

## Tree Condition

### All Species

This survey uses a conservative definition of "healthy;" meaning up to 10 percent crown dieback. Trees with over 10% dieback are labeled as declining. Based on this definition, most trees in the dominant and codominant crown positions were healthy in 1986, but 19 percent were rated as declining.

By 1991, over 50 % of the declining trees had recovered to a healthy crown condition, but 23% had died (Figure 4).

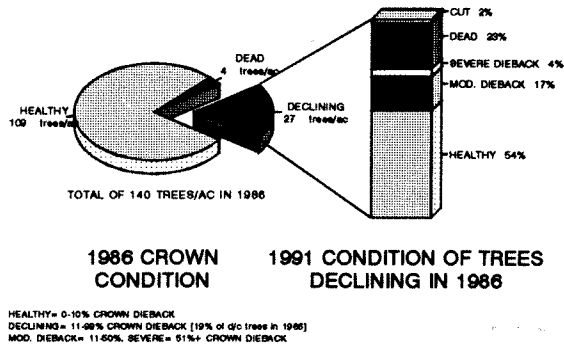


Figure 4. 1991 condition of all dominant & codominant trees rated as declining in 1986.

The percentage of dead trees in dominant and codominant crown positions increased from 2.9% in 1986 to 5.5% in 1991, but the percent of trees with moderate or severe dieback dropped sharply (Figure 5). The percent of healthy trees increased from 77.8% in 1986 to 85.6% in 1991.

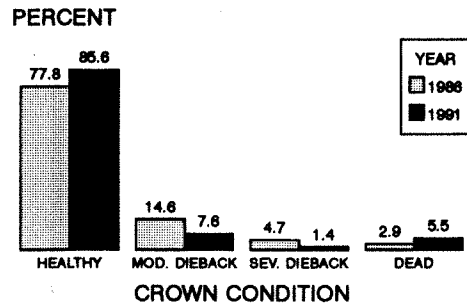


Figure 5. Crown dieback ratings of dominant and codominant trees in Vermont hardwood stands for 1986 compared to 1991.

### Individual Species

Nearly all species of live trees increased their percentage of healthy crowns between 1986 and 1991, but this was especially true for birch, beech, and maple (Figure 6). The dramatic improvement in beech crown conditions may be partially due to a decrease in oystershell scale populations. This insect caused beech twig and branch dieback in the mid-1980's when populations were at peak levels.

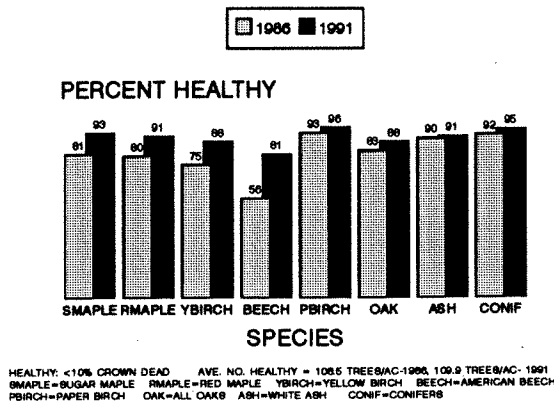


Figure 6. Percent of live dominant & codominant trees rated healthy in 1986 and 1991.

## CONCLUSIONS

Tree health in Vermont hardwood forests improved during the past five years. Nearly 86% of all trees in upper canopy positions had less than 10% crown dieback in 1991 compared to 78% in 1986. For the predominant hardwood species, over 88% had healthy tree crowns in 1991 except beech, which improved from 56% to 81% healthy.

The number of dead trees increased (2.9% to 5.5% standing dead) during the five years, mainly due to a progression of dieback on some of the trees that were unhealthy in 1986. Nearly one-fourth of the trees rated as declining in 1986 were dead in 1991. The deaths of these trees was probably triggered by stresses in the early 1980's. Improvements in crown condition of the surviving trees may be related to decreased insect damage and more seasons with above average precipitation since 1986.

### ACKNOWLEDGEMENTS

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### Reference:

Vermont Hardwood Tree Health Survey: 1986. 1987. R. Kelley and B. Eav. 30pp.

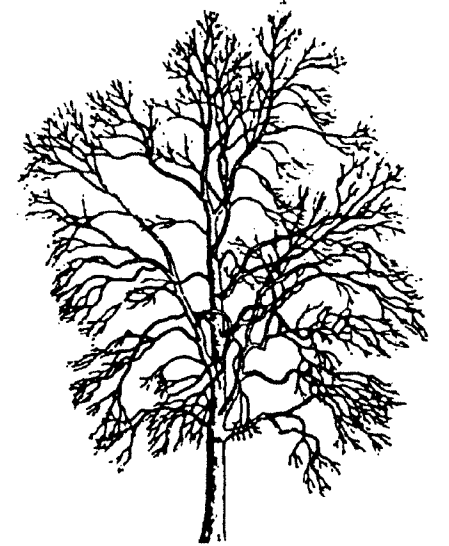
Related information available from VT Forests, Parks, and Recreation, 103 S. Main St., Waterbury, VT 05671-0601

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# Vermont Hardwood Tree Health In 1991 Compared To 1986



Vermont  
Agency of Natural Resources  
Department of Forests, Parks, and Recreation



United States Department of Agriculture



Forest Service  
1992

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## INTRODUCTION

In 1985 and 1986, a survey was initiated by the Vermont Department of Forests, Parks, and Recreation to determine the health status of Vermont's hardwood forests (Kelley and Eav 1987). This would establish a data base for future monitoring of tree condition and the effects of various stresses on hardwoods in the state. This survey was repeated in 1990 and 1991 to obtain the current health status of Vermont's hardwoods. Both surveys were a cooperative effort with the U.S. Forest Service.

The specific objectives of each survey were to :

- Determine number and volume of dead and declining hardwood trees per acre.
- Determine the area of hardwood decline and mortality by mortality class.
- Provide data on tree mortality, crown condition, site and stand factors to be used to determine stand trends over time.

The first survey followed a period between 1977 and 1982 when over one-fourth of Vermont's northern hardwoods (about 498,000 acres) were defoliated at least once by the forest tent caterpillar. This resulted in 33,000 acres of tree crown dieback and tree mortality. Thousands of additional acres were defoliated by outbreaks of gypsy moth, maple leaf cutter, and saddled prominent, as well as by late spring frosts in 1980 and 1986. Additional stress factors during this period included below average precipitation and a cold, open winter in 1980-81. This abundance of natural stress factors occurred when there was much public concern about the impacts of air pollutants on tree health.

## SURVEY METHODS

### Photo Interpretation

Color infrared aerial photos were taken over 170 sample points by the Forest Service in late summer of 1985. The photos were used to get a broad view of tree dieback and death and to serve as a basis for selection of ground plots. (Figure 1). Mortality area was determined by counting dead and dying trees on photos covering 612,000 acres. These sample points were re-photographed in 1990 to measure the change in number of dead and declining trees. At each photo point a 360 acre block was divided into 2.5 acre cells which were classified into one of the following mortality classes:

### Photo Mortality Classes

1. **Light**-Less than 10 percent of hardwood canopy trees dead.
2. **Moderate**-Ten to 30 percent of hardwood canopy trees dead.
3. **Heavy**-More than 30 percent of hardwood canopy trees dead.

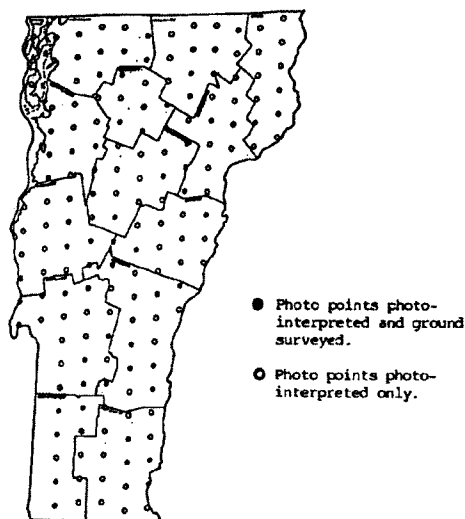


Figure 1. Sample point distribution in the Vermont Hardwood Health Survey, 1986 and 1991.

### Ground Survey

Ground survey methods were used to take a closer look at the extent of dieback and mortality. Based on interpretation of 1985 photos, two cells with heavy mortality, 22 cells with moderate mortality, and 51 cells with light mortality were intensively examined. Data were collected on site, soil, and trees within each cell in 1986 and again in 1991.

Tree data were collected for all trees one inch in diameter or greater. This totalled over 2,000 trees in dominant or codominant (upper canopy) crown positions. Sugar maple, red maple and yellow birch were the species most frequently evaluated (Figure 2).

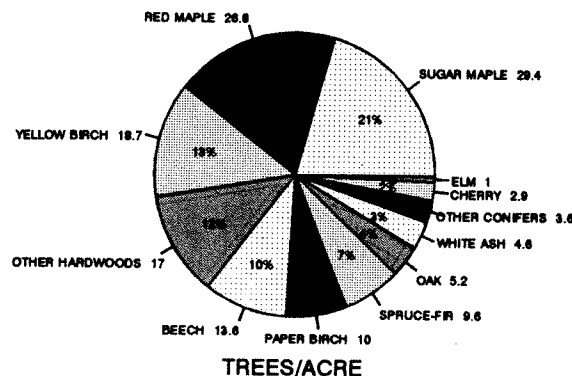


Figure 2. Number of dominant or codominant canopy position trees per acre by species, in Vermont hardwood stands evaluated for tree health in 1991.

Data included ratings for crown condition, including branch dieback. Dieback was based on visual estimates of the portion of tree crowns represented by twigs and branches that had recently died from the tips back.

### Crown Dieback Ratings

In 1986, these crown dieback ratings were used:

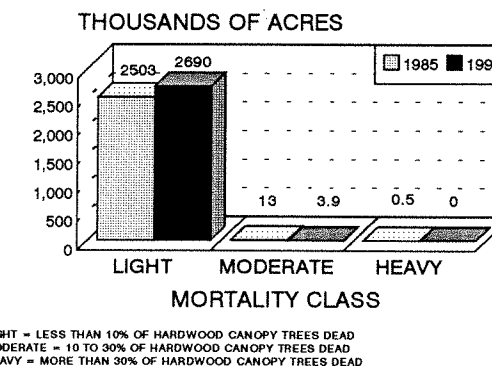
- Healthy
  - 1: No observable crown dieback
  - 2: 1-10% dieback
- Moderate Dieback
  - 3: 11-25% dieback
  - 4: 26-50% dieback
- Heavy Dieback
  - 5: 51-75% dieback
  - 6: Over 75% dieback

In 1991, crown dieback measurements were changed to 5 % categories (0, 5, 10 15 etc.) to compare to national forest health monitoring standards. These categories were combined during analysis of 1991 data to make direct comparisons to 1986. Seven percent of the ground points were remeasured to assess measurement variability. Over 95% of crown dieback remeasurements fell within  $\pm 10\%$  of the original 1991 field ratings.

## RESULTS AND DISCUSSION

### Area of Mortality

The area with more than 10% standing trees dead based on interpretation of aerial photographs dropped nearly 70% from over 13,000 acres in 1985 to less than 4000 acres in 1990 (Figure 3).



LIGHT = LESS THAN 10% OF HARDWOOD CANOPY TREES DEAD  
 MODERATE = 10 TO 30% OF HARDWOOD CANOPY TREES DEAD  
 HEAVY = MORE THAN 30% OF HARDWOOD CANOPY TREES DEAD

Figure 3. Vermont hardwood area within mortality classes estimated from interpretation of photos taken in 1985 and 1990.