MAPLE DECLINE EVALUATION IN VERMONT SUGAR BUSHES

Rick Alimi, FIDM U.S. Forest Service

Brent Teillon, Vermont Department of Forests and Parks

Imants Millers, FIDM U.S. Forest Service

Published by the Maple Decline Committee in cooperation with U.S. Forest Service, NA State and Private Forestry

PREAMBLE

This report was submitted to the Technical Committee on Maple Decline in Vermont. E.B. Walker, Chairman. The Committee has reviewed it and finds the report to be acceptable for publication.

Committee: E.B. Walker, Chairman

P. Benedict

J. Donnelly

A. Gotlieb

D. Huston

I. Millers

B. Teillon

MAPLE DECLINE SURVEY
PART I

ABSTRACT

Analysis of a mail questionnaire of 1429 members of the Vermont Maple Producers Association shows that approximately 33 percent feel that they have a maple decline problem. Use of the vacuum pump, defoliation, grazing, and logging were significantly associated with the decline problem at the 80 percent confidence level.

INTRODUCTION

The problem of sugar maple decline has attracted considerable attention lately, especially among the maple sugar producers in Vermont. At recent meetings of sugar makers, state, Federal, and University people, it was decided that a two part survey be conducted to assess the problem. The survey would attempt to answer three primary questions: 1) Is there a maple decline problem in Vermont, and if so how extensive is it; 2) What are some of the possible variables associated with the decline; and 3) What percentage of people, by county, feel they have a problem.

The analysis of the first part of the survey, the questionnaire, is completed while the second stage is still in progress.

SPSS Program

METHODS

The mail questionnaire (Appendix A) was sent out to 1429 members of the Vermont Maple Producers Association that had, this past season, or a 5 year average, of at least 200+ taps. Of the 1429 schedules 457 (32.0 percent) were returned by mail. Of the remaining 972 non-respondents, 181 (12.7 percent) were personnally contacted to bring the total number of completed schedules to 638 (44.6 percent).

The schedules were coded and then analyzed by the Statistical Package for the Social Sciences (SPSS) on the University of New Hampshire DecSystem 10 Computer. Summary statistics were calculated for all questions by each group of respondents; mail, personal contact, and the combined group. The summary statistics for selected variables can be found in Appendix B.

On the questionnaire there were three questions that would indicate a problem in a sugar bush. They were:

28) Do the trees in your sugar bush appear, in general, to be healthy?

29) Have you had rapid loss of trees in your sugar bush?

30) Would you say that the trees in general appear to be less thrifty than they were ten years ago?

A sugar bush would have a problem if one or more of the questions indicated it by answering them no, yes and yes respectively.

From the summary statistics it was decided that the following variables would be examined by chi square analysis 1/ to see if any significant associations with one of the problem indication variables (Q28, Q29 and Q30) were present.

Question Number	Variable
Q7A	Pump used
Q7B	Pump ever used
Q8	Pill used
Q9	Pill ever used
Q19	Grazed now
Q23	Logging
Q25A	Defoliated

A significance of difference test 2/ was used to determine if the mail response group and the personal contact group were distributed the same for each variable. If no difference was evident at the 95 percent confidence level the two groups were combined for further analysis.

A test of independence at the 80 percent confidence level was then run on all combinations of the variables in question to look for any

---

1/ When the assumptions of chi square were not met Fishers exact test on a ~~X~~ test was made
RE

2/ Surveys, Polls, and Samples by Parten.

associations that would cause confounding in further analysis. Variables found to be associated would be analyzed in a 2x2x2 table where one of the associated variables would be used as a controlling variable.

RESULTS

The significance of difference test showed a difference in the mail and personal contact groups for questions 19 and 25A, grazed now and defoliated. The combined group of data were used in all analyses that did not look at these variables directly while the individual response groups were used for these variables.

Summary statistics show that 32.8 percent (standard error 1.86 percent) of the sugar bush operators feel that they have a problem. This percentage is based on 634 valid answers to the problem indication questions.

Table 1 is a list of all the 2x2 tables that were examined, by response group, showing the controlling variable and level, the number of cases in the table, significance, and the Phi coefficient if significant. All tables were examined at the 80 percent confidence level.

Phi used w/ 2x2 Table

80% C/Level

Reg. C ↓

2 x 2 Table	Controlling Variable	level	No. Cases	Significance	Phi
pump used by healthy	grazed now	yes	166	NS	
"	"	no	334	NS	
pump used by rapid loss	"	yes	166	S	.10
"	"	no	332	S	.11
pump used by less thrifty	"	yes	158	NS	
"	"	no	309	NS	
pump ever used by healthy	logging	yes	65	S	.33
"	"	no	388	NS	
pump ever used by rapid loss	"	yes	65	NS	
"	"	no	387	NS	
pump ever used by less thrifty	"	yes	51	NS	
"	"	no	369	NS	
logging by healthy	pump ever used	yes	21	S	.39
"	"	no	432	NS	
logging by rapid loss	"	yes	22	S	.40
"	"	no	430	NS	
logging by less thrifty	"	yes	20	NS	
"	"	no	400	NS	
pill used by healthy	---	---	517	NS	
pill used by rapid loss	---	---	515	NS	
pill used by less thrifty	---	---	484	NS	

Table 1A.--Contingency tables that were examined using the combined group of data.

TABLE 1B

2x2 Table	Controlling variable	level	No. Cases	Significance	Phi
grazed now by healthy	defoliated	yes	14	NS	
"	"	no	146	NS	
grazed now by rapid loss	"	yes	15	NS	
"	"	no	143	NS	
grazed now by less thrifty	"	yes	13	S	.63
"	"	no	134	NS	
defoliated by healthy	grazed now	yes	62	S	.14
"	"	no	98	NS	
defoliated by rapid loss	"	yes	61	S	.29
"	"	no	97	NS	
defoliated by less thrifty	"	yes	60	NS	
"	"	no	87	NS	
defoliated by healthy	pump used	yes	16	NS	
"	"	no	105	NS	
defoliated by rapid loss	"	yes	16	NS	
"	"	no	103	S	.21
defoliated by less thrifty	"	yes	15	NS	
"	"	no	96	NS	

Table 1B.--Contingency tables that were examined using the personal contact response data.

TABLE 1C

2x2 Table	Controlling variable	level	No. Cases	Significance	Phi
grazed now by healthy	pump used	yes	42	NS	
"	"	no	329	NS	
grazed now by rapid loss	"	yes	42	NS	
"	"	no	330	NS	
grazed now by less thrifty	"	yes	40	NS	
"	"	no	308	NS	
defoliated by healthy	---	---	413	NS	
defoliated by rapid loss	---	---	414	NS	
defoliated by less thrifty	---	---	391	[illegible] S	.08

Table 1C.--Contingency tables that were examined using the mail response data.

Table 2 is a breakdown, by county, of the percentage of people with a problem.

TABLE 2

County	Percent that indicated a problem
Addison	27
Bennington	39
Caledonia	35
Chittenden	30
Franklin, Grand Isle	46
Lamoille	45
Orange	41
Orleans, Essex	28
Rutland	29
Washington	19
Windham	17
Windsor	51

Table II.--Percentage of people, by county, that indicated a problem.

DISCUSSION

The test of the null hypothesis (independence) was done at the $\alpha=.2$ level because it was felt that even slight association would be enough to warrant further investigation. For the same reason, if a variable was tested in the seperate mail and personal contact groups and was significant in only one group it would also warrant further investigation.

The results showed that there were five variables associated with the indication of a problem. They were pump used, pump ever used, logging, grazed now, and defoliated.

The variables pump used and defoliated were significantly associated with an indication of a problem at both levels of control and no control respectively. All the rest, including defoliated (in the personal contact group) were significant at a specific level of the control. In all but one case the level of the controlling variable was yes. This indicator that a combination of the variables can result in an association becoming significant.

APPENDIX B

SUMMARY STATISTICS

Question number	Description	Mean	Standard error	Number of observation
2	No. taps this spring	1614.4	69.10	528
3	Avg. No. taps last 5 yrs.	1651.0	59.23	502
4	Acres tapped	33.1	2.01	462
5	No. yrs. succession	27.0	1.12	501
10B	No. yrs. pill used	4.0	.25	268
13	No. taps last yr. tapped	921.3	61.71	105
14	Avg. No. taps last 5 yrs. tapped	1166.1	99.53	95
20A	No. acres grazed	26.0	2.90	199
20B	No. of cattle	36.5	1.85	204
21	No. yrs. grazed	42.4	2.28	195
22	No. cattle over time	32.8	1.43	211

Question number	Description	Adjusted Frequency Yes	No	Number of observations	
1	Tapped	83.1	16.9	638	Nominal data used
7A	Pump used	11.5	88.5	515	
7B	Pump ever used	5.0	95.0	478	
8	Pill used	8.1	91.9	528	
9	Past pill use	55.2	44.8	504	
16	Pump used when tapped	5.0	95.0	100	
17	Pill used when tapped	33.0	67.0	100	
19	Grazed now (mail data)	31.6	68.4	450	
19	Grazed now (Per. contact data)	41.0	59.0	178	

Question number	Description	Adjusted Frequency Yes	No	Number of observations
23	Logging	16.5	83.5	619
24A	Thinning or Brushing	67.1	32.9	620
24B	Thinning	100	----	329
24D	Brushing	100	----	229
25A	Defoliated (mail data)	14.8	85.2	419
25A	Defoliated (Per. contact data)	9.0	91.0	166
26A	Fire damage	100	----	12
26C	Hurricane & wind	100	----	152
26E	Drought damage	100	----	27
26G	Ice damage	100	----	54
28	Healthy	89.7	10.3	624
29	Rapid loss	16.1 (104)	83.9 (523)	623
30	Less thrifty	26.4 (154)	73.6 (430)	584
31	Examination	97.6	2.4	617
--	Problem indication	32.8	67.2	634

Question number	Description	Absolute frequency	Adjusted frequency	Number of observations
1 ~~18~~ 11	Mode used	---	100	525
	Tractor	221	42.1	
	Horses	30	5.7	
	Tubing	90	17.1	
	Combination	22	4.2	
	Other	16	3.0	
	Tractor & Horses	4	0.8	
	Tractor & Tubing	108	20.6	
	Tractor & Other	8	1.5	
	Horses & Tubing	14	2.7	
	Tubing & Other	12	2.3	
25C	Insects	---	100	47
	Maple leaf cutter	23	51.1	
	Forest tent caterpillar	8	17.8	
	Other	14	31.1	

ABSTRACT

Analysis of 91 randomly chosen sugar bushes in Vermont found 88 percent rates in good to excellent and 12 percent in fair to poor condition. Only one sugar bush was rated in poor condition. No single cause is apparent for the fair to poor stand conditions. Contributing causes appear to be overgrazing, over-tapping, poor soils, insect damage and stem and root rots. Tables are provided to show stocking levels, species and size distribution of trees and various associations of tree conditions and injuries.

INTRODUCTION

The problem, commonly identified as sugar maple decline sporadically draws attention in the Northeastern States. The maple sugar producers of Vermont became particularly concerned about 2 years ago when some sugar bushes with severe maple decline were brought to the public attention. Several meetings were held to discuss the problem and determine course of action.

A technical committee was formed to appraise the situation in Vermont. A questionnaire survey of sugar bush owners determined that about a third indicated that their stands were not in good condition. Many had observed declining tree conditions.

As a result, survey was designed in cooperation between:

University of Vermont

Vermont Department of Agriculture

Vermont Department of Forests and Parks

Sugar Maple Laboratory, U.S. Forest Service

Forest Insect and Disease Management, U.S. Forest Service

OBJECTIVES

The main purpose of the survey was to determine the intensity of tree mortality in Vermont's sugar bushes and to identify clues to possible causes of the decline.

METHODS

Sugar Bushes:

A list of sugar bush owners was obtained from the Maple Sugar Producers Association of Vermont. Over 1,000 names were selected which were supposed to be currently active producers, with at least 200 taps per year in the last 5 years. Roadside operations were not included.

At random, a 10 percent sample was drawn in each county, for a total initial sample of 144 sugar bushes. Of these, 35 sugar bushes did not meet the requirements. Finally, field data were collected from 91 sugar bushes. We believe that the selection process was reasonably random, to allow the expansion of the conclusions to the whole State.

Sample Plots:

In each sugar bush, 5 sample plots were taken, The survey crew would enter the sugar bush to the approximate center and establish plot 1. Thereafter, the remaining 4 plots were established with 1 plot about 5 chains away in each cardinal compass direction. A line of plots was used in several sugar bushes where the trees were in a narrow strip which did not allow sufficient area for the cluster design.

Each plot was a circular area containing 1/5th of an acre. Inventory was taken of stand, site, soil and tree condition of all species over 2 inches dbh. A complete listing of data taken and definitions of terms is presented in Exhibit 1 and 2.

Field data were collected by 12 survey teams made up of personnel from Vermont Department of Agriculture, Vermont Department of Forests and Parks, CETA (Civilian Employment Training Act) and U.S. Forest Service.

The field data were transcribed by CETA personnel onto optical scanner forms to be recorded on magnetic computer tape. The analysis was made by a Statistical Package for the Social Sciences (SPSS) on Dec System 10 Computer at the University of New Hampshire.

Descriptive statistics and frequency tables were compiled for all tree species found in the 91 sugar bushes. Cross tabluation tables and chi square tests of independence were done on selected variables. Detailed information in this report is presented for sugar maple only. Additional data on sugar maples and other tree species is available on tapes stored at Vermont Department of Forests and Parks Headquarters and at Portsmouth Field Office, U.S. Forest Service.

RESULTS

The field data were analyzed to provide information on the general conditions of sugar bushes in Vermont; then to provide descriptive descriptions based on sample plots; and finally, to give tree information for sugar maples. The following results are based on the analysis of data from 91 randomly selected sugar bushes in Vermont. Therefore, the information should be descriptive of the average conditions of Vermont.

The condition of the sugar bushes was to be rated after the survey team had a chance to see most of the stand, i.e. after sampling all

5 plots. However, some crews rated each plot separately. For this report, we have taken the plot data and established the stand condition on basis of majority of plots in a stand. Only about 10 percent of sugar bushes had plots of different ratings. The appraisal is that 88 percent of sugar bushes are in good to excelletn condition, and 12 percent were rated fair to poor (Table 1). These two groups hereafter are identified as good and fair, respectively.

The stand conditions in the plots, of course, are similar (Table 2). One might note, however. that a sprinkling of good condition plots were found in sugar bushes rated fair and vice versa.

Rock outcroppings were found in about 40 percent of the plots (Tables 5 and 6). Proportionally more plots with rock outcropping were observed in fair to poor stands than in good to excellent (chi^2 signif. at 0.01). Again, the association is weak (Phi=0.15).[1/]

Grazing signs were found in about half of the plots (Table 3). Although, Table 4 suggests declining stand conditions with increased intensity of grazing (Chi^2 signif. 0.01) the association seems to be weak (c=0.2).

1/ Phi is a measure of association for 2x2 scale of 0-1.0 table 1.

2/ C is Cramer's coefficient of association for larger than 2x2 tables: scale for small tables is 0-0.7.

About one third of the plots had stands rated with complete crown closure, half had partially closed crowns, and the rest were open (Table 7 and 8). The stands tend to be more open in the fair to poor stand conditions (Chi^2 signif. at 0.05), but the association is weak (c=0.12).

Soil disturbance was found on more than half of the plots (Table 9), and equally common among good and fair stands.

Table 1.--Stand condition ratings for Vermont sugar bushes

Stand Condition	Number of bushes	Percent of bushes
Excellent	26	29.5
Good	53	58.5
Fair	10	10.9
Poor	1	1.1

Table 2.--Distribution of plot conditions within sugar bushes in Vermont

(in percent)

Plot Condition Class	Sugar bush condition class	
	Good to Excellent	Fair to Poor
Excellent	33.3	1.9
Good	66.4	1.9
Fair	0.4	87.0
Poor	0	9.3

Table 3.--Trazing intensity on 451 sample plots in Vermont sugar bushes

Intensity Class	Number of plots	Percent of total
None	253	56
light	103	23
moderate	44	10
heavy	51	11

Table 4.--Distribution of percentages of grazing intensity classes by stand condition in Vermont sugar bushes.

Stand Condition	No. Plots	Intensity Classes			
		none	light	moderate	heavy
Excellent Good	397	59	20	11	10
Fair Poor	54	37	43	2	8

Table 5.--Presence of rock outcroppings on 444 sample plots in Vermont sugar bushes

Outcropping Class	Number of plots	Percent of total
Absent	272	61
Present	172	39

Table 6.--Distribution of percentages of rock outcroppings by stand condition in Vermont sugar bushes

Stand Condition	No. Plots	Outcropping	
		Absent	Present
Excellent Good	394	64	40
Fair Poor	50	36	60

Table 7.--Crown closure of 448 sample plots in Vermont Sugar bushes

Closure Class	Number of plots	Percent of total
Open	48	11
Partial	248	55
Closed	152	34

Table 8.--Distribution of percentages of crown closure classes by stand condition in Vermont Sugar Bushes

Stand Condition	No. Plots	Closure Classes		
		Open	partial	closed
Excellent Good	395	9	57	34
Fair Poor	53	21	47	32

Table 9.--Soil disturbance on 450 sample plots in Vermont sugar bushes

Disturbance Class	Number of plots	Percent of total
Not disturbed	153	34
disturbed	297	66

TREE EVALUATION

Over 8600 trees were examined in the 91 sugar bushes. On the average, 95 trees per acre were found of which about 65 percent are sugar maple (Table 10). The other major species were hophornbeam, american beach, red maple, yellow birch and some northern conifers.

The remaining tree evaluation is concerned with sugar maple only. About half of the trees in the sugar bushes are less tha 9 inches in diameter at dbh (Table 11). The largest tree examined was 88.8 inches at dbh. The average dbh of sugar maples is 9.7 inches.

Table 10.--Tree species composition in Vermont Sugar Bushes. (Based on 2 in. dbh and larger trees from 91 randomly selected sugar bushes)

Species	No./A	Percent
Sugar Maple	61.5	64.7
Hophornbeam	6.8	7.2
Beech	4.7	4.9
Red Maple	4.0	4.2
Yellow Birch	3.1	3.2
Hemlock	2.2	2.3
Spruce	1.9	2.0
Balsam Fir	1.0	1.1
Others (less than 1%)	9.8	10.4
TOTAL	95.0	100.0

Table 11.--Distribution of dbh size classes of sugar maple in Vermont Sugar Bushes (91 random sugar bushes)

dbh CLASS	Tree Number	Percent of total	Accumulative Percentage
2	704	12.7	12.7
4	894	16.1	28.8
6	769	13.9	42.7
8	681	12.3	55.0
10	580	10.5	65.5
12	506	9.1	74.6
14	392	7.1	81.7
16	274	4.9	86.6
18	223	4.0	90.6
20	147	2.7	93.3
22+	376	6.8	100
TOTAL	5546	100	

Table 12.--Crown classes of sugar maples in Vermont sugar bushes

Crown Class	Number per Acre	Percent
Dominant	33.2	54.3
Intermediate	11.6	18.9
Suppressed	16.4	26.8

About one half of the sugar maples occupy dominant crown position, while only 27 percent are suppressed.

Most of the trees in all the dbh classes are healthy, although the 2-8 inch class has the lowest proportion (Table 13). The smallest trees have the largest percentage of dead trees. Of all the dead trees, about 80 percent were found in the 2-8 dbh class (Table 14).

Table 13.--Crown condition of sugar maples within dbh classes in Vermont sugar bushes

dbh Class inches	No. Trees No.	Crown Condition Class Healthy %	Fair %	Poor %	Dead %
2-6	2367	73.8	16.0	3.2	6.9
8-12	1767	79.8	17.2	1.7	1.3
14-18	889	81.0	17.2	0.9	0.9
20+	523	76.3	20.3	2.5	1.0
All Trees	5546	77.2	17.0	2.3	3.6

Table 14.--Distribution of dbh classes for each tree condition class in Vermont sugar bushes

Tree Condition	No.	2-6	8-12	14-18	20+
Healthy	4275	40.1	33.0	16.8	9.3
Fair	944	40.4	32.2	16.2	11.2
Poor	127	59.8	23.6	6.3	10.2
Dead	200	82.0	11.5	4.0	2.5

Table 15.--Evaluation of dead sugar maples in Vermont sugar bushes. Number of years dead for all sugar bushes, and comparison between good and fair sugar bushes

No. Years Dead	All Bushes (91) %	Good Bushes (80) %	Fair Bushes (11) %
1	12.5	14.8	0
2	16.0	16.0	16.1
3	22.0	20.1	32.3
4+	49.5	49.1	51.6

About half of the sugar maples have been dead for more than 3 years (Table 15). While the distribution of percentages in good bushes is similar to the average of all bushes, the fair bushes are quite different. Here the current mortality is nil and 3 years ago twice as many trees died than 2 years ago.

The most common damage recorded on sugar maples was defoliation. (Table 16). Nearly all the trees had some defoliation, although over 3/4 of trees were less than 10 percent defoliated (Table 17). No obvious differences in defoliation appear between the trees growing in sugar bushes rated good and fair. Of interest might be that all 5 plots taken in the sugar bush rated poor, had most of the maples more than 50 percent defoliated.

Most of the defoliation was caused by maple leafcutter (Table 18). The sugar bushes rated in fair to poor condition have less maple leafcutter damage but more leafroller damage than the good bushes.

Table 16.--Types and frequency of damage recorded on sugar maples in Vermont sugar bushes.

Type of Damage	Sugar Bushes		
	All	Good	Fair
		Percent	
Defoliation	96.1	96.0	96.1
Stem rot	29.5	28.4	37.8
Sugar Maple borer	17.5	17.0	21.2
Root collar rot	17.2	16.8	20.1
Logging	15.2	15.1	15.7
Grazing	14.1	14.2	12.8
Leaf damage	8.6	8.7	7.6
Leaf Scorch	8.2	7.4	14.6
Cankers	8.2	8.0	9.7
Bird & animal	4.1	4.3	2.1

Table 17.--Severity of defoliation on sugar maple in Vermont sugar bushes

Defoliation Severity Class	Sugar Bushes All	Good	Fair
Less than 10%	70.1	69.2	77.5
10-50%	18.7	19.8	10.8
More than 50%	11.1	11.1	11.7

Table 18.--Type of defoliation on sugar maple in Vermont sugar bushes

Type of Defoliator	Sugar Bushes All	Good	Fair
Maple leaf cutter	61.7	65.5	32.1
Leaf rollers	14.0	11.7	31.8
Large caterpillars	5.3	4.9	8.4
Other	14.8	13.5	24.9
Absent	4.2	4.4	2.7

Most severe defoliation was recorded on the suppressed trees (Table 19). Less than 50 percent defoliation was equally distributed among the 3 crown classes.

Table 19.--Relationship between intensity of defoliation and crown class of sugar maples in Vermont sugar bushes.

Intensity of defoliation	Crown Class		
	Dominant	Intermediate	Suppressed
More than 50%	7.9	9.7	19.5
10% - 50%	19.1	19.6	17.3
1% - 10%	69.2	66.7	59.3
Absent	3.8	4.0	3.9

Table 20.--Relationship between sugar maple borer damage and crown class of sugar maples in Vermont sugar bushes

Crown Class	Sugar Bushes		
	All	Good	Fair
	Percent		
Dominant	22.3	21.3	29.7
Intermediate	16.2	16.3	14.9
Suppressed	7.7	8.0	5.3

Sugar maple borer damage appears to increase as the tree crown classes increase (Table 20). Dominant trees have higher percentage of borer damage than suppressed.

Analysis of data on the tapping show that the average tapped tree has 3.6 open and 13.6 closed tap holes. No differences are apparent between trees in good and fair sugar bushes.

EXHIBIT II

Maple Decline Codes

PLOT LAYOUT 1 Line
2 Group

County - Addison 1
Bennington 2
Caledonia 3
Chittenden 4
Essex 5
Franklin 6
Grand Isle 7
Lamoille 8
Orange 9
Orleans 10
Rutland 11
Washington 12
Windham 13
Windsor 14

STAND CONDITION (Record last)
(Avoid suppressed trees)

1. Excellent - overall stand healthy
2. Good - some dieback but not alarming
3. Fair - obvious dieback present - a potential problem
4. Poor - Serious dieback and death of trees

PROBLEM LOCATION 1. edge
2. pocket
3. scattered

PLOT DATA
SLOPE: degrees slope
ASPECT: degrees azimuth
CLOSURE: 0 open
1 partially closed
2 closed
GRAZING: 0 none
1 light
2 moderate
3 heavy

GROUND COVER - 1. HD Hardwoods
2. CN Conifers
3. FN Ferns
4. GS Grass
5. RU Rubus
6. BA Barren
7. OT Other

SOIL - Outcrops 0=absent
1=present
Distrubance 0=not distrubed
1=disturbed
Sample 0=not taken
1=taken
Mottled 0=not mottled
1=mottled

TREE DATA (2.0" DBH & up)
Species
1. SM Sugar maple
2. RM Red maple
3. AP Striped maple
4. YB Yellow birch
5. WB White birch
6. QA Aspen (poplar)
7. WA White oak
8. BE Beech
9. BC Cherry
10. AE Elm
11. HY Hickory
12. OK Oak
13. IW Ironwood (Hophornbeam)
14. HK Hemlock
15. WP White pine
16. BF Fir
17. SP Spruce
18. HD Hardwood
19. CN Conifer

DBH: diameter at breast height to nearest 1/10 foot.

CROWN CLASS
1 Dominant/Codominant
2 Intermediate
3 Overtopped

Field	Section
TREE NUMBER	TREE DATA
SPECIES	
DBH	
CROWN CLASS	
CROWN CONDITION	
NO. YEARS DEAD	
LOGGING	
S.M. BORERS	
CANKERS	
BIRD & ANIMAL	
STEM ROT	
DEFOLIATION	
DEFOLIATORS	
LEAF SCORCH	
LEAF DAMAGE	
GRAZING	
ROOT COLLAR ROT	
ARMILLARIA	
	TAPPING
TAPPED	
SEVERITY	
NO. HOLES OPEN	
NO. HOLES CLOSED	
TAP HOLE CLOSURE	
CORED	GROWTH
WIDTH OF LAST 5 RINGS (MM)	
WIDTH OF LAST 10 RINGS (MM)	

— CONTINUATION —

Field	Section
DAY	DATE
MONTH	
YEAR	
PLOT LAYOUT	
COUNTY	BUSH DATA
BUSH NUMBER	
STAND CONDITION	
PROBLEM LOCATION	
PLOT NUMBER	PLOT DATA
SLOPE	
ASPECT	
CLOSURE	
GRAZING	
GROUND COVER	
OUTCROPPING	
DISTURBANCE	
SAMPLE	
MOTTLED	
~~DEPTH TO HARD-PAN (CM)~~ pH	

EXHIBIT I

Dear Cooperator

Please review for technical matters the attached Maple Decline report. It will be submitted to the Technical Committee and then published as a separate report. We would appreciate your comments by the end of September, or earlier. Please, send comments to I. Millers, U.S. Forest Service, Federal Building, Portsmouth, NH 03801

For your information, copies for review are being sent to the following:

K. Knauer, FIDM, NA

E. Walker, Dept. Forestry & Parks, VT

B. Benedict, Dept. Agric., VT

R. Walters, NEFES, Sugar Maple Lab.

R. Young, MAG

Dr. D. Huston, NEFES Hamden

Dr. A. Gotlieb, Univ. VT