

# ANNUAL ASSESSMENT OF FOREST HEALTH ON MOUNT MANSFIELD 1994

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## Abstract

Forest health is monitored annually using two different methods. One plot-cluster of the North American Maple Project (NAMP) monitors trends in the condition of sugar maple at an elevation of 415 m (1360'). Site characterization, crown condition, and bole and crown damage are measured. In addition, 8 plots have been established following the design and measurement variables of the National Forest Health Monitoring Program. These are located on the west slope of the mountain along an elevation gradient, with pairs at 1400, 2200, 3000 and 3800 feet. Measurements taken on these plots are used to determine current tree health and to create a baseline for long-term monitoring.

NAMP data on sugar maple condition has been recorded since 1988 and shows a general improvement from 1988 to 1989, then a stable and generally healthy condition thereafter. In 1994, 95.8% of trees were considered healthy ( $\leq$  15% dieback), average dieback was 7.6%, transparency of foliage was 10.4, and no new mortality was observed. Denser foliage can be attributed to a reduction in pear thrips defoliation from 1993 and generally favorable growing conditions. Light defoliation on lower canopy foliage was observed from Bruce spanworm feeding.

Tree health data from the other forest health plots also showed an improvement or stable condition of most dominant or codominant trees. Exceptions were seen in balsam fir trees at 3000' and sugar maple at 2200' elevations, which both have shown a trend towards increasing dieback over the last 3 years. Most of these trees, however, had less than 15% dieback, as reflected in the 92 and 86% of trees considered healthy, respectively. Noteworthy is a trend in improving condition of red spruce in the 3000' elevation plots since 1992.

## Introduction

Annual assessments of crown condition, mortality, and damage are conducted on permanent plots located at four elevations. The purpose of these plots is to document changes in tree health over time and will 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, 8 additional plots use the design and measurement variables of the National Forest Health Monitoring Program (NFHM).

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## NAMP Plot Methods

Plot establishment, site characterization and annual tree evaluations follow standardized NAMP protocols (Millers et al, 1991). Annual evaluations of tree condition and foliage damage 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 12 % 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.

## NAMP Plot Results and Discussion

Sugar maple tree health continued to be good in 1994, with 95.8% of trees considered healthy ( $\leq$  15% dieback) (Table 1). Average dieback and transparency were slightly better in 1994 than in the previous 2 years. No new mortality occurred.

Denser foliage in 1994 may be attributed to a lack of pear thrips defoliation, as observed in 1993, and generally good growing conditions. Some defoliation from Bruce spanworm was observed on lower canopy foliage of sugar maples. An abundance of flowers were observed in the spring, but no significant seed production followed.

<b>YEAR</b>	<b>DIEBACK (%)</b>	<b>TRANSPARENCY (%)</b>	<b>MORTALITY (%)</b>	<b>% HEALTHY TREES</b>
1988	11.3	27.3	0	88.6
1989	7.1	23.0	0	91.4
1990	7.6	14.0	0	91.4
1991	3.0	10.9	0	97.1
1992	8.1	14.3	0	94.3
1993	8.2	14.3	0	91.5
1994	7.6	10.4	0	95.8

**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.

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### Forest Health Plot Methods

Eight permanent plots are used to monitor the health of forests on the west slope of Mount Mansfield. 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, one plot is 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 both plots at this elevation are in the Browns River watershed. English units are used for data collection and analysis.

### Forest Health Plot Results and Discussion

A stable or improving trend in tree condition occurred for most species in 1994 (Table 2a & 2b). Noteworthy is that red spruce at 3000 foot elevation has shown a trend towards improving condition over the last 3 years as indicated by decreasing average dieback (Table 2a). Conversely, balsam fir at 3000' and sugar maple at 2200' have shown an increase in average dieback over the same period. Most of these trees, however, had less than 15% dieback, as reflected in the 92% and 86% of trees considered healthy, respectively (Table 2b).

**Table 2a.** Average dieback for overstory trees of species growing on monitoring plots at different elevations on Mt. Mansfield from 1992 through 1994.

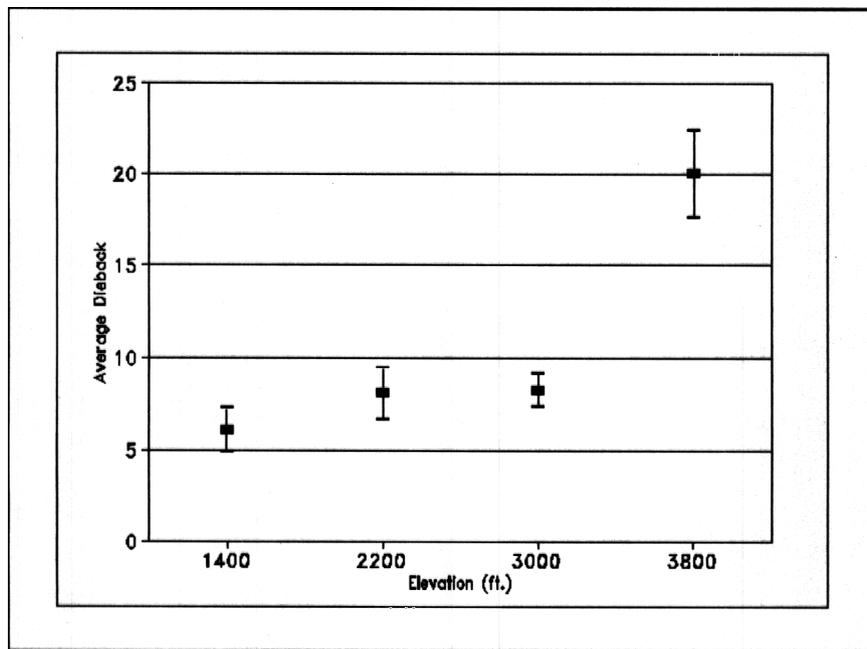
SPECIES	ELEVATION	1992 DIEBACK (%)	1993 DIEBACK (%)	1994 DIEBACK (%)
BALSAM FIR	3000	5.6	6.8	8.2
	3800	18.8	20.5	20.3
RED SPRUCE	3000	15.6	11.1	7.1
RED MAPLE	1400	3.0	6.0	4.0
SUGAR MAPLE	1400	4.2	5.6	5.6
	2200	8.3	10.8	12.9
YELLOW BIRCH	1400	5.7	5.7	4.3
	2200	6.6	7.1	5.4
PAPER BIRCH	3000	9.6	8.4	6.1
ALL SPECIES	1400	5.3	6.1	5.4
	2200	8.6	9.4	8.3
	3000	9.0	8.4	9.2
	3800	18.8	20.2	20.7

**Table 2b.** The percentage of overstory trees of different species growing at different elevations on Mt. Mansfield that are considered healthy ( $\leq 15\%$  dieback) over a 3 year period, 1992 through 1994.

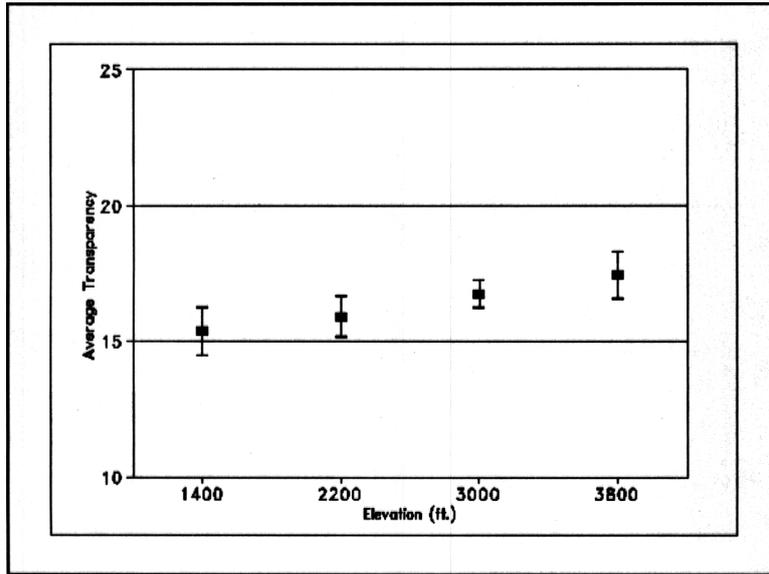
SPECIES	ELEVATION	1992 HEALTHY (%)	1993 HEALTHY (%)	1994 HEALTHY (%)
BALSAM FIR	3000	100	91.3	92
	3800	54.0	60.6	57
RED SPRUCE	3000	66.7	77.8	100
RED MAPLE	1400	100	100	100
SUGAR MAPLE	1400	100	100	100
	2200	83.3	100	86
YELLOW BIRCH	1400	100	100	100
	2200	94.7	94.7	100
PAPER BIRCH	3000	88.5	83.3	97
ALL SPECIES	1400	97.0	100	100
	2200	90.6	90.6	97
	3000	89.8	88.5	92
	3800	54.0	60.6	57

Data from 1992-1994 was combined to generate a baseline of tree condition on Mt. Mansfield (Figure 1-3). From this we will compare annual changes in tree condition and look at differences between elevations in measurements of tree health.

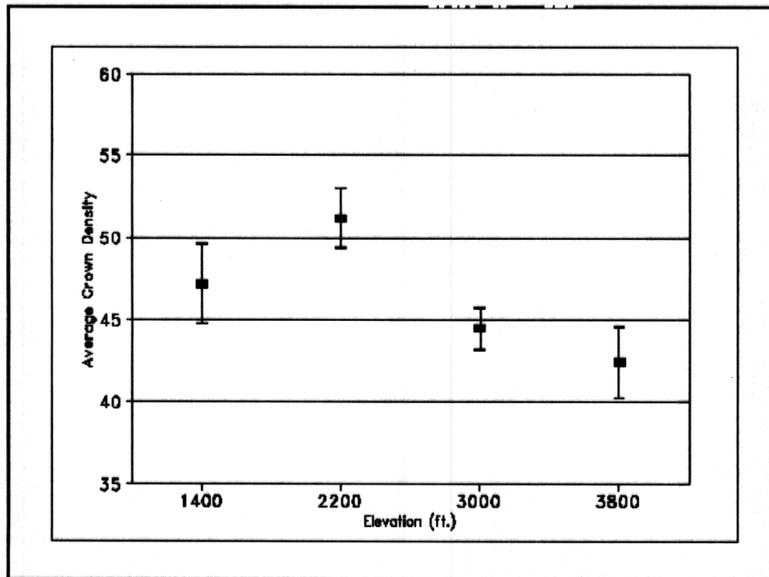
Tree health at 3800 feet continues to be a concern because of extremely high average dieback (20.3% in 1994) and only 57% of trees in a healthy condition (Table 2a & 2b). When 3 years of data are combined, there is a statistically significant difference between average dieback at 3800 and all other elevations.



**Figure 1.** Average dieback of trees growing on monitoring plots at 4 elevations on Mt. Mansfield, 1992 through 1994. Trees at 3800' had significantly higher average dieback than at other elevations.



**Figure 2.** Average transparency of trees growing at different elevations on Mt. Mansfield, 1992-1994. There is no significant difference between transparency of trees at different elevations.



**Figure 3.** Average density of tree crowns on trees growing at different elevations on Mt. Mansfield, 1992 - 1994. Trees at 2200 feet have denser crowns than those growing at 3000 and 3800 feet.

Another measure of tree health, foliage transparency (how much light comes through the foliage), does not show a significant difference between trees at different elevations. Crown density is a measure of the density of the crown in terms of foliage, branches, and reproductive structures, and can be an indication of a lack of branches, dieback, or thin foliage. This measure showed no significant difference between trees at 1400 and 2200 foot elevations, but trees growing at 3000 and 3800 feet had significantly less dense crowns than those at 2200 feet. Some of this may be accounted for in the difference in tree species grow at these elevations. This will serve as a baseline to measure changes within and between elevations over time.

No new mortality occurred in plots at 1400, 2200, and 3000'. One balsam fir tree at 3800' with a previous dieback rating of 85% died in 1994, resulting in a 1.4% mortality rate at this elevation.

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## References

Millers, I., D. Lachance, W. Burkman & D. Allen. 1991. North American Sugar Maple Decline Project: organization and field methods. Gen. Tech. Rep NE-154. Radnor, PA: U.S. Dept. of Agr., Forest Service, Northeastern Forest Experiment Sta. 26 p.

Tallent-Halsell, N.G. (ed.). 994. Forest Health Monitoring 1994 Field Methods Guide. EPA/620/R-94/027 U. S. Environmental Protection Agency, Washington, D.C.