FOREST INSECT AND DISEASE CONDITIONS IN VERMONT

CALENDAR YEAR 1988

AGENCY OF
NATURAL RESOURCES

DEPARTMENT OF FORESTS,
PARKS, AND RECREATION

WATERBURY, VERMONT 05676

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FOREST INSECT AND DISEASE

CONDITIONS IN VERMONT

CALENDAR YEAR 1988

Prepared by

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AGENCY OF NATURAL RESOURCES

DEPARTMENT OF FORESTS, PARKS AND RECREATION

Division of Forestry

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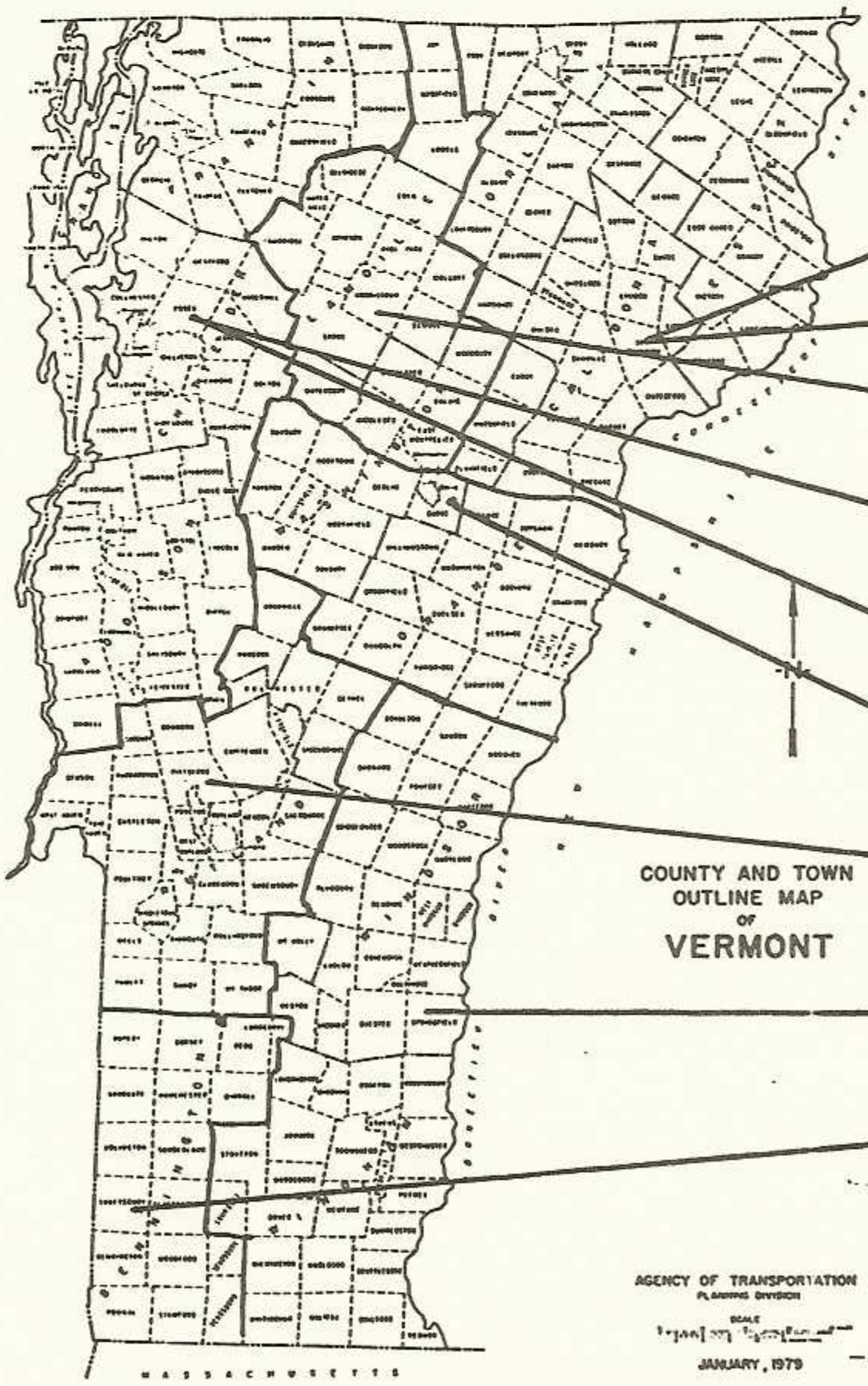

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VERMONT

INSECT AND DISEASE HIGHLIGHTS
1988

Birch Leaf Miner caused moderate to heavy defoliation of birch throughout the state. Birch defoliation has been widespread in Vermont for 2-4 years.

Forest Tent Caterpillar caused only light defoliation. Populations appear to be building, based on moth catches, egg masses, and larvae observed.

Gypsy Moth populations continued to build, with 1300 acres of light-moderate defoliation mapped in Rutland and Chittenden Counties. Egg mass counts indicate that additional defoliation will occur in 1989. A field experiment to determine whether gypsy moth outbreaks can be suppressed by treating "foci" was begun, in cooperation with the U.S. Forest Service and the University of Vermont.

Oak Defoliation associated with oak leafroller, treehoppers, and lecanium scale was common on oak in southeastern Vermont early in the season. Oak leaftier moths were trapped, but larvae were not observed.

Saddled Prominent populations are increasing, although no defoliation was mapped during aerial surveys.

Spruce Budworm populations continued at very low levels. No larvae were observed, and few moths were trapped.

Aphids (Periphyllus sp.) were common on sugar maple throughout the state in the spring, sometimes associated with leaf yellowing, stunting, or premature leaf drop.

Pear Thrips populations exploded, with 469,000 acres of defoliation mapped from the air. Many trees, including most of those on the 8,100 acres mapped as severely defoliated, did not produce any primary leaves at all, although they did eventually refoliate. In response to the severity of damage, a Governor's Technical Task Force on Pear Thrips was appointed to coordinate research and management efforts.

Lecanium Scale and Oystershell Scale continued to be heavy in some locations on hardwood twigs.

Balsam Shootboring Sawfly killed new shoots in scattered balsam and fraser fir Christmas tree plantations. Because the insect has a two-year life cycle, heavy populations are not expected in 1989.

Beech Bark Disease was increasingly visible.

Maple Cankers and branch flagging occurred throughout the state. Dry weather and defoliation made bark more vulnerable to the opportunistic fungi that cause these diseases.

Scleroderris Canker was not found in any new locations this year.

Ozone pollution was at the highest levels recorded in Vermont. This is one of the pollutants thought to be most harmful to plants.

Drought increased tree stress, especially on poor sites, and led to increased symptom severity on trees already stressed by other factors. Precipitation was below average in every month but August.

Larch Decline continues to spread outward from recently dead trees in northern Vermont.

Maple Decline continued to be of concern. Dieback and branch flagging were commonly observed in association with drought stress. Plots were established in 26 locations to monitor maple health as part of the joint U.S.-Canadian North American Maple Project.

White Pine Needle Blight was mild this year after five successive years of severe symptoms.

VERMONT

1988 FOREST INSECT & DISEASE MANAGEMENT RECOMMENDATIONS

The following recommendations summarize information in this report of particular importance to forest managers. Additional information can be found under specific pests mentioned. Separate summaries are available for sugarbush and Christmas trees managers.

For assistance in identifying pests, diagnosing forest health problems, on-site evaluation, and insect sampling or to obtain copies of defoliation maps, management recommendations, and additional literature, contact forest resource protection personnel (page 1) or your county forester.

Sugar Maple - Pear thrips defoliation was mapped on 1/6 of the northern hardwood forest type in the state. According to early results of soil sampling, thrips numbers are high in some areas that weren't defoliated in 1988, including some northern Vermont locations, indicating that some of next year's damage may occur in different areas.

"Recommendations for Thinning Forest Stands Infested by the Pear Thrips" are available. The impact of pear thrips on tree health remains uncertain. Some trees which were completely defoliated, and then refoliated, were able to recover from the stress enough to finish the season with adequate food reserves in the form of root starch. These trees may be more severely stressed by repeated defoliations. It will be important to re-evaluate defoliation in 1989.

Populations of forest tent caterpillar and saddled prominent are building. Historically, dieback after defoliation by these insects has been more serious in stands that were recently thinned. If thinnings are scheduled, or have recently been completed, near areas where forest tent caterpillar and saddled prominent have been a problem in the past, these stands should be visited. Look for caterpillars (forest tent caterpillar in late June, saddled prominent in late July), chewed pieces of leaf on the ground, and the sound of insect frass dropping. If defoliators are present, scheduled thinnings should be postponed. If the stand has been recently thinned, and defoliators are present, contact the Division of Forestry about sampling insect numbers to determine whether or not spraying is recommended.

Sugar maples on shallow sites should be handled with care. These trees are the most vulnerable to 1988's unusual weather (the spring-summer drought and the open conditions of early winter). Let them recover before any additional disturbance.

Birch - Birch, especially paper birch, has been through 2-4 late season defoliations in some areas. Some dieback is showing up at higher elevations and in northern locations. Ambrosia beetles often attack and degrade stems of dying birch. Stands with dieback should be watched for signs of beetle activity (pinholes on the mainstem). Trees with dieback should be salvaged where beetles are active.

Beech - Beech bark disease continues to be building in much of the state. Stands where beech is mixed with hemlock favor the buildup of beech scale. Guidelines for managing stands to reduce the impact of beech bark disease are available.

Oystershell scale is responsible for some twig and branch mortality in northern Vermont.

Oak - Gypsy moth populations are building. Defoliation is expected, in 1989, in parts of Rutland and Chittenden Counties. To avoid dieback in defoliated stands, follow the recommendations for forest tent caterpillar and saddled prominent. Gypsy moth is most noticeable in late June.

Oaks in parts of southeastern Vermont were defoliated early in the season. Several insects were associated with this damage. Because oak leaf tier has recently caused red oak mortality in nearby areas of Massachusetts and New Hampshire, this insect should be watched for. It is a small green caterpillar, with dark markings. It feeds on buds and webs together foliage of expanding shoots.

Spruce-Fir - No new mortality from spruce budworm was observed this year, and budworm populations remain very low. The Spruce Budworm Demonstration Project continues to provide assistance to land managers and landowners who wish to improve stand resistance to the next outbreak.

Guidelines are being developed for managing spruce stands to prevent losses from root rot after thinning, particularly in deer wintering areas.

White Pine - Although white pine needle blight was widespread for the past five years, it was uncommon in 1988. The impact of previous damage is not evident.

Caliciopsis canker remains common on stagnated pines. Suspect this disease where resin is heavy between branch whorls.

Hemlock - Hemlock woolly adelgid has not been seen in Vermont. To prevent the introduction of this insect into the state, a quarantine regulating the movement of hemlock seedlings, nursery stock, logs, lumber with bark, and chips from infested areas has been enacted. Infested areas in the northeast include Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, and the District of Columbia.

INTRODUCTION

The information in this report is based on aerial surveys to detect defoliation, dieback and mortality; as well as ground surveys and observations of Forest Resource Protection personnel and other forestry staff.

Aerial surveys were flown in early to mid-June (6/1-6/13) to detect thrips defoliation and late in the season (8/5-9/2). U.S. Forest Service personnel also flew over the Green Mountain National Forest in June (6/9).

Diagnostic assistance was provided by the University of Vermont, Vermont Department of Agriculture, the U.S. Forest Service, Penn State University, and USDA-APHIS.

WEATHER SUMMARY

The winter of 1987-88 was generally mild, with below normal precipitation (Figure 1). Spring was also drier than normal, with the Palmer drought index already indicating "moderate drought" in northeastern Vermont during May. This was followed by a severe dry period in June. Lamoille, Washington, and Orange Counties were very dry during June, with no measurable precipitation recorded between 1 June and 23 June. Mid-summer temperatures were also warmer than normal, with the hottest July since 1975. By mid-July, the Palmer drought index registered moderate for much of the state, and severe in the very northeastern corner of the state. Only the month of August showed precipitation that was above normal. Dry weather caused symptoms of stress to be more severe than normal on many species, especially on poor sites, and where trees were suffering from other insect and disease problems.

Bud-break for most trees began close to normal this spring, but leaf development was held back one to two weeks by cool and/or dry conditions. This may have been a factor in the heavy thrips damage this year. This was also a very heavy seed year for many tree species, especially maple.

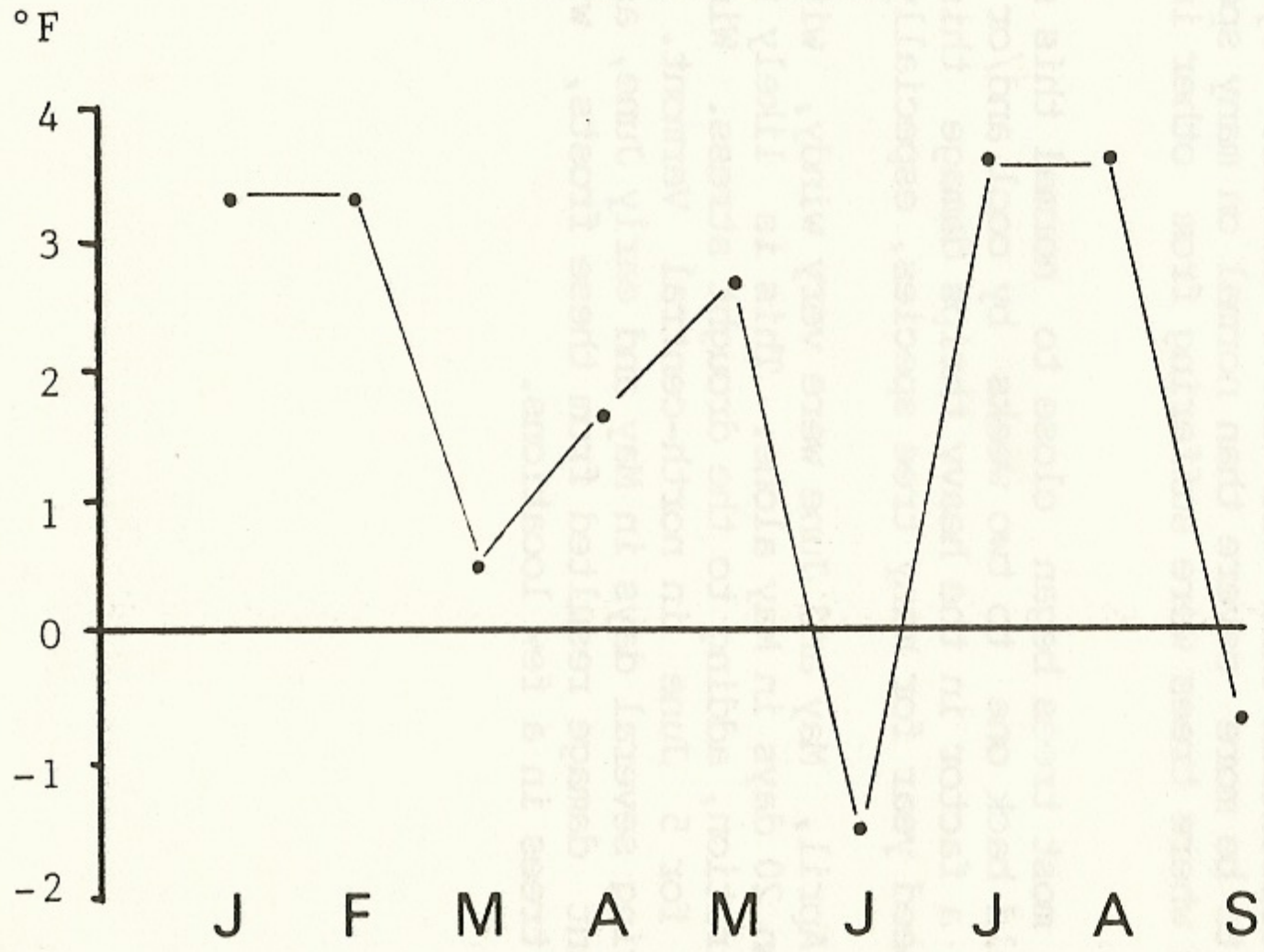
The months of April, May and June were very windy, with wind speeds in excess of 10 mph on 20 days in May alone. This is likely to have increased plant evapo-transpiration, adding to the drought stress. Wind gusts up to 50 mph were recorded for 5 June in north-central Vermont. Scattered light frosts occurred during several days in May and early June, as well as in late August. Little plant damage resulted from these frosts, with the exception of young Christmas trees in a few locations.

Figure 1: 1988 Weather Summary

Data from NOAA Local Climatological Data: Monthly Summary
Burlington International Airport

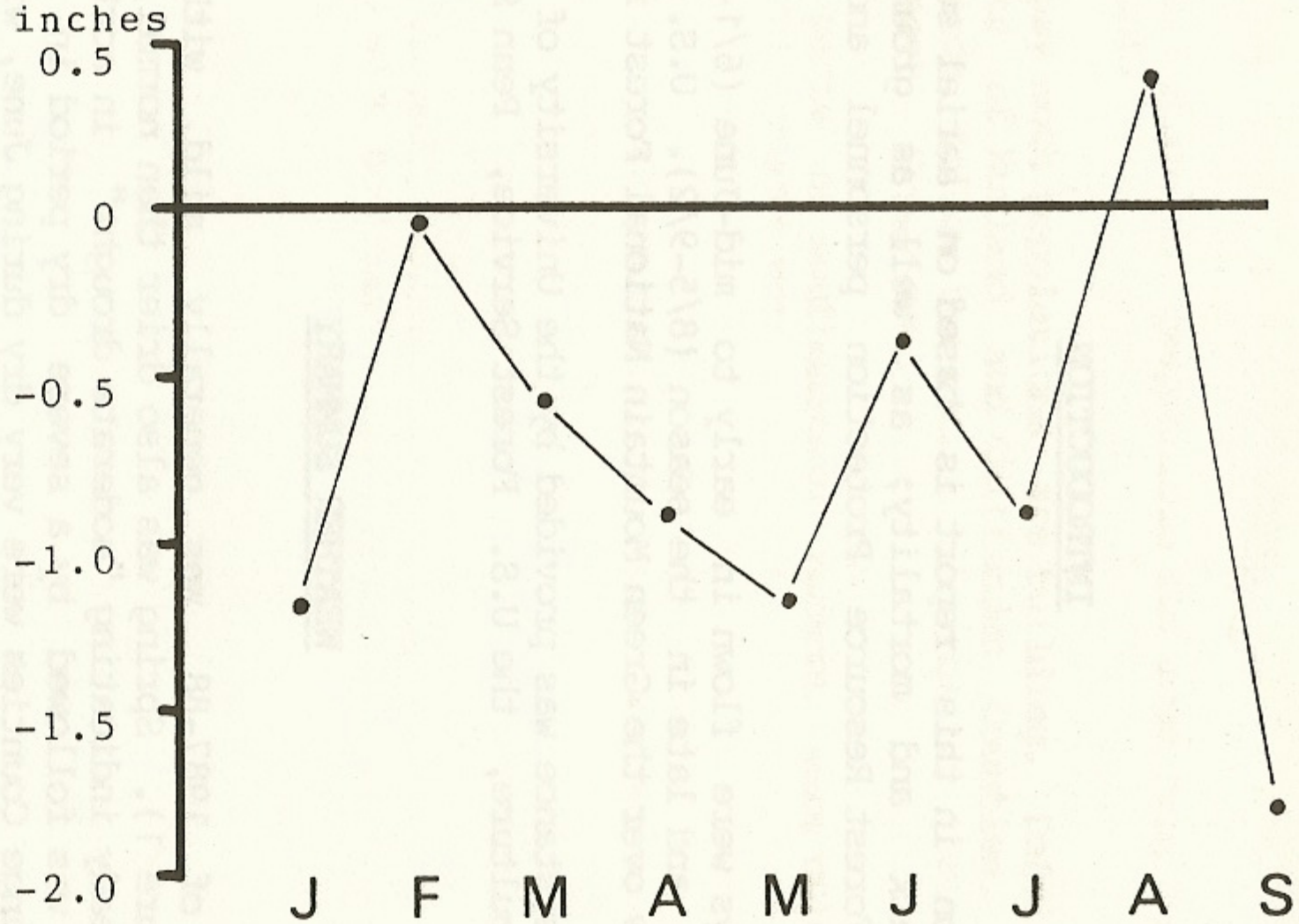
Temperature:

Departure from Normal



Precipitation:

Departure from Normal

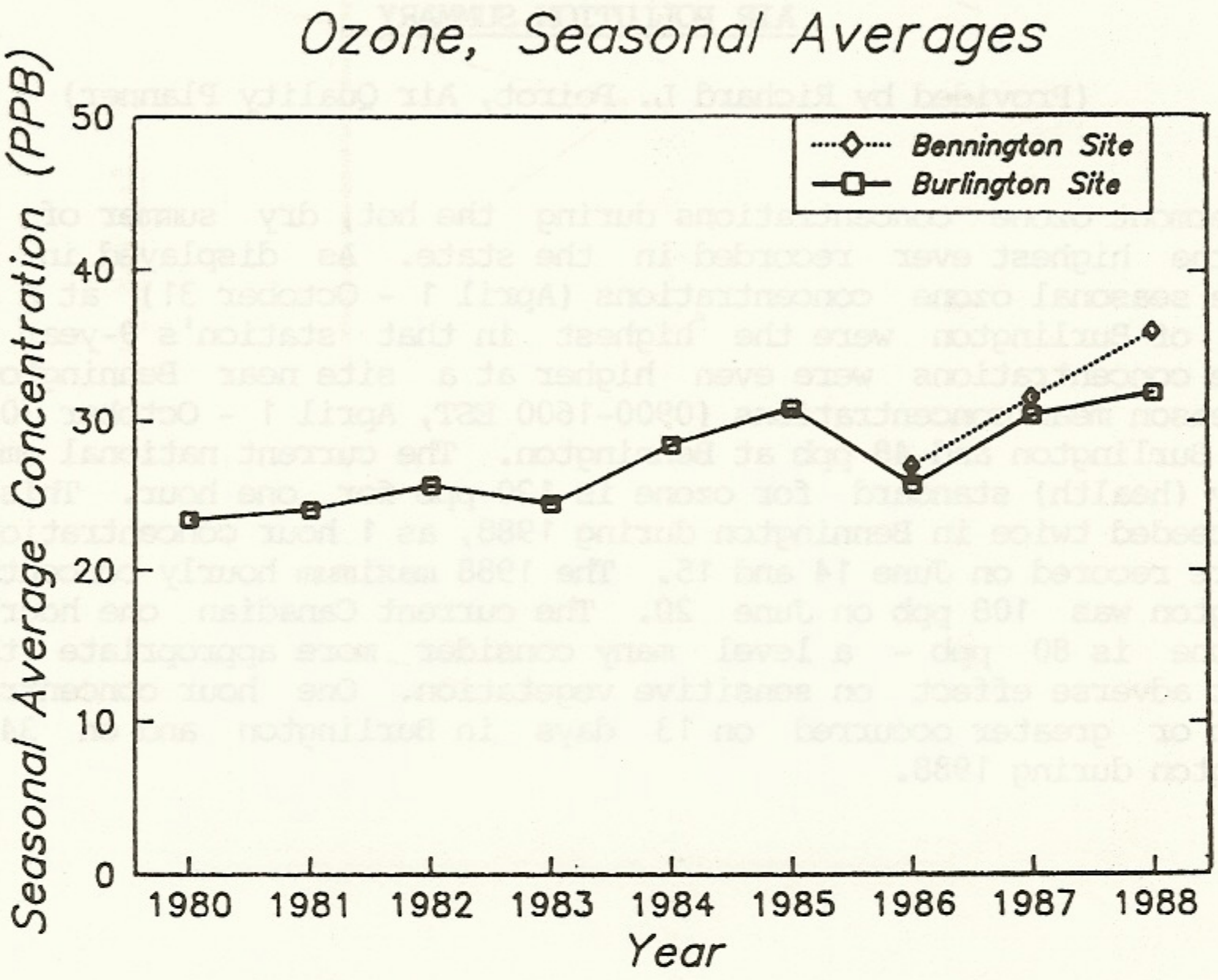


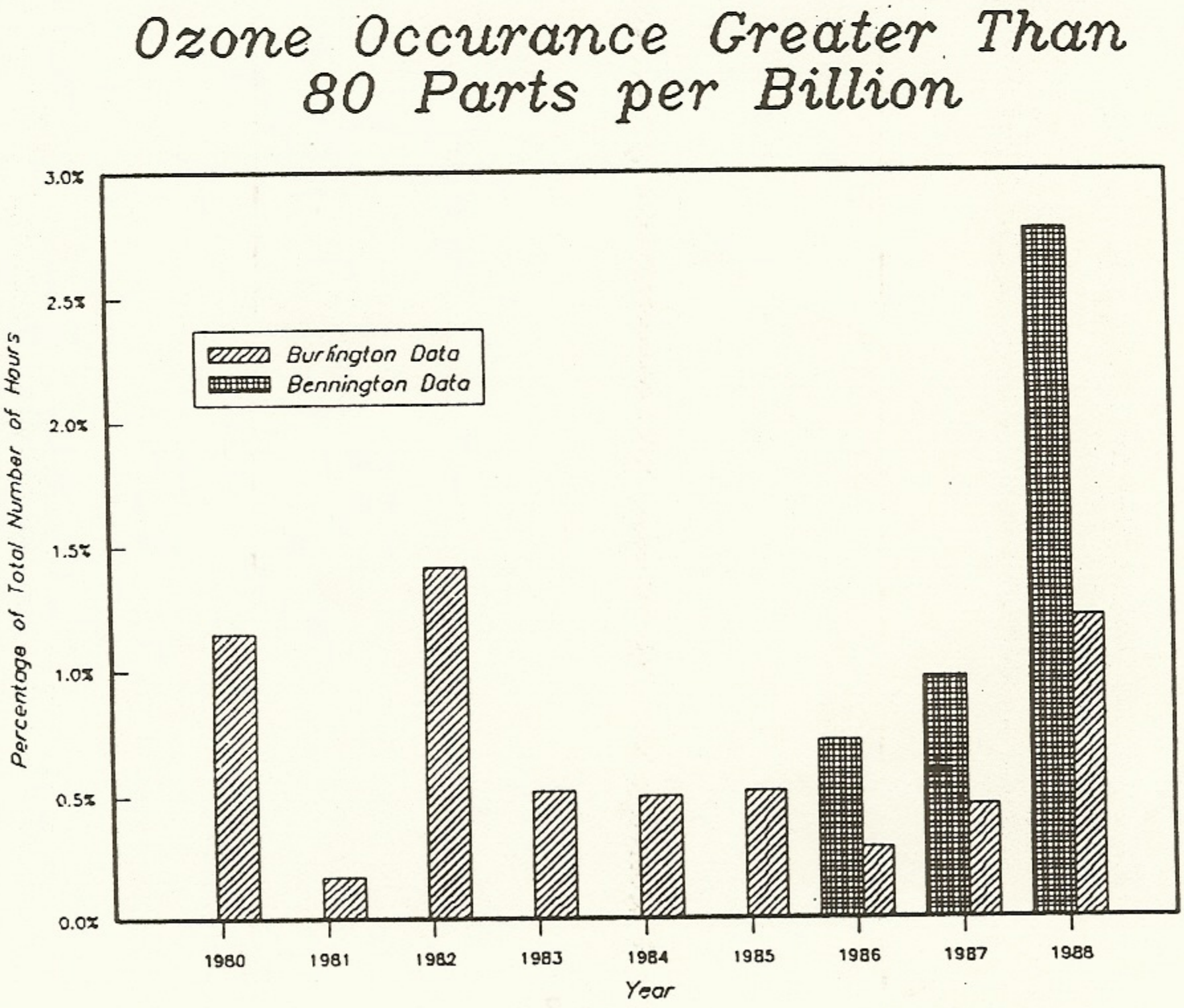
AIR POLLUTION SUMMARY

(Provided by Richard L. Poirot, Air Quality Planner)

Vermont ozone concentrations during the hot, dry summer of 1988 were among the highest ever recorded in the state. As displayed in Figure 2, average seasonal ozone concentrations (April 1 - October 31) at a site just upwind of Burlington were the highest in that station's 9-year history. Average concentrations were even higher at a site near Bennington. Seven hour season mean concentrations (0900-1600 EST, April 1 - October 30) were 40 ppb at Burlington and 48 ppb at Bennington. The current national ambient air quality (health) standard for ozone is 120 ppb for one hour. This standard was exceeded twice in Bennington during 1988, as 1 hour concentrations of 125 ppb were recored on June 14 and 15. The 1988 maximum hourly concentration in Burlington was 108 ppb on June 20. The current Canadian one hour standard for ozone is 80 ppb - a level many consider more appropriate to protect against adverse effect on sensitive vegetation. One hour concentrations of 80 ppb or greater occurred on 13 days in Burlington and on 34 days in Bennington during 1988.

Figure 2. Vermont Ozone Levels 1980–1988.





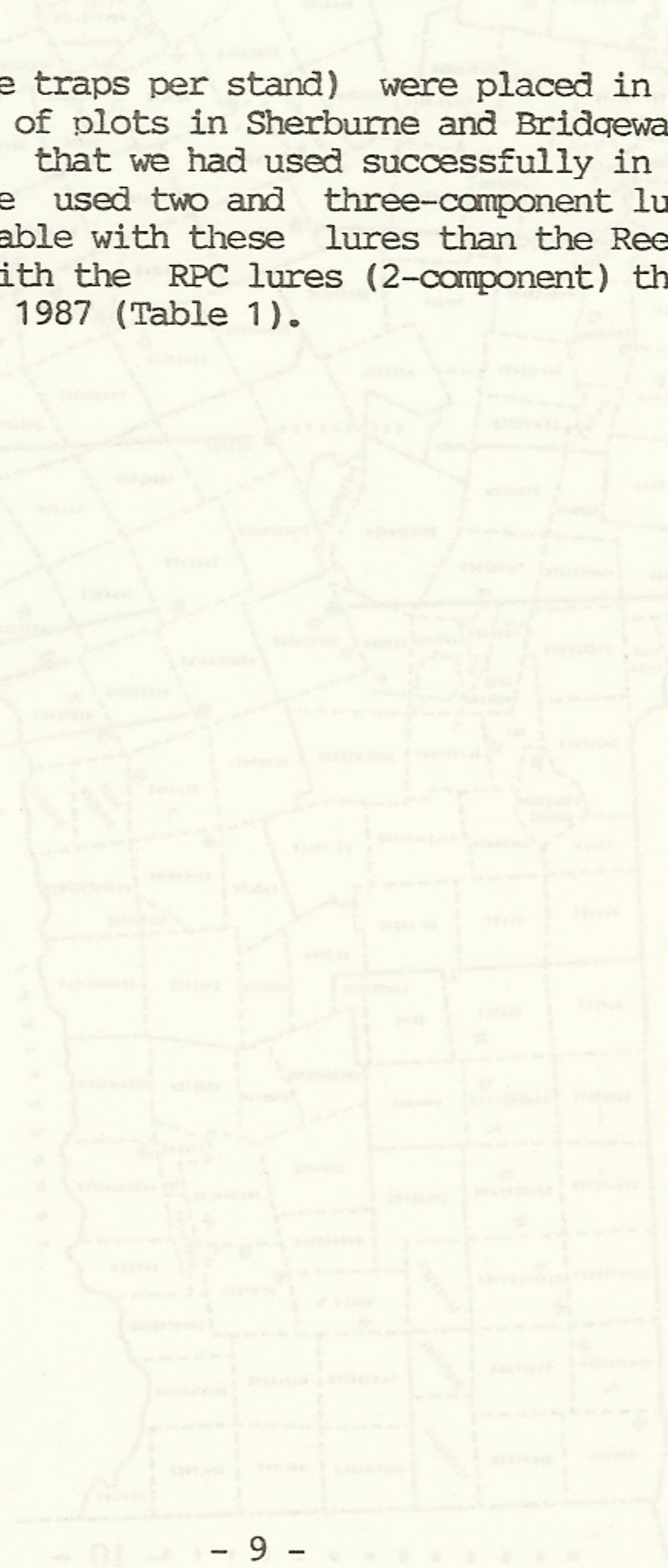
FOREST INSECTS

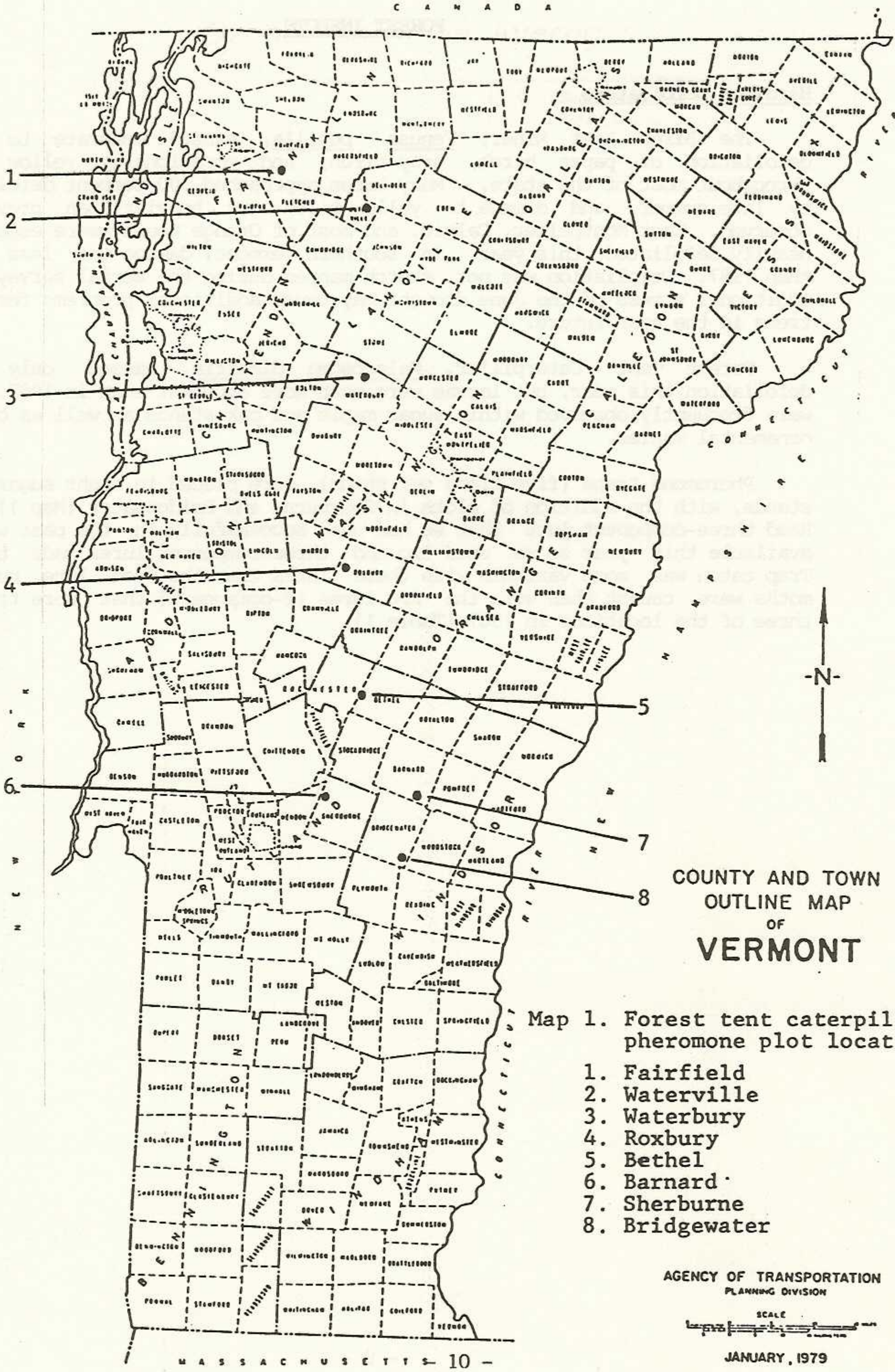
Hardwood Defoliators

The Birch Leaf Miner, Fenusa pusilla, caused moderate to heavy defoliation of paper birch, gray birch, and occasionally yellow birch throughout most of the state. Many trees approached 100 percent defoliation by late summer, and damage to yellow birch was heavier than previously observed. East Montpelier, Calais, and most of Orange County were especially heavily defoliated this year. In southern Vermont, damage was less severe than 1987. Defoliation was not sketch-mapped during the aerial survey. The additional stress of the June drought may cause additional problems for these trees in the near future.

Forest Tent Caterpillar, Malacosoma disstria, caused only light defoliation this year, but larvae were much more abundant than in 1987. They were frequently observed within sugar maple and oak stands as well as on some ornamental maples.

Pheromone traps (five traps per stand) were placed in eight sugar maple stands, with the addition of plots in Sherburne and Bridgewater (Map 1). The Reed three-component lure that we had used successfully in the past was not available this year so we used two and three-component lures made by RPC. Trap catch was more variable with these lures than the Reed lure, but more moths were caught than with the RPC lures (2-component) that were tried in three of the locations in 1987 (Table 1).





COUNTY AND TOWN OUTLINE MAP OF VERMONT

Map 1. Forest tent caterpillar pheromone plot locations

1. Fairfield
2. Waterville
3. Waterbury
4. Roxbury
5. Bethel
6. Barnard
7. Sherburne
8. Bridgewater

AGENCY OF TRANSPORTATION
PLANNING DIVISION

SCALE

JANUARY, 1979

Table 1. Forest tent caterpillar moth catch in pheromone traps 1987-1988.

Location	Average number of moths per trap 1987		1988	
	Reed lure	RPC-2 lure	RPC-3 lure	RPC-2 lure
Roxbury	2.0	0.0	0.0	0.0
Waterbury	2.0	0.2	1.0	1.2
Waterville	6.6	0.0	2.2	0.2
Fairfield	4.8	-	0.2	-
Bethel	2.0	-	1.8	-
Barnard	13.6	-	1.8	1.0
Bridgewater	-	-	17.6	-
Sherburne	-	-	15.0	-
Ave. for all sites	5.2	0.07	5.0	0.6

High trap catches in Bridgewater and Sherburne may indicate that forest tent caterpillar is starting to build up in these areas. During the past outbreak, heavy defoliation showed up first in this part of the state (Rutland and Windsor Counties) before spreading statewide. The average trap catch with RPC three-component lures in 1988 for all sites in Table 1 is 5.0. This compares with an average of only 0.1 for eight sites in the Green Mountain National Forest trapped by the U.S. Forest Service using three traps per site. The reason for this difference is unclear, but our observations, based on larvae, 1988 vs. 1987 trap catch with the two-component lure, and more recently, noticeable egg masses in one Orange County location, indicate that this insect is increasing in numbers.

Gypsy Moth, Lymantria dispar, populations continued to build, with 1,300 acres of light to moderate defoliation mapped in Rutland County (West Haven (550 A), Fair Haven (350 A), and Benson (400 A)) and four acres in Chittenden County (Milton). (Map 2). Light defoliation and caterpillars were observed in areas throughout the state.

Populations continued to increase in most of the focal area monitoring plots (Table 2, Map 3). In many areas, larval and egg mass counts were as high, or higher in the "resistant" areas as in the focal areas.

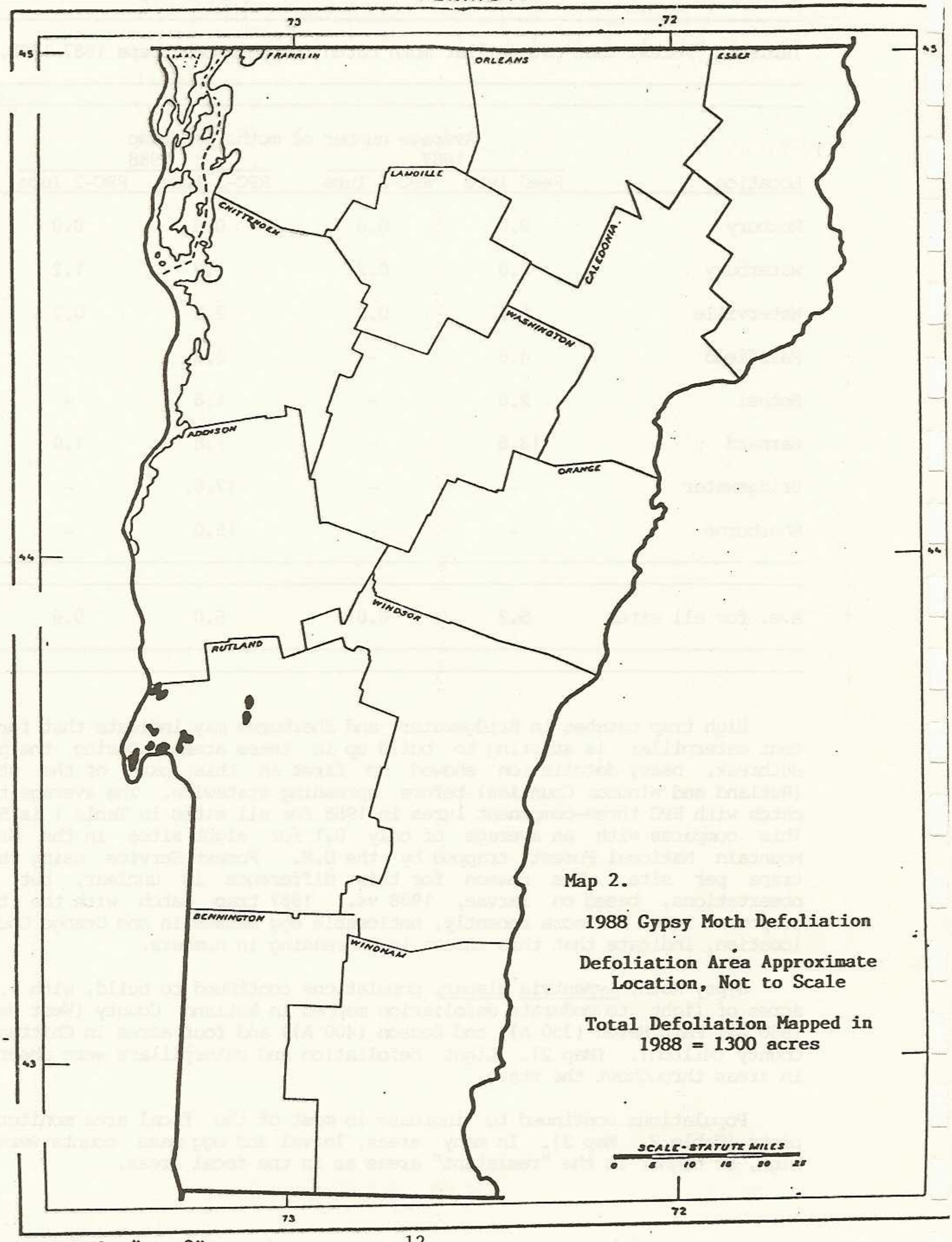
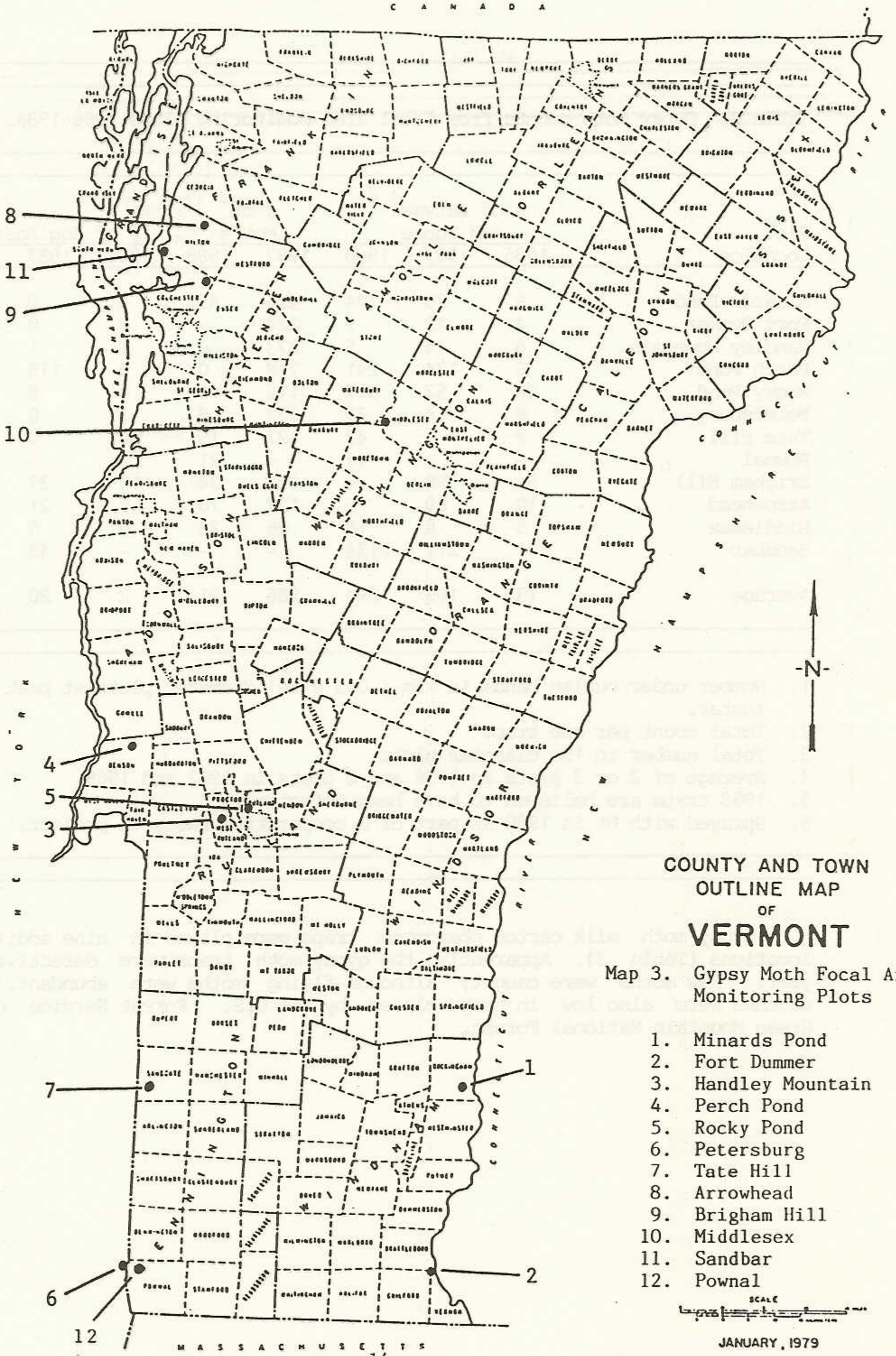

VERMONT
73
72
45
44
43
FRANKLIN
ORLEANS
ESSEX
LAMOILLE
CHITTENDEN
CALEDONIA
WASHINGTON
ADDISON
ORANGE
WINDSOR
RUTLAND
BENNINGTON
WINDHAM
Map 2.
1988 Gypsy Moth Defoliation
Defoliation Area Approximate Location, Not to Scale
Total Defoliation Mapped in 1988 = 1300 acres
SCALE - STATUTE MILES
0 5 10 15 20 25

Table 2. Gypsy moth counts from focal area monitoring plots 1986-1988.

Plot Location	# of Larvae and Pupae[1,4]			# of Moths[2]		# of Egg Masses[3,4]		
	1986	1987	1988	1987	1988[5]	1986	1987	1988
Minards Pond	9	28	104	495	45	0	0	7
Fort Dummer	4	12	9	324	-	2	0	1
Handley Mountain	6	4	5	273	0	1	1	4
Perch Pond[6]	6	134	241	718	0	0	115	226
Rocky Pond	26	57	317	176	0	0	6	53
Petersburg	8	14	31	359	8	1	0	1
Tate Hill	2	1	47	127	15	0	0	6
Pownal[6]	-	-	44	-	21	-	-	0
Brigham Hill	54	598	-	193	24	10	37	28
Arrowhead	10	89	-	127	70	5	21	48
Middlesex	5	8	18	66	24	0	0	1
Sandbar	-	211	2124	-	-	-	45	173
Average	13	105	294	286	21	2	20	46

1. Number under burlap bands in 15m (.045 acre) diameter plots at peak 5th instar.
2. Total count per one trap.
3. Total number in 15m diameter plots.
4. Average of 2 or 3 plots in 1986 and 2 plots in 1987 and 1988.
5. 1988 traps are believed to have been defective.
6. Sprayed with Bt in 1988 as part of a cooperative research project.

Gypsy moth milk carton pheromone traps were placed in nine additional locations (Table 3). Apparently the gypsy moth traps were defective this year. Few moths were caught, although flying moths were abundant. Moth catches were also low in traps placed by the U.S. Forest Service on the Green Mountain National Forest.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

Map 3. Gypsy Moth Focal Area Monitoring Plots

1. Minards Pond
2. Fort Dummer
3. Handley Mountain
4. Perch Pond
5. Rocky Pond
6. Petersburg
7. Tate Hill
8. Arrowhead
9. Brigham Hill
10. Middlesex
11. Sandbar
12. Pownal

SCALE

JANUARY, 1979

Table 3. Gypsy moth population counts from other monitoring plots, 1987-1988.

Location	# of Moths[1] 1987	# of Moths[1] 1988[2]	# of Egg Masses[3] 1987	# of Egg Masses[3] 1988
Springfield Office	-	91	-	-
Edgewater (Milton)	370	23	0.6	0.6
Church (Essex)	-	23	-	-
Pinewood Manor (Essex)	-	34	-	0.0
Trailer Park (Essex)	-	88	-	2.0
Mississquoi H.S. (Swanton)	-	33	-	3.0
St. Albans	-	6	-	-
Essex Office	-	4	-	-
Blakely Road	-	-	-	119.0
North Hero State Park	-	-	-	11.0
USFS-GMNF[4]	80	9	-	-

1. Total count per one milk carton trap for each location.
2. 1988 traps are believed to have been defective.
3. Average number per plot in 15m diameter plots.
4. Mean for five locations; data from I. Millers, USDA-Forest Service, S&PF, Durham, NH.

Additional five-minute walk egg mass surveys were done in Rockingham, Rupert, Sandgate, Pownal, and Petersburg, New York (Table 4). Areas of light or moderate defoliation are predicted for the sites in Rupert and Sandgate.

Table 4. 1988 Gypsy moth egg mass 5-minute walk counts.

Location	# of Walks	% Egg Mass New	Avg. # New Egg Masses/5 Minutes	Estimated Egg Masses/Acre
Rupert	2	95%	12	150-250
Sandgate	4	95%	13	175-300
Pownal	2	--	0	<100
Petersburg	2	--	0	<100
Rockingham	22	100%	<1	<100

Egg mass counts statewide indicate that populations are either remaining fairly constant at low levels or are increasing, but are not decreasing. Except for heavy parasitism in one of the Perch Pond plots, egg masses throughout the region are large and healthy. Scattered egg masses are found in mixed hardwood sites as well as pure oak stands. Visible defoliation is likely in a few scattered locations in 1989, including Milton, Colchester, and western Rutland County.

A field experiment to determine whether gypsy moth outbreaks can be suppressed by treating "foci" to prevent spread to surrounding areas was initiated in May. Focal areas are located on Map 3. Two focal areas - Perch Pond in Benson (420 acres) and Brigham Hill in Colchester (85 acres) - were aerially sprayed on 27 May using an aqueous formulation (SAN 415 SC 32 LV) of the NRD-12 strain of Bacillus thuringiensis at 20 BIU per acre. This was a cooperative pilot project with the USDA-Forest Service and the University of Vermont. Gypsy moth populations within, adjacent to, and outside (checks) of the treated areas were surveyed this year and will continue to be monitored in future years to determine the effect of this "early intervention" when populations were first beginning to build. Early indications are that populations are suppressed whenever spray coverage was adequate.

Maple Leaf Cutter, Paraclemensia acerifoliella, caused mostly light defoliation, but was more common than in 1987. Moderate defoliation was observed in one Franklin County sugarbush.

Oak Leafroller, Archips semiferanus, was associated with other insects causing early oak defoliation in southern Vermont. Other insects associated with defoliation were treehoppers and lecanium scale. The most severe damage often occurred in areas with heavy pear thrips defoliation. Symptomatic trees often had tattered or mishapen leaves with scars on the veins and petioles. This suggests that thrips may also be involved in the damage observed.

Oak Leaf Tier, Croesia semipurpurana, moths were caught in pheromone traps placed in Brattleboro and Rockingham in mid-June (Table 5). Identification was confirmed by the APHIS systematics laboratory in Beltsville. No oak leaf tier caterpillars have been observed.

Table 5. Oak leaf tier moth catch in pheromone traps.

Location	# of Traps	# of Moths/Trap
Brattleboro	3	40
Rockingham	1	60

Saddled Prominent, Heterocampa guttivata, populations are increasing. Caterpillars were observed throughout, although no defoliation was mapped during aerial surveys. Larvae were especially numerous in the Orange County towns that received heavy defoliation during the 1980-81 outbreak. This raised concern among several landowners who experienced considerable sugar maple mortality during the previous outbreak.

Pupal sampling (Table 6) indicates that defoliation will remain light in many areas, although some heavier defoliation is expected. Egg mass surveys by the U.S. Forest Service on the Green Mountain National Forest in late June correctly predicted negligible defoliation.

Table 6. Number of saddled prominent pupae found in fall 1988 samples.

Location	Live Pupae/Ft^2		Pupal Skins/Ft^2	
	1987	1988	1987	1988
Shrewsbury - forest	0.3	1.7	0.6	0.6
Shrewsbury - sugarbush	0.3	0.6	0.2	1.1
Granville	-	0.2	-	0.1
Chittenden	-	0.2	-	0.1
Danby	-	0.1	-	0.3

Pupae were easy to find in Strafford on 29 August, with 40 being collected in one and one-half hours by three individuals. Egg surveys in late June/early July are planned for areas of concern.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
American Aspen Beetle Gonioctena americana			Not observed.
American Dagger Moth Acronicta americana			Not observed.
Birch Leaf Folder Ancylis discigerana	Yellow Birch	Lamoille Washington Orange Chittenden Counties	Light, scattered defoliation similar to 1987.
Birch Leaf Miner Fenusa pusilla			See narrative.
Birch Skeletonizer Bucculatrix canadensisella	White Birch Yellow Birch	Lamoille Washington Orange Essex Counties	Light, scattered defoliation.
Bruce Spanworm Operophtera bruceata	Sugar Maple	Moretown Cabot	Few larvae and very light defoliation observed; none seen in 1987.
Cherry Scallop Shell Moth Hydria prunivorata			Not observed.
Early Birch Leaf Edgeminer Malacosoma americanum	Birch sp.	Throughout	Moderate defoliation. Less than 1987.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Eastern Tent Caterpillar *Malacosoma americanum*	Cherry Apple	Widespread	Some trees with heavy defoliation, but less than 1987, in south. Up slightly in the north.
Elm Leaf Beetle *Pyrrhalta luteola*	American Elm Chinese Elm	Scattered throughout	Low populations, similar to 1987.
Elm Leaf Miner *Fenusa ulmi*	Elm	Brattleboro	Ornamentals.
Fall Cankerworm *Alsophila pometaria*		Bennington	Egg mass collected.
Fall Webworm *Hyphantrea cunea*	Hardwoods	Widespread	Scattered defoliation of ornamentals and roadside trees. Less than 1987 in south, increasing in north.
Forest Tent Caterpillar *Malacosoma disstria*			See narrative.
Green Striped Mapleworm *Anisota rubicunda*	Maples	Scattered	Individual caterpillars observed.
Gypsy Moth *Lymantria dispar*			See narrative.
Half Winged Geometer *Phigalia titea*	Red Oak Sugar Maple	Middlesex	A few larvae seen in gypsy moth focal area area plot, similar to 1987.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Japanese Beetle Popillia japonica	Ornamentals	Widespread	Moderate to heavy defoliation of individual plants, similar to 1987.
Lace Bugs Corythucha	Elm	Chittenden Lamoille Washington Counties	Moderate to heavy defoliation of elms as in 1987, but a little more widespread.
Large Aspen Tortrix Choristoneura conflictana			Not observed.
Linden Looper Erranis tiliaria		Lamoille Orange Washington Counties	Occasional larvae observed.
Locust Leaf Miner Odontata dorsalis	Black Locust	All areas except Northeast Kingdom	Scattered light defoliation in most areas. Heavy defoliation in Fairlee and Putney.
Maple Leaf Cutter Paraclemensia acerifoliella			See narrative.
Maple Trumpet Skeletonizer Epinotia aceriella	Sugar Maple Red Maple	Widespread	Mostly light defoliation but populations definitely increased over past levels; caused some concern on shade maples and in sugarbushes.
Maple Webworm Tetralopha asperatella	Sugar Maple	Northern Vermont except Northeast Kingdom	Light defoliation common in many sugarbushes for the first time in several years.
Mountain Ash Sawfly Pristiphora geniculata	Mountain Ash	Caledonia, Bennington and Rutland Counties	Scattered larvae. Down dramatically from previous years.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Oak Leafroller Archips semiferanus			See narrative.
Oak Leaf Tier Croesia semipurpurana			See narrative.
Oak Skeletonizer Bucculatrix ainsliella	Oak	S. Bennington County	Light populations. Lower than 1987.
Orange-humped Mapleworm Symmerista leucitys	Sugar Maple	Fairfield	One colony of larvae observed.
Pear Sawfly Caliroa cerasi	Hawthorne	Danville	Heavy on one ornamental.
Pin Oak Sawfly Caliroa sp.			Not observed.
Red-humped Oakworm Symmerista canicosta	Red Oak	Georgia	On one small oak.
Rose Chafer Macrodactylus subspinosus	Hardwood Ornamentals	Lamoille County	A few seen.
Saddled Prominent Heterocampa guttivata			See narrative.
Satin Moth Leucoma salicis	Silver Poplar Balsam Poplar	Johnson Ryegate	Only two reports.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Solitary Leaf Roller Sparganothis pettitana	Sugar Maple	Chittenden Franklin Lamoille Counties	Scattered light populations; increasing over 1987 levels.
Solitary Oak Leaf Miner Cameraria hamadryadella			Not observed.
Spiny Elm Caterpillar Nymphalis antiopa			Not observed.
Spring Cankerworm Paleacrita vernata			Not observed.
Uglynest Caterpillar Archips cerasivoranus	Cherry	Widespread	Scattered light defoliation similar to 1987.

Softwood Defoliators

Spruce Budworm, Choristoneura fumiferana, populations continued at extremely low levels in 1988 with no aerially-visible defoliation for the fifth consecutive year. No budworm larvae were seen this year, and only 3 of 60 pheromone traps deployed by our department caught any moths.

Pheromone traps were deployed in 20 stands this year compared to 19 in 1987 and 15 in 1986 (Map 4). Each plot consisted of three Multi-pher traps in a cluster, using the same lure and trap as in 1986 and 1987. Moth catch per trap per site averaged 0.05 this year compared to 0.01 in 1987 and 1.2 in 1986 (Table 7), indicating a continuation of very low population numbers. U.S. Forest Service traps on the Green Mountain National Forest have caught similarly few moths during the past three years.

Table 7. Spruce budworm moth catch in pheromone traps, 1986-1988.

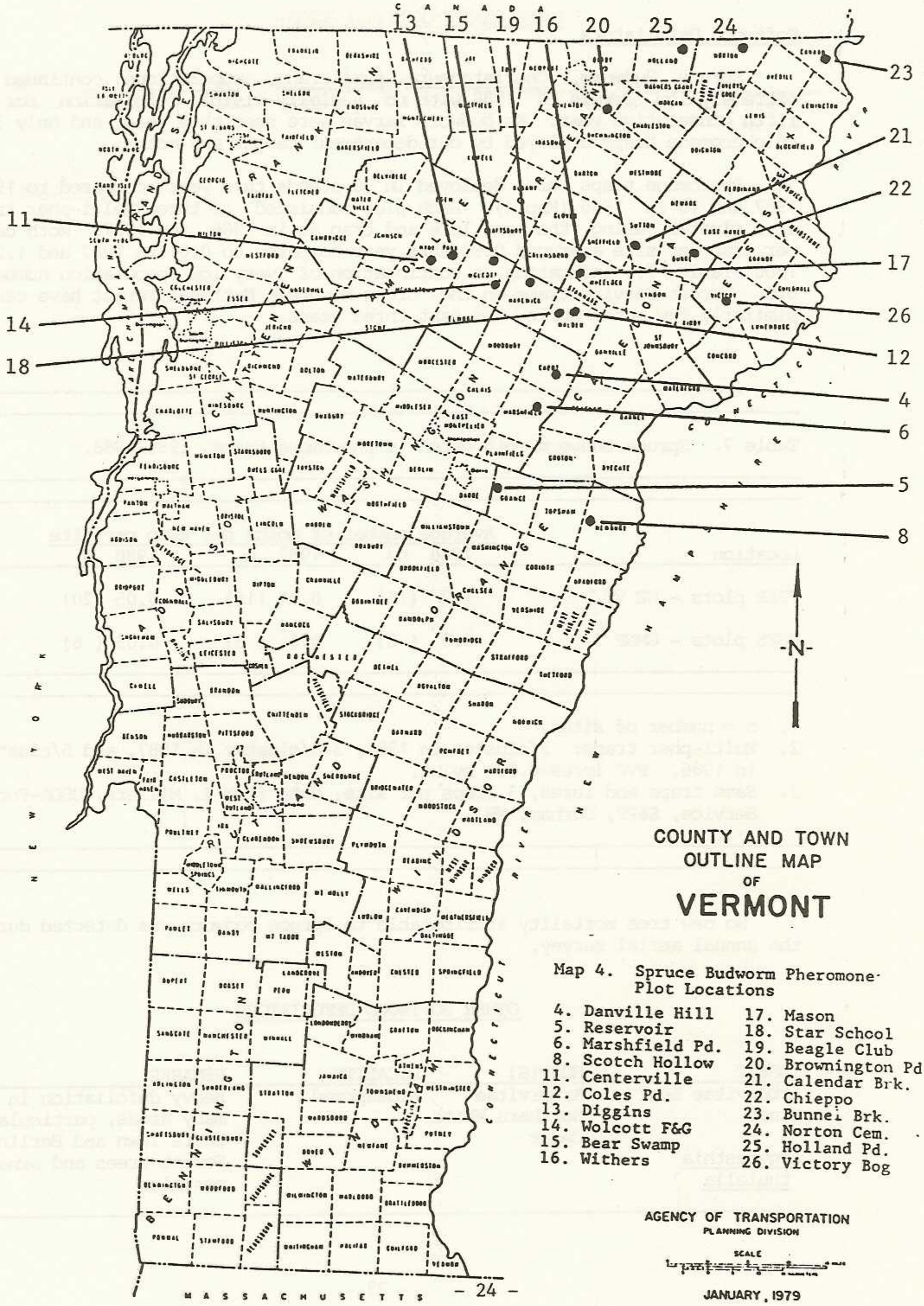
Location	Average number of moths per trap per site 1986 n[1]	1987 n	1988 n
FP&R plots - NE VT [2]	1.2 (15)	0.01 (19)	0.05 (20)
USFS plots - GMNF [3]	0.0 (6)	0.0 (6)	0.05 (6)

1. n = number of sites.
2. Multi-pher traps: 3/cluster in 1988, 3-5/cluster in 1987, and 5/cluster in 1986. PVC lures-0.03% by wt.
3. Same traps and lures, 3 traps per site, data from I. Millers, USDA-Forest Service, S&PF, Durham, NH.

No new tree mortality attributable to spruce budworm was detected during the annual aerial survey.

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Arborvitae Leaf Miner Argyresthia thuiella	Arborvitae Northern White Cedar	Widespread	Heavy defoliation in many areas, particularly Barre Town and Berlin. Forest trees and ornamentals.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

Map 4. Spruce Budworm Pheromone Plot Locations

4. Danville Hill
5. Reservoir
6. Marshfield Pd.
8. Scotch Hollow
11. Centerville
12. Coles Pd.
13. Diggins
14. Wolcott F&G
15. Bear Swamp
16. Withers
17. Mason
18. Star School
19. Beagle Club
20. Brownington Pd.
21. Calendar Brk.
22. Chieppo
23. Bunnel Brk.
24. Norton Cem.
25. Holland Pd.
26. Victory Bog

AGENCY OF TRANSPORTATION
PLANNING DIVISION

SCALE

JANUARY, 1979

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Green Hemlock Needleminer *Coleotechnites apicitripunctella*	Hemlock	Woodstock	Ornamental.
Introduced Pine Sawfly *Diprion similis*	White Pine Scots Pine	Clarendon	Ornamental. Not observed elsewhere despite numerous sightings on Christmas trees in northern Vermont in 1986 and 1987.
Larch Casebearer *Coleophora laricella*	European Larch Japanese Larch Eastern Larch	Widely scattered	Mostly light but increasing populations similiar to 1987.
Larch Sawfly *Pristophora erichosonii*			Not observed.
Pine False Webworm *Acantholyda erythrocephala*	Red Pine	Albany Middlebury	Light damage to ornamentals.
Pine Webworm *Tetralopha robustella*			Not observed.
Red-Headed Pine Sawfly *Neodiprion lecontei*	Red Pine	East Haven	Light damage to ornamentals.
Spruce Bud Moth *Zeiraphera canadensis*	White Spruce	Caledonia Essex, Orleans, Counties	Scattered trace damage, little change since 1987.
Spruce Budworm *Choristoneura fumiferana*			See narrative.

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Spruce Sawfly	Red Spruce	Randolph	About five acres of heavy defoliation in a 20-year old plantation. Adjacent white and Norway spruce only lightly defoliated.
Unidentified species possibly Little Spruce Sawfly			
White Pine Sawfly			Not observed.
Neodiprion pinetum			
Yellow-headed Spruce Sawfly			Not observed despite some reports in previous years.
Pikonema alaskensis			

SAPSUCKING INSECTS, MIDGES, AND MITES

Aphids, Periphyllus spp., especially Periphyllus americanus and P. testudinaceus, were very common on sugar maple throughout the state, often in association with pear thrips. These aphids are very similar to P. lyropictus, the Norway maple aphid, which occurs primarily on Norway maple. Periphyllus aphids are unusual in that they produce modified first instar larvae called dimorphs during the summer. The dimorphs are white, flattened, translucent, and immobile and can be found pressed against the undersides of the leaves during mid-summer, resuming normal development late in the season. Some heavily-infested trees suffered no apparent damage while others suffered some leaf yellowing or premature leaf drop that may have been caused by the aphids.

Aphid counts were made along with pear thrips counts on developing buds in six sugarbushes (see Pear Thrips). Data from two sugarbushes which were also sampled in 1987 suggest that aphid numbers dropped in 1988 (Table 8). In general, there was no correlation between aphid numbers and thrips numbers, or between aphid numbers and subsequent defoliation of nearby trees (Table 9).

Table 8. Average number of Norway maple aphids from plots in 2 sugarbushes: 1987-1988.

Location	Number of Aphids Per Bud[1]					
	Plot					Sugarbush Average
	1	2	3	4	5	
Dummerston						
1987	0.1	1.7	1.2	10.1	0.0	2.6
1988	0.0	0.0	0.1	0.0	0.1	0.0
Sunderland						
1987	13.6	4.9	2.2	0.6	6.7	5.6
1988	1.4	0.4	0.6	1.0	1.7	1.0

1. Average of 20 developing buds from sugar maple regeneration.

Table 9. Average number of Norway maple aphids, pear thrips and percent defoliation in 6 sugarbushes: 1988.

Sugarbush Location	Insect Counts[1] # of Aphids/Bud	# of Thrips/Bud	% Defoliation[2]
Woodstock	1.8	1.1	10
Landgrove	2.0	8.7	70
Smokey House	0.4	15.7	16
Danby	0.5	9.6	56
Sunderland	1.0	12.4	78
Dummerston	0.0	4.9	50

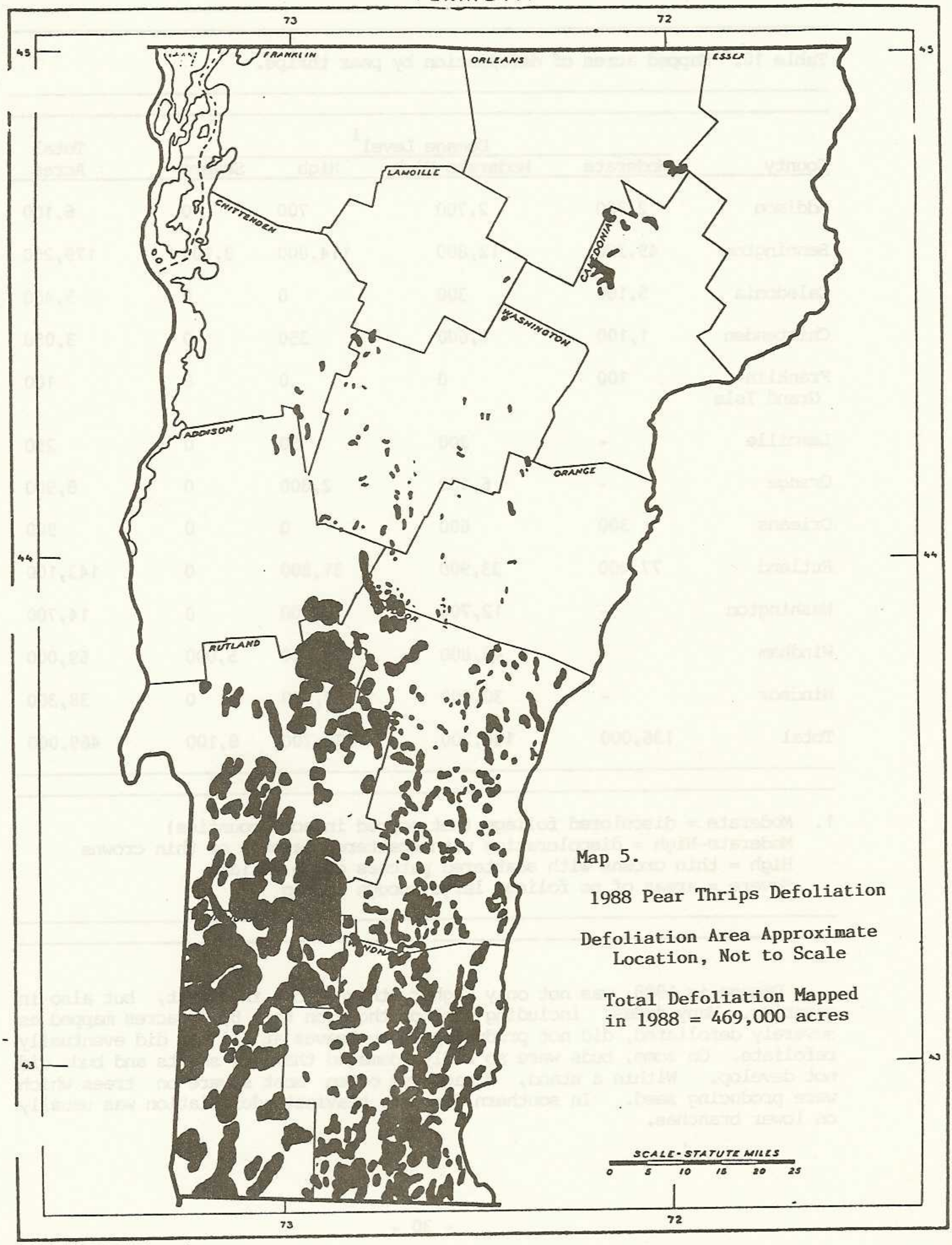
Correlation Coefficients (n=30)

Aphids:	Defoliation	.06 (n.s.)
Aphids:	Thrips	-.08 (n.s.)
Thrips:	Defoliation	.31 (n.s.)

1. Average of 100 buds.
2. Average of 5 trees.

Pear Thrips, Taeniothrips inconsequens, populations exploded, causing damage to foliage of sugar maples throughout the state. Mapped from the air were 469,000 acres of defoliation, compared with only 21,800 acres mapped in 1987 (Table 10, Map 5). This is an underestimate of actual acreage damaged, since much of the light to moderate defoliation could not be aerially detected. The most severe damage was in the southern towns, with less damage in the main range of the Green Mountains. Especially hard hit were the towns of Arlington, Dorset, Manchester, Pownal, Sandgate, Brattleboro, Halifax, Marlboro, Westminster, and Whitingham.

VERMONT



Map 5.

1988 Pear Thrips Defoliation

Defoliation Area Approximate Location, Not to Scale

Total Defoliation Mapped in 1988 = 469,000 acres

AD-400.43 "11-58"

Table 10. Mapped acres of defoliation by pear thrips.

County	Damage Level[1]				Total Acres
	Moderate	Moderate-High	High	Severe	
Addison	2,700	2,700	700	0	6,100
Bennington	49,300	12,800	114,000	3,100	179,200
Caledonia	5,100	300	0	0	5,400
Chittenden	1,100	1,600	350	0	3,050
Franklin-Grand Isle	100	0	0	0	100
Lamoille	-	200	50	0	250
Orange	-	6,100	2,800	0	8,900
Orleans	300	600	0	0	900
Rutland	77,400	33,900	31,800	0	143,100
Washington	-	12,700	2,000	0	14,700
Windham	-	44,800	19,200	5,000	69,000
Windsor	-	30,500	7,800	0	38,300
Total	136,000	146,200	178,700	8,100	469,000

1. Moderate = discolored foliage (not mapped in some counties)
   Moderate-High = discoloration with scattered patches of thin crowns
   High = thin crowns with scattered patches of no foliage
   Severe = areas of no foliage large enough to map

Damage in 1988 was not only higher than before in extent, but also in severity. Many trees, including most of those on the 8,100 acres mapped as severely defoliated, did not produce primary leaves at all but did eventually refoliate. On some, buds were so badly damaged that new shoots and buds did not develop. Within a stand, damage was often most severe on trees which were producing seed. In southern Vermont, heaviest defoliation was usually on lower branches.

The heaviest damage occurred to sugar maple (Figure 3), but many other tree species within heavily-infested areas were damaged to some extent, including red maple, black cherry, white ash, yellow birch, and American beech. The response of black cherry to thrips attack appeared to be early leaf drop and refoliation, while other species tended to hold damaged leaves that were not completely destroyed into, and sometimes through, the summer.

Figure 3. Heavy pear thrips defoliation.

Severely-defoliated trees began refoliating during the first week of June. Many stands completely refoliated, although trees on shallower sites had thin crowns throughout the summer. Refoliation on heavily-damaged sugar maples was sometimes slow, probably due to the May and June drought conditions. In general, defoliation had to reach 50 percent of normal leaf surface area before any refoliation occurred, and many trees only partially refoliated. Partially-defoliated trees also retained damaged leaves through the season.

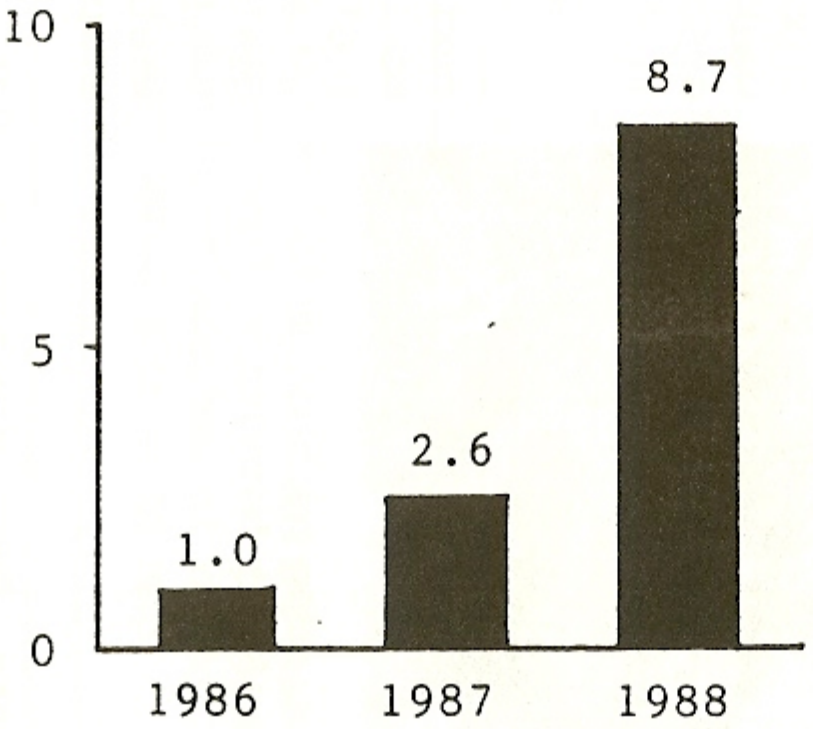
Twig and branch mortality was evident on many damaged sugar maples by early June. The fungus Steganosporium, believed to be an opportunistic pathogen that kills weak branches, was commonly associated with branch mortality (see Stem Diseases).

The severe damage was caused, in part, by higher numbers of thrips (as indicated by thrip monitoring plots, Figure 4) and cool spring weather. Swollen buds expanded slowly in early May, giving the thrips a long time to feed on the tiny leaves. Dry weather may have further increased symptom severity.

Additional data from monitoring plots strengthens the correlation between numbers of insects in buds of regeneration and overstory defoliation (Figures 5 and 6).

One sugarbush studied, however, (Smokey House), continues to have high insect numbers and little defoliation. (Without this sugarbush, r for sugarbushes (n = 10) is .89, and for trees (n = 50) is .76). The height of the crowns may prevent damage to foliage in this location.

Figure 4. Average thrips counts[1] in buds for six sugarbushes[2]: 1986-1988.



1. Average of 100 buds

2. For only two sugarbushes in 1986

Figure 5. Percent defoliation of 6 sugarbushes (average of 5 trees) by number of thrips in developing buds of adjacent understory maples (average of 100 buds) 1986-1988. Correlation coefficient = .56, significant at p = .10. Letters indicate different locations.

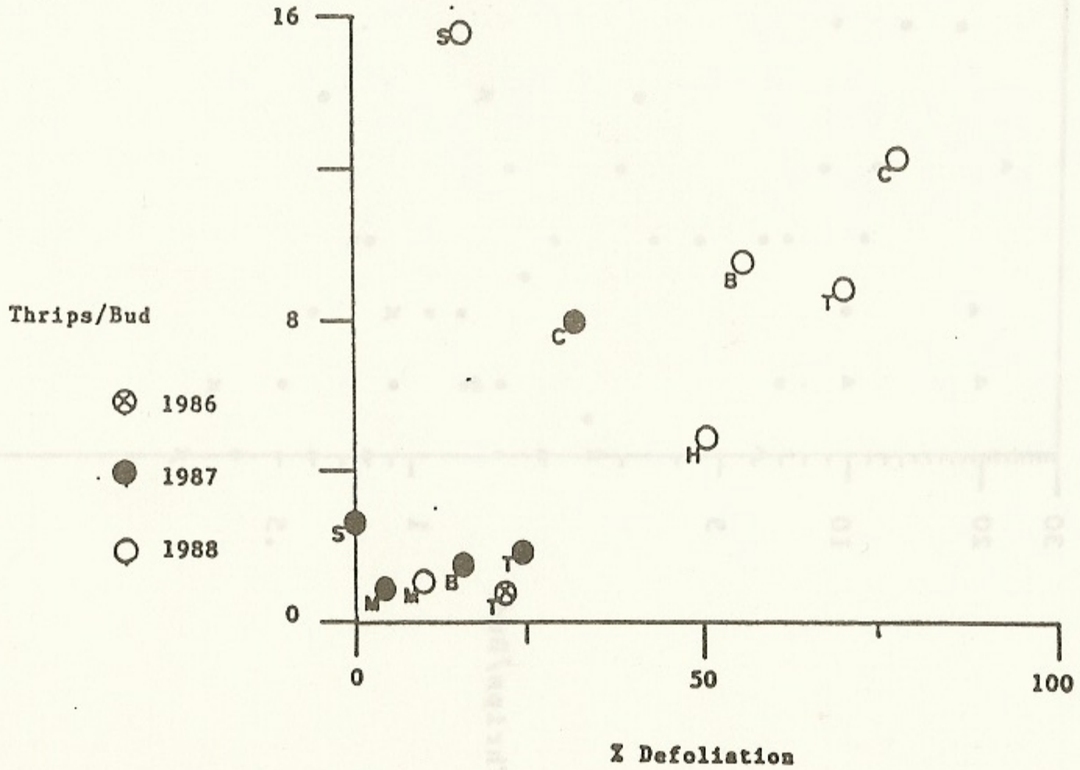
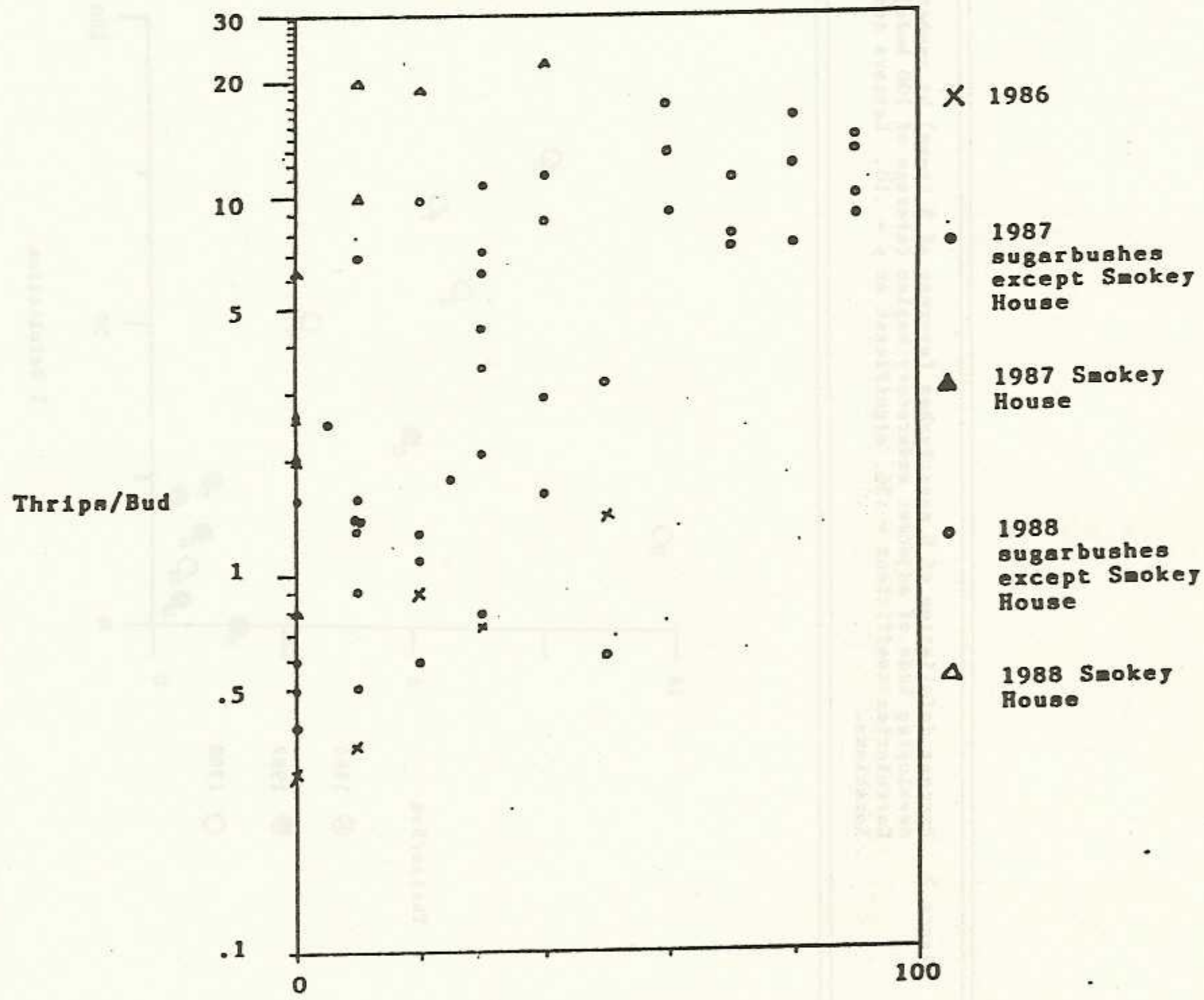


Figure 6. Percent defoliation of 5 plot trees in 6 sugarbushes by number of thrips in developing buds of adjacent understory maples (average of 20 buds) 1986-1988. Correlation coefficient = .53, significant at p = .01.



An aerial application of Sevin XLR plus was applied to 20 acres of a defoliated sugarbush on May 26 (1 lb. A.I./acre) to test the efficacy on thrips immatures. Results are being analyzed by the University of Vermont. Half of the spray area (10 acres) was subsequently fertilized by air. Fifty pounds of 7-9.4-18.8 with 12% calcium oxide, 8% Mg oxide, 4% calcium nitrate and 2% Mg sulfate was applied.

Another sugarbush in Braintree was aerially sprayed with carbaryl (sevin 80S) on 27 May also to determine whether thrips populations could be suppressed for the next year by controlling the larval stage. Larvae were already migrating into the ground by the time the trees were sprayed, and only 50 percent mortality of larvae was achieved.

A low volume application of dye was tested in a sugarbush in Shaftsbury to see if buds could be covered with low water volume ground equipment. Some coverage was obtained to the top of 70' tall trees.

In response to the severity of damage by this little-known insect and concern by landowners and legislators, a major effort is underway to do research and to assist in management. The efforts of sugarmakers, state agencies, and the University of Vermont are being advised by the Governor's Technical Task Force on Pear Thrips with the assistance of the U.S. Forest Service and other states.

Supplemental funding was obtained for needed research and survey, as well as for a Pear Thrips Coordinator position. Five well-attended public meetings were held in the counties of Bennington, Windsor, Windham, Rutland, and Orange during July. Recommendations for Sugarbush Management and for Thinning Forest Stands Infested by the Pear Thrips were mailed to foresters in the state. Both are available from our department.

Other work of task force members, completed or in progress includes:

Getting the insect positively identified, and reviewing all of what's already known about pear thrips.
Studying the insect's life cycle, and testing its ability to survive cold temperatures.
Sampling sugarbushes to find out where thrips are in the soil (90% are in the top 4"), and working out a method for counting thrips in soil samples.
Statewide mapping of damaged areas, and testing whether satellite pictures can be used to produce more accurate maps.
Surveying sugarmakers by questionnaire to collect more information about damage and to set priorities.
Evaluating the impact of pear thrips by root starch testing, and offering a root starch testing service to interested sugarmakers.
Testing whether the insect can be controlled by spraying the larval stage, and testing methods of spraying buds.
Testing the effect of fertilization on tree recovery.
Holding public informational meetings and technical conferences.

Additional work planned for 1989 includes:

Sampling soil to determine insect distribution statewide.
Collecting natural enemies of pear thrips in the U.S. and Europe.
Monitoring when the insect comes out of the ground, and how and where it spreads.
Testing the effectiveness of chemical and non-chemical insecticides.

Lecanium Scale, Lecanium sp., was very heavy in some sugarbushes and forest stands in southern Vermont, and on ornamental oaks statewide. Affected stands had heavy sooty mold on understory foliage. It was seen throughout, on red oak, sugar maple or black locust. On oak in Windsor and Windham Counties, it was often associated with treehoppers and oak leafroller. In most locations, populations were lighter than 1987. The impact of this insect remains unknown.

Oystershell Scale, Lepidosaphes ulmi, continued to cause light to moderate twig and branch mortality of American beech. It was especially common in Orleans, Washington, and Orange Counties, but appeared to be less noticeable in Franklin and Chittenden Counties compared to 1987.

An evaluation of scale population levels within Camel's Hump State Forest in Huntington showed little change between 1987 and 1988 (Table 11). Although the average number of scale insects per twig for current year's growth dropped slightly from 1987 to 1988, the number of insects per millimeter increased due to a reduction in twig length. It was interesting to note that beech internode length on the branches sampled was about twice as long for 1985 (the year following the wettest growing season in recent years) as for 1984 or any years since 1985.

Table 11. Number of oystershell scales on current year twigs in Camel's Hump State Forest, 1987 - 1988.[1]

Tree Dominance	Average number of mature viable scales on current year's growth per twig		per millimeter	
	1987	1988	1987	1988
Suppressed	3.7	3.4	0.10	0.22
Intermediate	6.8	2.8	0.07	0.12
Codominant	9.3	8.8	0.28	0.64

1. Average number for 10 branches from one tree per dominance class, collected in September 1987 and September 1988.

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Aphids	Many	Widespread	See narrative.
Aphids *Cinara sp.*	Balsam Fir White Pine	Scattered	Few sightings or reports compared to 1987.
Balsam Gall Midge *Pardiplosis tumifex*	Balsam Fir	Widespread in northern Vermont	Some moderate to heavy Christmas tree damage now beginning to show up in scattered locations; expected to increase in 1989.
Balsam Twig Aphid *Mindarus abietinus*	Balsam Fir	Widespread	Mostly light to moderate Christmas tree damage similar to 1987; moderate damage recorded for 167 acres out of 200 Christmas tree acres where twig aphid was detected.
Balsam Woolly Adelgid *Adelges piceae*	Balsam Fir	Groton Sherburne Weston	Light populations evident following several years of absence. Light damage.
Beech Scale *Cryptococcus fagisuga*	Beech		See Beech Bark Disease.
Birch Budgall Mite *Aceria rudis*	Birch	Jericho	
Cooley Spruce Gall Adelgid *Adelges cooleyi*	Blue Spruce White Spruce	Barre Weathersfield Pownal	Occasionally observed; down from 1987.
Cottony Maple Scale *Pulvinaria innumerabilis*	Sugar Maple	Roxbury Vershire	A few individuals seen.

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Eastern Spruce Gall Adelgid Adelges abietis	Red Spruce White Spruce	Widespread	Remains common; heavy damage to individual ornamentals and light to moderate damage in three Christmas tree plantations.
Hemlock Woolly Adelgid Adelges tsugae	Hemlock	Absent	No suspects seen. Quarantine on hemlock logs and nursery stock from infested areas in effect.
Leafhoppers	Sugar Maple Misc. hardwoods	Widespread	Very light damage noticed.
Lecanium Scale Lecanium sp.	Red Oak Sugar Maple	Widespread	See narrative.
Maple Spindle Gall Mites Vasates aceris-crumena	Sugar Maple	Throughout	Common in northern Vermont.
Norway Maple-type Aphid Periphyllus americanus and Periphyllus testudinacea			See aphids in narrative.
Oystershell Scale Lepidosaphes ulmi			See narrative.
Pear Thrips Taeniothrips inconsequens			See narrative.
Pine Bark Aphid Pineus strobi	White Pine	Widespread	Remains common, including Christmas trees.
Pine Leaf Adelgid Pineus pinifoliae	White Pine	Lyndon	Heavy on white pine understory at Lyndon S.F.

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Pine Needle Midge *Contarinea baeri*	Scots Pine	Addison County	Light damage throughout a Christmas tree plantation in Lincoln; trace damage common elsewhere, same as in 1987.
Pine Needle Scale *Chionapsis pinifoliae*	White Pine Mugho Pine	Widely scattered	Mostly light on ornamentals.
Pine Spittlebug *Aphrophora parallela*	Conifers	Widespread	Light to moderate infestations reported on over 100 acres of Scots pine Christmas trees; up from 1987.
Pine Thrips *Gnophothrips* sp.	Scots Pine	Lincoln Eden	Moderate damage to scattered Christmas trees.
Pine Tortoise Scale *Toumeyella parvicornis*	Scots Pine		Not observed.
Root Aphid *Prociphilus americanus*	Balsam Fir Fraser Fir	Elmore Morristown Georgia Brownington Craftsbury Lyndon	Fewer aphids present in previously infested Christmas trees; 16% of 25 plantations checked by Jon Turmel in 1988 had aphids.
Spruce Bud Scale *Physokermes piceae*			Not observed.
Spruce Spider Mite *Oligonychus ununguis*	White Spruce Fraser Fir Balsam Fir Red Spruce Arborvitae Locust	Widespread	Remains a serious problem in a few Christmas tree plantations. Also on ornamentals.
Treehoppers *Membracidae*	Red Oak	Windham & So. Windsor Counties	Sometimes heavy on defoliated oak. Associated with lecanium scale and oak leafroller.

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Woolly Alder Aphid Prociphilus tessellatus	Silver Maple Alder	Widespread in northern Vermont	Unusually heavy on ornamentals this year.
Woolly Apple Aphid Eriosoma lanigerum	American Elm	Derby Line	Ornamental.

BUD, SHOOT AND STEM INSECTS

The Balsam Shootboring Sawfly, Pleroneura brunneicornis, caused moderate to heavy damage to balsam and fraser fir Christmas trees this year and was of concern to some growers. The adults lay eggs into the buds soon after the bud scales have dropped and the white larva that hatches bores within the newly-emerging shoot, causing the tip to appear flattened at first. Eventually, the new growth tips turn reddish-brown and die, looking much like frost damage. Unlike frost damaged tips, however, they can be easily plucked from the tree to reveal the hollowed-out shoot.

Damage to balsam fir this year was lighter in plantations sprayed early (near bud break) with diazinon for control of balsam twig aphid than in unsprayed plantations. This suggests that this would be the best timing and material for control of this insect. However, in 10 years of observing this sawfly, it has always been heaviest every other year, in even years only, with only light populations in odd years. It probably has a two-year life cycle, with the majority of the population emerging in even years. Therefore, control should not be necessary in 1989 but heavy populations could appear again in 1990.

OTHER BUD, SHOOT & STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Allegheny Mound Ant Formica exsectoides	White Spruce	Shrewsbury	Scattered dead Christmas trees.
Ambrosia Beetle Scolytidae	Birch	Widespread	Common at higher elevations.
Balsam Shoot-boring Sawfly Pleroneura brunneicornis	Balsam Fir		See narrative.
Butternut Curculio Conotrachelus juglandis			Not observed.
Coneworm Dioryctria spp.	Fraser Fir	Elmore	Moderate shoot damage (resembling frost) to scattered individual Christmas trees.

OTHER BUD, SHOOT & STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Locust Borer *Megacyllene robiniae*			Not observed.
Maple Petiole Borer *Caulocampus acericaulis*			Not observed.
Northern Pine Weevil *Pissodes approximatus*			Not observed.
Pales Weevil *Hylobius pales*	Scots Pine	Widespread in northern Vermont	25 acres of mostly light damage to Christmas trees detected; down considerably from the 287 acres in 1987.
Pine Gall Weevil *Podapion gallicola*			Not observed.
Pine Root Collar Weevil *Hylobius radicis*	Scots Pine	Rutland	Causing pockets of mortality in Christmas trees.
Pitted Ambrosia Beetle *Corthylus punctatissimus*	Sugar Maple Seedlings	Highgate	Moderate mortality of seedlings in one sugarbush.
Pseudanthonomus validus	Yellow Birch	Johnson Stowe Duxbury Cavendish	This weevil causes the "Glastonbury Wilt" symptom last seen in southern VT in 1976. Weevil larvae bore in the petiole, causing individual leaves to wilt and die (Figure 7).

OTHER BUD, SHOOT & STEM INSECTS

Figure 7. "Glastonbury Wilt" caused by a petiole weevil Pseudanthonomus validus.

INSECT	HOST(S)	LOCALITY	REMARKS
Round-headed Apple Tree Borer Saperda candida	Apple	Essex	
Twig Pruner Elaphidionoides villosus			Not observed.
White Pine Weevil Pissodes strobi	White Pine Scots Pine Blue Spruce Norway Spruce White Spruce Red Spruce	Widespread	Remains common; light to moderate damage to 70 acres of white and Scots pine Christmas trees.
White Spotted Sawyer Monochamus scutellatus			Not observed.

BARK BEETLES

INSECT	HOST(S)	LOCALITY	REMARKS
Bronze Birch Borer *Agrilus anxius*	White Birch	Quechee Springfield	Stressed ornamentals.
Eastern Larch Beetle *Dendroctonus simplex*	American Larch	Widespread	Associated with larch decline.
Elm Bark Beetles *Hylurgopinus rufipes* *Scolytus multistriatus*	American Elm	Widespread	See Dutch Elm disease.
Hemlock Borer *Melanophila fulvoguttata*			Not observed.
Pine Engraver *Ips pini*	Red Pine	Barnet Lyndon	Mature pines severely damaged.
Red Turpentine Beetle *Dendroctonus valens*			Not observed.

Root Insects

The Conifer Swift Moth, Korsheltellus gracilis, formerly called the Ghost Moth, continus to be found associated with feeding wounds on the roots of balsam fir and red spruce at high elevations in northern Vermont. An update on research being conducted by the University of Vermont will be submitted when available.

OTHER ROOT INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Broad Necked Root Borer Prionus laticollis			Not observed.
Conifer Swift Moth Korsheltellus gracilis			See narrative.
Wireworms Elateridae	Fir	Weston	Associated with trees.

Forest Diseases

Stem Diseases

Beech Bark Disease, caused by Cryptococcus fagisuga and Nectria coccinea var. faginata was increasingly visible. Symptomatic crowns were not as obvious as 1987 in southern Vermont. Heavy scale populations were observed on many individual trees in widely scattered locations and Nectria fruiting is also more common than a few years ago.

Scale and Nectria returned to pre-1987 levels in monitoring plots (Figure 8) except in Woodford. This reflects an increase in beech scale seen throughout Bennington County.

Heavy scale populations are particularly common where beech is mixed with hemlock. The hemlock is thought to protect the insects from widely fluctuating temperatures (solar heating) during the winter months. Expect scale populations to increase as long as mild winters continue.

Caliciopsis Canker, caused by Caliciopsis pinea, continues to be evident in many white pine stands, particularly in eastern Orange County. Heavy resin flow on heavily infected trees resembles white pine blister rust. Newly-identified areas with infection include stands at Ainsworth State Forest, Londonderry, and Plainfield. Heavily infected trees often have unhealthy appearing crowns, but no mortality has yet been observed.

Dutch Elm Disease, caused by Ceratocystis ulmi, caused mortality throughout. The damage was greater than usual again this year in northern Vermont. Many trees died quickly this year, probably due to drought.

According to U.S. Forest Service Pathologist Dave Houston, an aggressive strain of the fungus is becoming more abundant in the state and is likely responsible for the increase in elm mortality. The 1986 Vermont Hardwood Tree Health Survey estimated that 34 percent of the dominant/codominant American elms in the state were dead, excluding snags. Most of this mortality was due to Dutch elm disease.

Maple Cankers and branch flagging, caused by Steganosporium sp. or Nectria sp., occurred on sugar maple throughout the state. Symptoms appeared by early June. Affected branches were mostly in the lower crown. Dry weather and defoliation may have reduced bark moisture, making branches particularly vulnerable to canker diseases this year.

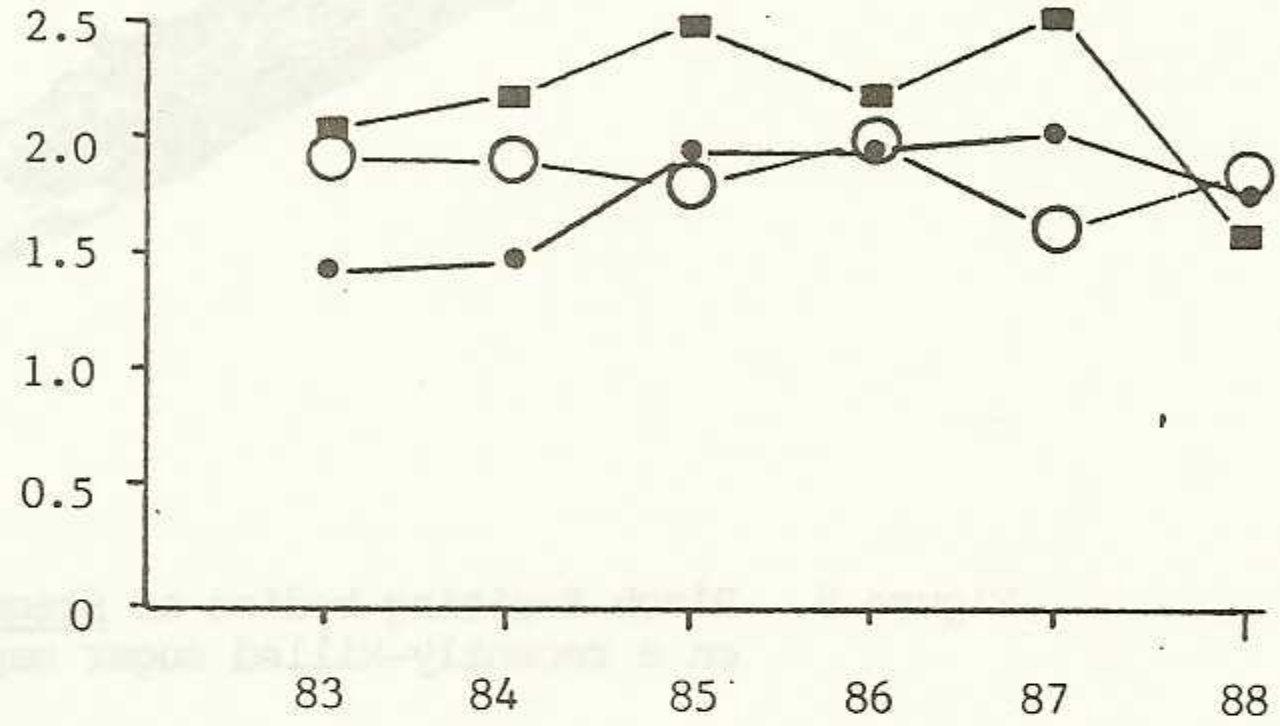
Steganosporium is an opportunistic fungus. It is sometimes referred to as the Armillaria of branches, since it is presumably a weak pathogen that can become aggressive in attacking weakened branches. The black, protruding spore masses were frequently found at the junction of live and dead wood on branches that had recently died (Figure 9).

Figure 8. Summary of Beech Bark Disease Monitoring Plots 1983-1988.

Plot Location: ● Sherburne ○ Ludlow ■ Woodford

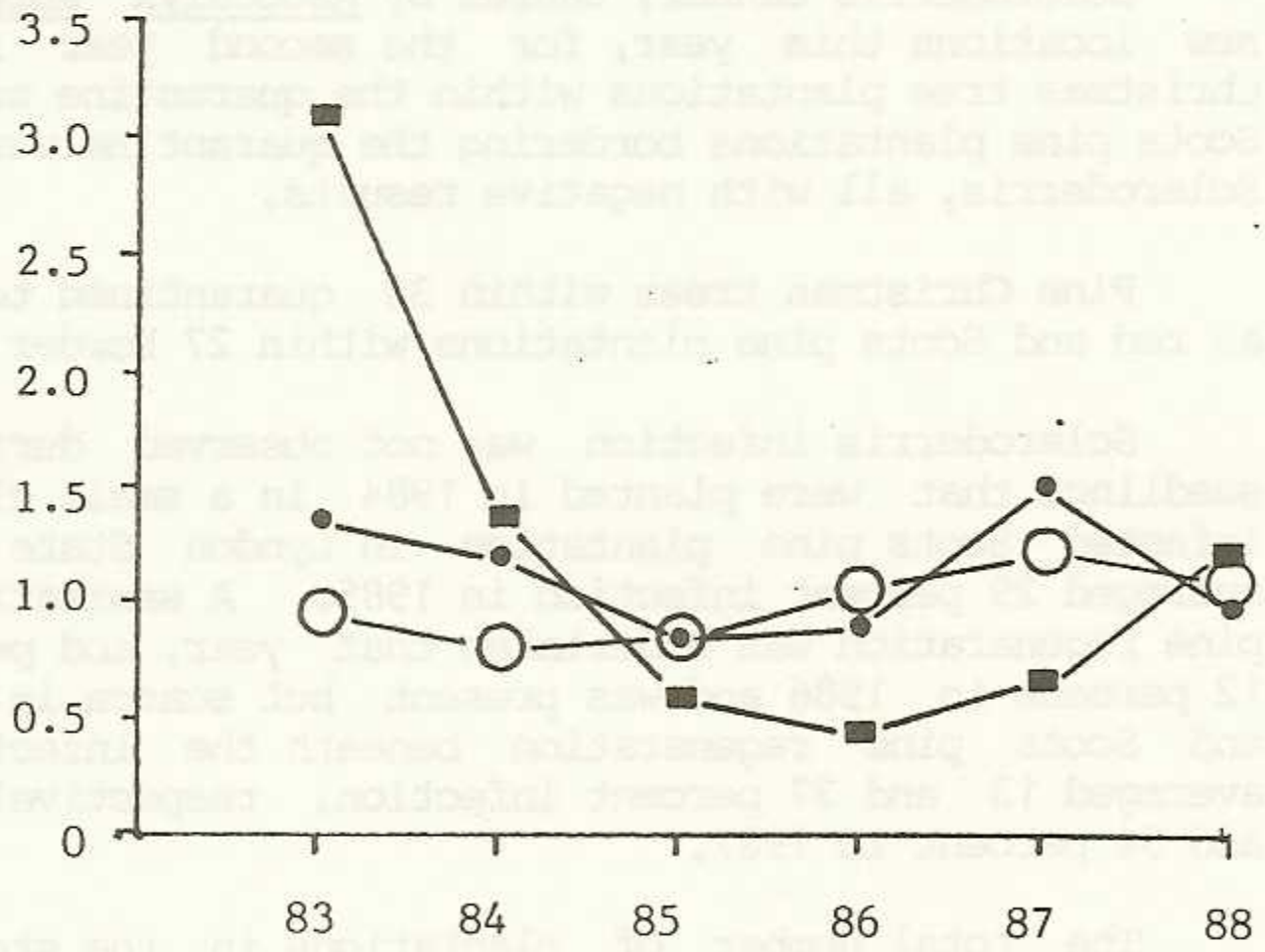
Average Tree Condition

1 Good
2 Fair
3 Poor
4 Dead



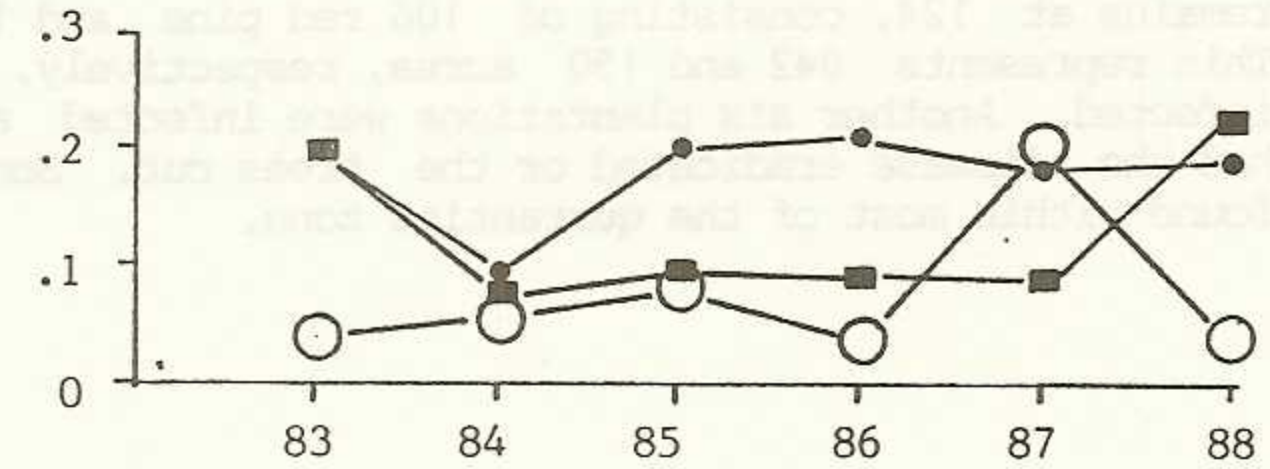
Average Wax Cover

0 No colonies
1 Trace
2 Light
3 Moderate
4 Heavy
5 Very Heavy



Average Nectria Fruiting

0 Absent
1 Sparse
2 Moderate
3 Heavy
4 Very Heavy



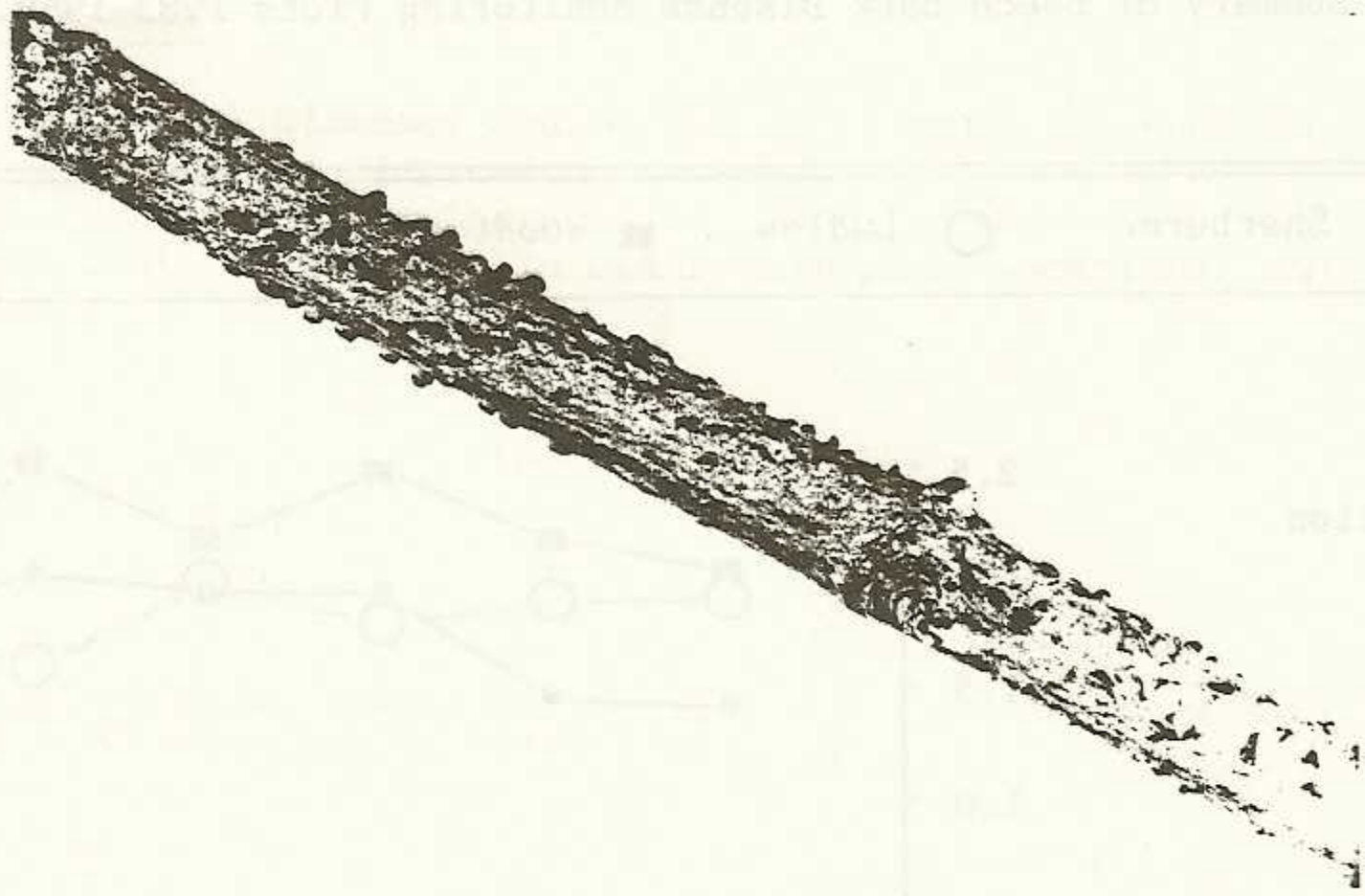


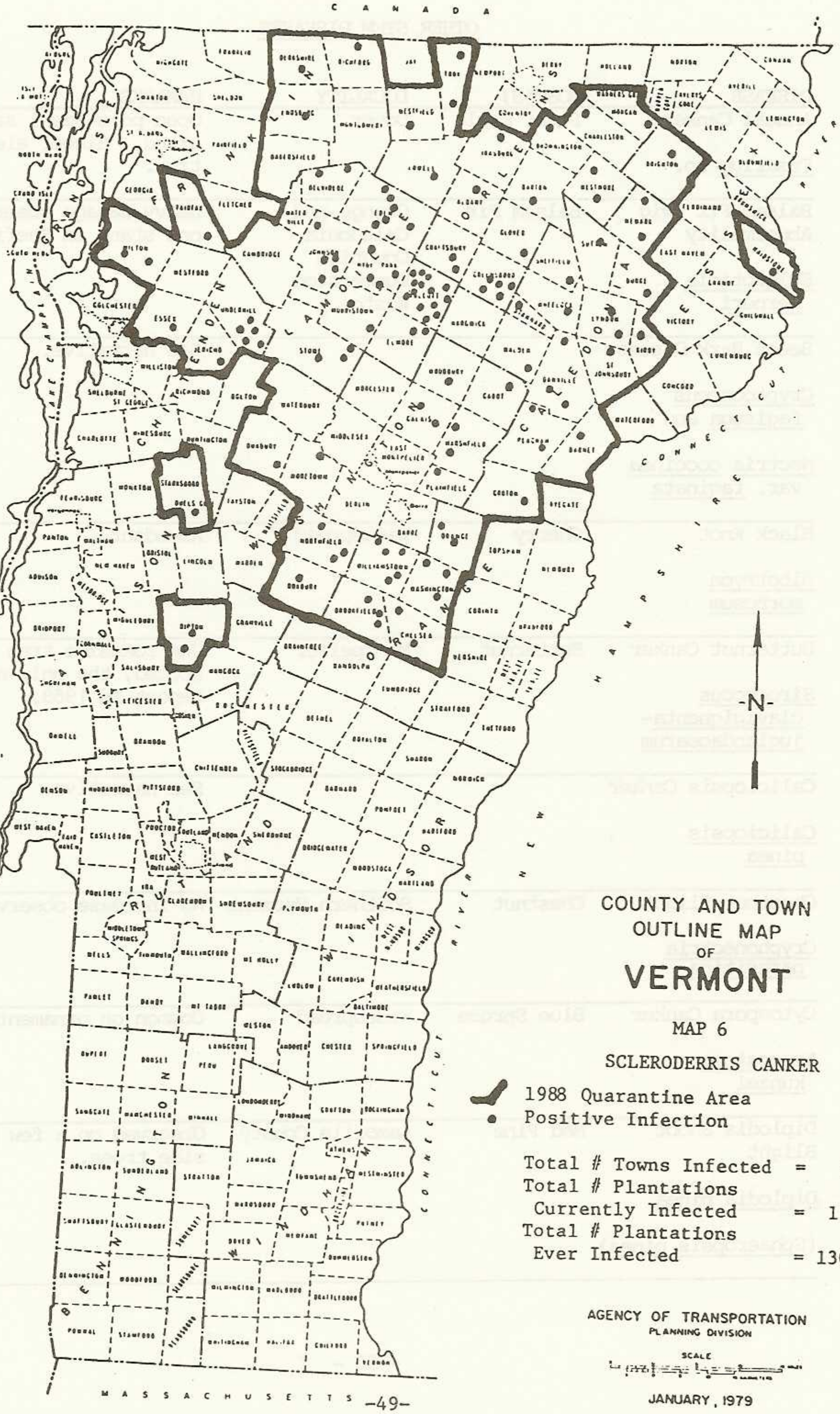
Figure 9. Black fruiting bodies of Steganosporium on a recently-killed sugar maple branch.

Scleroderris Canker, caused by Ascocalyx abietina, was not found in any new locations this year, for the second year in a row. A total of 54 Christmas tree plantations within the quarantine zone (Map 6) and 122 red and Scots pine plantations bordering the quarantine were surveyed for presence of Scleroderris, all with negative results.

Pine Christmas trees within 33 quarantined towns were inspected as well as red and Scots pine plantations within 27 border towns.

Scleroderris infection was not observed during a survey of white pine seedlings that were planted in 1984 in a small clearcut, within a heavily-infested Scots pine plantation in Lyndon State Forest. These seedlings averaged 29 percent infection in 1985. A sanitation removal of nearby Scots pine regeneration was undertaken that year, and percent infection dropped to 12 percent in 1986 and was present but scarce in 1987. Natural white pine and Scots pine regeneration beneath the infected Scots pine overstory averaged 13 and 37 percent infection, respectively, in 1988 compared to 12 and 34 percent in 1987.

The total number of plantations in the state known to be infected remains at 124, consisting of 106 red pine and 18 Scots pine plantations. This represents 842 and 150 acres, respectively, for a total of 992 acres infected. Another six plantations were infected at one time, but have since had the disease eradicated or the trees cut. Some recent infection can be found within most of the quarantine zone.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

MAP 6

SCLERODERRIS CANKER

1988 Quarantine Area

• Positive Infection

Total # Towns Infected = 64
Total # Plantations Currently Infected = 124
Total # Plantations Ever Infected = 130

AGENCY OF TRANSPORTATION
PLANNING DIVISION

SCALE

JANUARY, 1979

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Annual Canker *Fusarium* sp.	Sugar Maple	Dover	Open pole-small sawlog stand. Higher elevation.
Balsam Fir Twig Abnormality *Sclerotinia kerneri*	Balsam Fir	Orange and Caledonia Counties Dummerston Weston	Heavy damage observed in one stand in Sheffield.
Beech Bark Disease *Cryptococcus fagisuga* and *Nectria coccinea* var. *faginata*			See narrative.
Black Knot *Dibotryon morbosum*	Cherry	Widespread	Abundant.
Butternut Canker *Sirococcus clavigignenta-juglandacearum*	Butternut	Montpelier	One roadside tree infected, the only new report in 1988.
Caliciopsis Canker *Caliciopsis pinea*			See narrative.
Chestnut Blight *Cryphonectria parasitica*	Chestnut	Southern Vermont	No increase observed.
Cytospora Canker *Leucostoma kunzei*	Blue Spruce	Widespread	Common on ornamentals.
Diplodia Shoot Blight *Diplodia pinea* (*Sphaeropsis pinea*)	Red Pine	Lamoille County	Observed on a few roadside trees.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Dutch Elm Disease *Ceratocystis ulmi*			See narrative.
Eastern Dwarf Mistletoe *Arceuthobium pusillum*	Red Spruce		No new locations discovered.
Fir Broom Rust *Melampsorella caryophyllacearum*	Balsam Fir	Widely scattered	Brooms fairly common in fir stands.
Fireblight *Erwinia amylovora*	Mountain Ash Apple	Wallingford	Not observed elsewhere despite numerous reports in 1987.
Hypoxylon Canker *Hypoxylon pruinatum*	Quaking Aspen	Throughout	Light to moderate mortality common, in northern Vermont.
Maple Canker *Steganosporium* sp. *Nectria* sp.			See narrative.
Oak Wilt *Ceratocystis fagacearum*	Oaks	Absent	No suspects seen by trained observers during aerial flights.
Polyporus tomentosus	White Spruce	Hardwick	Necessitated a salvage cut in a Hardwick town forest plantation; preliminary data indicates a sawlog volume loss of 40% for infected trees.
Red Ring Rot *Phellinus pini*	Norway Spruce	Hardwick	Responsible for some volume loss along with *Polyporus tomentosus* in Hardwick town forest.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Sapstreak Ceratocystis coerulescens	Sugar Maple	Plainfield Williamstown Corinth Danville	Several trees in sugarbushes and maple stands had the characteristic staining pattern in the root-flare region.
Sclerodereris Canker Asocalyx abietina			See narrative.
Sirococcus Shoot Blight Sirococcus strobilinus	Red Pine	Plainfield Jones S.F.	Some new infections discovered in different area from 1987.
Verticillium Wilt Verticillium albo-atrum or V. dahliae	Sugar Maple		Not observed.
White Pine Blister Rust Cronartium ribicola	White Pine	Widespread	Causing moderate losses in 4 of 11 Christmas tree plantations infected (40 of 80 acres); little change from 1987 in mortality but recent infections more scarce.
Woodgate Gall Rust Endocronartium harknessii	Scots Pine	Widespread	Detected in 7 Christmas tree plantations in northern Vermont, comprising 85 acres. About 70 acres had heavy shoot and branch mortality; down slightly from 1986.

FOLIAGE DISEASE

DISEASE	HOST(S)	LOCALITY	REMARKS
Anthracnose *Gloeosporium* spp.	Sugar Maple	East Haven Sutton	Trace damage at higher elevations; down from 1987. Reported elsewhere to be associated with early damage to maple leaves.
Cedar-Apple Rust *Gymnosporangium juniperi-virginianae*	Eastern Red Cedar Apple	Chittenden	Some urban calls.
Cyclaneusma Needlecast (formerly Naemacyclus) *Cyclaneusma minus*	Scots Pine	Widespread	Moderate Christmas tree damage in 5 of 11 plantations infected, comprising 80 acres; also at state nursery. Banding of inside needles commonly observed in the fall.
European Larch Needlecast *Mycosphaerella laricina*	European Larch	Chester	Ornamental.
Fir-Fern Rust *Uredinopsis mirabilis*	Balsam Fir	Widespread in northern VT	Continued very light levels in Christmas tree plantations this year, similar to 1987.
Lophodermium Needlecast *Lophodermium seditiosum*	Scots Pine	Widespread in scattered locations	Only light damage to Christmas trees; down slightly from 1987.
Poplar Leaf Bronzing	Balsam Poplar	Caledonia County	Unknown cause.
Rhabdocline Needlecast *Rhabdocline pseudotsugae*	Douglas Fir Christmas trees	Williamstown Weathersfield	Continues in heavily-infected plantations.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Rhizosphaera Needlecast Rhizosphaera kalkhoffi	Blue Spruce	Underhill Bennington	Causing heavy needle loss in two locations.
Sooty Mold Perisporiaceae	Regeneration	Windham and S. Windsor Counties	Heavy in locations where lecanium scale has been heavy.
Swiss Needlecast Phaeocryptopus gaumanni	Douglas Fir	Hardwick Bakersfield Essex Stowe Weathersfield	Continues in previously infected plantations but damage somewhat reduced.
Tar Spot Rhytisma acerinum	Red Maple Sugar Maple	Scattered	Only occasionally seen.

ROOT DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Annosus Root Rot Heterobasidion annosum	Red Pine		No new reports this year.
Shoestring Root Rot Armillaria spp.	Many	Widespread	Continues to be common on declining trees. No increase in severity observed. White pine seedling mortality at Lyndon S.F. now down to 1%.

DIEBACKS DECLINES & ENVIRONMENTAL DISEASES

AIR POLLUTION, and its affect on tree health, continues to cause concern. Although quantitative cause/effect relationships between air pollution and Vermont forest health have not been conclusively demonstrated, many scientists believe that ozone may pose a significant stress on forest health throughout the country.

Ozone is a powerful oxidant produced in the atmosphere from reactions of nitrogen oxides and volatile hydrocarbons in the presence of sunlight. Maximum concentrations can occur many miles distant from the original precursor emissions, and average concentrations are generally higher in rural forested areas than in cities.

Short-term exposure to high ozone concentration can result in acute cellular injury in sensitive plants, with consequent visual foliar symptoms appearing within hours or days of exposure. These visual sympoms include stippling (pigmentation), chlorosis, and bifacial necrosis in broadleaf species and chlorotic mottle and tipburn in conifer species. Black Cherry, White Ash, and Eastern White Pine appear to be particularly sensitive tree species. Other ozone sensitive forest bioindicator plants include blackberry, wild grape, milkweed, and poison ivy.

Long-term exposure to low to moderate ozone concentrations may produce chronic effects which may or may not result in visible symptoms. Even if visible injury does not result, ozone may make trees more susceptable to injury from other stresses by weakening cell membranes, reducing photosynthesis, altering respiration and carbon fixation, and/or reducing frost hardiness. Sugar Maple, for example, may experience a significant reduction in photosynthetic rate within the range of ozone concentrations commonly experienced in Vermont. (Contributed by Richard L. Poirot, Air Quality Planner).

The U.S. Forest Service conducted an ozone damage survey using sensitive species in the GMNF Lye Brook Wilderness area. Foliar damage was observed.

ASH DIEBACK and mortality remains common in southern Vermont and the Champlain Valley. There is very little dieback in the Northeast Kingdom. No new reports of "ash yellows" disease as a cause of the dieback were received, and no change in disease severity was noted.

BIRCH DECLINE is increasing, particularly in the northern part of the state and at higher elevations including parts of the Green Mountain National Forest. Several successive years of widespread birch defoliation is probably responsible for some of the increase. Ambrosia beetles are often found in association with declining birch.

DROUGHT CONDITIONS during spring and early summer increased tree stress throughout. The effects of drought were most severe on poor or shallow sites. Symptoms of stress by insects, disease, or other factors were exacerbated by drought conditions. Drought conditions were also responsible for many transplanting failures and sugar maple dieback.

FROST DAMAGE from several June frosts occurred this year in mountainous sections of northern Vermont, but it caused mostly scattered, light damage particularly to balsam fir. Frost injury was detected in 10 Christmas tree plantations compared to 24 in 197. Moderate to heavy damage to balsam fir, fraser fir, white spruce and Douglas fir did occur on 84 acres in Brookfield, Craftsbury, Morristown, and Hyde Park, but most of this was for seedlings or transplant-age trees.

IMPROPER PLANTING was the cause of mortality to a spruce Christmas tree plantation in Brookline and hemlock ornamentals in Putney. Trees were planted too deep.

LARCH DECLINE continues to spread outward from recently-dead trees within eastern larch stands in northern Vermont. The eastern larch beetle continues to be associated with the decline. New areas mapped during aerial survey this year totaled 646 acres, with the most damage in Caledonia County (Table 12). This is not as heavy as it was several years ago, but is an increase over 1987 detections. This year's drought may be responsible for the increase and could result in a further acceleration in the decline over the next year or two.

Table 12. 1988 acres of new larch decline.

County	Acres
Orleans	149
Caledonia	416
Essex	81
Total	646

MAPLE DECLINE continues to be a concern to forest landowners, sugarmakers, and the general public. Trees on poor sites, or suffering from previous mismanagement, were further stressed by drought conditions this year. No new areas of decline were identified during the aerial survey this year, but areas identified in past years often remain visible. No clear trend in maple decline is evident. Some stands appear to be improving while others continue to deteriorate at varying rates. In the Northeast Kingdom, decline in stands that had been previously heavily thinned was particularly noticeable, with the drought conditions resulting in leaf scorch, curling, branch dieback and, in some cases, tree mortality.

Our department began participating in a Canada-USA cooperative reserach effort on maple decline research this year called the North American Maple Project (NAMP) (Figure 10). This project was designed by the U.S. Forest Service to study the nature and severity of sugar maple decline in both high and low sulfate deposition areas over the next three years using uniform methods. The plots are split between sugarbushes and forested maple stands. Twenty-six plots were established in Vermont this year. Tree health was rated during July and August and will be rated again in future years. Seven northern states and four eastern provinces are cooperating in the project. Changes in tree health over time will be compared to amounts of pollutants received to see if a cause and effect relationship exists.

Figure 10. Bill Burkman (L), Quality Assurance Specialist; Brent Teillon (C), Chief of Forest Resource Protection; and Imants Millers, USFS Core Team Chairman, confer with the NAMP training team mascot at a July training session held in Fairfield.

NUTRIENT DEFICIENCY is suspected to be the cause of chlorotic foliage on balsam fir Christmas trees in Windsor County. Only current growth on lower branches is chlorotic on trees with mild symptoms, suggesting that an immobile nutrient is involved. Foliar analysis indicated that chlorotic foliage had much less Manganese than normal needles.

RED SPRUCE DECLINE continues throughout the state, particularly on high elevation and dry sites. No new areas of decline were reported. A GIS mapping project by the U.S. Forest Service is nearing completion. This will identify areas of spruce and fir mortality by vegetation type and elevation.

SNOW DAMAGE, from the October 1987 snowstorm, is still obvious in affected areas of Bennington County. Several severe windstorms (<40 M.P.H.) have occurred, which caused additional breakage of weakened branches and stems. Often, adjacent trees are broken, when they are hit by falling debris.

SPECIAL EFFECTS killed a dozen trees on the green in Townshend. Vermont didn't have enough snow to suit its image in Hollywood, so the trees were coated with fire retardant foam. Sugar maple branches that were sprayed in the winter were dessicated by early spring.

SUGAR MAPLE DIEBACK was very common this year, beginning in June and continuing throughout the summer. Affected branches leafed out normally, but then the leaves wilted and turned brown, much the same as for Verticillium wilt symptoms, but no Verticillium could be found. This malady was widespread throughout the region, but was particularly heavy in Orange, Windsor and Windham Counties. Branches scattered throughout the crown died but usually they were concentrated in the lower half of the crown. This was particularly noticeable on roadside maples. Several large yard trees, most with previous wounds, died suddenly. Occasionally, the same symptoms were seen on red maple and other hardwoods. This branch dieback was sometimes associated with heavy flowering and sometimes with thrips injury, but often by neither. Drought stress is thought to be the primary cause. Similar branch dieback was noticed throughout the lower crowns of oak and elm growing on a dry but normally wet site in Waterbury in June. Steganosporium, an opportunistic fungus capable of killing weakened branches, could almost always be found fruiting at the junction of live and dead wood on affected maple branches. Many sugar maples lost a few branches, but some were observed to lose 30 percent or more of their crown.

TRANSPLANT FAILURES due to the early summer drought were common, especially in the Champlain Valley where heavy mortality occurred in some plantations.

WIND DAMAGE occurred sporadically throughout much of northern Vermont this year. Severe windthrow occurred in Troy and Derby from two separate storms.

WHITE PINE NEEDLE BLIGHT was very mild this year, after five successive years of severe symptoms. This depsite the fact that the Department of Environmental Conservation measured the highest levels of ozone ever recorded in this state this summer. Research on the cause of this syndrome at Penn State University and by the U.S. Forest Service is looking at Vermont trees. A new needlecast fungus has been described on affected needles.

ANIMAL DAMAGE

ANIMAL	SPECIES DAMAGED	LOCALITY	REMARKS
Beaver	Many	Widespread	Flooding damage increasing with increasing populations.
Deer	White Pine	Andover	Damage was heavy on pole sized trees in former deeryard. Wounds from past bark stripping are now closing.
Moose			Not observed.
Mouse			Not observed.
Porcupine	Many	Scattered	Mostly light damage but increasing in frequency.
Sapsucker	White Birch	Lamoille and Windsor Counties	Several homeowner complaints; damage heavy.
Squirrel	Maple tubing	Widespread	Complaints down from last year. Requests referred to APHIS.