

Annual Assessment of Forest Health on Mount Mansfield

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Cooperators

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Introduction

Annual assessments of crown condition, mortality, and damage are conducted on permanent plots located at four elevations and two aspects. The purpose of these plots is to document changes in tree health over time and to aid in the identification of causes for declines, if they occur.

Two types of plots are used: one plot at low elevations is part of the North American Maple Project (NAMP) plot system, 14 additional plots use the design and measurement variables of the National Forest Health Monitoring Program (NFHM).

NAMP Plot Methods

Plot establishment, site characterization and annual tree evaluations follow standardized NAMP protocols (Cooke et al, 1998) and are comparable to the other 39 plots in Vermont, and over 200 plots in the U.S. and Canada. Annual evaluations of tree condition (i.e. crown dieback, foliage transparency, tree vigor, bole damage, taphole closure) and foliage damage (i.e. defoliation) require two - three visits to the plot to determine extent of injury from early-, mid-, and late-season defoliators: one in mid-to-late June, July, and early September. Evaluators are trained and certified with other state and provincial field crews to maintain high Quality Control. Between-crew and between-state remeasurements are done on 10 % of the plot-clusters and with each field crew. Data entry is completed in-state, and statewide data is acquired following quality check by the NAMP data analyst at SUNY in Syracuse, NY. Metric units are used for data collection and analysis.

A special ice injury assessment was conducted in May to quantify the extent and severity of ice injury from a January 1998 ice storm that affected forests throughout Vermont and the region. This survey was developed by the international NAMP project leaders for implementation in the U.S. and Canada. Measurements collected included the amount and location of crown, bole and root breakage; and bole wounds within and below the crown. Regeneration assessments were made during the regular summer visit to establish a baseline for seedling and sapling abundance in each stand, so that regeneration changes resulting from the ice storm could be assessed as they compare with stands unaffected by the ice storm. One mil-acre plot 12 ft. from plot center was established in each of the 5 plots. Number of sugar maple, other hardwoods and conifers were counted in 3 size classes: seedlings less than 1m, seedlings 1 m height to < 1 cm DBH, and saplings 1 – 3.9 cm DBH.

NAMP Plot Results and Discussion

The NAMP plot on Mount Mansfield was not affected by the January ice storm. No significant change in sugar maple dieback (7.8%) or percent of trees healthy (94.9%) was measured in 1998 and no new mortality occurred. An increase in foliage transparency (12.6%) reflects a similar statewide trend, and may be related to light defoliation by maple leaf cutter, pear thrips, and maple trumpet skeletonizer. Baseline regeneration results shows the presence of sugar maple regeneration at all stages: 9 seedlings class I, 3 seedlings class II, and 5 saplings were recorded.

Table 1. Tree health results for the NAMP plot at 415 m (1360 ft) at the Proctor Maple Research Center, Mount Mansfield, Vermont. Average crown dieback, average foliage transparency (the amount of light coming through the foliated portions of the crown), mortality, and percent of trees healthy are all used to assess the health of dominant and codominant sugar maple trees in this plot.

Year	Dieback (%)	Foliage Transparency (%)	New Dead (%)	Trees healthy (%)
1988	11.3	27.3	0	88.6
	7.1	23.0	0	91.4
		14.0	0	91.4
	3.0	10.9	0	97.1
	8.1	14.3	0	94.3
1993	8.2	14.3	0	91.5
1994	7.6	10.4	0	95.8
1995	7.3	11.3	0	95.8
1996	6.9	9.5	0	95.7
1997	8.1	10.88	0	94.9
1998	7.8	12.6	0	94.6

Forest Health Monitoring Plot Methods

Eight permanent plots are used to monitor the health of forests on the west slope of Mount Mansfield, annually. Two plots at each of four elevations (1400, 2200, 3000 and 3800 feet) were established following the design and measurement variables of the NFHM program (Tallent-Halsell 1994). At each elevation, except 3800 ft, paired plots were located in each of the two watersheds: Browns River and Stevensville Brook. In the Stevensville Brook watershed, no canopy trees were present at the 3800 foot elevation, so the paired plots at this elevation are in the Browns River watershed. English units are used for data collection and analysis.

In 1997, 6 additional plots were established on the east slope of the mountain, in the Ranch Brook watershed. Paired plots at three elevations (1400, 2200, and 3000 feet) provide an opportunity to compare tree health between west and east aspects.

A special survey was conducted in May to assess tree injury from a January 1998 ice storm that affected forests throughout Vermont, and the region. The amount and location of crown, bole and root breakage was assessed. Bole wounds within and below the crown were recorded.

Forest Health Plot Results and Discussion

The January 1998 ice storm coated trees on Mount Mansfield. The west slope icing was found in 2 bands: one occurring between the elevations of 2,300 feet and 3,000 feet, the second at the ridgeline. On the east slope, icing occurred throughout Ranch Valley at all elevations. Injury in the form of branch and bole breakage was not prevalent on forest health plots on the west slope, but did affect trees on plots at 2,200 and 3,000 feet on the east slope, and at the summit (3800 feet). Tree recovery was aided by favorable growing season weather, with abundant precipitation.

West slope plot results

Trends in tree health indicators varied according to elevation. Trees on survey plots at 1400 and 2200 feet showed little change from past years, and 100% and 89% of overstory trees were considered healthy ($\leq 15\%$ dieback), respectively (Figures 1-7). On 3000 foot elevation plots, trees improved foliage transparency in 1998 over other years, and 86% of trees were healthy. These trees, however have significantly lower crown density ratings than trees at all other elevations. At the highest elevation, crown density of trees improved in 1998, but only 66% of trees are considered healthy. These trees continue to have significantly higher dieback than trees at all other elevations. New mortality occurred only on the 3800 foot plots, where the mortality rate was 3.0%.

Heavy seed crops were common on many species and may have affected the density of foliage. Species especially affected were yellow birch, paper birch and balsam fir.

Damages to trees can play a significant role in tree health. The most common type of damage at the 1400, 2200, and 3000 foot elevation plots was indicators of decay, past wounds that have begun to decay. At the summit plots, where extreme winter weather can adversely affect trees, dead or broken tops was the most common type of damage. The number of trees with significant damage varied with elevation, with trees at the 2200 foot plots having the highest frequency of damage (63%) and trees at 1400 foot plots having the lowest frequency of damage (27%).

Figures 1-3. Trend in health indicators at 4 elevations on Mount Mansfield: Crown Density (Figure 1), Crown Dieback (Figure 2) and Foliage Transparency (Figure 3).

Figure 1. Crown Density.

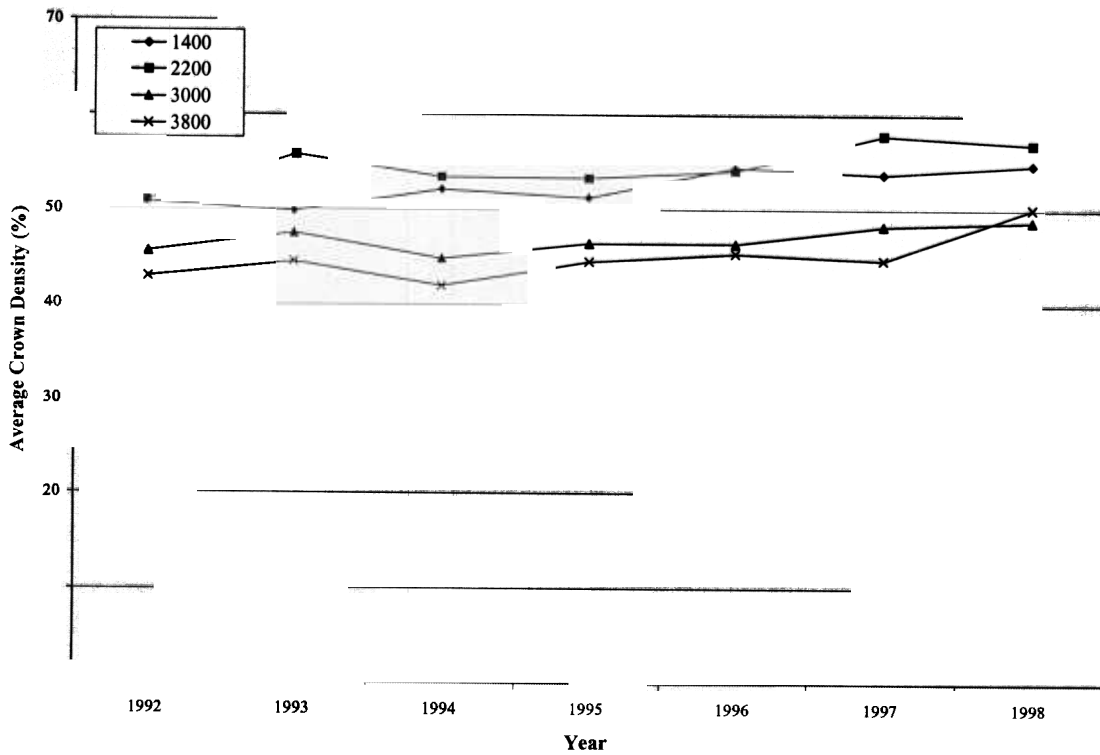


Figure 2. Crown Dieback.

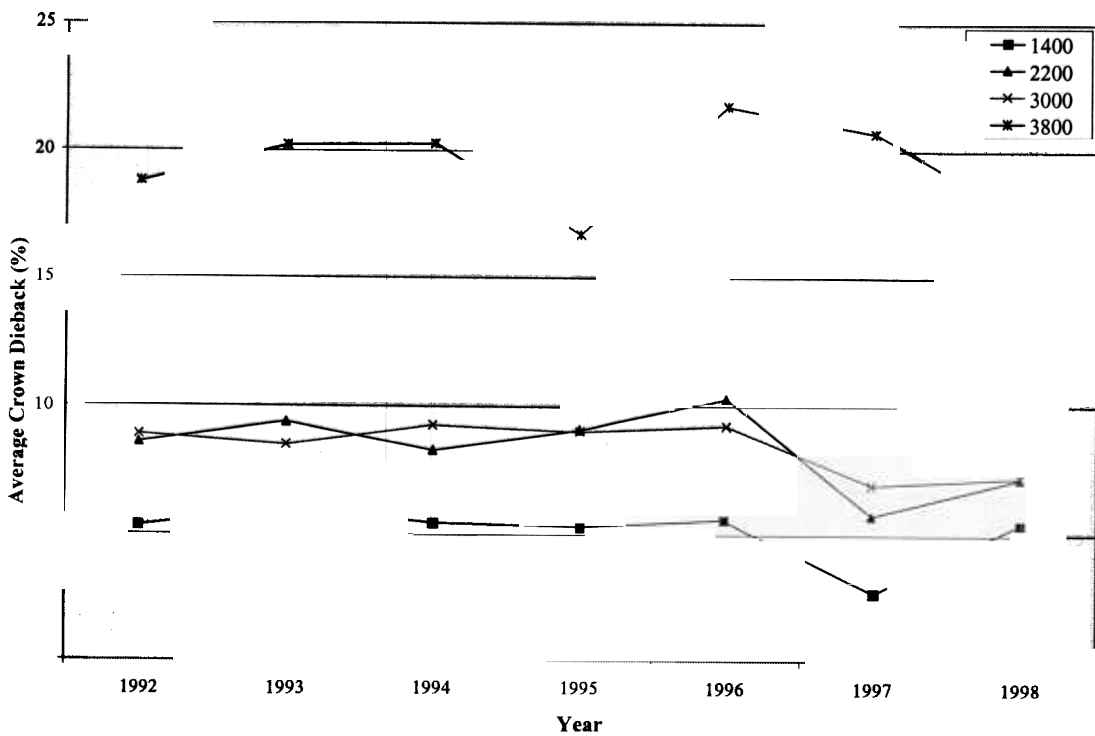
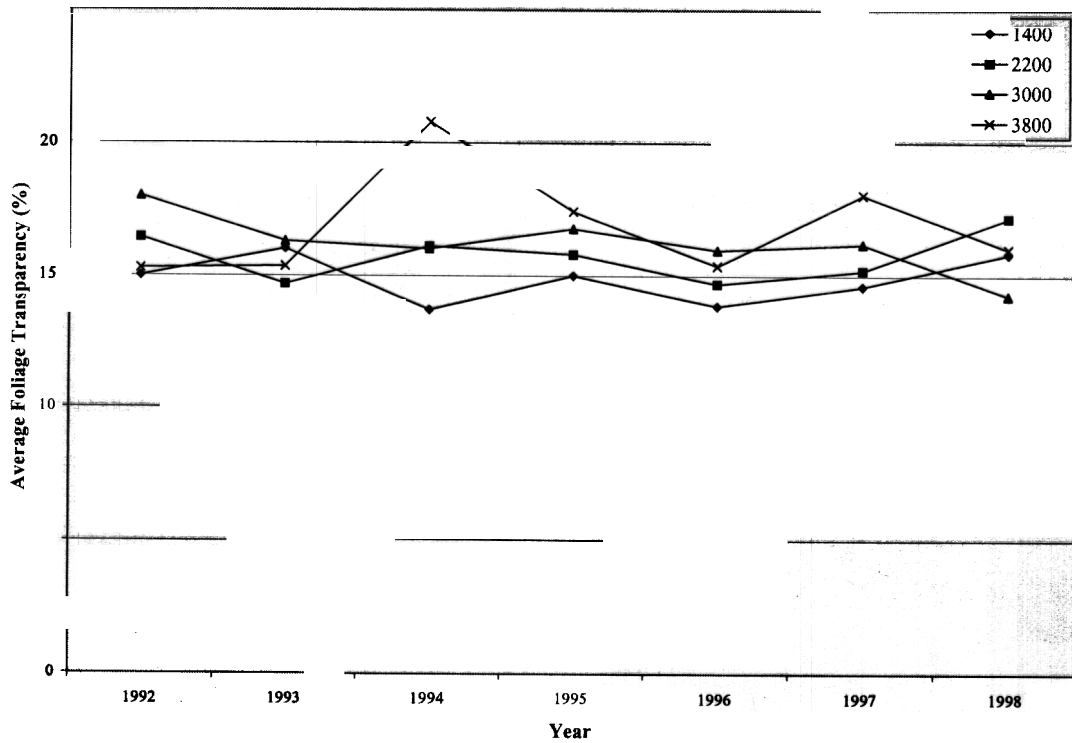


Figure 3. Foliage Transparency.



Figures 4-7. Overstory tree health in 1998 compared to 6 year averages (baseline) for survey plots at 4 elevations on the west slope of Mount Mansfield: 1400 feet (Figure 4), 2200 feet (Figure 5), 3000 feet (Figure 6) and 3800 feet (Figure 7).

Figure 4. 1400 feet.

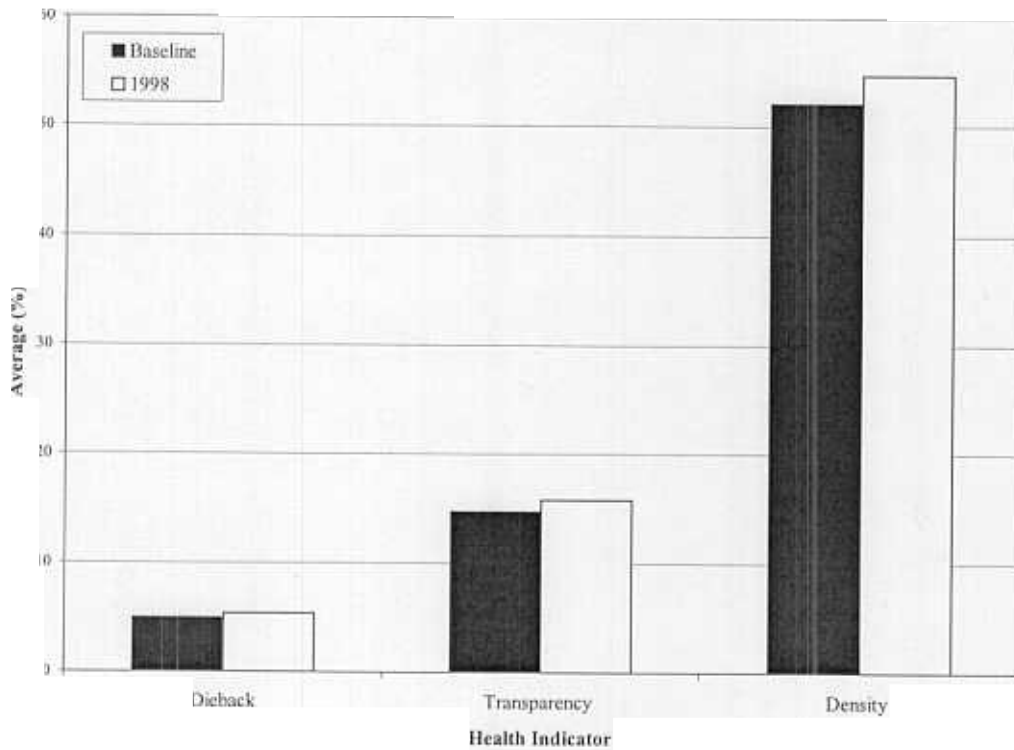


Figure 5. 2200 feet

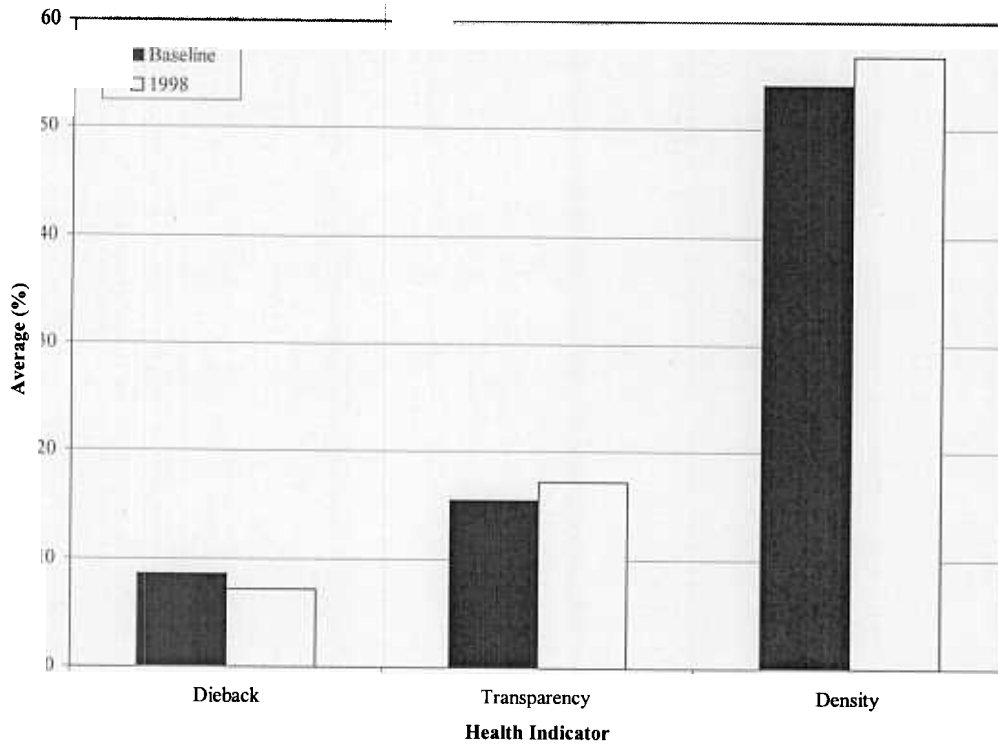


Figure 6. 3000 feet.

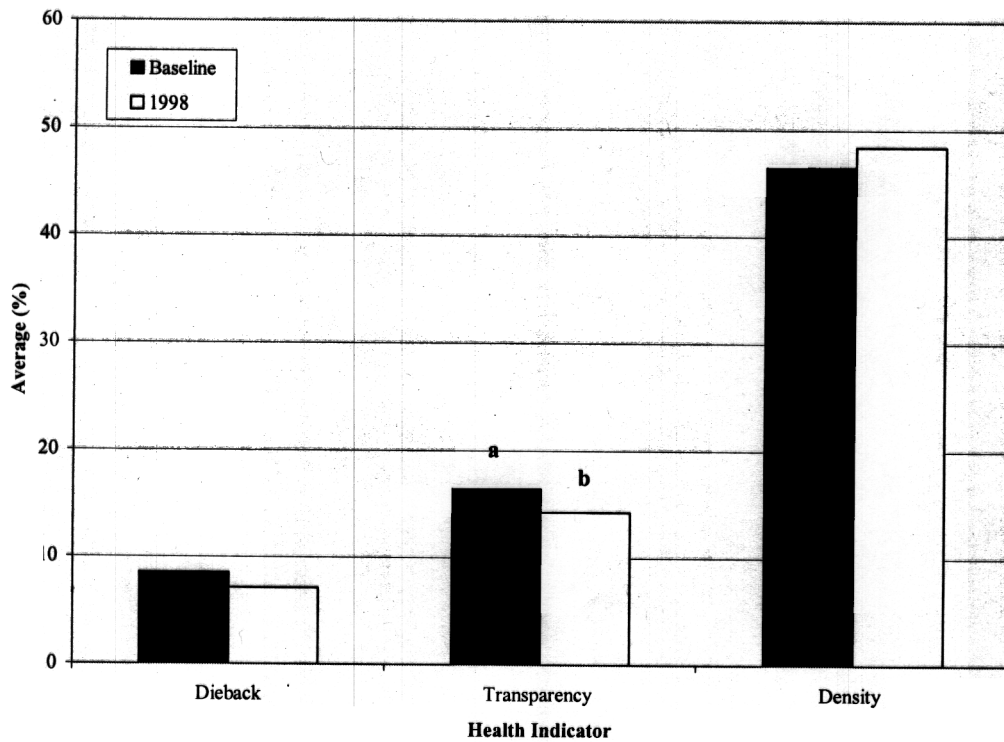
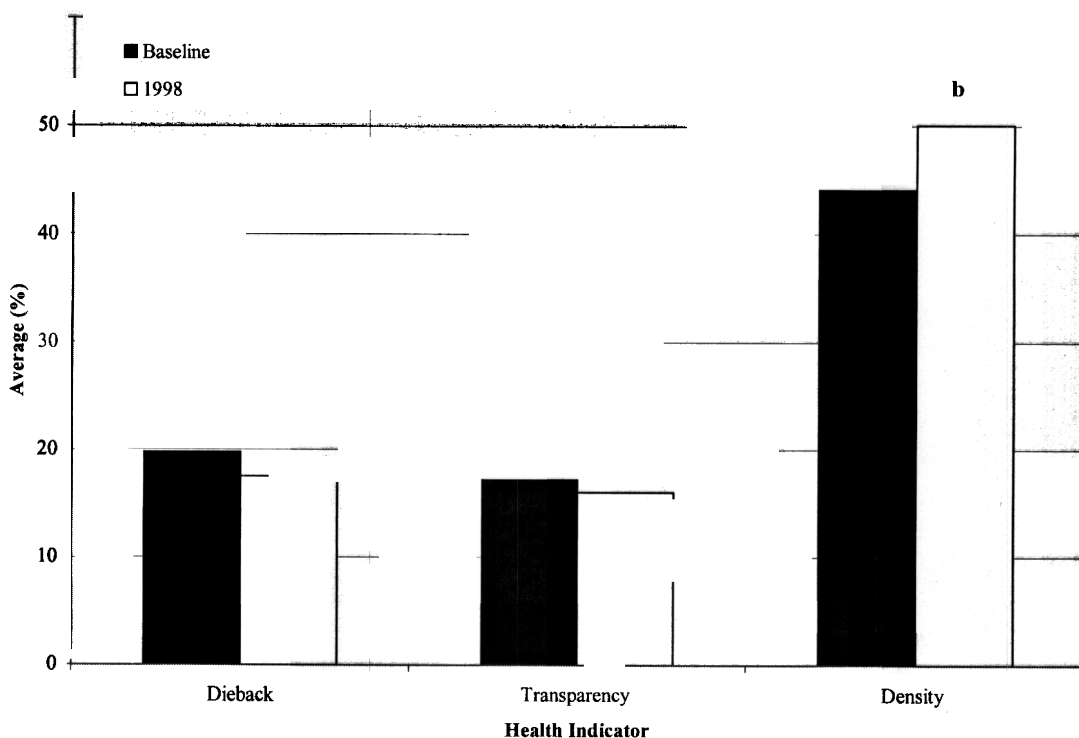


Figure 7. 3800 feet.



East slope results and comparison with west slope

Trees on the east slope of Mount Mansfield were injured by the 1998 ice storm. Most of the injury resulted in crown loss (Figure 8). Tree condition during the summer following the ice storm is best illustrated using the crown density indicator (Figure 9). Results show a loss in crown density, with branches and twigs broken off, and a reduced amount of foliage. The severity of injury (percent crown loss) varied with elevation; none to light injury occurred on 1400 foot plots, moderate injury occurred at 2200 feet, and light injury occurred on 3000 foot plots (Figure 10). Health conditions before the ice storm (1997) and after (1998) characterize the initial injury. Mortality of overstory trees was 2% at 2200 feet, and 9% at 3000 feet. Tree condition measurements over time will show the full impact in terms of mortality, or recovery.

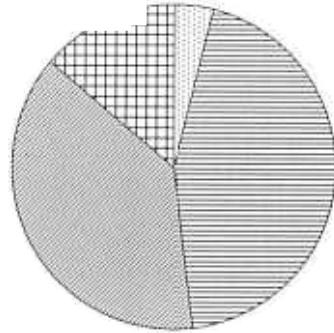
Table 2. Percent of trees on west slope plots affected by significant damages in 1998. Minimum thresholds for each type of damage are those considered significant for tree growth and vigor. Protocols follow those of the National Forest Health Monitoring Program.

Elevation (feet)	Percent of trees with damage	Percent of trees affected by each type of damage
1400	27%	23% Indicator of decay
		7% Canker
		7% Dead or broken top
		2% Other
2200	63%	66% Indicator of decay
		7% Canker
		11% Open wound
		9% Damaged buds, foliage or shoots
		8% Other
		2% Dead or broken top
3000	37%	22% Indicator of decay
		11% Canker
		7% Open wound
		5% Dead or broken top
		5% Broken branches
		2% Other
3800	52%	32% Dead or broken top
		13% Indicator of decay
		12% Broken branches
		5% Open wounds
		3% Broken bole or roots
		1% Other

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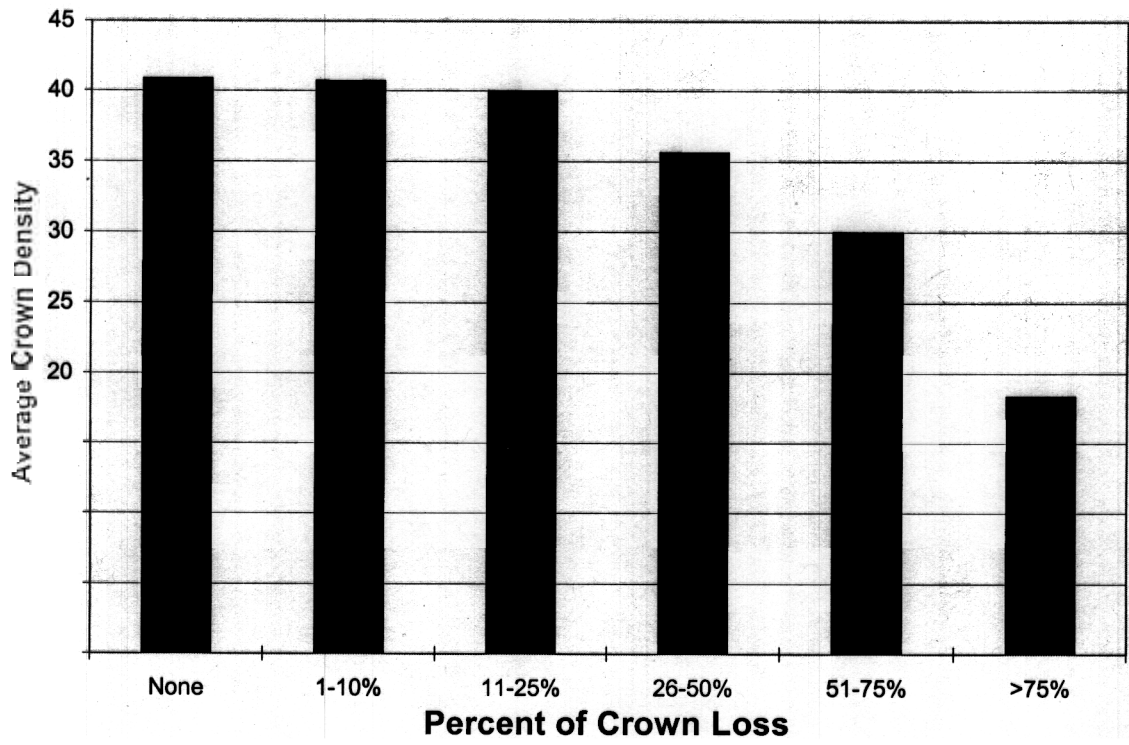
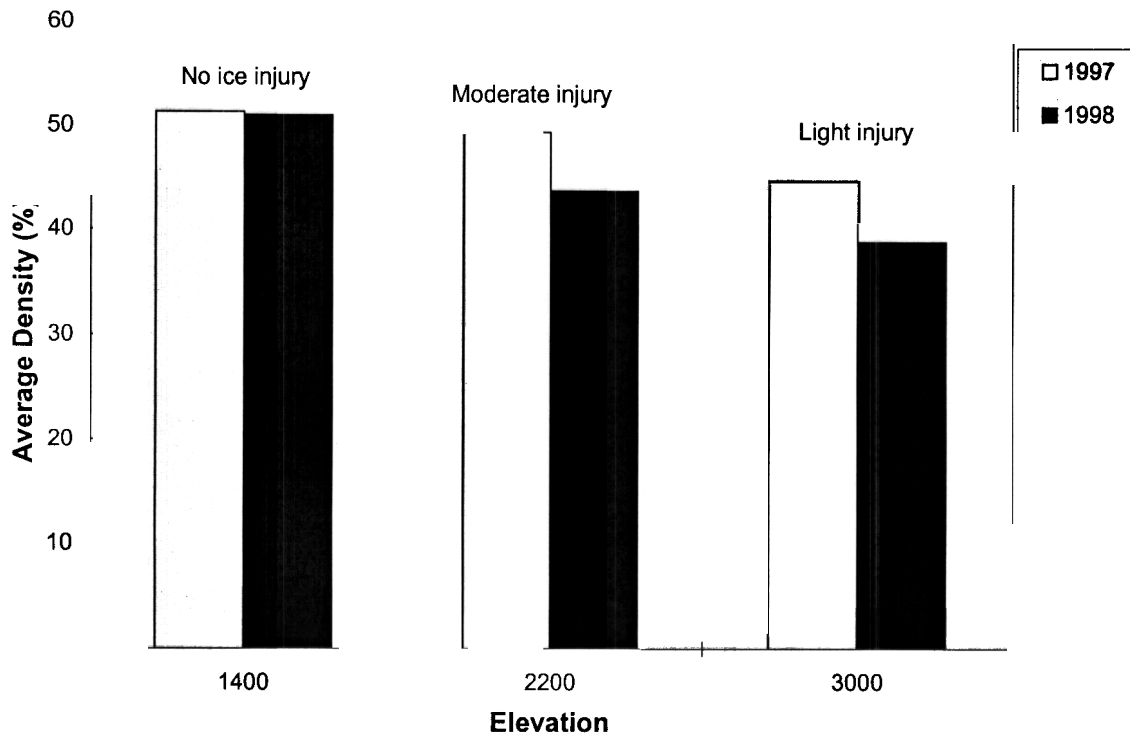


Figure 10. Crown density of trees at 3 elevations on Mount Mansfield, before and after the 1998 ice storm. Level of injury due to ice loads is based on percent of crown lost.



The most common type of damage to trees on the east slope at all elevations was indicators of decay. Other common damage types were cankers, and dead or broken tops. Injury from the ice storm was not fully captured by these damage measurements, but future ramifications from the initial injury may create trees less vigorous and more vulnerable to pathogens or mechanical injury.

Table 3. Percent of trees on east slope plots affected by significant damages in 1998. Minimum thresholds for each type of damage are those considered significant for tree growth and vigor. Protocols follow those of the National Forest Health Monitoring Program.

Elevation (feet)	Percent of trees with damage	Percent of trees affected by each type of damage
1400	47%	35% Indicator of decay
		10% Canker
		3% Dead or broken top
		11% Other
2200	53%	26% Indicator of decay
		23% Canker
		21% Dead or broken top
		11% Other
3000	39%	18% Indicator of decay
		13% Dead or broken top
		10% Canker
		6% Broken branches
		5% Open wound
		3% Other

Trees on the west slope plots at 1400 and 2200 foot elevation show higher dieback than on the east slope. Otherwise, health indicators show poorer health on the east slope for foliage transparency and crown density. The 3000 foot plots on the east slope show a greater impact from the ice storm, possibly due to poor initial health, and a lower resiliency. Relatively high dieback (11.8%), low percent of trees healthy (71%), and high mortality rate (8.8%) at this elevation on the east slope show the initial impact from the ice storm. Since half the trees on these plots are paper birch, which is susceptible to environmental stresses such as drought or ice damage, the recovery of trees at this elevation may be less successful than trees at lower elevations.

Table 4. Comparison of tree health on the west and east slope of Mount Mansfield using dieback, foliage transparency, crown density, the percent of trees healthy, and mortality as health indicators.

Health indicator	West Slope			East Slope		
	1400	2200	3000	1400	2200	3000
Dieback	5.4	7.2	7.2	4.6	5.8	11.8
Transparency	15.8	17.2	14.2	20.3	19.9	22.4
Density	54.7	56.8	48.7	50.9	43.7	38.8
Percent healthy	100	89	86	96	98	71
Mortality	0	0	0	0	2.2	8.8

References

Cooke, R., D., Lachance, W. Burkman & D. Allen. 1998. North American Sugar Maple Decline Project: organization and field methods. Updated from: Gen. Tech. Rep NE-154. Radnor, PA: U.S. Dept. of Agr., Forest Service, Northeastern Forest Experiment Sta. 22 p.

Tallent-Halsell, N.G (ed.). 1994. Forest Health Monitoring 1994 Field Methods Guide. EPA/620/R-94/027. U. S. Environmental Protection Agency, Washington, D.C. 1998 version.