Specialist, Department of Forests, Parks and Recreation, Morrisville, VT

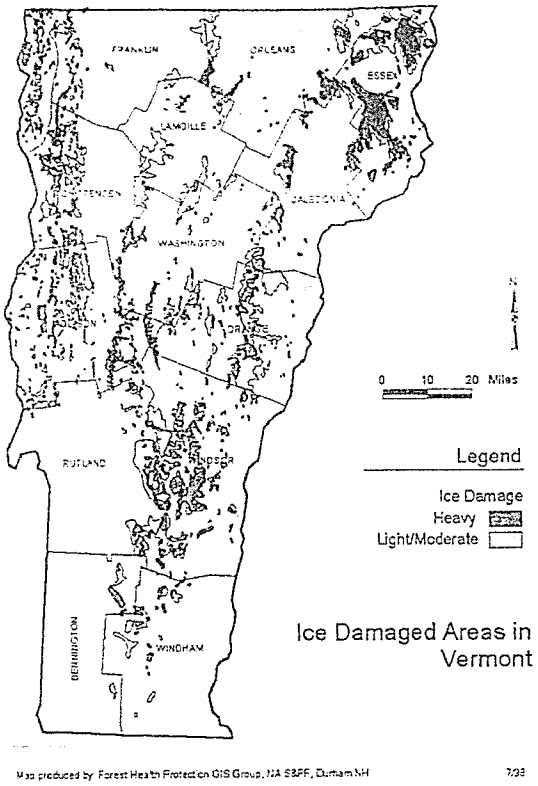

Figure 1.--1998 ice damage. Mapped area is 260,000 hectares.

MANAGEMENT GUIDELINES

Within a few weeks after the ice storm, department personnel began receiving many calls from foresters and landowners wanting to know how badly damaged a tree could be and still have a good chance of surviving or retaining economic value. Sugarmakers were asking similar questions about which trees should be tapped for maple syrup production.

Forest Management Guidelines

A search of the literature revealed very little comprehensive information on tree recovery following crown breakage. We did, however, have ten-year data on the fate of several different hardwood species with various levels of crown dieback in 1986 (Kelley et al. 1997). This data showed that most overstory trees with more than 50 percent crown dieback were more likely to die than to recover within a ten-year period. Birches, particularly paper birch, were considered a higher risk because most failed to recover from dieback in excess of 25 percent.

Ice-damaged trees went into the winter of 1997-98 in good condition, with a full complement of roots containing stored food reserves. Knowing that they should respond more vigorously than trees with traditional crown dieback, the data for likely recovery was adjusted upward one category to produce the following management guidelines (Table 1).

Table 1. **ADVICE FOR LANDOWNERS AND FORESTERS MANAGING STANDS DAMAGED BY THE JANUARY 1998 ICE STORM**

The Vermont Department of Forests, Parks and Recreation has developed the following guidelines for forest stands damaged by the recent ice storm. They are based on ten-year crown dieback data from the Vermont Hardwood Tree Health Survey, a research review by US Forest Service researchers and information on tree response to heavy pruning. These guidelines are tempered by the knowledge that in most cases, tree root systems were not injured, and have good reserves of food available for spring growth.

FIRST:

❄ **Don't Panic** - Stop, think and be patient. Trees went into dormancy in very good health and have excellent recovery potential. **Landowners have at least the upcoming growing season to fully assess damage and determine the need for salvage.**

❄ **Safety First and Foremost** - Clearing access roads and evaluating forest stands containing hanging limbs and bent trees is dangerous. Use safety precautions at all times.

❄ **Get Professional Advice** - Landowners should seek advice from a professional forester. Each stand is different. Site quality and other factors must be considered in applying these recommendations. Call your County Forester for details. **Trees with up to 10% crown loss can be managed normally.**

Recommendations Based On Tree Species and Type of Damage*

	If species is:	And crown loss is:	Recommendations is:
❄	red or sugar maple, beech, oak, cottonwood, poplar, ash, conifers others not listed	11-50%	Can retain or thin to leave best trees.
		50-75%	Trees at risk. Can retain these for now, but re-evaluate within 5 years.
		75% +	Remove hardwoods within 5 years. Remove conifers with broken main stems within 1 year.
❄	paper birch yellow birch	11-25%	Can retain or thin to leave best trees.
		25-50%	Trees at risk. Can retain these for now, but re-evaluate within 5 years.
		50% +	Remove within 5 years.
❄	**If tree (all species) is:** Uprooted or on the ground		Salvage within 1 year.

*Internal staining and decay may eventually cause a loss of value in damaged trees. The rate of infection will vary with species and degree of damage, but **this is a very slow process.** Broken main stems or stem forks are the most serious. Discoloration spread downward can range from a few inches per year to a foot or more per year with this type of damage. Large broken branches which have torn the tree's bark are also serious. Infection associated with broken branches shouldremain mostly within branch wood. This is especially true for otherwise healthy sugar maples.

* **These are Guidelines Only** - They are based on data for upper canopy trees. Young trees tend to be even more resilient. Every site and every tree is different. Standard silvicultural considerations such as spacing, bole condition, presence or absence of suitable replacement trees, site quality, etc., must be kept in mind when evaluating trees.

Tapping Guidelines

A similar format as used for the landowner and forester management guidelines, stressing patience, safety and the need for professional advice, was developed for operators of sugarbushes damaged by the ice storm. Tapping recommendations were based on the following four crown loss categories: (1) less than 10 percent crown loss - OK to tap normally, (2) 11-25 percent crown loss - Tap lightly, reduce number of taps, (3) 26-75 percent crown loss - trees at risk. Consider all factors including desirability to retain tree in the stand. Best not to tap if tree is retained, (4) 76 percent crown loss - Poor chance of tree survival. Tap now and plan to salvage at a later date.

SUGARBUSH DAMAGE

A questionnaire survey was mailed to 2500 sugarmakers seeking information on ice storm damage to sugarbushes. Based on a 26 percent response, 14 percent said that their sugarbush was damaged by the January 1998 ice storm. Of these, 25 percent said the damage was heavy, 31 percent said it was moderate, and 44 percent said it was light. Based on this questionnaire, an estimated 75,000 taps were lost.

DAMAGE TO MONITORING PLOTS

The department maintains 166 permanent monitoring plots that are visited annually or periodically to collect forest health data, including crown evaluations for dieback and transparency. This includes 40 North American Maple Project (NAMP) plots equally divided between sugarbushes and sugar maple stands, 22 national Forest Health Monitoring (FHM) plots, 19 Vermont Forest Ecosystem Monitoring (VForEM) plots, and 84 Vermont Hardwood Health Survey (VHHS) plots. All plots that were within the footprint of the ice storm, as indicated by the aerial survey map (Figure 1) were visited in the summer of 1998 and evaluated for ice damage. In addition, all the other tree and plot information, that is taken when these plots are normally visited, was collected.

Plot visits revealed that 7 NAMP plots, 19 VForEM plots, and 17 VHHS plots (18 percent of all plots) were damaged by the ice storm. In addition, the USDA Forest Service maintains about 950 forest inventory analysis (FIA) plots in the state which were last visited in 1996 and 1997. Their crews revisited 126 plots that fell within the ice storm footprint and collected data on the 116 (12 percent) plots that received damage.

SEVERITY OF DAMAGE

Information on tree damage in these plots is currently being analyzed. As one might expect, damage ranged from very light to severe, depending on plot location. In general, pole size trees suffered the most bole breakage, while saplings tended to bend and larger trees tended to lose mostly crown branches.

Dominant and codominant trees had greater crown loss than trees in lower canopy positions. Ice damaged plots had fewer healthy trees in 1998 than when previously evaluated.

Species Affected

Hardwood species received the most damage. A variety of species were damaged, as reflected by data from the Vermont Hardwood Health Survey plots (Figure 2).

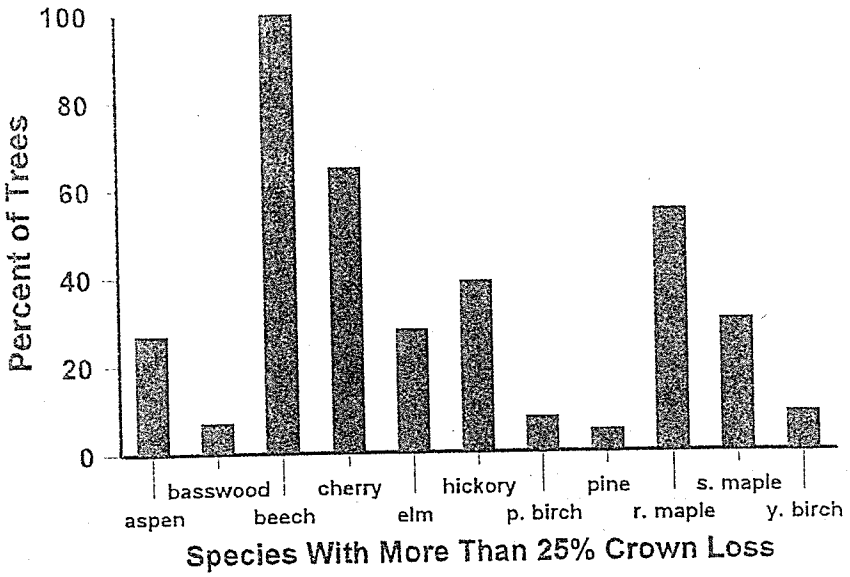

Figure 2.--Upper canopy trees in ice-damaged Vermont hardwood health plots that received significant crown loss, by species.

FUTURE PLANS

Permanent plots will continue to be visited for crown ratings and other forest health measurements. Additional surveys will be conducted for sugarbushes and for urban and roadside trees. Damaged trees are being sawed and the lumber examined before and after kiln drying to determine any hidden losses in value due to the ice storm. Special intensive monitoring plots in heavily damaged and non-damaged areas will be established to better evaluate vegetative changes. This will include crown and canopy photography to document changes over time. Plans are also being made to dissect sugar maple and white ash trees with ice wounds that occurred ten or more years ago, to look at extent of discoloration and decay associated with those wounds.

Evaluating trees with varying amounts of damage over time should provide better answers on survivability and recovery of different tree species and forest stands following a major ice storm. Thus, the next time a major event such as this occurs, there should be better information to provide to foresters, sugarmakers and landowners seeking advice on how to best manage their damaged trees.

LITERATURE CITED

Kelley, R.S., E.L. Smith, S. Cox and B. Frament. 1997. Vermont hardwood tree health in 1996 compared to 1991 and 1986. Dept. Forests, Parks and Recreation, Waterbury, VT. 32pp.

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Section II: Vermont Tree Damage

1. Ice Damage to Vermont Sugarbushes

2. Damage to Vermont Hardwood Tree Health Plots by the January 1998 Ice Storm

3. Vermont Roadside Tree Health Survey – 1999

Ice Damage to Vermont Sugarbushes

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.

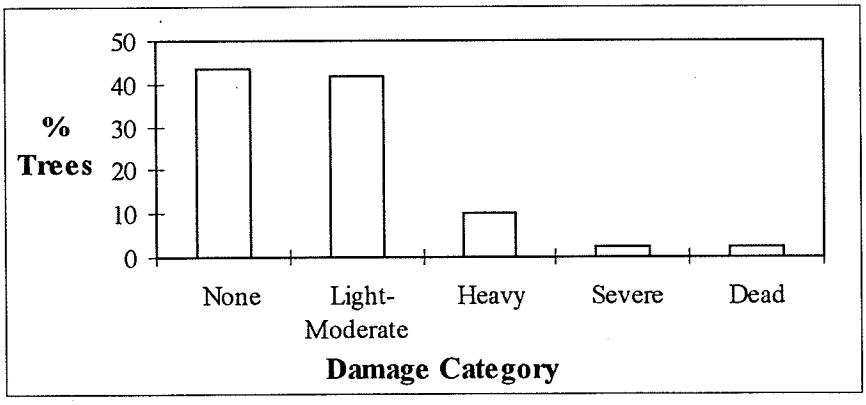

Figure 1. Percent Trees In Crown Damage Categories

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.

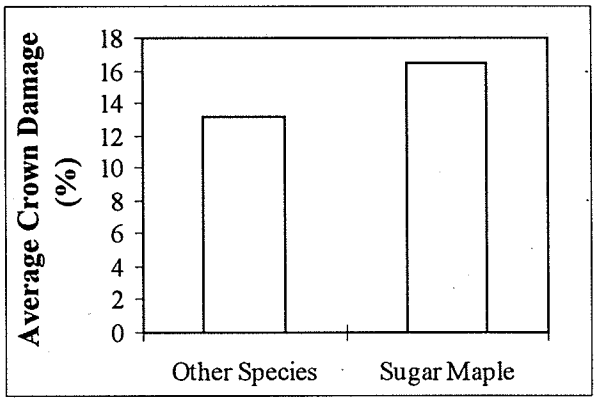

Figure 3. Comparison of Crown Damage on Sugar Maple and Other Species

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.

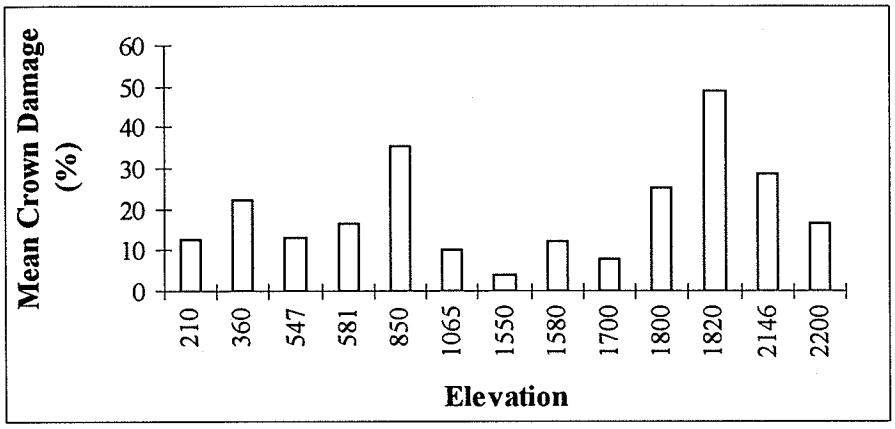

Figure 4. Crown Damage at Different Elevations

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.

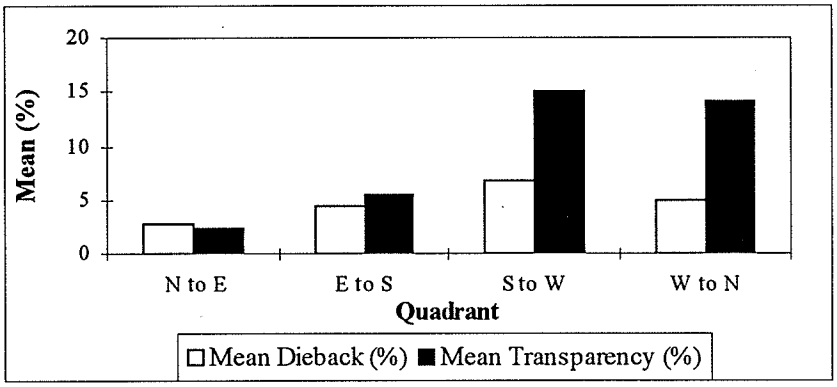

Figure 5. Stand Aspect and Damage

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.

Damage to Vermont Hardwood Health Plots

Damage to Vermont Hardwood Tree Health Plots By The January 1998 Ice Storm

Introduction

The Vermont Hardwood Tree Health plot system consists of 84 ground plots distributed throughout the state. Plots were randomly selected based on mortality classes from interpretation of 1985 photography. Each plot consists of five, 10-factor prism points.

In the spring of 1998, all plots that fell within areas aerially mapped as having been impacted by the ice storm were visited to collect damage information. The ice storm damaged 17 of the plots but some of these had only very light damage. It was decided that only those plots that had two or more dominant/codominant trees with more than 25 percent crown loss due to the ice storm would be revisited for summer crown evaluations. Data analysis was done for the 9 plots (containing 437 trees) that exceeded that threshold. Five of these plots were located in Shelburne and South Burlington (Champlain Valley) at elevations of 300 to 400 feet. Three were in Jay at elevations above 2,100 feet and one was in Roxbury at an elevation of 2,000 feet.

Methods

North American Maple Project guidelines were followed for the early spring ice damage evaluations. Bole breakage was recorded as: 0) none, 1) single bole broken, 2) multiple bole with at least 1 unbroken or 3) multiple bole, all broken. Crown loss due to breakage was recorded as: 0) none, 1) 1-10%, 2) 11-25%, 3) 26-50%, 4) 51-75% or 5) 76-100%. Crown dieback and transparency was recorded to the nearest 5% (FHM standards) during a follow-up summer visit.

Results

The majority of trees in these plots received either light or no damage (Figure 1). Dominant/codominant trees received more crown damage than trees in other canopy positions, except for trees down on the ground or with boles broken below the crown (100% crown loss). The small pole-size trees were the ones most likely to break due to heavy ice loading. About 15 percent of the dominant/codominant trees had severe crown damage (more than 50%).

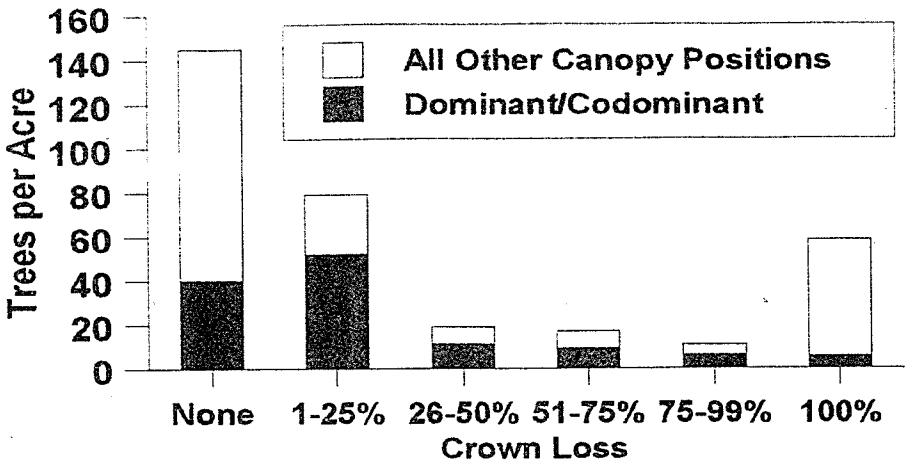

Figure 1. Crown loss due to the January 1998 ice storm.

Beech trees suffered the most severe damage (Figure 2) but all of these trees were located in one very heavily damaged plot. More than 25 percent of the dominant/codominant black cherries, red maples and hickories had heavy to severe damage. Next to beech, more of the sugar maples were killed by the storm than any other species.

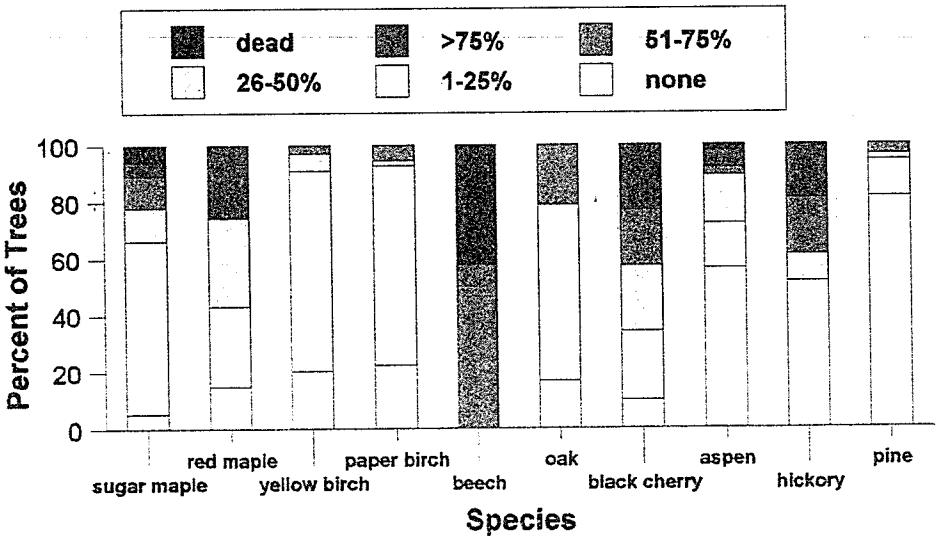

Figure 2. Crown loss due to the January 1998 ice storm for dominant/codominant trees by species.

Average dieback and transparency increased dramatically in these ice-damaged plots compared to when evaluations were last conducted in 1996 (Figure 3). Many of the heavily damaged trees were observed to have poor foliage production along many of the remaining branches, as well as smaller than normal leaf size. These trees will continue to be monitored to determine whether they survive.

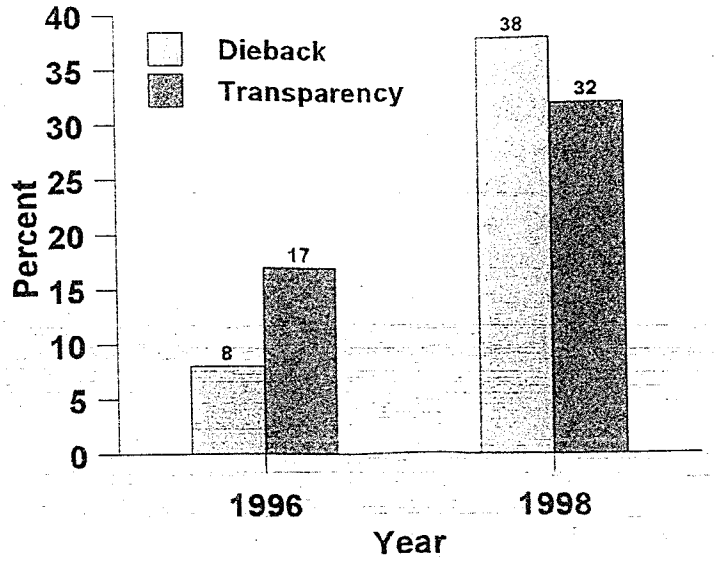

Figure 3. Average crown dieback and transparency for dominant/codominant trees before (1996) and after (1998) the January ice storm.

Ronald S. Kelly
3 May 1999

Vermont Roadside Tree Health

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.

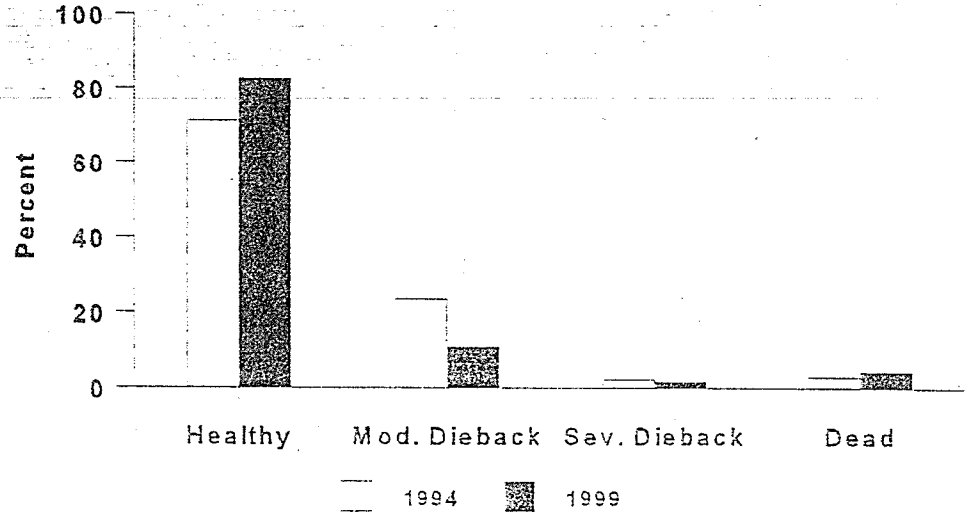

Figure 1. Crown dieback ratings of trees 5 inches dbh or greater along Vermont roads in 1994 and 1999. Healthy = 0-10% crown dieback; Mod. Dieback = 11-50% crown dieback; Sev. Dieback = >50% crown dieback.

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.

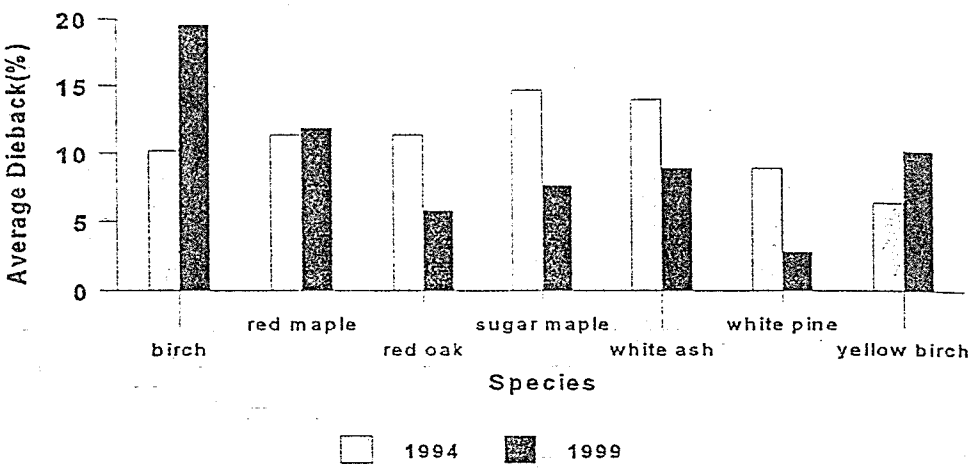

Figure 2. Average crown dieback by species in 1994 and 1999.

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.

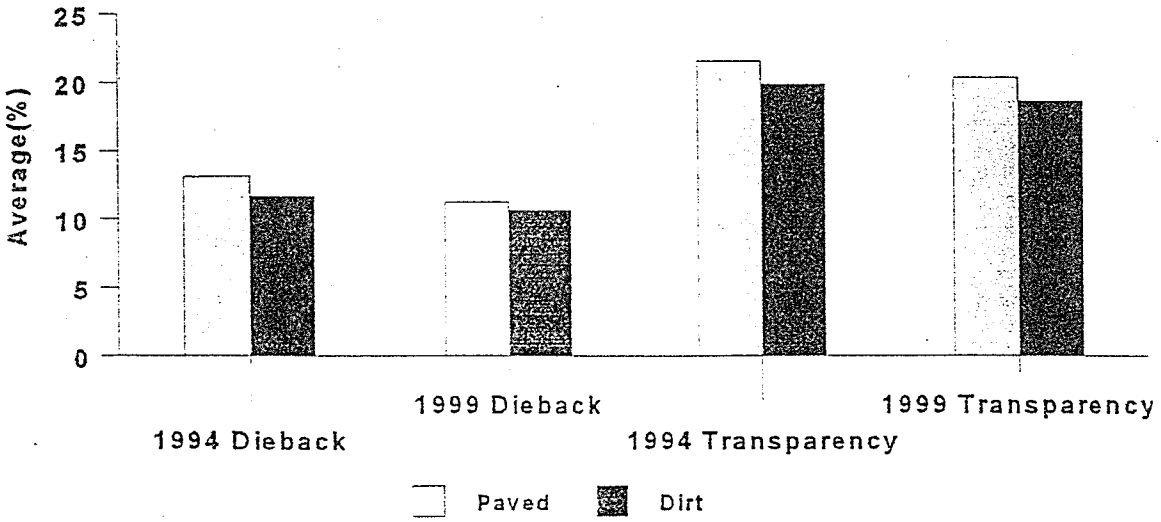

Figure 3. Average crown dieback and transparency in 1994 and 1999 along paved and unpaved (dirt) roads.

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Section III: North American Maple Project (NAMP)

1. VT NAMP Plots in 1998

2. VT NAMP Plots in 1999

Head - This w/ NAMP ✓
1998
2 SFPV will have '99 NAMP

VT NAMP Plots in 1998:
Trend in Forest Condition

TREND 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 11 years. Tree vigor, crown dieback, foliage transparency and mortality are all measures of tree health that vary depending on site, stress levels, disturbance and year. In the NAMP, 5 tree species are represented in large enough samples to monitor over time: sugar maple, beech, yellow birch, white ash and red maple.

Sugar Maples

Trends in overstory sugar maple condition on a statewide basis varied little from previous years, with 93% of sugar maples in NAMP plots in a healthy condition (≤15% dieback). The only indicator that showed significant change was mortality (Figure 1). Average annual mortality of overstory trees from 1989 to 1997 was between 0.1 and 0.9%, but rose to 1.7% in 1998.

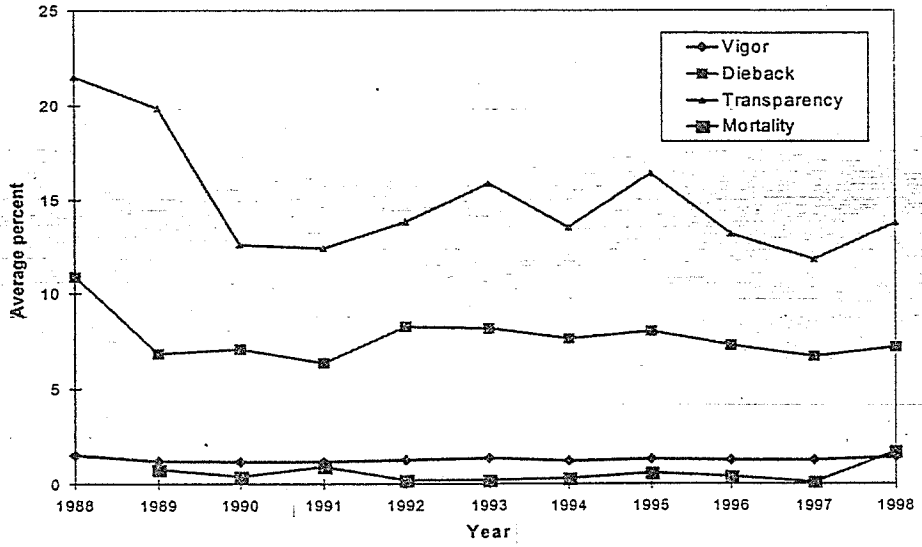

Figure 1 Trend in overstory sugar maple condition on NAMP plots.

The 1998 ice storm was a major disturbance in those forests affected by heavy ice loads. Seven of the 40 NAMP plots received light to heavy damage from the ice storm. Average dieback of sugar maple trees in ice damaged plots was 8.9% compared to 7.0% for unaffected plots (Figure 2). Transparency of foliage was 18.7% in ice damaged plots compared to 13.4% in unaffected plots. And mortality was 5.0% on ice damaged plots compared to 3.4% on other plots.

Other stresses on forests in 1998 included abundant precipitation, resulting in a variety of foliar diseases. Moderate to heavy seed production was observed on 12% of plots.

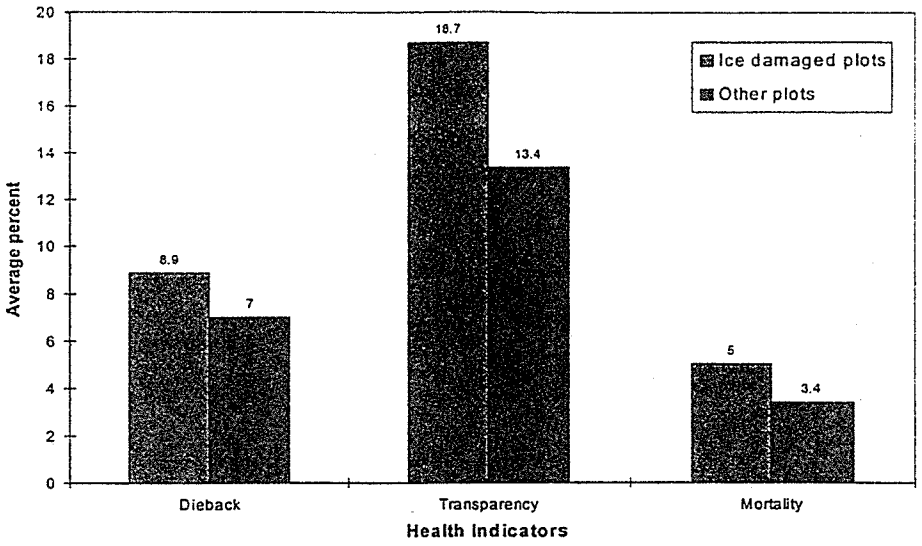

Figure 2 Sugar maple health in ice affected NAMP plots.

Other Hardwood Species

Indicators of tree condition for 1998 showed that red maple (Figure 3) and white ash (Figure 4) on NAMP plots remained in stable condition. Yellow birch foliage was thinner than normal (Figure 5). Beech foliage was thin and dieback increased dramatically over previous years (Figure 6). These two species may have been affected by foliar diseases and ice injury in affected plots.

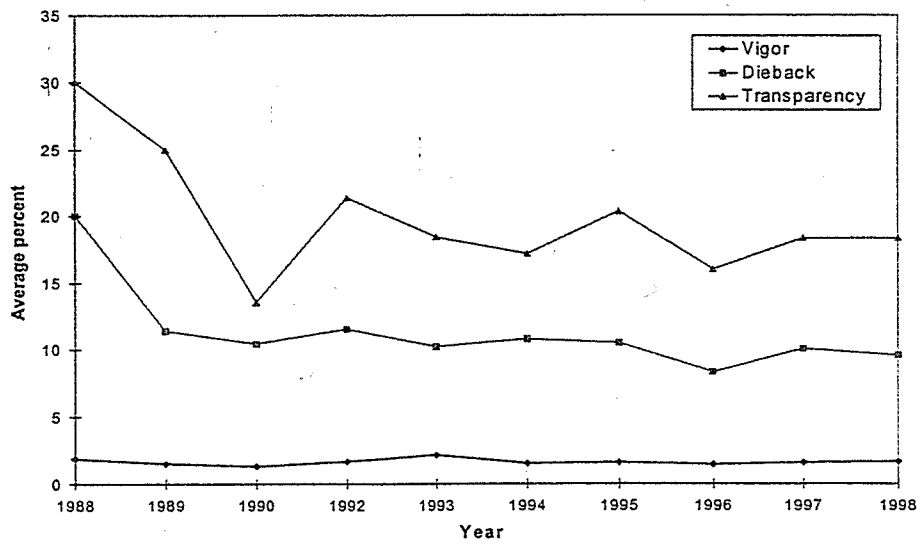

Figure 3 Trend in red maple tree condition on NAMP plots.

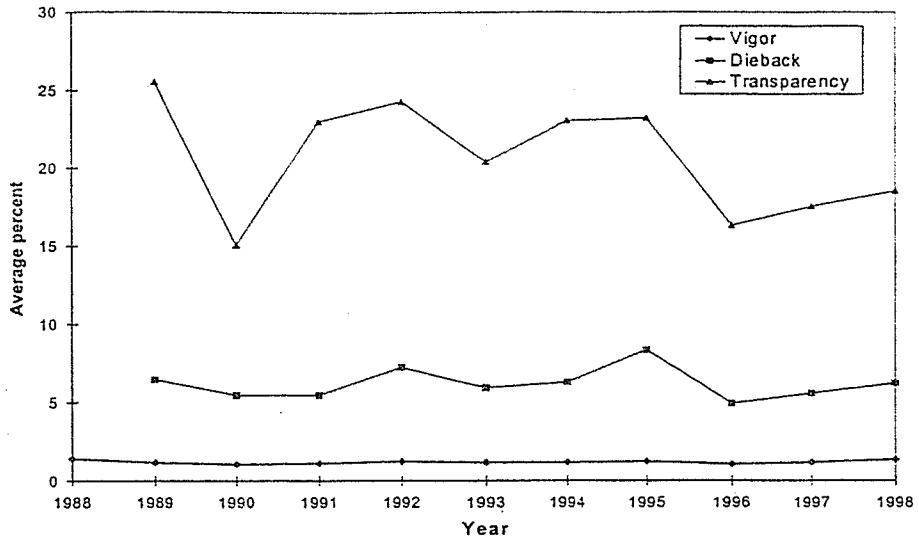

Figure 4 Trend in white ash tree condition on NAMP plots.

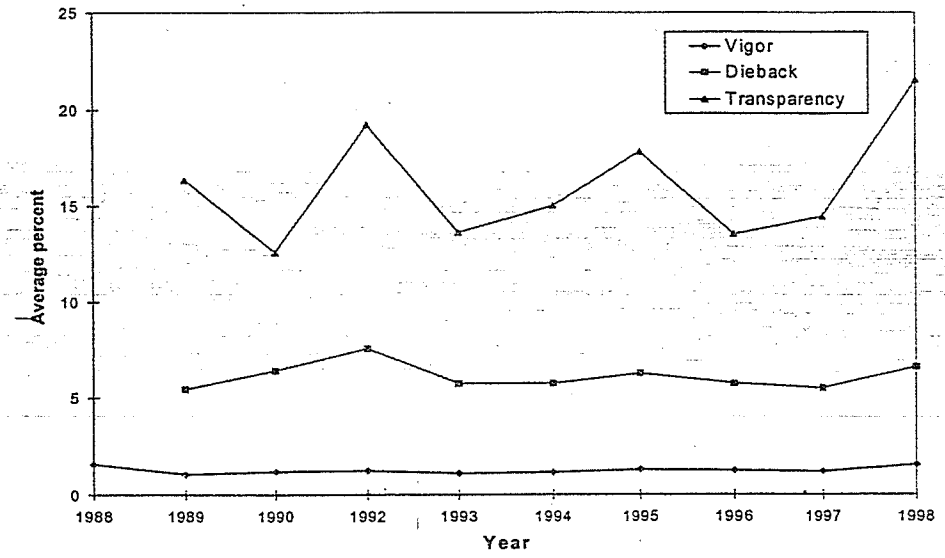

Figure 5 Trend in yellow birch tree condition on NAMP plots.

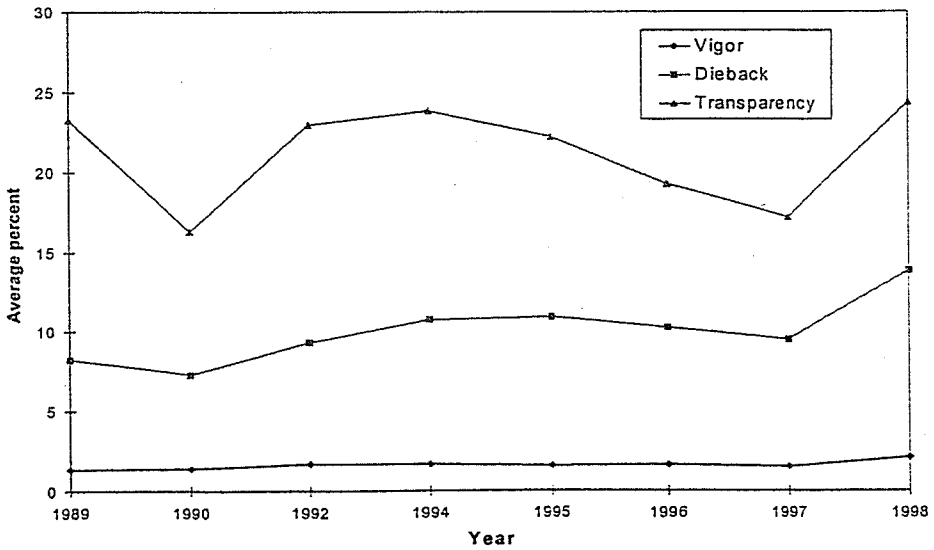

Figure 6 Trend in beech tree condition on NAMP plots.

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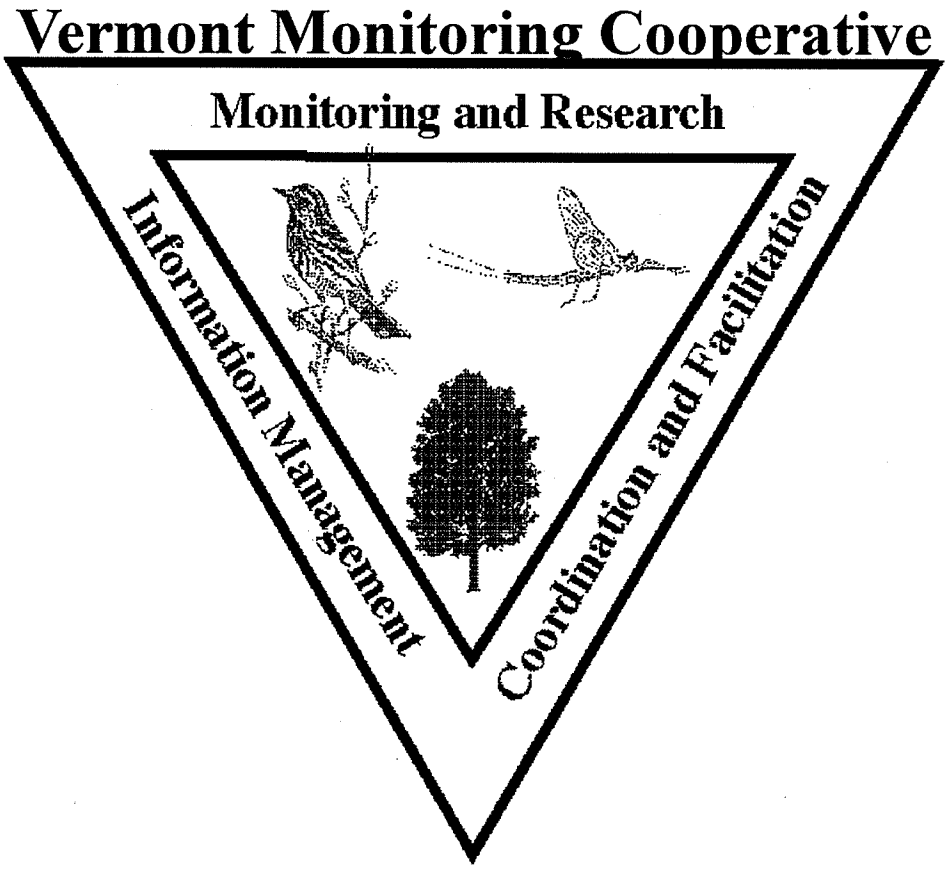
Section IV. Vermont Monitoring Cooperative Data



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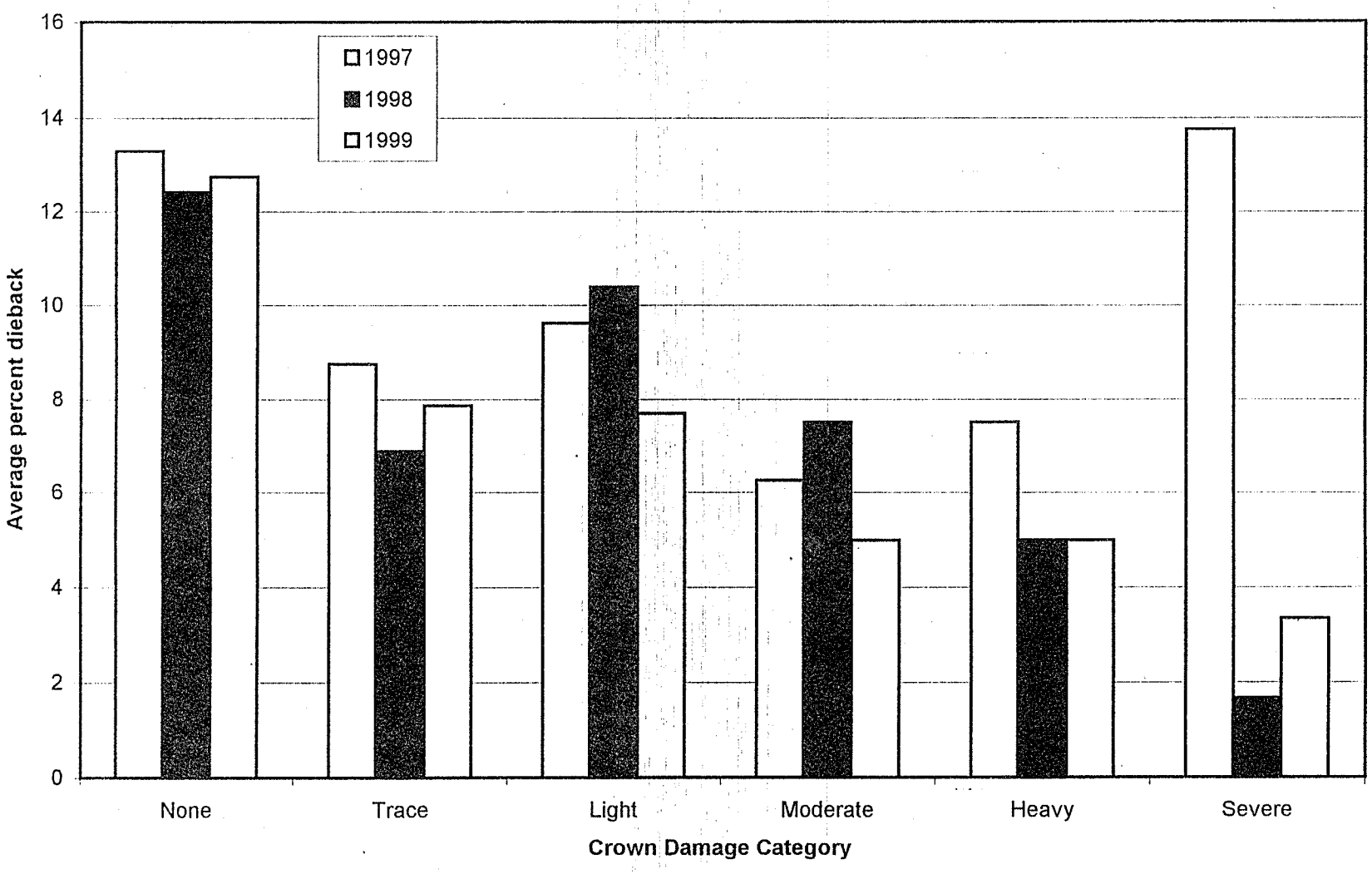
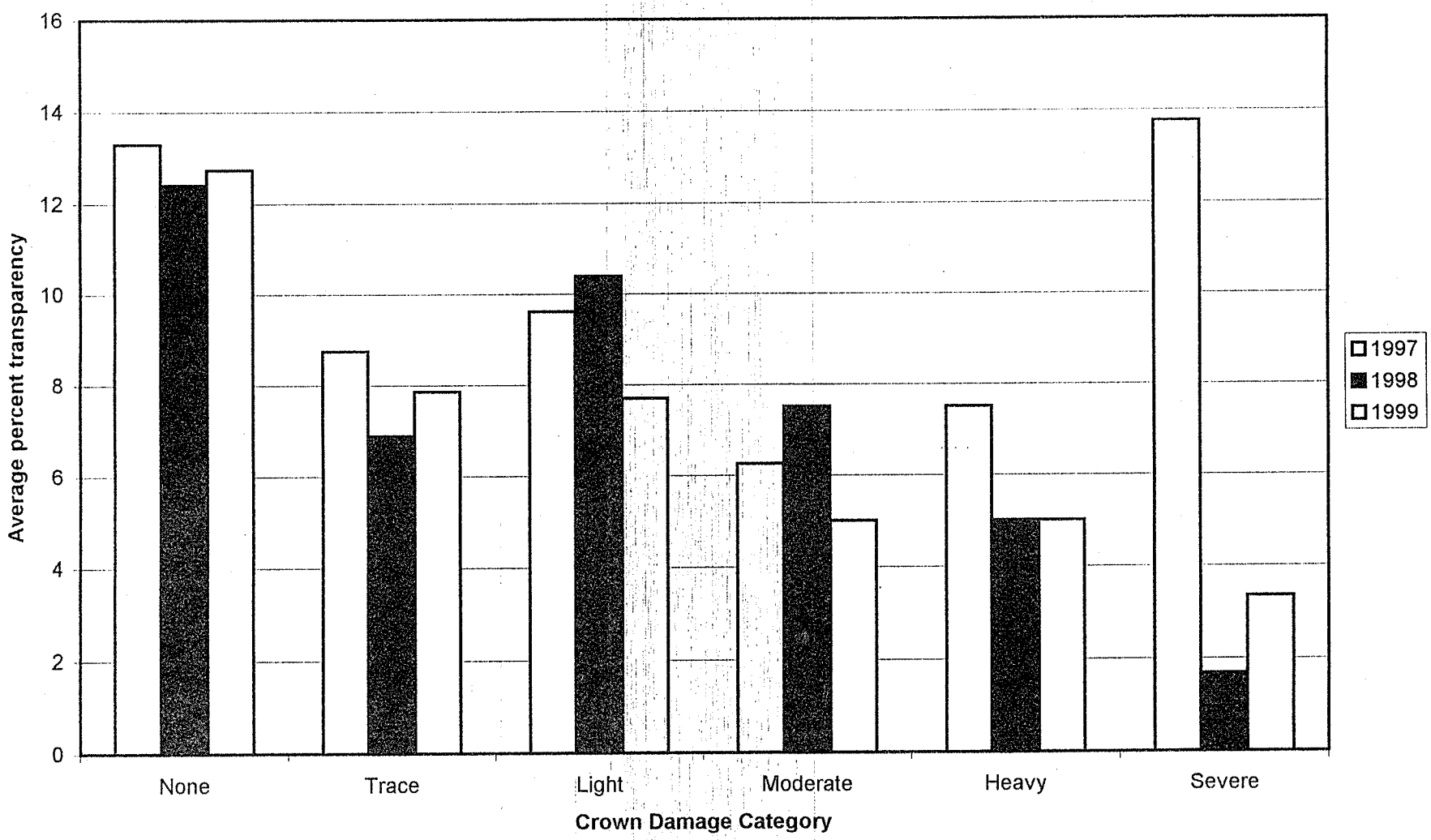
Ice Storm Effects on Mansfield: Trend in Dieback by Crown Damage Categroy - All species and crown classes

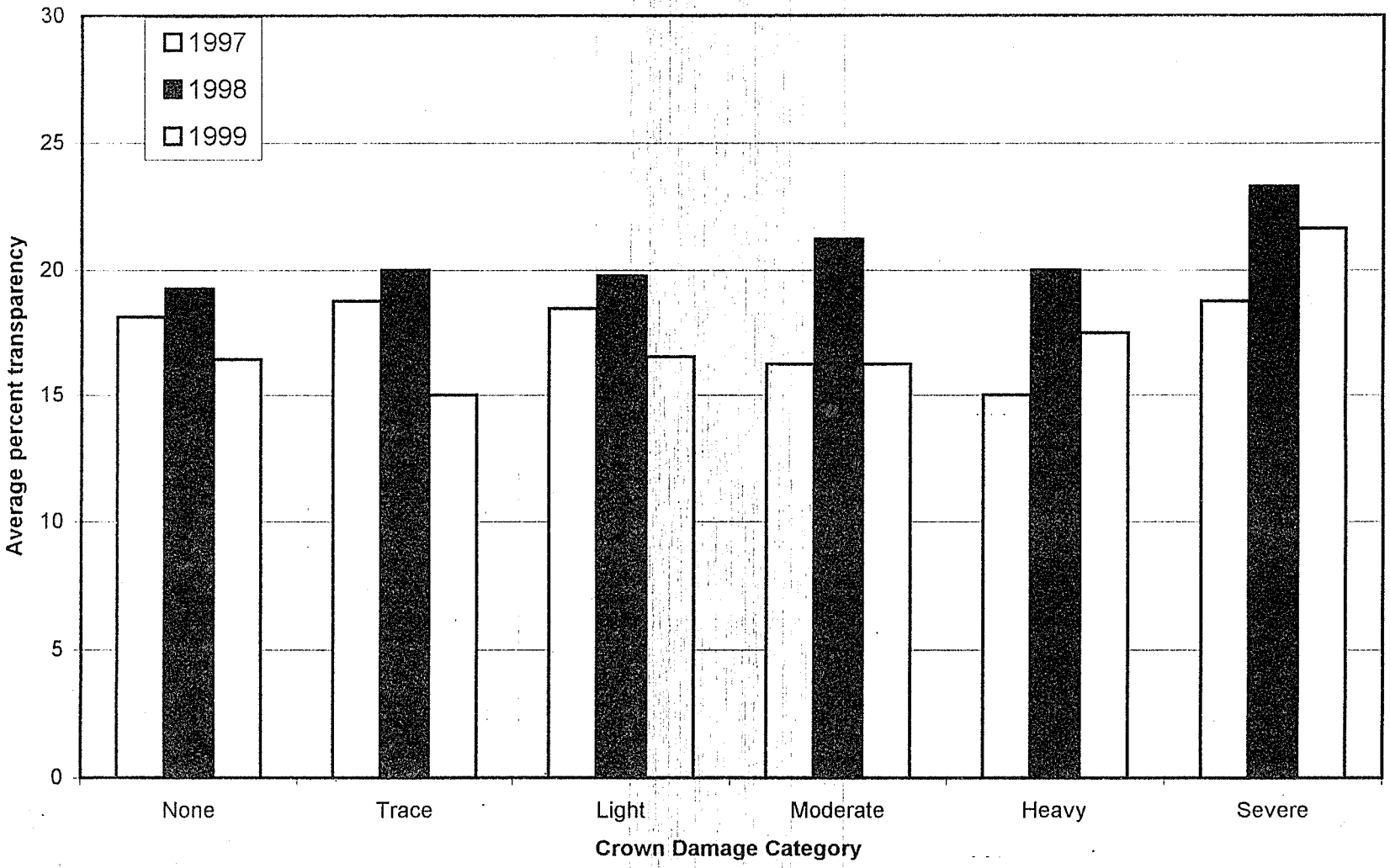


same as previous graph

Ice Storm Effects: Trend in Dieback by Crown Damage Categroy - All species and crown classes



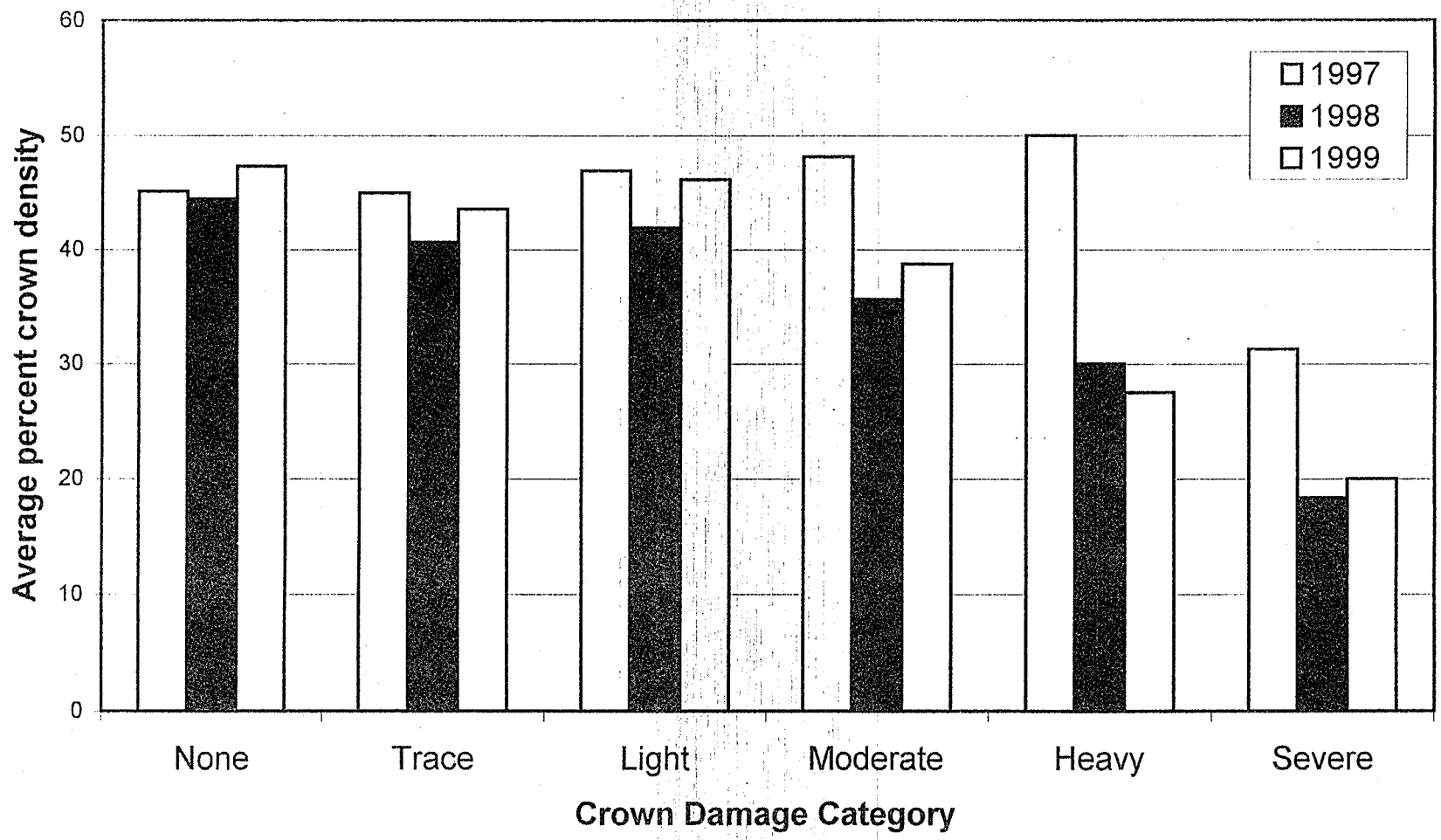
Ice Storm Effects on Mansfield: Trend in Transparency by Crown Damage Category - All species and crown classes



Ice Storm Effects on Mansfield:

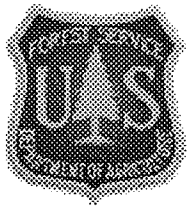
Trend in Density by Crown Damage Category -

All species and crown classes



Vermont Publications on the 1998 Ice Storm and Related Forest Health Damage

Section V. USDA Forest Service Ice Monitoring Plots



General Summary of the Ice Storm Forest Response Study

2 States
12 Sites - 8 in NH, 4 in VT
54 Plots – 37 in NH 17 in VT

2471 Total Trees Measured

of which:
334 Dead

of which:
95 died since January 1998
44 Moderately old
186 Snags

of the 2471 measured trees
128 Dominant
816 Codominant
545 Intermediate
982 Suppressed

The height classes on trees were what we believed the pre Ice storm class would have been

We also measured:

723 Saplings Trees 1.4 meters or greater in height but less than 5.0 cm DBH
5775 Seedlings were all trees less than 1.4 meters in height.

The Saplings were measured on subplots that were only 8% of the entire 400 square meter plot. If distribution is equal across the entire plot from what we mearured then 9037 saplings would have occurred.
The Seedlings were measured on smaller subplots that were only 2% of the 400 square meter plot. If distribution is equal across the entire plot from what we mearured then 288,750 saplings would have occurred.

Plant species break down was
20 Deciduous Trees
6 Coniferous Trees
26 Deciduous Shrubs
2 Evergreen Shrubs
3 Dwarf Shrubs
12+ Grass and Sedge Species
25 Ferns and Ground Mosses
74 Herbaceous Plants

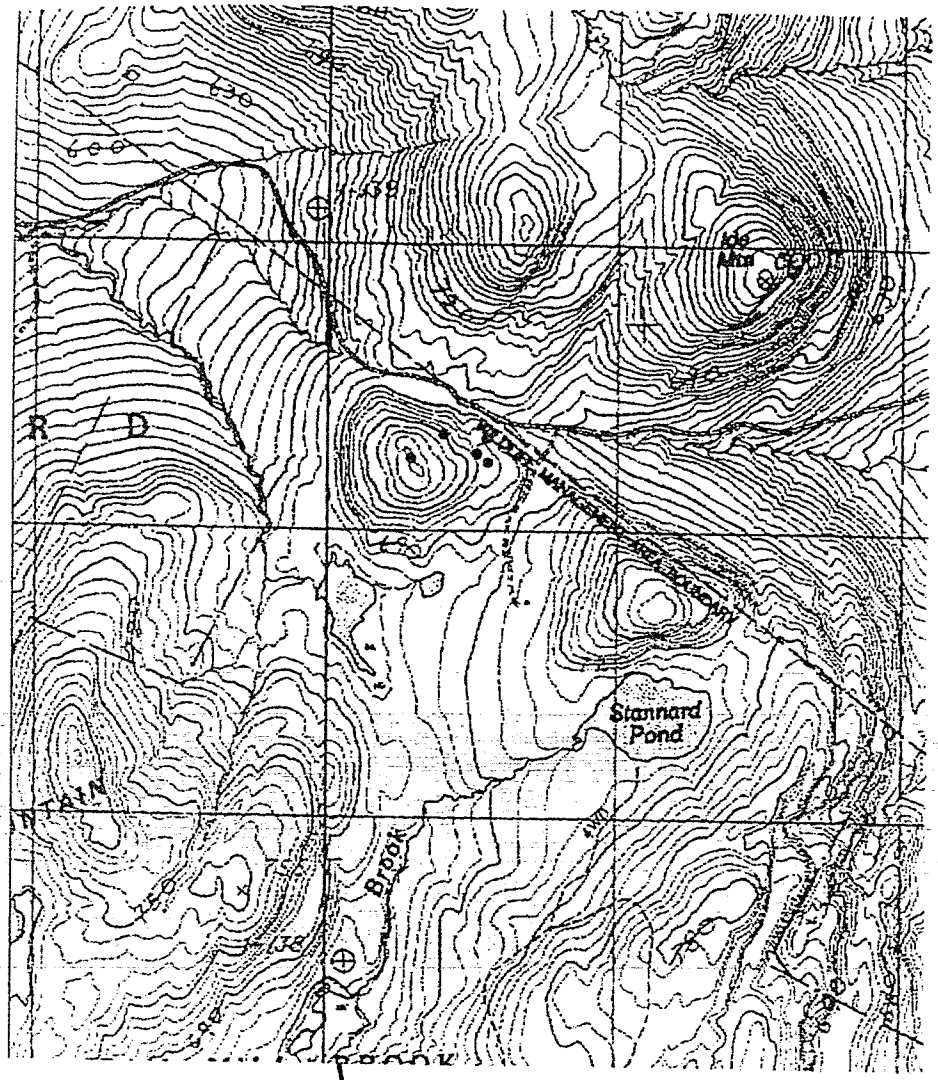
168 Total Species

Other interesting notes

269 trees were 5.0 cm to 6.0 cm DBH over 10% of all trees measured.
we had one 80.5 cm DBH Sugar Maple on WMNF land

40% of measured trees had no crown damage
7 % had 100% crown damage

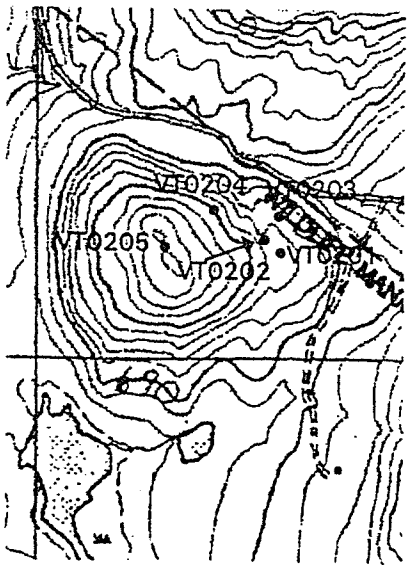
Stannard, VT USGS 7.5" Ouad



Scale

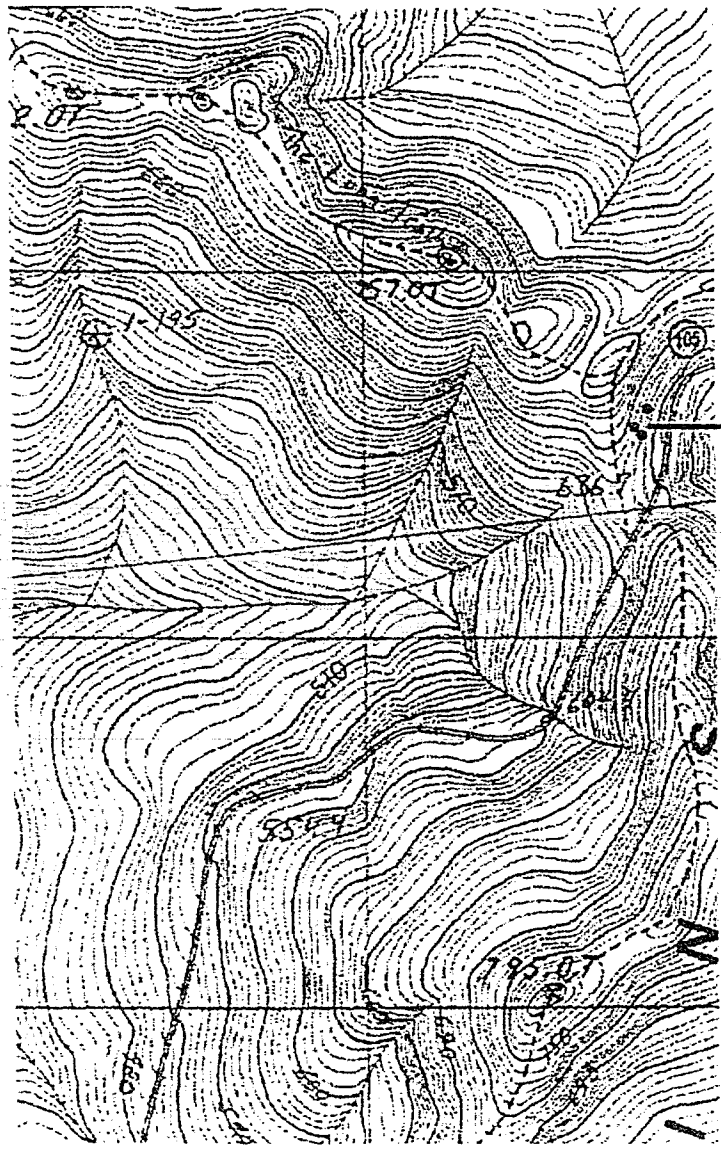
2000 0 2000 4000 6000 Feet

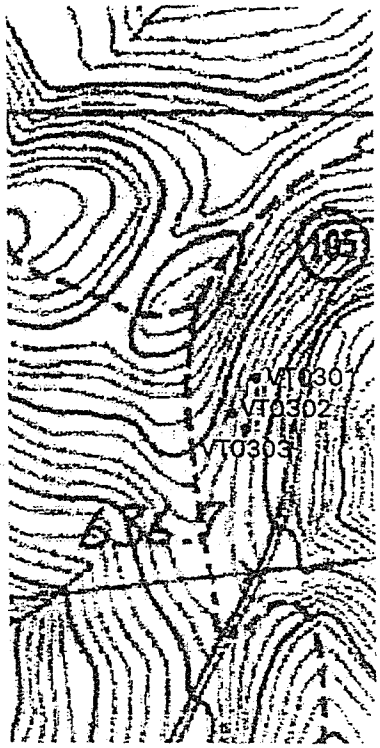
1 : 25229.73



VT0201	44 32' 14.9827" 72 10' 25.3146"
VT0202	44 32' 15.9865" 72 10' 26.9269"
VT0203	44 32' 17.6894" 72 10' 25.3834"
VT0204	44 32' 18.2984" 72 10' 31.9868"
VT0205	44 32' 15.6804" 72 10' 37.1532"

Jay Peak,VT USGS 7.5" Quad





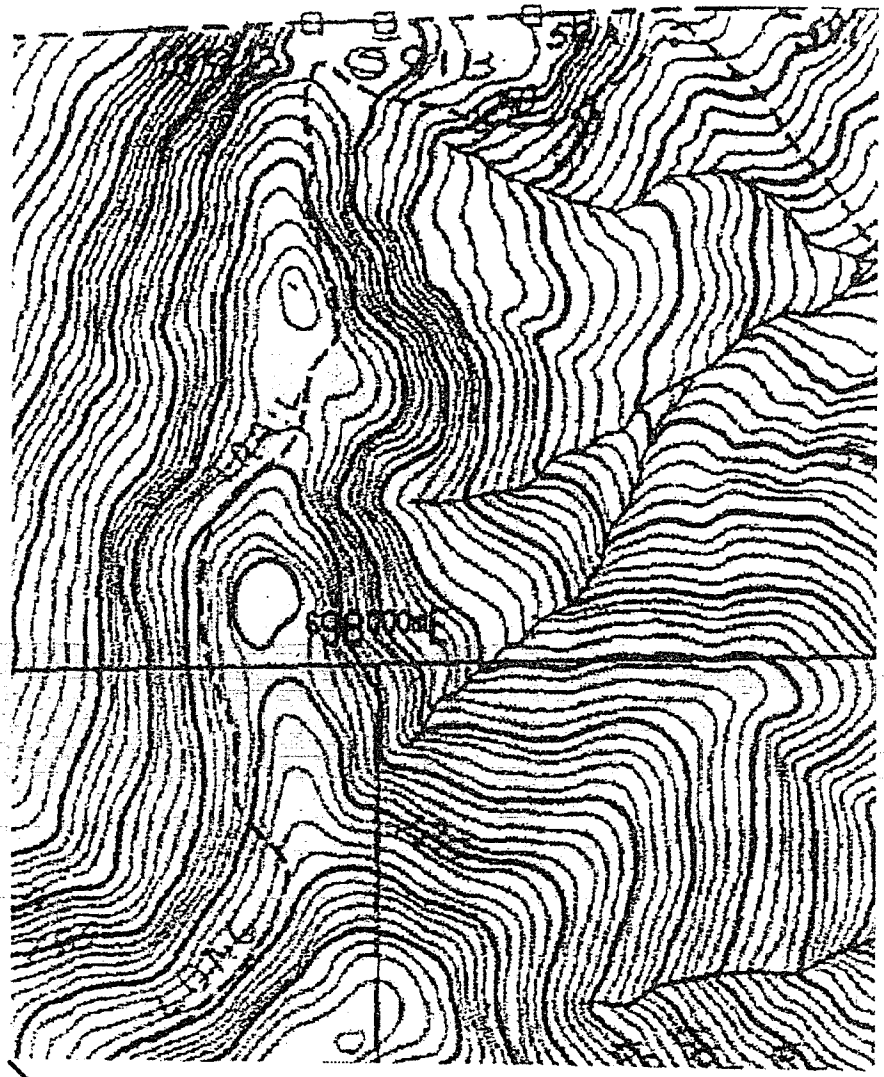
VT0301	44 59' 23.0559" 72 30' 13.8099"
VT0302	44 59' 21.0486" 72 30' 15.4550"
VT0303	44 59' 20.7580" 72 30' 14.5935"

Scale

2000 0 2000 4000 Feet

1 : 19746.86

North Troy, VT USGS 7.5" Quad



Scale

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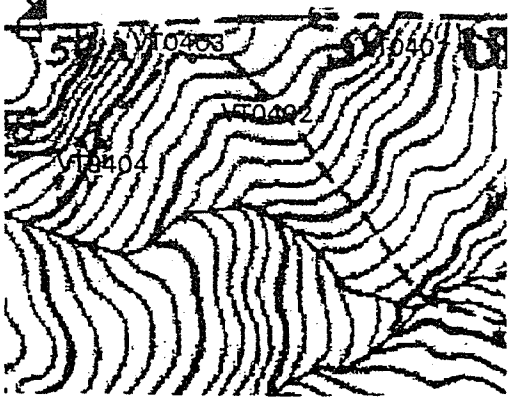
1 : 11049.32



VT0401	45 00' 30.9935" 72 28' 44.4544"
VT0402	45 00' 29.0285" 72 28' 49.9671"
VT0403	45 00' 30.7196" 72 28' 54.1569"
VT0404	45 00' 27.1311" 72 28' 59.8881"

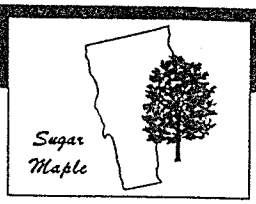
Vermont Publications on the 1998 Ice Storm and Related Forest Health Damage

Section VI. Vermont Forest Health Highlights

1. September 1999
2. April 2000

Forest Health Highlights

Vermont



September 1999

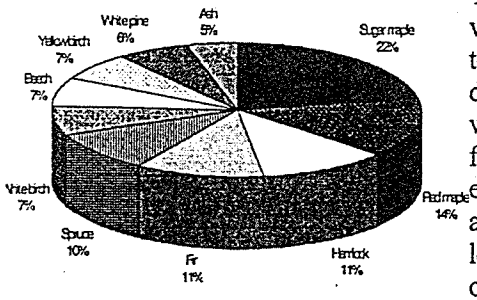
The Resource

Vermont's forests are valuable ecologically, economically, and socially. Covering nearly 80 percent of the state, forests provide jobs, stability to the landscape, wildlife habitats, biological diversity, clear water, scenic vistas, and diverse recreational opportunities. While changes are always occurring to the forests, there are values that Vermonters want to maintain.

A Forest Resource Plan was developed to sustain the many values and meet the various demands on the forest resource. The vision states that: *In the future, the forests of Vermont will consist of healthy and sustainable ecosystems, with a prosperous and sustainable forest products industry, abundant recreational opportunities, and a combination of ownership patterns supporting a working forest landscape and undeveloped forest land.*

78% of the state is forested, covering 4,544,000 acres, with 97% timberland and 3% non-commercial forest.

Most Common Tree Species in Vermont Forests



Special Issues

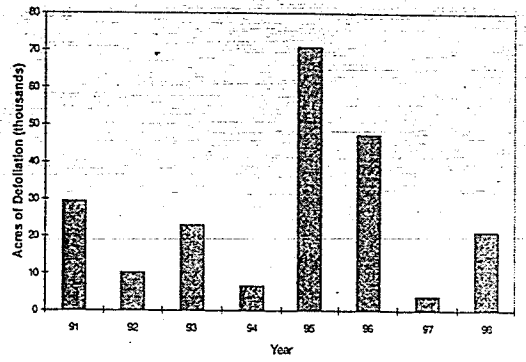
The **January 1998 ice storm** impacted 951,589 acres, one-fifth of the forest land in Vermont *(See map on back page).* The heavy ice loads that weighted trees and caused serious branch and stem breakage affected low elevations in the Champlain Valley (up to 1000 feet) and higher elevations in central and eastern Vermont. Sugar maples were most commonly injured, but damage was more serious on beech and birch trees. Sugarmakers affected by the storm are estimated to have reduced the number of taps by 75,000. Individual tree recovery or decline is expected to occur over the next 3 to 5 years. Several monitoring projects are underway to assess the long-term impact of the storm to the State's forest resource.

On a statewide basis, trends in **sugar maple condition** varied little from previous years, with 93% of sugar maples in the North American Maple Project in a healthy condition, with less than 15 percent crown dieback. The only tree health indicator that showed significant change was mortality as a result of the ice storm. Average annual mortality of overstory trees from 1989 to 1997 was between 0.1 and 0.9%, but rose to 1.7 % in 1998, due to heavy ice damage.

The summer of 1998 was the second wettest and the fifth warmest, as opposed to the drought conditions that occurred during the summer of 1999. In 1998, the warm humid air created conditions that favored development of **leaf diseases**, especially on hardwoods. Anthracnose, a disease which causes dead patches on leaves, was recorded on 243,730 acres of forest. Damage was heaviest on sugar maple, paper birch, and yellow birch. While this foliage disease can reduce the vigor of affected trees, most are expected

Birch defoliation by birch leaf miners and anthracnose was observed on 21,283 acres of forest in 1998, an increase from 3,842 acres in 1997. Tree recovery is expected, except in locations where defoliation has occurred several years in succession, causing reduced tree vigor, or in areas where trees were already stressed from ice storm injury.

Trend in Acres of Birch Defoliation in Vermont



Pear thrips, a recent pest on sugar maple, defoliated 36,081 acres of forest in 1998. Damage was especially severe in the southern part of the state. In some stands, defoliation was combined with anthracnose disease and trees were left with small ineffective leaves throughout the growing season. High populations of the **maple trumpet skeletonizer** also combined with leaf diseases and left some woods looking brown, with dead and dying leaves.

Hardwood decline and dieback, prevalent in 1997, decreased to 5,675 acres in 1998. **Spruce mortality** was reduced to 784 acres, mostly at high elevations. Tree recovery may have been related to abundant precipitation which occurred in 1998. Historically, wet years have been associated with lower acreages of declining trees.

Special Issues cont.

An unusual **white pine malady** was observed in scattered locations throughout the state in 1998, especially in southeastern Vermont. No single causal agent was consistently associated with the unthrifty crowns. Also, many species had **heavy seed crops**. Spruce, fir, pine, red maple, oak and beech are some of the species observed with heavy seed production, which impacts crown appearance and affects tree health.

Christmas Tree Problems

Two insect pests that cause serious damage in Christmas tree plantations were found at higher than normal levels in 1998. **Balsam shootboring sawfly** populations increased dramatically, affecting about 260 acres. This insect attacks the buds as shoots are emerging and can cause mortality of the new shoots. The **balsam gall midge** causes deformities to new shoots. Galls were found in nearly every balsam fir Christmas tree plantation visited in northern Vermont.

Exotic Insects

Two regionally significant exotic insects, the hemlock woolly adelgid and the Asian longhorned beetle, are not currently found in Vermont. The **hemlock woolly adelgid** is attacking and in some cases causing serious decline of hemlock as near as northern Massachusetts. An external quarantine is in effect to reduce the chances of introduction of the adelgid from infested areas into Vermont.

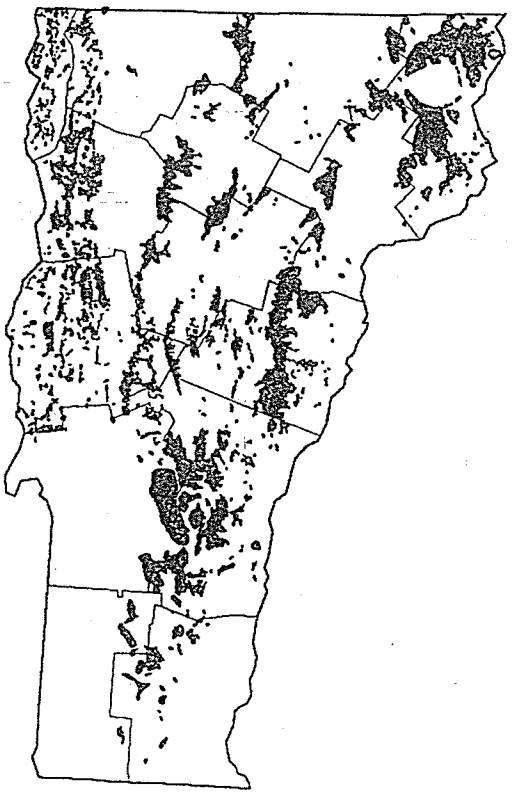
Attempts are underway to eradicate the **Asian longhorned beetle** from parts of Long Island, New York City, and Chicago, Illinois. This large wood boring insect often prefers maples to other tree species. An action plan is under development by State organizations to provide for a quick response if the insect is found in Vermont. The Department of Forests, Parks and Recreation is cooperating with the University of Vermont on a State and regional public awareness program concerning the beetle.

Air quality and Forests

Ground level **ozone** injury to forests is being monitored annually at specific sites statewide as part of the National Forest Health Monitoring program. While ozone exposure can reduce tree growth and tree resiliency, low level leaf damage has been detected on monitored sites in Vermont. Sensitive plant species at 60% of the locations surveyed in 1998 had symptoms of ozone injury.

The New England Governors and Eastern Canadian Premieres have given priority to addressing **acid deposition** impacts on forests through the implementation of their Acid Rain Action Plan of 1998. The action plan identifies mapping forest sensitivity to acid deposition as one of its priorities. Forest resilience to acid deposition depends largely on the ability of soils to buffer the acid inputs, thereby keeping soil nutrition stable for tree growth. The mapping project in Vermont will be completed in 2001.

(Continued from front page) **Areas of moderate and heavy tree damage in Vermont from the January 1998 Ice Storm, based on aerial sketch mapping:**



For More Information

Vermont Department of Forests, Parks and Recreation
103 South Main St.
Waterbury, VT 05671-0602

(802)-241-3678

Forest Health Protection
USDA Forest Service
P.O. Box 640
Durham, NH 03824

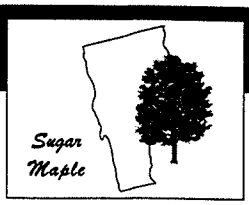
(603) 868-7709

FORESTS, PARKS & RECREATION VERMONT

State and Private Forestry

Forest Health Highlights

Vermont



April 2000

The Resource

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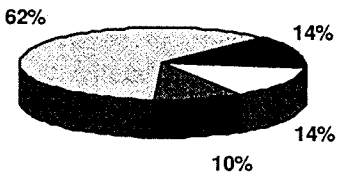
A Forest Resource Plan was developed to sustain the many values and meet the various demands on the forest resource. The vision states that: *In the future, the forests of Vermont will consist of healthy and sustainable ecosystems, with a prosperous and sustainable forest products industry, abundant recreational opportunities, and a combination of ownership patterns supporting a working forest landscape and undeveloped forest land.*

Today 78% of the state is forested (4,544,400 acres) compared to 63% in 1948. Out of the forested area:

- **97.3% timberland**
- **2.7% non commercial**

Major Forest Types



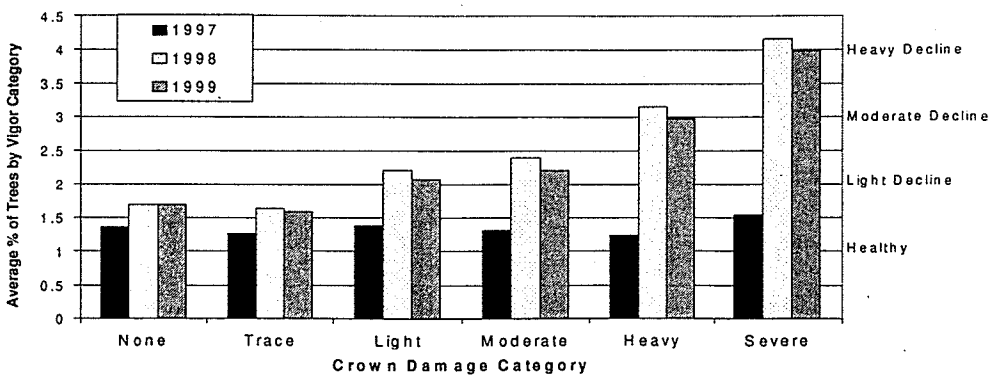
Special Issues

For a second year in a row, **extreme weather conditions** affected Vermont's forests. The year 1999 was warmer than usual, the 5th warmest on record; drier than usual, the 3rd driest summer on record; wetter than usual in September, the wettest on record; and featured three heavy wind storms, one brought on by Hurricane Floyd and accompanied by heavy rains, and two others in July. Forests were impacted by these events in several ways. The drought stressed trees, especially those on ledgy or shallow soils, causing leaf scorch, leaf yellowing and browning, and early leaf color and leaf drop. In some cases, leaves browned and dropped in June and July. Most symptoms of drought were not visible until late summer. Drought symptoms were recorded on 84,727 acres. Trees such as birches and beech were especially affected. Beech bark disease was more conspicuous than normal, due to the drought with 4000 acres of damaged trees recorded. Tree stress this year may result in smaller leaves and other symptoms in 2000, despite replenished soil water from September rainfall. Heavy winds caused tree breakage and uprooting on over 1116 acres.

Trees in areas affected by the **1998 ice storm** are still recovering. Results from the North American Sugar Maple Project show that leaf and branch growth is filling in on injured tree crowns. Most severely injured trees are still alive, but will take many years to return to a healthy condition. Some may never fully recover.

Special surveys were conducted in 1999 to identify potential effects from the 1998 ice storm on sugarbushes and to monitor the health of roadside trees. The **sugarbush survey** was conducted across Vermont in sugarbushes known to have ice injury to trees. Results show that in stands which were hardest hit by the ice storm, more sugar maples experienced tree crown injuries than other tree species. While the amount of crown damage varied within each sugarbush from none to 100%, average crown damage for all sugarbushes was less than 30%. Elevation was a key factor in determining sugarbush damage, with 2 distinct elevation bands of damage, 200-1100 feet and 1700-2200 feet.

Ice Storm Effects: Trend in Vigor by Crown Damage Category - All species and crown classes

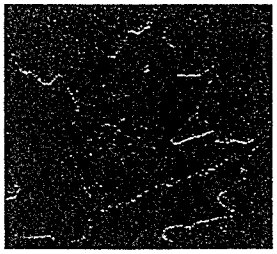


Vermont Publications on the 1998 Ice Storm and Related Forest Health Damage

Section VII. Vermont Forest Insect and Disease Conditions

FOREST INSECT AND DISEASE CONDITIONS IN VERMONT

CALENDAR YEAR 1998



EDITED BY

Barbara S. Burns, Forestry Protection Specialist

PREPARED BY

H. Brenton Teillon, Chief, Forest Resource Protection

Barbara S. Burns, Forestry Protection Specialist

Ronald S. Kelley, Forestry Protection Specialist

Trish Hanson, Director, Forest Biology Laboratory

AGENCY OF NATURAL RESOURCES

DEPARTMENT OF FORESTS, PARKS AND RECREATION

Division of Forestry

Forest Resource Protection Section

AGENCY OF NATURAL RESOURCES

JOHN KASSEL, SECRETARY

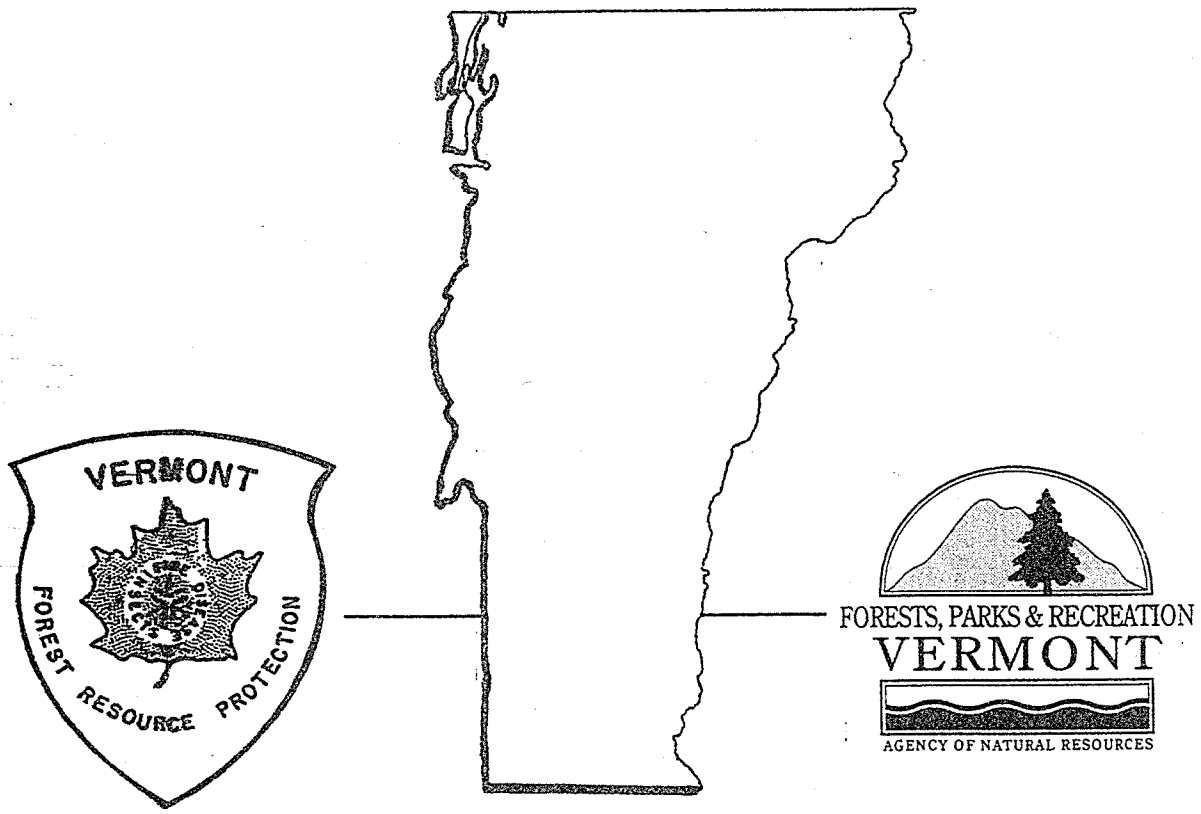
DEPARTMENT OF FORESTS, PARKS AND RECREATION

CONRAD M. MOTYKA, COMMISSIONER

DAVID C. STEVENS, DIRECTOR

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 1998



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

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.

Three major aerial surveys were flown this year. The entire state was flown for ice damage. This survey was flown while ice was still on the trees in most of the state; in the Northeast Kingdom, it was flown later. A survey was flown in early July in southern Vermont for pear thrips. A statewide survey was flown in August to target defoliation by anthracnose, leaf miners, and declines. In addition to Forests, Parks and Recreation flights, surveys were also flown by the US Forest Service over the Green Mountain National Forest.

A survey of Christmas tree plantations is conducted annually in North-Central Vermont as part of the Scleroderris quarantine. This year, 261 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 Kathy Decker, Sandy Wilmot, Jay Lackey, Tom Simmons, Hollis Prior, Pete Reed, Bernie Barton, John St. Arnauld, Allan Sands, Lars Lund, Tess Greaves, 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 Ron Wells, Brad Greenough, Mike Johnson, Lisa Thornton, Jon Bouton, Dave Willard, Gary Sawyer, Jeff Briggs, Jay Maciejowski, Dave Wilcox, and Dick Greenwood. Matt Mancini assisted in surveys of Christmas tree plantations. 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, Mike Brownbridge, and Gordon Nielson (emeritus) from the University of Vermont; Jon Turmel and Scott Pfister from the Vermont Department of Agriculture; Bill Merrill and Nancy Wenner from Pennsylvania State University, Doug Allen and Jenna Spear from SUNY-College of Environmental Science and Forestry; Charlie Burnham and Ken Gooch from Massachusetts Dept. of Environmental Management, and Dick Dearborn and Clark Granger from the Maine Forest Service. Assistance in preparing maps and survey acreages was provided by Tom Luther and Bob Cooke from the US Forest Service, Forest Health Protection and Tom Merrifield and Laura Cadmus from the Vermont Agency of Natural Resources. Title page photo is from W.A. Cole and D.C. Allen 1973.

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.

Ice Damage was widespread following a severe ice storm the second week of January. Damage was mapped on 951,585 acres, or 1/5th of the forest land in the state. Based on a questionnaire survey, an estimated 75,000 taps were lost in sugarbushes. By the end of the summer, many broken trees had produced epicormic sprouts, but food reserves in recovering trees are now low. Requests for information, recommendations, and assistance inspired a large ice storm recovery program.

Vermont 1998 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.

General - Ice damage affected one-fifth of the forestland in the state. Therefore, management of ice-damaged areas is of concern to many. Although management guidelines were produced for foresters, landowners, and sugarmakers shortly after the storm, the following should be kept in mind.

- Decline or recovery take time. Trees going into the 1999 season, and beyond, have low root reserves, since they were functioning with deficient crowns in 1998. (Research in Ontario on sugar maple has shown lower overwintering starch reserves in damaged sugar maples.) This is unlike the carbohydrate status of damaged trees going into the 1998 season. Some trees which seemed to be recovering in 1998 may look worse in the following growing seasons. Following other stress events, we consider that 3-5 years are required before the "survivors" and "losers" are sorted out.

- Decay takes time. Even large wounds created by the storm will not produce much decay within a few years. The amount of decay that occurs will depend on wound size, species, amount of prior defect, and genetics. Anticipate more decay from wounds comprising 40% or more of the circumference, and less from wounds comprising 20% or less. Anticipate more decay from wounds to birch, and a lot less from wounds to sugar maple. (Work at the US Forest Service Northeastern Forest Experiment Station is demonstrating that some sugar maples which sustained storm damage a decade ago have very little decay beyond the location of the wound itself.) Anticipate more decay if previous storm damage or careless harvesting has left a lot of wounds in the stand already. And anticipate more decay if trees are poor branch healers.

- Information takes time. A lot of research is being done on trees with ice storm damage. Keep listening. Every year, the amount of available information based on good data will increase.

Outside of ice damage areas, trees are generally healthy going into 1999 where foliage problems were not severe. All things being equal, rainfall drives the health of trees from year to year, and several growing seasons in succession have been moist. Some crowns will be thin because heavy seed crops have occurred on many species.

Hardwoods - Browning of foliage was very noticeable in 1998 because of widespread anthracnose and late-season defoliators. In most of the state this will not cause a problem because food reserves had a chance to build up earlier in the season. However, anthracnose fungi have built up and could be a problem in 1999 if wet conditions occur again.

Maple - There is cause for concern in southeastern Vermont, where the combination of thrips and anthracnose resulted in poor foliage on some sugar maple maples for the entire growing season. Any effort to reduce additional stress (avoid harvesting, road construction, tapping) will increase the opportunity for stand recovery. In the Taconics, pay special attention to the condition of red maple, which was thin for much of the summer. Above all, encourage friends and relatives to leave their firewood at home if traveling to Vermont from out of state. It will take only one small pile of firewood at a campsite or condominium to spread the Asian longhorned beetle from any of the sites where it is now known to occur.

Poplar - Monitor the health of poplar, particularly in low-lying areas, where there have been several consecutive years of fungus defoliation. In addition, satin moth and large aspen tortrix populations have been building in northern New England. We do not know of any areas where poplar mortality is occurring because of this defoliation, but timely salvage is more important for poplar than other species because it degrades quickly.

Oak - Growing conditions for oak continue to be good. Gypsy moth populations remain low, but neighboring states have experienced some gypsy moth defoliation. Oak skeletonizer could build up quickly, as it produces two generations in a year. In the mid-Atlantic states, aphids, oak leaftier, and oak slug sawfly are at high populations on oak. Although no management adjustments are currently necessary, keep informed on the status of oak defoliators.

Spruce-Fir - Spruce and fir received little damage from the ice storm, and there was little winter injury. Spruce and fir defoliators are at low levels. Outside of Christmas tree plantations, the greatest health problem to spruce or fir was in fir regeneration. Fungal diseases and balsam gall midge, which are normally innocuous, had a significant impact in some stands. Most affected trees should recover as gall midge populations drop, and if drier growing seasons slow down the spread of fungal pathogens. If spruce-fir stands are to be regenerated, inspect the condition of existing regeneration before making the decision to cut.

White Pine - In south-central Vermont, there are areas with unthrifty white pine crowns. The cause is unknown. We will continue to follow the condition of trees in this region to determine if the condition changes, and to try to pinpoint a cause. Inspect crown condition carefully in selecting crop trees in white pine; some trees with clear, straight stems may have crowns which will produce little growth in the years to come.

There is a renewed interest in growing currants by small fruit growers throughout the region. Although white pine blister rust remains a concern, resistant varieties of currants are available. Many of our white pine stands are now above the age where heavy infection occurs. However, continue to monitor regeneration and young pole-sized trees to assess the importance of blister rust in these areas.

Management Recommendations prepared by Barbara S. Burns

WEATHER AND PHENOLOGY

The winter of 1997-98 was above normal for precipitation and was the fifth warmest winter on record for Vermont[1]. No extreme temperatures occurred.

Snow cover was adequate to prevent root injury throughout the winter. The first snow arrived in mid-November, and stayed through most of December, followed by a heavy snowstorm on December 30. There was little snow in midwinter. Significant snowfall occurred again in March, with a heavy accumulation on March 21.

1998 started off with a bang (or, more correctly, a multitude of snaps) with the year's defining forest health event. A melt down occurred when rain arrived on January 5. This turned to freezing rain between January 7-11, causing the most severe ice storm in the experience of many Vermonters. Trees and utility poles broke off, and there were extensive power outages. The storm extended from southern Ontario and Quebec to New York, Vermont, New Hampshire, and Maine, affecting about 25 million acres of forestland. This is the largest acreage of forestland damaged by an ice storm in this century.

Maple sugaring season was early and short. There were good runs in late February and early March, but sapflow was interrupted by cold weather until late March. Some sugarmakers who were not already finished had a good run in early April, but then sugaring shut down because of warm weather. Although production was down, much of the syrup produced was fancy.

The hot, dry spell in late March included temperatures in the 70s and low 80s. This created a short early fire season, and an early spring. A wet period of 7-10 days followed soon after, and some trees were stalled at budbreak for about 10 days. Heavy rains and rapid snowmelt caused Lake Champlain to exceed the 100' high water mark for the third time in the past five years. Bud development was generally three weeks early, and phenology stayed about three weeks ahead of schedule even into August. Although water availability varied from very low to very high, spring was just above normal for precipitation.

1998 was the second wettest summer on record for the state[1]. May and June were very wet, but rainfall averages showing above average precipitation tell only part of the story. Weather vacillated between very wet, with some torrential rains, and then long dry spells. Flooding was common, especially in central and northern Vermont, following the rains in mid and late June. Tornadoes and lightening in late May caused some damage to trees in Bennington County.

Variable rainfall continued throughout the summer, with some severe localized storms in July and August. During June, July, and August, the Fairbanks Museum weather station in St. Johnsbury recorded 18.5" of rain, and the Department of Forests, Parks and Recreation weather station in Elmore recorded 21.4". This weather resulted in abundant foliar diseases on nearly every species of tree and shrub. There were very few extremely hot days. A severe storm on August 24 caused some tree blowdown in Bethel.

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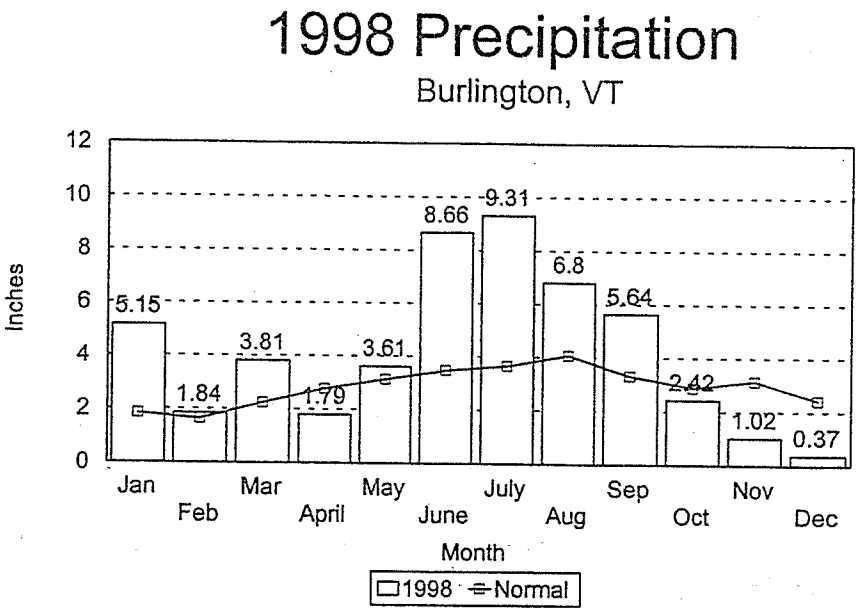
[1] Data from the Northeast Regional Climate Center.

Autumn averaged one degree above normal for temperature, and dropped a bit below normal for precipitation. Although the sumac was outstanding, it was difficult for pessimistic foliage viewers to find positive adjectives to describe the foliage in 1998. With heavy rains, widespread foliage diseases, and maple insects, there were thin crowns, a lot of brown, and less red than usual. The ice storm also produced a different foliage texture. The peak of sugar maple color occurred around October 6-10 in southern Vermont, being slightly earlier in northern regions.

There was a heavy seed crop on most species. Sugar maple pollen was unusually heavy. Although apples blossomed heavily, rainfall during bloom interfered with apple production in some areas. Other species with heavy seed were spruce, fir, pine, red maple, paper and yellow birch, oak, and beech. There was some early beechnut drop.

Statewide weather conditions are summarized in Figure 1. Phenology is summarized in Table 1 and Figures 2-3.



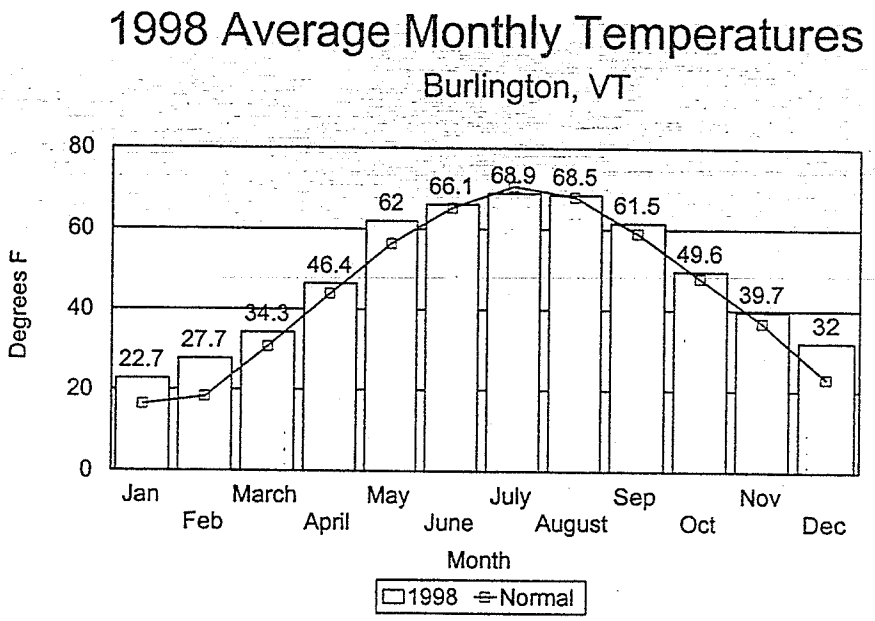


Figure 1. Average monthly precipitation and temperature for 1998 and departure from normal data from the National Weather Service, Burlington. Numbers above the bars indicate total monthly precipitation and average monthly temperature in 1998.

Ice Damage was widespread following a severe ice storm the second week of January, and was the most significant factor affecting tree health in 1998. Although, according to the US Army Corps of Engineers Cold Regions Research Laboratory, the thickness of the ice was typical of storms that are expected to occur several times in a century, the area covered was exceptional. Aerial surveys for ice were flown within a week, while ice was still on the trees. Additional ice-damaged areas were visible and mapped in during the summer surveys.

Damage occurred in every county in the state and was mapped on 951,589 acres, or 1/5th of the forest land in the state (Table 17, Figure 24). This includes 30,000 acres damaged on the Green Mountain National Forest. The Champlain Valley received the most continuous severe damage. Elsewhere, damage was scattered at mid elevations, generally above 1400 feet, but especially above 1800 feet. East-facing slopes had the heaviest damage.

Table 17. Mapped acres of ice damage in 1998. Heavily damaged areas had over 25% crown damage on over 25% of the trees.

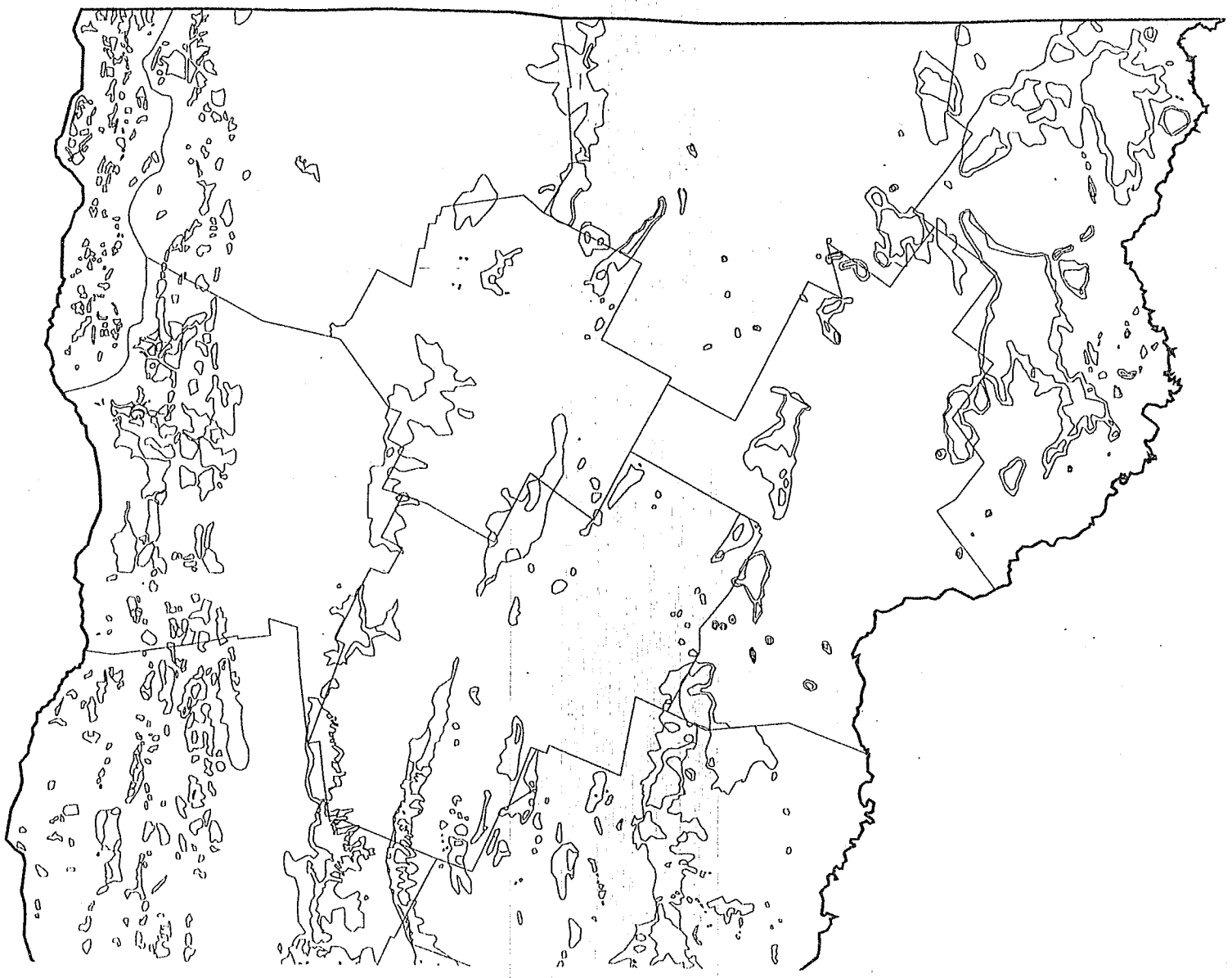
County	Damage Severity		Total
	Heavy	Light	
ADDISON	33821	75780	109601
BENNINGTON	7517	6640	14157
CALEDONIA	20856	25984	46840
CHITTENDEN	23470	44278	67748
ESSEX	79032	71175	150207
FRANKLIN	3010	22148	25158
GRAND ISLE	12560	4408	16968
LAMOILLE	1354	34508	35862
ORANGE	22720	75583	98303
ORLEANS	17174	27994	45168
RUTLAND	34676	55816	90492
WASHINGTON	21918	42716	64634
WINDHAM	8515	18645	27160
WINDSOR	99724	59567	159291
Grand Total	**386347**	**565242**	**951589**

Damage was most severe to hardwoods, and recently thinned stands had more breakage than unthinned stands. Most vulnerable to breakage were branches less than 8" in diameter, and pole-sized trees. Many paper birch mainstems bent to the ground, and some areas of young regeneration were flattened. Most of these stems straightened over the course of the growing season. Tip-up of root systems occurred rarely, and only on shallow sites. In addition to causing breakage to trees, damage made woods roads and trails impassable, and made many sugarbush tubing lines and tree shelters unusable.

Sugarbush damage was estimated by a questionnaire survey mailed to 2500 sugarmakers. Based on a 26% response, 14% said that their sugarbush was damaged by the ice storm. Of these, 25% said that the damage was heavy, 31% said it was moderate, and 44% said it was light. Based on this questionnaire, an estimated 75,000 taps were lost.

About 18% of the permanent plots examined for forest health monitoring evaluations were damaged. These will continue to be revisited to assess tree condition. Leaf production and size on many of the climax species with heavy damage (more than 50% crown loss) was not very impressive. These trees will need continued monitoring to see if they will survive. A summary of damage on Hardwood Tree Health plots is in the appendix.

ICE DAMAGE



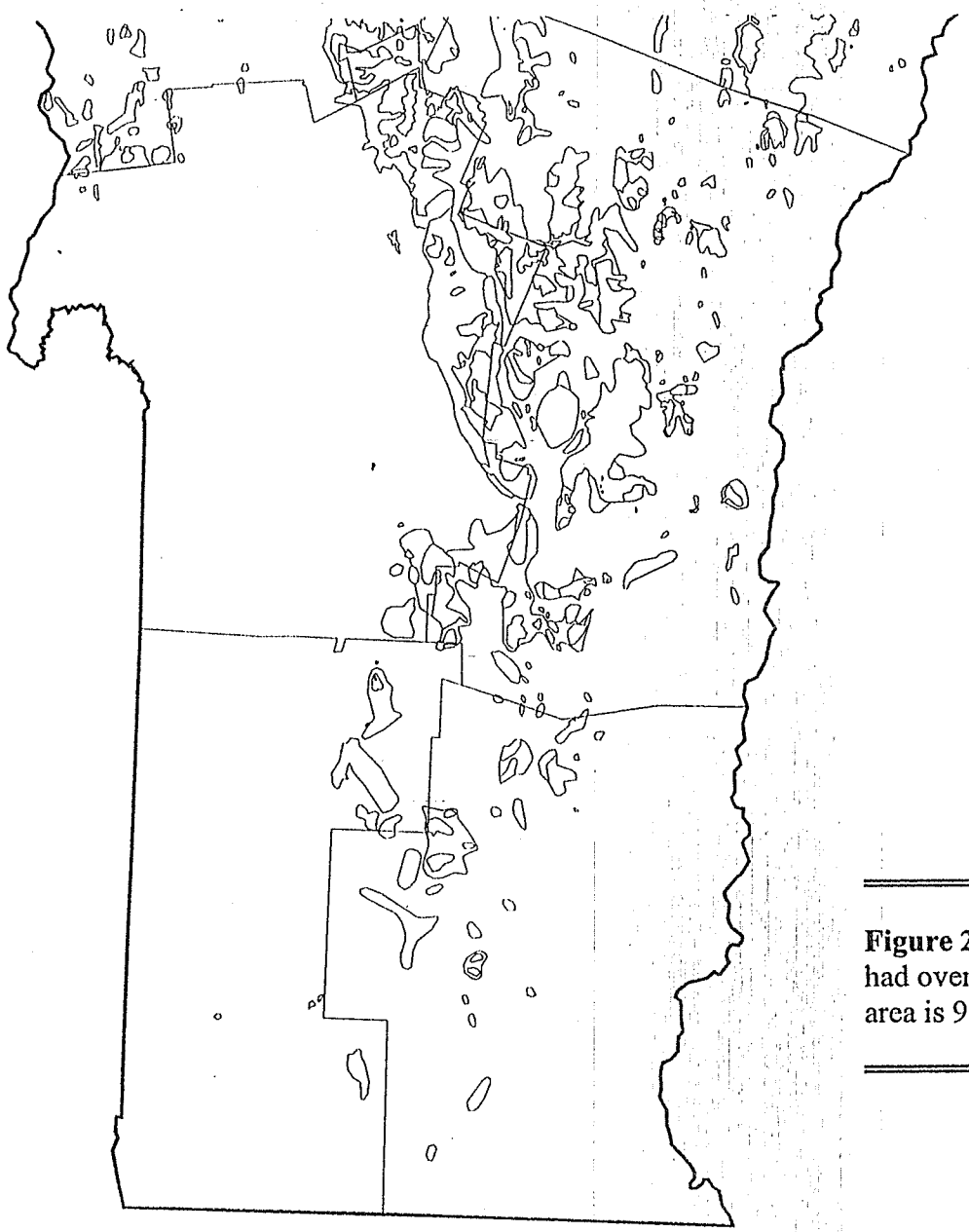


Figure 24. 1998 Ice damage. Heavily damaged areas had over 25% damage to over 25% of trees. Mapped area is 951,589 acres.

Assessments of damage were made in the seven maple stands which are part of the North American Maple Project that were impacted by the ice storm. Only 2% of the trees which were rated were down, usually from failure to the root system. Four percent of the trees which were standing had broken mainstems. Of the trees with breakage in the top, 89% had breakage of small branches only. Results of the crown damage ratings are in Table 18.

Table 18. Percent of trees in each of five crown damage categories in seven North American Maple Project plots which were damaged by the ice storm. Data are from 624 trees.

Crown Rating: Percent of Crown Damaged by Ice	Percent of Trees
Dead Tree	19%
None	20%
1-10%	26%
11-25%	12%
26-50%	10%
51-75%	6%
76-100%	7%

By the end of the summer, many broken trees had produced epicormic sprouts. White ash responded particularly vigorously to the breakage. Epicormic shoot production on sugar maple occurred late, and leaves stayed green late into the fall, and , like other juvenile shoots, sometimes did not drop leaves, which stayed brown on the tree. These epicormic shoots will continue to grow straight with little branching until they become more mature.

Coral spot nectria was commonly seen fruiting on broken limbs. This weak pathogen may cause some cankering in the future on stressed trees.

Food reserves in recovering trees are now lower than they were a year ago. Less food was produced because trees had fewer leaves than normal during the growing season. Additionally, trees had to divert food energy to closing wounds and growing new shoots.

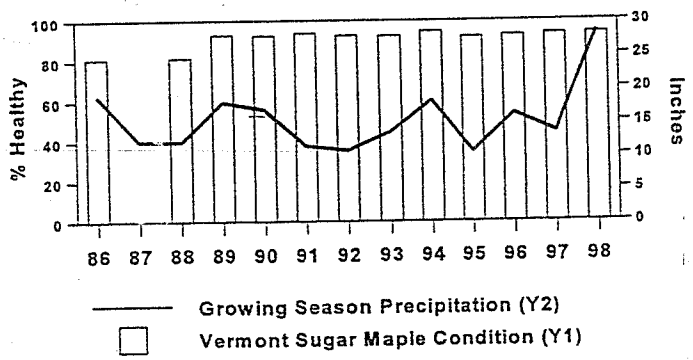
Requests for information, recommendations, and assistance inspired a large ice storm recovery program. Additional information about the many ice storm related activities can be found in other Department of Forests, Parks & Recreation and US government publications.

HEALTH OF SUGAR MAPLE IN VERMONT - 1998

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 1998, all 4.7 million acres of forestland were evaluated from an airplane twice; with a third survey for pear thrips in southern Vermont. In addition, survey crews walked to over 150 forested locations to rate tree condition.

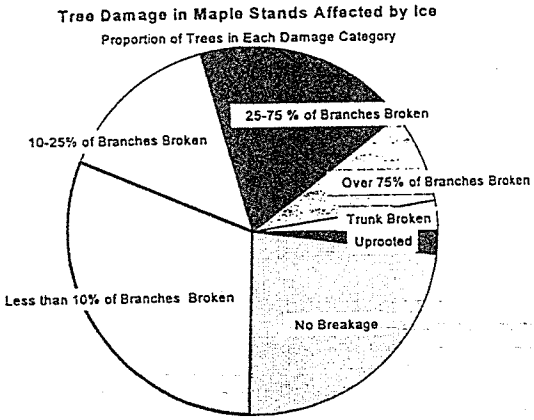
To assess the **General Condition** of sugar maples in 1998, 2000 sugar maples were evaluated for the North American Maple Project. Only 3% of them were unhealthy, based on how many dead twigs they had.



The **Ice Storm** during the first week of January deposited a layer of ice up to 3" thick on 943,000 acres of Vermont forestland. Ice damage was most severe in the Champlain Valley and on east-facing slopes above 1800'.

A survey was done of Vermont sugarmakers to assess the extent of damage to sugar production. Thirteen percent of respondents indicated that they had damage. Guidelines were produced recommending that trees with over 10% of branches broken be tapped only lightly or not at all, and that trees with over 75% of branches lost had a poor chance of survival.

All forest health monitoring plots in the affected area were evaluated to determine the long-term impact on tree condition. Seven out of 40 of the North American Maple Project plots and 17 out of 84 Vermont Hardwood Health Survey plots were in the affected area. The graph below shows what trees in the damaged North American Maple Project plots looked like when they were evaluated in March '98.



Broken trees continued to show evidence of disruption throughout the season. Many produced sprouts from the trunk or broken limbs. These sprouts will lead to structural weakness and defective sawlogs. Foliage from the sprouts often failed to drop in the fall. A bark-infecting fungus, Coral Spot, was common on broken branches. This may cause cankers on weakened or drought-stressed trees in the next few years.

Sugarmakers should continue to be conservative when tapping broken trees in 1999. Food reserves will be even lower than last year because of their reduced leaf area this summer.

Early Maple Browning in Southern Vermont was observed on scattered maples. The main cause was infection by a fungus called *anthracnose*. This was worst on trees which were made more susceptible to the fungus because they had early damage from *pear thrips*. Populations of thrips were not particularly high, and spring was, in general, early and fast, so damage was not expected. However, scattered trees were still in bud when cooler, wet weather hit. Thrips damage to these trees allowed anthracnose to get an early start. In early July, we mapped 36,000 acres of damage.

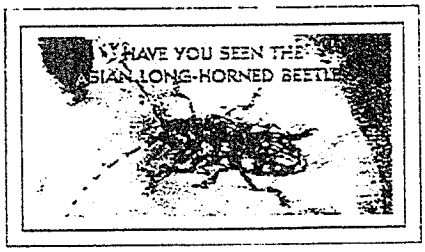
Normally, defoliated trees would put out a second set of leaves within a few weeks. However, the long stretch of wet weather allowed anthracnose to blight this "refoliation". New leaves developed sparsely, or not at all. Those new leaves which did survive were mostly small and yellow because rainy weather interfered with the absorption of soil nutrients. In addition, the fungus spread to other trees, and the extent of damage grew.

Some maples had almost no green foliage all summer. A similar situation occurred in Pennsylvania in 1994. Defoliation by caterpillars in June was followed by anthracnose on the refoliation in July. This combination caused dieback and mortality the following year. In one county, over 30% of the maples were dead on 35,000 acres. Recent research in Pennsylvania, in Vermont at the Proctor Maple Research Center, and in Quebec, indicates that soil fertility is an important factor in determining whether stressed sugar maples will recover or continue to decline.

Dr. Phil Wargo, a forest pathologist with the US Forest Service, has spent his career studying the impact of defoliation. He warned that landowners of affected trees should expect to see some dieback next year. "The trees will be in pretty tough shape; I suspect that food reserves will be very low". He suggested that sugarmakers consider not tapping affected trees in the spring. "If more than 50% of the foliage is missing, I would be concerned", he said.

Late Season Browning Statewide occurred because of heavy populations of two other insects, maple leaf cutter and maple trumpet skeletonizer (at left). Damage by the trumpet skeletonizer was heavier than it has been for at least the past forty years. In some sugarbushes, nearly every leaf had the characteristic damage: a rolled, brown leaf gnawed down to the network of veins, with webbing and a hard black tube inside. The caterpillar actually feeds from inside the tube. By late August, due to the buildup of anthracnose and these two insects, the area of brown hardwoods mapped during the aerial survey jumped to 234,000 acres. However, damage from these late defoliators should not affect tree health.

Asian Longhorned Beetle is still a serious threat to maple health, even though it hasn't been seen in Vermont. Sugar maple is a favored host species, and it sometimes kills trees in less than three years. Based on its distribution in China, researchers believe the Asian longhorned beetle would be able to survive Vermont winters.



Because newly infested trees are difficult to detect, experts predict that it will take about 10 years to eliminate the Asian longhorned beetle from the two infestations on Long Island, in spite of the fact that over 2,000 trees have already been cut down. In 1998, an additional infestation was found in Chicago. Eradication efforts will continue there and in New York.

The Asian longhorned beetle has usually entered this country in wood used to pack pipe, granite blocks, and heavy machinery shipped from China. This beetle has been intercepted in warehouses in fourteen states. To reduce the risk of bringing it to new locations, the US Department of Agriculture has enacted an interim rule requiring that imported wood packing material be treated before use.

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