ANNUAL ASSESSMENTOF FOREST HEALTH ON MOUNT MANSFIELD

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Cooperators

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Abstract

Forest health is monitored annually using two different methods. One plot of the North American Maple Project monitors trends in the condition of sugar maple at an elevation of ca. 1400 feet. Site characterization, crown condition, and bole and crown damage are measured. In addition, 7 plots have been established following the design and measurement variables of the National Forest Health Monitoring Program. These are located along an elevation gradient, with pairs at 1400, 2200, and 3000. Only one plot was established at 3800 feet, but a second plot will be added at this elevation in 1993. Measurements taken on these plots will determine current health and create a baseline for long term monitoring. Measurements include: site characterization, understory vegetation, seedling number and vigor, sapling and tree size, crown condition, and symptoms of damage.

NAMP data on sugar maple condition has been recorded since 1988 and shows a general improvement over the first 4 years. Crown condition in 1992, however, was slightly worse than in 1991, with 94.2 % of trees considered healthy (less than or equal to 15 % dieback in crowns). No mortality has occurred on this plot since it's establishment. Light defoliation from maple leaf cutter was present, but not expected to seriously affect tree health. Heavy seed production was evident, with some reductions in foliage production as a result.

Tree health data on the other forest health plots were stratified by species, elevation and crown class (dominant and codominant trees reported). The percentage of healthy (less than or equal to 15 % dieback in crowns) dominant and codominant trees was less at high elevations than at low elevations, with 96.97 % of trees healthy in the 1400 foot elevation plots compared to

54.06 % of trees healthy in the 3800 foot elevation plot. The percentage of standing dead trees was also higher at the highest elevation plot, where 43.3 % of trees were standing dead, compared with 8.0 % in the 1400 foot elevation plots.

Balsam fir at the 3800 foot plot and red spruce at the 3000 foot plots had low numbers of healthy trees and high percentages of standing dead trees. In addition, beech and sugar maple in the 2200 foot elevation plots had unusually high numbers of standing dead trees, as compared to other Vermont surveys.

In a study of within season variation of crown condition measurements, there were no significant changes on study trees evaluated three times during the field season. This indicates that crown condition measurements can be taken from mid-June to August with similar accuracy of the variables, which is the current practice.

Introduction

The types of forests on Mount Mansfield vary depending on the elevation, site characteristics and past land use practices. Two general forest types are covered under this study: lower and mid- elevation northern hardwood forests and high elevation spruce-fir forests.

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, 7 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 (Millers et al, 1991). Annual evaluations of tree condition and foliage damage require 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 state remeasurements are done on 12 % of the clusters and each field crew. Data entry is completed by the NAMP data analyst, and statewide data is acquired following quality check by the analyst. Metric units are used for data collection and analysis.

NAMP Plot Results

The trend in both the amount of dieback and the transparency of foliage (the amount of light coming through the crown) of sugar maples in the NAMP plot showed an improvement in tree condition from 1988 to 1991 (Table 1). However, in 1992, there was a slight increase in the amount of dieback and the transparency of crowns. The number of trees with less than 15 % dieback (% healthy trees) also decreased, although 94.3 % of trees are presently considered healthy. These may be a temporary changes in crown condition, or may indicate a trend towards poorer tree health at this site. Future years are needed to determine this.

Evaluations of crowns for damage from insects, diseases or other agents found light damage (1-30 % defoliation) from maple leaf cutter. In addition, some thin crowns were attributed to light to moderate seed crop, which often reduces either foliage size or amount.

YEAR	DIEBACK (%)	TRANSPARENCY (%)	MORTALITY (%)	% HEALTHY TREES
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

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), total mortality, and percent of trees healthy are all used to assess the health of dominant and codominant sugar maple trees in this plot.

Forest Health Plot Methods

Six new permanent plots were established in 1992 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 (Conkling & Byers, 1992). At each elevation, one plot was established 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 no plot was established. A total of seven plots were measured in 1992. English units are used for data collection and analysis.

Within-season variation in crown measurements was also measured to determine the optimum time for assessing tree condition. Crown dieback, transparency and density were measured three times during the field season at 3 week intervals.

Forest Health Plot Results

Results for all species combined, which includes balsam fir, red spruce, red maple, sugar maple, yellow birch, paper birch, and small numbers of beech, white ash, and black cherry, show a trend towards fewer healthy trees (trees with less than 16 % dieback) with increased elevation (Table 2). In general, where trees of each species were located in abundance at more than one elevation, greater percentages of trees at the lower elevation were healthier. The most notable change occurs with balsam fir between 3000 and 3800 feet. Only half the trees at the higher elevation were considered healthy.

This same trend is present for average percent dieback (Table 3), whereas foliage transparency (the amount of light coming through the foliated portion of the crown) doesn't follow a clear trend. Crown density decreases with elevation on plots from 2200 to 3800 feet (Table 4). Yellow birch trees in the 2200 foot plot, however, had denser crowns than those in the lowest elevation plot.

Average diameter at breast height (DBH) and percent of trees standing dead are presented in Table 5 and 6, respectively. Balsam fir, sugar maple and yellow birch trees all had larger diameter trees at the higher elevations. The hardwood tree sizes may be a reflection of land use practices. The balsam fir DBH measurements, while larger at the higher elevations, are very similar (6.76 and 7.11, low and high elevations, respectively).

SPECIES	% HEALTHY TREES BY ELEVATION			
	1400	2200	3000	3800
BALSAM FIR	---	---	100	54.05
RED SPRUCE	---	---	66.67	---
RED MAPLE	100	---	---	---
SUGAR MAPLE	100	83.33	---	---
YELLOW BIRCH	100	94.74	---	---
PAPER BIRCH	---	---	88.46	---
ALL SPECIES	96.97	90.63	89.83	54.05

Table 2. Percent of dominant and codominant trees considered healthy (less than or equal to 15 % crown dieback) in permanent plots located at 4 elevations: 1400, 2200, 3000 and 3800 feet. Minimum reported sample size = 5 trees.

SPECIES	AVERAGE CROWN DIEBACK BY ELEVATION			
	1400	2200	3000	3800
BALSAM FIR	---	---	5.6	18.78
RED SPRUCE	---	---	15.56	---
RED MAPLE	3.0	---	---	---
SUGAR MAPLE	4.0	8.33	---	---
YELLOW BIRCH	5.71	6.58	---	---
PAPER BIRCH	---	---	9.62	---
ALL SPECIES	5.3	8.59	8.90	18.78

Table 3. Average crown dieback of dominant and codominant trees in permanent plots, by species and elevation. Minimum reported sample size = 5 trees.

SPECIES	AVERAGE FOLIAGE TRANSPARENCY BY ELEVATION			
	1400	2200	3000	3800
BALSAM FIR	---	---	18.0	15.27
RED SPRUCE	---	---	13.89	---
RED MAPLE	15.0	---	---	---
SUGAR MAPLE	12.0	14.17	---	---
YELLOW BIRCH	19.29	15.26	---	---
PAPER BIRCH	---	---	18.85	---
ALL SPECIES	15.0	16.41	17.97	15.27

Table 4. Average foliage transparency (amount of light passing through foliated portion crown) of dominant and codominant trees located in permanent plots, by species and elevation. Minimum reported sample size = 5 trees.

SPECIES	AVERAGE CROWN DENSITY BY ELEVATION			
	1400	2200	3000	3800
BALSAM FIR	---	---	46.4	42.97
RED SPRUCE	---	---	46.11	---
RED MAPLE	53.0	---	---	---
SUGAR MAPLE	54.0	47.5	---	---
YELLOW BIRCH	49.29	53.95	---	---
PAPER BIRCH	---	---	43.46	---
ALL SPECIES	50.76	50.94	45.51	42.97

Table 5. Average crown density of dominant and codominant trees located in permanent plots, by species and elevation.

SPECIES	AVERAGE DBH (inches) BY ELEVATION			
	1400	2200	3000	3800
BALSAM FIR	---	---	6.76	7.11
RED SPRUCE	---	---	6.99	---
RED MAPLE	9.96	---	---	---
SUGAR MAPLE	7.23	10.08	---	---
YELLOW BIRCH	10.64	13.43	---	---
PAPER BIRCH	---	---	7.09	---
ALL SPECIES	9.18	12.9	7.26	7.11

Table 6. Average DBH of dominant and codominant trees located in permanent plots, by species and elevation. Minimum reported sample size = 5 trees.

SPECIES	PERCENT MORTALITY BY ELEVATION			
	1400	2200	3000	3800
BALSAM FIR	---	---	19.44	43.28
RED SPRUCE	---	---	50.0	---
RED MAPLE	0	---	---	---
SUGAR MAPLE	14.29	17.65	---	---
YELLOW BIRCH	11.11	0	---	---
PAPER BIRCH	---	---	5.71	---
BEECH	---	25.0	---	---
ALL SPECIES	8.0	9.8	22.5	43.3

Table 7. Percent of trees greater than or equal to 5 inches in diameter (DBH) standing dead (recent and past mortality) by species and elevation. Minimum reported sample size = 5 trees.

Within season remeasurements of 3 crown variables showed no significant changes in dieback, transparency or density ratings, despite a slight increase in the transparency and density ratings (Table 8).

DATE	DIEBACK (AVE. %)	TRANSPARENCY (AVE. %)	DENSITY (AVE. %)
6-23-92	6.6	12.3	53.5
7-17-92	5.6	13.0	54.0
8-26-92	6.0	14.1	55.4

Table 8. Results of within season remeasurement of crown variables on 2 forest health plots.

Discussion

Crown ratings in the NAMP plot showed a slight decrease in the percentage of healthy sugar maples this year as compared with last year, yet most trees were generally healthy in 1992.

Crown condition of trees on forest health monitoring plots showed that balsam fir at 3800 feet and red spruce at 3000 feet had high dieback ratings and lower numbers of healthy trees (54.5 and 66.7 % of trees healthy, respectively). In addition, there were high percentages of past and recently dead trees of these species at the same elevations.

The number of standing dead sugar maple and beech trees was also higher than normal (compared with other Vermont surveys). Since these averages included intermediate and suppressed trees, this may account for these differences. Beech bark disease is present at the site, and may account for some of the beech mortality.

These forest health measurements mark the beginning of long term monitoring at four elevations on the west slope of the mountain. Although this baseline information is of interest in describing the present condition of trees in plots, trends in health over time will provide critical information to evaluate forest health as it relates to various natural and anthropogenic stress agents.

References

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