FOREST INSECT AND DISEASE CONDITIONS IN VERMONT

CALENDAR YEAR 1987

AGENCY OF
NATURAL RESOURCES

DEPARTMENT OF FORESTS,
PARKS, AND RECREATION

WATERBURY, VERMONT 05676

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FOREST INSECT AND DISEASE

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CALENDAR YEAR 1987

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AGENCY OF NATURAL RESOURCES

DEPARTMENT OF FORESTS, PARKS AND RECREATION

Division of Forestry

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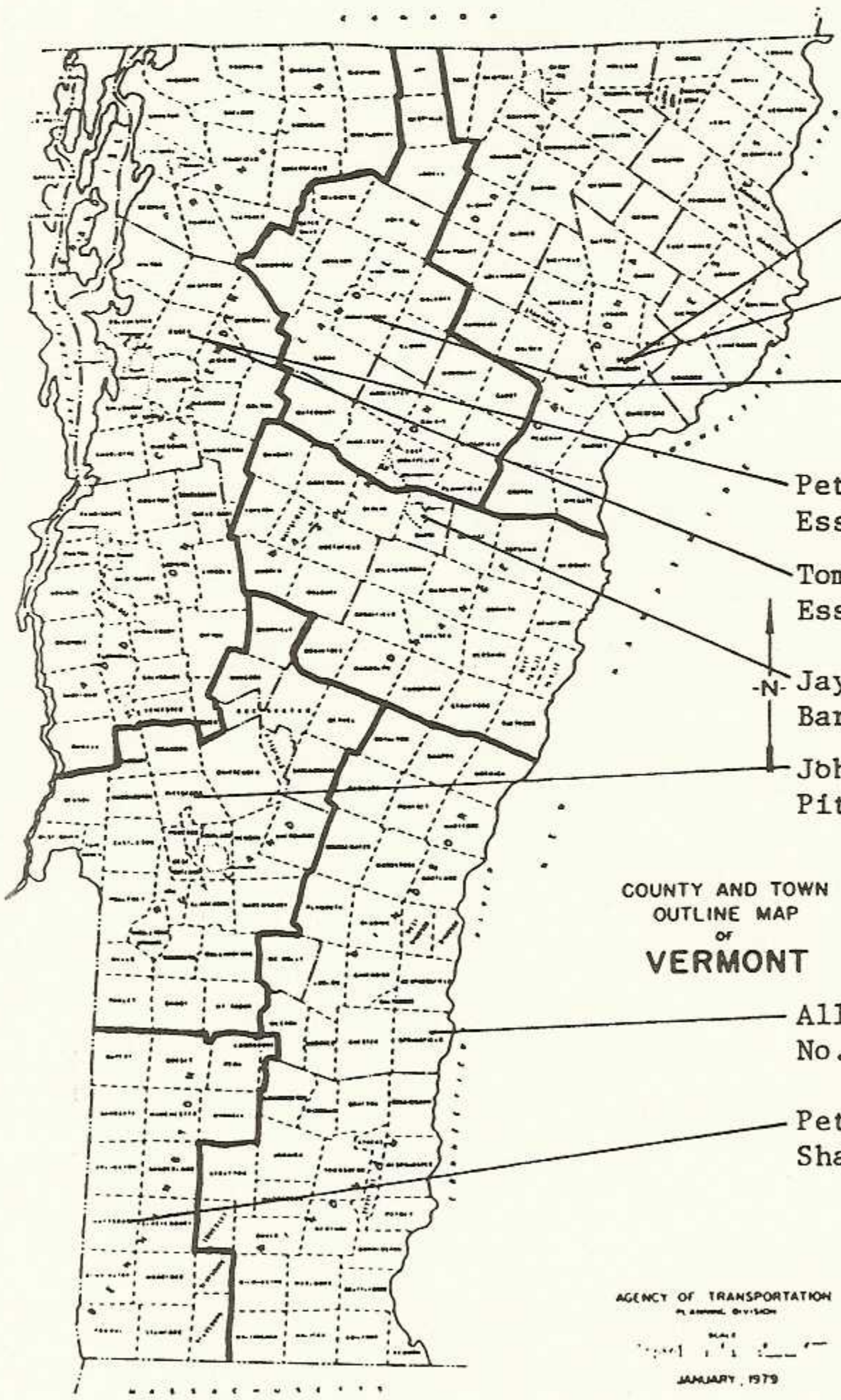

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VERMONT
INSECT AND DISEASE HIGHLIGHTS
1987

Birch Leaf Miners, including the Early Birch Leaf Edgeminer, caused conspicuous browning of birch throughout the state. Defoliation was mapped on 24,170 acres.

Forest Tent Caterpillar caused no noticeable defoliation, although larvae were commonly observed. Average moth trap catches increased for the first time in three years, indicating that populations are building.

Gypsy Moth populations are building, with light defoliation observed in scattered locations. Egg mass counts from focal area monitoring plots and elsewhere indicate that some areas will be defoliated in 1988.

Saddled Prominent larvae were commonly seen, causing only light defoliation. Numerous pupae in some locations indicate that populations will be higher next year.

Spruce Budworm populations continue to drop to extremely low levels, and caused no visible defoliation. Mortality from past budworm damage remains visible on 12,641 acres. Scattered balsam fir trees, stressed by previous defoliation, have been attacked by the balsam fir bark beetle, which may lead to additional mortality.

Lecanium Scale and Oystershell Scale occurred on a variety of hardwoods statewide, and have caused twig dieback in scattered locations.

Pear Thrips caused moderate-heavy defoliation on over 21,800 acres of maple in southern Vermont, including sugarbushes. This insect was often accompanied by Norway Maple Aphid. Severely affected stands refoliated. After two years of testing, counting insects in expanding buds appears to be a promising way to forecast defoliation.

Beech Bark Disease was increasingly visible. Yellow crowns indicate mortality may increase in the future.

Scleroderris Canker was not found in any new plantations, and no new towns will be added to the quarantine area.

Hardwood Decline was mapped in on over 3,000 acres, often associated with past logging. Results of the statewide hardwood tree health survey show that, in Vermont, 2% of the hardwood trees are dead and 21% show decline.

Ash Dieback has been confirmed as being caused by a mycoplasma (ash yellows) in several locations.

Birch Decline continues to be evident in northern Vermont. White and yellow birch are affected.

Snow Damage occurred in much of the state, but was severe in Bennington County where a storm on October 4 dumped up to 16" of snow.

Oak Wilt was not detected during annual aerial surveys and has not been found in Vermont.

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, statewide, late in the season (August and September). Additional surveys were a flight over the southern counties to detect maple defoliation and look for possible oak leaftier damage (7/2, 6/25) and a flight over the Manchester Ranger District of the Green Mountain National Forest with U. S. Forest Service personnel (6/22). Diagnostic assistance was provided by the University of Vermont, the Vermont Department of Agriculture, the U. S. Forest Service, the Maine Forest Service, and North Carolina State University.

WEATHER SUMMARY

Early winter of 1986-87 was snowy. Although there was less snowfall later in the season, steady cold conditions prevented winter drying and allowed the snow to remain deep. This provided good protection for gypsy moth eggs masses and other insects on or near the ground.

Spring came early, which caused early bud break and ruined the maple sugaring season for the second year in a row. Cold, wet weather returned in mid-April and continued to mid-May, when the weather became unusually dry.

Frosts occurred on 10 days in May, but were not heavy enough to cause widespread damage. Scattered light frosts also occurred in June, July and August.

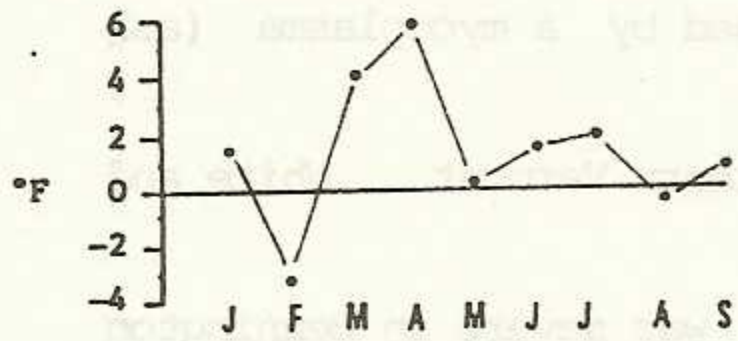
Summer was warm with light to moderate rainfall and high humidity and a dry August. Hailstorms caused scattered damage. September was rainy. Snow fell on October 4 throughout the state with up to 16" in parts of Bennington County.

Weather for the season is summarized in Figure 1.

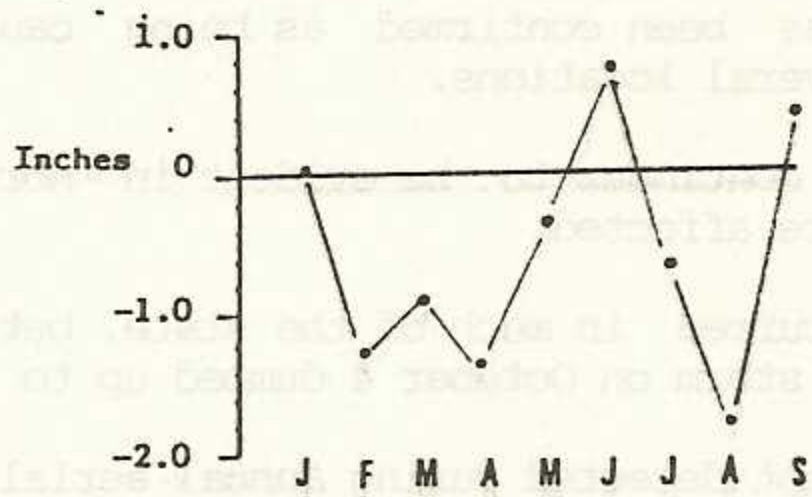
Figure 1: 1987 Weather Summary

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

Temperature: Departure from Normal



Precipitation: Departure from Normal



FOREST INSECTS

Hardwood Defoliators

Birch leaf miners, primarily the Early Birch Leaf Edgeminer, Messa nana in southern Vermont, caused conspicious browning of birch throughout the state. The edgeminer causes large blotch mines starting at the leaf margin. The Birch Leaf Miner, Fenusa pusilla, was also widespread in leaf miner damaged areas. Damage occurred everywhere, but was especially heavy at upper elevations, and in stands composed mostly of birch. Damage was heaviest in the more southern counties, and lightest in the Champlain Valley. Birch defoliation was mapped on 24,170 acres during aerial surveys (Table 1, Map 1).

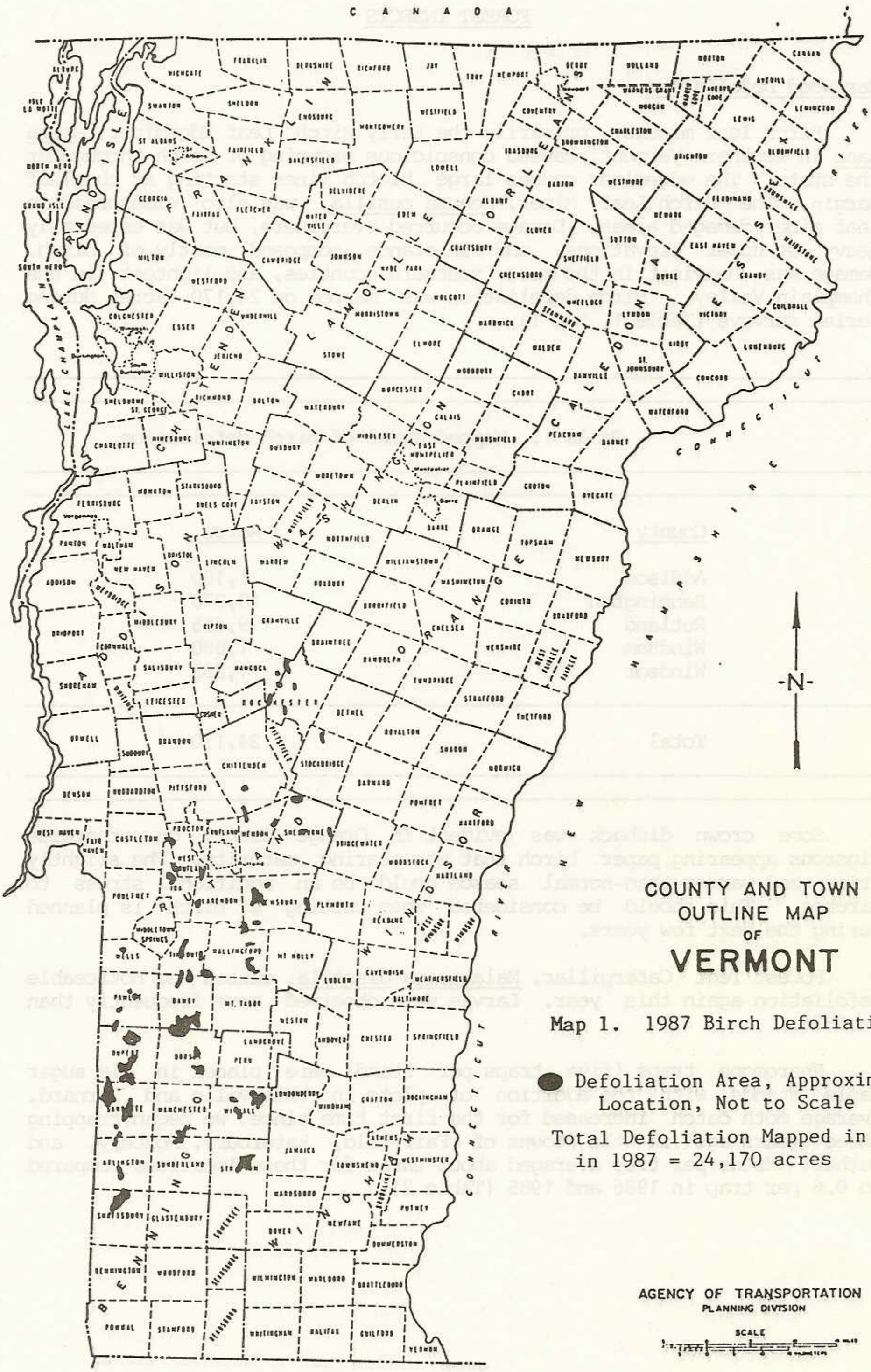
Table 1. Mapped acres of birch defoliation.

County	Acres
Addison	1,180
Bennington	10,270
Rutland	9,485
Windham	1,880
Windsor	1,355
Total	24,170

Some crown dieback was evident in Orange County on otherwise vigorous appearing paper birch that was nearing maturity. The slightly drier and warmer-than-normal season could be an additional stress to birches. This should be considered when cutting of birch is planned during the next few years.

Forest Tent Caterpillar, Malacosoma disstria, caused no noticeable defoliation again this year. Larvae were observed more frequently than in 1986.

Pheromone traps (five traps per stand) were placed in six sugar maple stands, with the addition of plots in Waterville and Barnard. Average moth catch increased for the first time since we began trapping three years ago in the towns of Fairfield, Waterbury, Roxbury, and Bethel. Moths per trap averaged about three for these locations compared to 0.6 per trap in 1986 and 1985 (Table 2).



COUNTY AND TOWN OUTLINE MAP OF VERMONT

Map 1. 1987 Birch Defoliation

● Defoliation Area, Approximate Location, Not to Scale

Total Defoliation Mapped in in 1987 = 24,170 acres

AGENCY OF TRANSPORTATION
PLANNING DIVISION

SCALE

Table 2. Forest tent caterpillar moth catch in pheromone traps - 1985 to 1987.

Location	Average Number of Moths per Trap 1985	1986	1987
Roxbury	0.6	0.2	2.0
Fairfield	0.6	0.6	4.8
Bethel	0.6	0.8	2.0
Waterbury	0.6	0.8	2.0 (Hara)
Waterville	-	-	6.6
Barnard	-	-	13.6

Traps were also placed in the Green Mountain National Forest by the U. S. Forest Service. Average trap catch was 6.5 moths compared to 6.7 in 1986. Again, the traps with the highest catches were in the southern part of the state.

Gypsy moth, Lymantria dispar, populations are building in some areas. Light defoliation was observed in scattered locations, including some residential areas in Colchester. No defoliation was observed during aerial surveys. High concentrations of egg masses have been found on over 100 acres in Benson and Orwell, where defoliation is expected in 1988.

Gypsy moth population counts continued at ten focal area plots (Map 2, Table 3). Milk carton pheromone traps were added this year to monitor moth populations. In many plots, larval and egg mass counts were up for the first time in the past three years, indicating a building population. Only the Perch Pond and Colchester sites, however, had over 800 egg masses per acre (34/plot), indicating that they will be defoliated next year. Most of the remaining plots had fewer than 200 per acre (9/plot).

Since cutting immediately prior to defoliation increases oak mortality from gypsy moth, oak stands in northwestern Rutland County should be watched closely for signs of gypsy moth buildup in 1988. Silvicultural treatments should be postponed in stands that will not be protected by spraying.

Table 3. Gypsy moth counts from focal area monitoring plots: 1986-1987.

Plot location	# of Larvae & pupae [1,4]		# of Moths [2]	# of Egg Masses [3,4]	
	1986	1987	1987	1986	1987
Minards Pond	9	28	495	0	0
Ft. Dummer	4	12	324	2	0
Handley Mtn.	6	4	273	1	1
Perch Pond	6	134	718	0	115
Rocky Pond	26	57	176	0	6
Petersburg	8	14	359	1	0
Tate Hill	2	1	127	0	0
Milton	10	89	127	5	21
Colchester	54	598	193	10	37
Middlesex	5	8	66	0	0

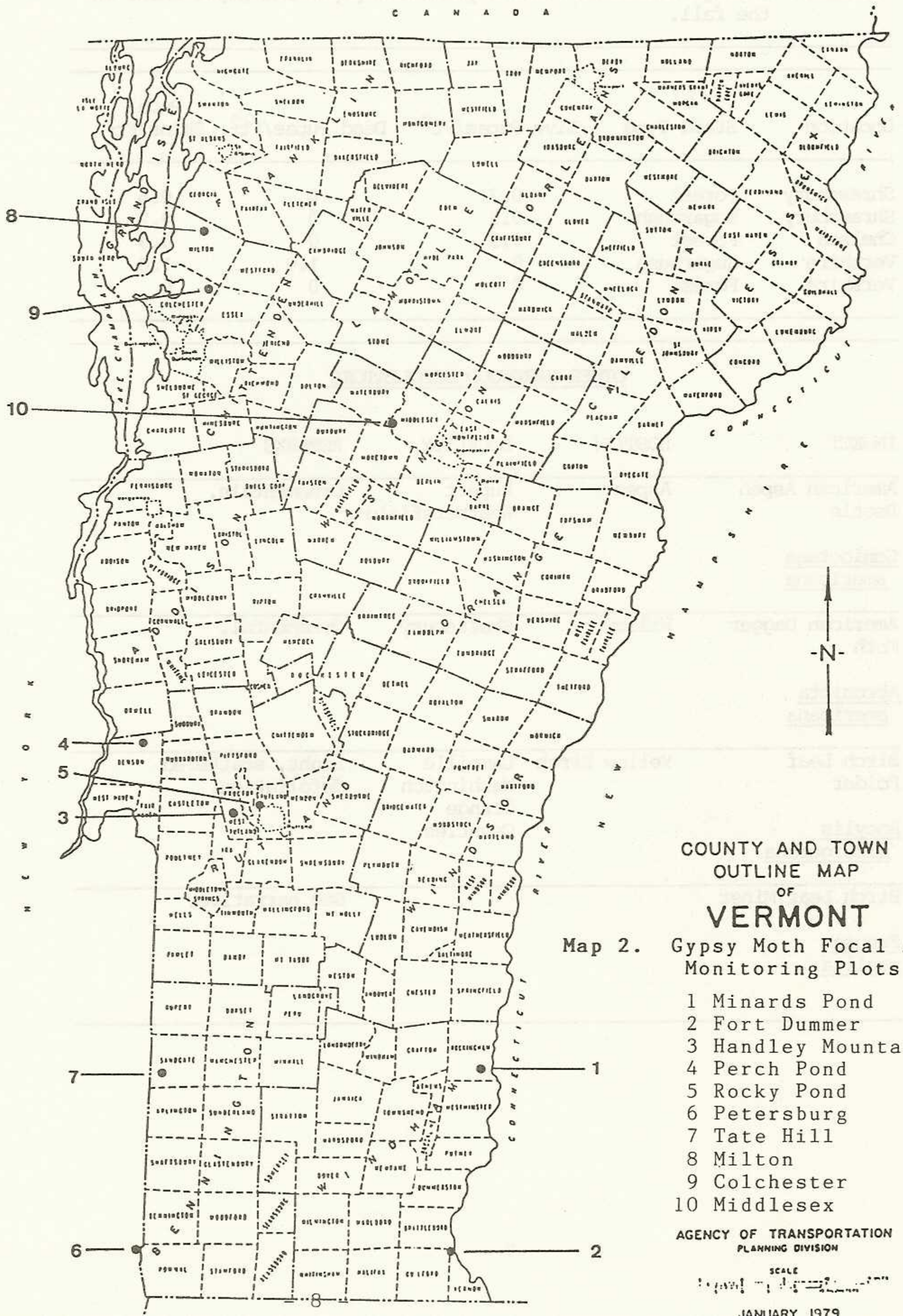
1 Number under burlap bands in 15m. (.045 acre) diameter plots at peak 5th instar
2 Total count per one trap
3 Total number in 15m. diameter plots
4 Average of 2 or 3 plots in 1986 and 2 plots in 1987

Maple Leaf Cutter, Paraclemensia acerifoliella, caused light defoliation only, including 243 acres in Chittenden County visible during the aerial survey.

A sugarbush in Landgrove was sampled on July 10. Larval mines averaged 1.3 per leaf based on two leaf clusters from each of ten trees. A resample on July 23 also averaged 1.3 per leaf. Subsequent defoliation was light.

Saddled Prominent, Heterocampa guttivata, larvae were more noticeable throughout the state than during the past five years, but there was only light defoliation. Pupae were numerous enough this fall to be observed wherever soil was disturbed in several locations, including Lincoln, Underhill, and Vershire. This probably indicates increaing populations for 1988. July surveys for eggs on sugar maple leaves are planned for potential hot spots.

Pupae were sampled in the fall in Shrewsbury, Vershire, and Chelsea. The Shrewsbury area had received only light defoliation in 1987. The Vershire and Chelsea stands had a history of heavy defoliation during the past outbreak. Plots consisting of five 1 ft^2 subplots were sampled. The results are shown in Table 4. The large proportion of pupal skins to live pupae in some stands indicates that predators are helping to keep the population low.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

Map 2. 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 Milton
9 Colchester
10 Middlesex

AGENCY OF TRANSPORTATION
PLANNING DIVISION

SCALE

JANUARY 1979

Table 4. Average number of saddled prominent pupae and pupal skins in the fall.

Location	Stand Type	Live Pupae/Ft^2	Dead Pupae/Ft^2	Pupal Skins/Ft^2
Shrewsbury	Forest	0.3	0	0.6
Shrewsbury	Sugarbush	0.3	0	0.2
Chelsea	Forest	0.3	0	0.3
Vershire	Sugarbush	0	1.0	1.0
Vershire	Forest	0	0	0

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
American Aspen Beetle Gonioctena americana	Aspen	Rupert Weathersfield	Ornamentals.
American Dagger Moth Acronicta americana	Willow	Shaftsbury	Ornamental.
Birch Leaf Folder Ancylis discigerana	Yellow Birch	Lamoille Washington Orange Counties	Light, scattered defoliation.
Birch Leaf Miner Fenusa pusilla			See narrative.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Birch Skeletonizer Bucculatrix canadensisella	White Birch Yellow Birch	Lamoille Washington Orange Counties	Light, scattered defoliation.
Bruce Spanworm Operophtera bruceata			Not observed.
Cherry Scallop Shell Moth Hydria prunivorata	Black Cherry	Rochester	Single tree.
Cutworm Noctuidae	Oak	Rockingham	Numerous. Species unknown. Suspected cause of light defoliation.
Early Birch Leaf Edgeminer Messa nana			See narrative.
Eastern Tent Caterpillar Malacosoma americanum	Cherry Apple	Widespread	Some roadside trees completely defoliated in Windsor & Windham Counties. Populations more numerous throughout than in 1986.
Elm Leaf Beatle Pyrrhalta luteola	American Elm Chinese Elm	Scattered throughout	Low populations.
Euonymous Caterpillar Yponomeuta multipunctella	Spindletree	Rockingham	Shrubs completely defoliated and shrouded with webbing.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Fall Cankerworm *Alsophila pometaria*			Not observed.
Fall Webworm *Hyphantrea cunea*	Cherry, Apple, Maple and other hardwoods	Widespread	Scattered. Highest populations in Connecticut River Valley. Some roadside trees completely defoliated.
Forest Tent Caterpillar *Malacosoma disstria*			See narrative.
Green Striped Mapleworm *Anisota rubicunda*	Red Maple Sugar Maple	Scattered	Scattered individual larvae observed.
Gypsy Moth *Lymantria dispar*			See narrative.
Half Winged Geometer *Phigalia titea*	Red Oak	Middlesex	A few larvae seen in gypsy moth focal area plot.
Hickory Tussock *Acronicta americana*	Willow	Shaftsbury	Ornamental.
Japanese Beetle *Popillia japonica*	Ornamentals	Chittenden Caledonia Counties	Moderate to heavy defoliation of individual plants.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Lace Bugs Corythucha	Elm	Chittenden and Washington-ton Counties	Moderate to heavy defoliation of elm.
	Yellow Birch	Lamoille Orange Orleans Counties	Light defoliation of yellow birch.
Large Aspen Tortrix Choristoneura conflictana			Not observed.
Linden Looper Erranis tiliaria		Lamoille Orange Washington Caledonia Counties	Occasional larvae observed.
Locust Leaf Miner Odontata dorsalis	Black Locust	All areas except Northeast Kingdom	Moderate-heavy defolia-tion in Orange, Bennington, Chitten-den, Windsor and Windham Counties.
Maple Leaf Cutter Paraclemensia acerifoliella			See narrative.
Maple Trumpet Skeletonizer Epinotia aceriella	Sugar Maple Red Maple	Widespread	Mostly trace to light populations except occasional small areas of moderate defolia-tion in Lamoille and Orange Counties. Increasing in Orange County.
Maple Webworm Tetralopha asperatella	Sugar Maple Norway Maple	Swanton Chester Shrewsbury	Light defoliation in Swanton.
Mountain Ash Sawfly Pristiphora geniculata	Mountain Ash	Scattered throughout	Not as heavy as in recent years in northern Vermont. Causing light defoliation at high elevations elsewhere.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Oak Skeletonizer *Bucculatrix ainsliella*	Oak	Scattered throughout	Light damage only. Less common than in past couple of years in southern Vermont. Increasing in northern Vermont.
Orange-humped Mapleworm *Symmerista leucitys*	Sugar Maple	Scattered throughout	Occasional larvae observed.
Pin Oak Sawfly *Caliroa sp.*			Not observed.
Red-humped Caterpillar *Schizura concinna*	Crimson King Maple	St. Johnsbury	Moderate defoliation of one tree.
Red-humped Oakworm *Symmerista canicosta*	Oak	Woodford	Individual larvae.
Rose Chafer *Macrodactylus subspinosus*	Hardwoods Ornamentals	Springfield	Less common than in 1985 and 1986.
Saddled Prominent *Heterocampa guttivata*			See narrative.
Satin Moth *Leucoma salicis*	Poplar	Chittenden County and Newport	
Solitary Leaf Roller *Sparganothis pettitana*	Sugar Maple	Addison Chittenden Franklin Counties	Scattered trace populations.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Solitary Oak Leaf Miner *Cameraria hamadryadella*	Red Oak	Addison Bennington Chittenden Franklin Counties	Light scattered defoliation.
Spiny Elm Caterpillar *Nymphalis antiopa*	Birch	Ludlow	Individual larvae.
Spring Cankerworm *Paleacrita vernata*			Not observed.
Uglynest Caterpillar *Archips cerasivoranus*	Cherry	Widespread in northern Vermont. Also observed in Fair Haven	Scattered light defoliation similiar to 1986.
Unidentified Leaf Miner	Balsam Poplar	Orange County	Was common in Northeast Kingdom in 1986. Caused occasional heavy defoliation in Orange County this year.
Walking Stick *Diaphoromera femorata*	Maple	Shaftsbury	Ornamental.

Softwood Defoliators

Spruce Budworm, Choristoneura fumiferana, populations continued to drop to extremely low levels in 1987 with no aerially visible defoliation for the fourth consecutive year. No budworm larvae were seen this year and only one of 69 pheromone traps caught any moths.

Pheromone traps were deployed in 19 stands this year compared to 15 in 1986. New plots were established further north in the Northeast Kingdom to include areas near the Canadian border where budworm defoliation was first detected in 1976. Each plot consisted of three to five traps in a cluster, using the same lure and trap as in 1986. Only one moth in one trap in Hardwick was caught this year, resulting in an average moth catch per trap, per plot of 0.01 moths compared to 1.2 moths in 1986. This corresponds to extremely low numbers of overwintering larvae (0.4 per 100 ft^2 of foliage) found in the fall of 1986.

Balsam fir defoliation, based on a Fettes evaluation of five branches per stand for 19 stands, averaged only 0.4 percent compared to 0.7 percent in 1986 and 2 percent in 1985. At this point, it is difficult to say that spruce budworm is responsible for the small amount of defoliation observed.

Overwintering larvae were soaked out of five branches per plot for each of the 19 pheromone plots in the fall of 1987. Population levels for 1988 remain very low in widely scattered locations. Up until the recent standardization of pheromone traps, counts of overwintering larvae soaked out of whole branches have been our most sensitive and consistent survey method. Table 5 shows the dramatic drop in population levels that has occurred since the height of the infestation in 1981.

Table 5. Average number of overwintering (L2) spruce budworm larvae for all plots surveyed - 1981 to 1987.

	Year						
	1981	1982	1983	1984	1985	1986	1987
No. of larvae per 100 ft^2 of foliage[1]	1040	385	140	95	7	0.4	1.4

1 It takes at least 100 larvae per 100 ft^2 of foliage to result in moderate defoliation (30%).

Stands containing spruce-fir mortality from past budworm damage remain visible from the air. The annual aerial survey detected 12,641 acres of mortality (Table 6), down only slightly from the 14,045 acres detected in 1986.

Table 6. Acres of mortality visible in 1987 due to past spruce budworm defoliation.

County	Acres of mortality			
	Light[1]	Moderate[2]	Heavy[3]	Total
Caledonia	206	1,369	1,765	3,340
Essex	67	2,197	2,507	4,771
Orleans	218	1,918	2,394	4,530
Total	491	5,484	6,666	12,641

1 1-10%, scattered or patchy
2 11-25%, scattered
3 Over 25%

A resurvey of 11 permanent ground plots in budworm-damaged stands showed that annual balsam fir tree mortality averaged 0.0, 0.5, and 1.0 percent, respectively, for formerly heavily, moderately, and lightly damaged stands, compared to 6.8, 4.5, and 3.2 percent in 1986. Applying these data to acres of mortality from Table 6 results in a total volume loss of 797 cords, representing 7,436 dead trees. Current mortality cannot be attributed to budworm and probably does not exceed background mortality from other causes. The 1973 Forest Inventory of Vermont, completed prior to the most recent budworm outbreak, reported an annual mortality rate of 1.5 percent of the growing stock volume for balsam fir.

Scattered balsam fir trees left with small crowns as the result of past budworm damage, exhibited pitch flow from recent bark beetle attacks in many of the stands surveyed. The beetle, probably the balsam fir bark beetle based on larval galleries, Pityokteines sparsus, was unsuccessful in colonizing some of the trees, but others were well infested by early fall even though most trees were not dead. This is likely to result in a slight increase in future balsam mortality in these stands.

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Arborvitae Leaf Miner *Argyresthia thuiella*	Arborvitae Northern White Cedar	Scattered throughout	Mostly light defoliation; some heavy damage to ornamentals in Barre and Stowe.
European Pine Sawfly *Neodiprion sertifer*	Red Pine	Bennington	Moderate defoliation in plantation pine.
Introduced Pine Sawfly *Diprion similis*	White Pine Scots Pine	Widespread in Northern Vermont, also observed in Quechee	Light populations on white pine (98 acres) and Scots pine (112 acres) Christmas trees were similar to 1986.
Larch Casebearer *Coleophora laricella*	European Larch	Chittenden Lamoille Orange Counties	Light, but increasing populations.
Larch Sawfly *Pristophora erichosonii*			Not observed.
Pine Nesting Sawfly *Acantholyda zappei*	Scots Pine	Williston	Trace of damage.
Pine Webworm *Tetralopha robustella*	Scots Pine	Lincoln Dorset Bennington	Light damage in Christmas tree plantations.
Red Headed Pine Sawfly *Neodiprion lecontei*	Mugho Pine Ornamentals Scots Pine Christmas Trees	Shaftsbury Townshend	Moderate defoliation on individual trees.
Spruce Bud Moth *Zeiraphera canadensis*	White Spruce	Caledonia County Craftsbury Berkshire Wolcott	Scattered trace damage; mostly light damage to Christmas trees.

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Spruce Budworm Choristoneura fumiferana			See narrative.
White Pine Sawfly Neodiprion pinetum	White Pine	Eden	Two, 15-foot tall pines completely defoliated. First time in many years that heavy defoliation by this insect has been observed.
Yellow-headed Spruce Sawfly Pikonema alaskensis	Blue Spruce	Barre	Some defoliation.

SAPSUCKING INSECTS, MIDGES, AND MITES

Lecanium Scale, Lecanium sp., occurred in significant numbers throughout the state. It was found on a variety of hardwoods including sugar maple, red oak, beech, ash, hickory, and butternut. In sugar maple stands in the southern counties, high levels of lecanium scale often occurred where cottony maple scale, pear thrips, and Norway maple aphid were also high. In northern Vermont, heaviest populations were found in scattered red oak.

In one sugarbush, wounds on twigs throughout the crown and heavy sooty mold on lower branches indicated that past damage from this insect was, at least in part, responsible for crown dieback. On some ornamental oaks a high concentration of scales near the bud scale scars caused current year's twigs to drop off.

High crawler numbers in some infested areas indicate that lecanium scale may be a problem again next year.

Norway Maple Aphid, Periphyllus lyropictus, was common on sugar maple throughout, especially Chittenden, Windham, Bennington, Windsor and Rutland Counties. High aphid numbers in southern Vermont were often accompanied by high levels of pear thrips. Since both do much of their feeding in developing buds, it was difficult to attribute the amount of damage due to each. In one location in Springfield, where the aphid occurred alone, leaves appeared normal in shape, but were falling off green in late May.

Aphids were counted in develping buds of two sugarbushes in conjunction with counts being made for pear thrips (Table 7). The maximum number of aphids was 36 per bud, compared to a maximum of 17 thrips.

The wingless stage, occurring in buds (late April) is yellow-green with purple markings and prominent cornicles. By mid-May only the black winged stage was found, often covering leaf undersides. Soon afterward these were replaced by small white nymphs. This second generation gradually disappeared, without causing any apparent damage.

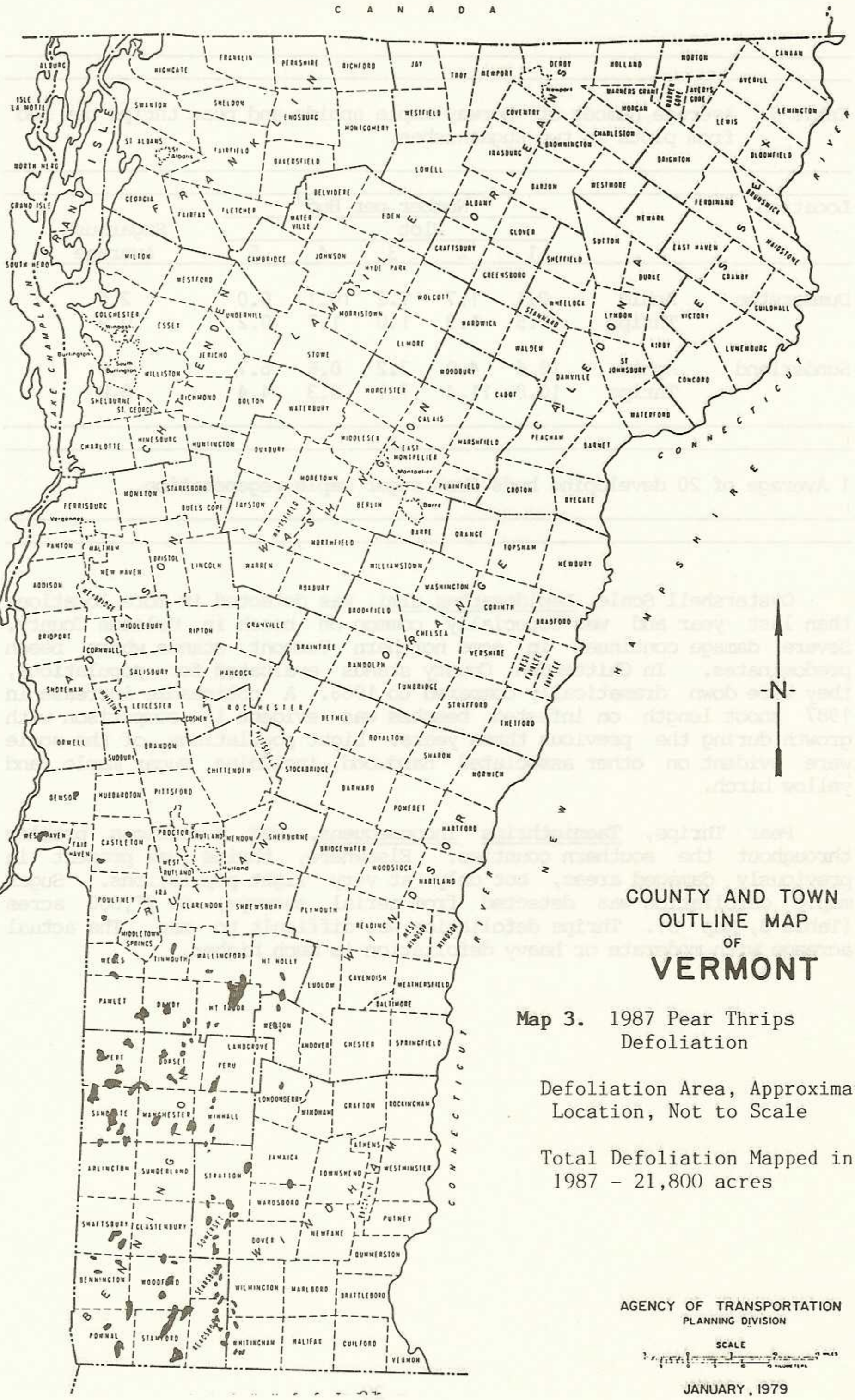
Table 7. Average number of Norway maple aphids and pear thrips per bud from plots in two sugarbushes.

Location		Number per Bud[1]					
		Plot					Sugarbush Average
		1	2	3	4	5	
Dummerston	Aphid	0.1	1.7	1.2	10.1	0.0	2.6
	Thrips	0.5	1.3	1.0	1.7	0.2	0.9
Sunderland	Aphid	13.6	4.9	2.2	0.6	6.7	5.6
	Thrips	10.8	11.4	7.1	6.3	4.4	8.0

1 Average of 20 developing buds from sugar maple regeneration.

Oystershell Scale, Lepidosaphes ulmi, was detected in more locations than last year and was especially common on beech in Orleans County. Severe damage continues in some northern Vermont stands where beech predominates. In Chittenden County stands evaluated for populations, they were down dramatically compared to 1986. A noticeable increase in 1987 shoot length on infested beeches was evident in comparison with growth during the previous three years. Light populations of the scale were evident on other associated hardwood, including sugar maple and yellow birch.

Pear Thrips, Taeniothrips inconsequens, was a serious problem throughout the southern counties. Elsewhere, thrips was present in previously damaged areas, but only at very light populations. Sugar maple defoliation was detected from aerial surveys, on 21,800 acres (Table 8, Map 3). Thrips defoliation was difficult to map. The actual acreage with moderate or heavy defoliation is much higher.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

Map 3. 1987 Pear Thrips Defoliation

Defoliation Area, Approximate Location, Not to Scale

Total Defoliation Mapped in 1987 - 21,800 acres

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JANUARY, 1979

Table 8. Mapped acres of defoliation by pear thrips.

County	Acres
Bennington	14,460
Rutland	4,400
Windham	2,690
Windsor	250
Total	21,800

Defoliation by thrips was often accompanied by damage from Norway maple aphid, lecanium scale, and cottony maple scale. Refoliation of severely affected stands was underway by the third week in June.

This was the third, and most severe, year of infestation by this insect. Its impact on affected trees remains unclear. Several sugarbushes were sampled for root starch in the fall to determine current tree vigor.

Thrips monitoring plots were continued or established in five sugarbushes. Each plot was centered on a dominant sugar maple. Four adult emergence traps were placed in the ground around each tree, near the drip line, at snow melt. A trap consisted of a 6" length of 4" PVC pipe. This was covered with a square of plexiglass, coated with tanglefoot. In addition, 20 expanding buds were taken from the sugar maple regeneration nearby, and all thrips in the buds were counted. This was on April 23 and 24, when the buds were 1-2" in length. In mid-June the dominant plot tree was rated for defoliation.

The results for the five sugarbushes, and the 1986 results for the sugarbush in Landgrove, are shown in Table 9.

Table 9. Average thrips counts in buds and emergence traps, and average defoliation, for four sugarbushes sampled in 1987 and 1986.

Sugarbush Location	Thrips Counts #/Bud[1]	#/Emergence Trap[2]	% Defoliation[3]
Woodstock (1987)	0.9	1.0	4%
Landgrove (1987)	1.8	3.4	24%
Landgrove (1986)	0.8		22%
Smokey House (1987	2.6	2.0	0%
Danby (1987)	1.5	5.5	16%
Sunderland (1987)	8.0	2.2	32%

Correlation Coefficients:

Bud Counts: Defoliation	0.66 (n.s.)
Trap Counts: Defoliation	0.32 (n.s.)
Bud Counts: Trap Counts	0.18 (n.s.)

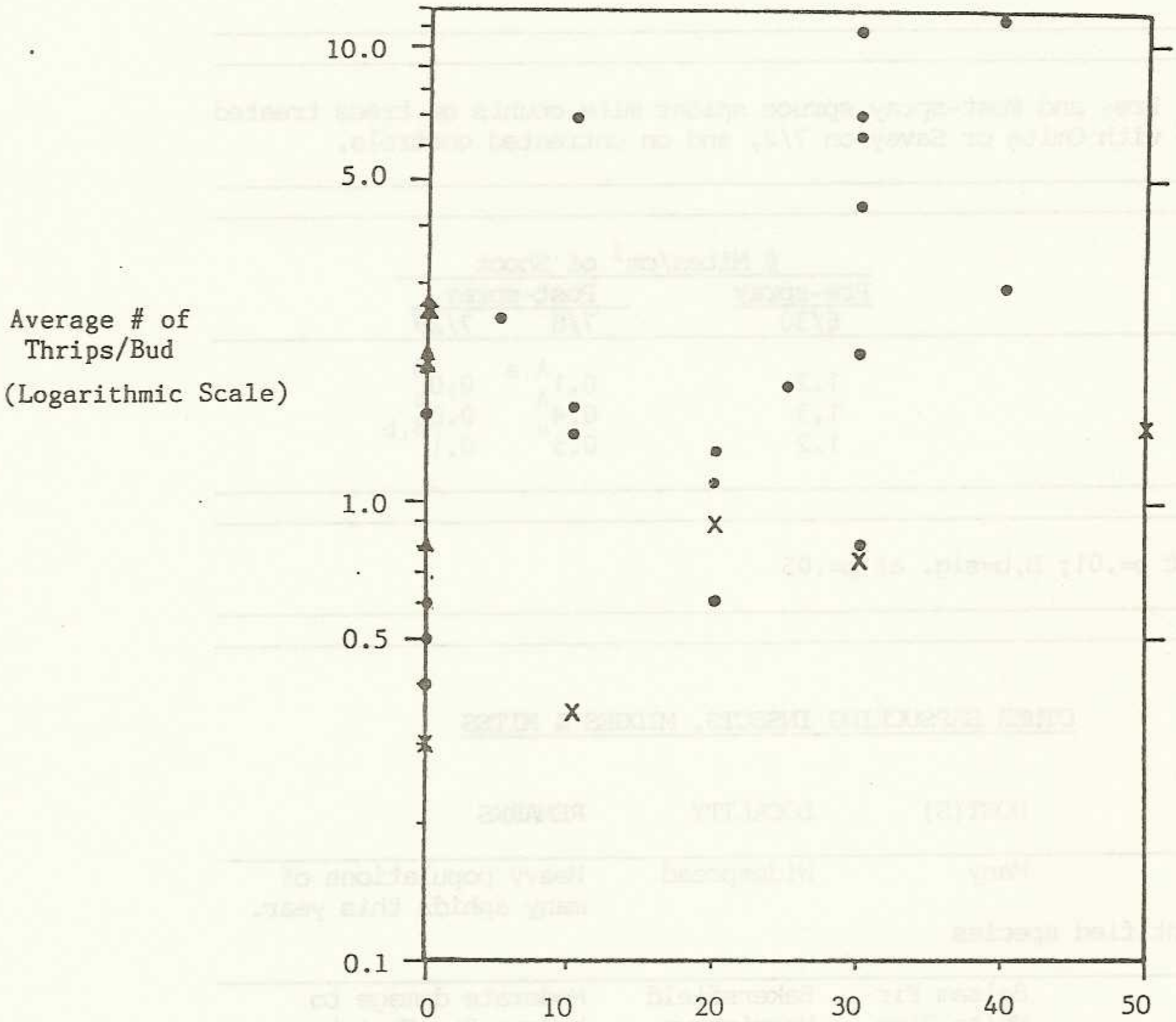
1 Average of 100 buds
2 Average of 20 traps
3 Average of 5 trees

Trap counts were not correlated with bud counts, and were a poor predictor of defoliation. Average bud counts for an entire sugarbush were also uncorrelated with subsequent defoliation.

Average counts from buds adjacent to a plot tree were, however, significantly related to that tree's defoliation (Figure 2). In most sugarbushes, counts in excess of one thrip per bud suggest that some significant defoliation will occur, while counts under one per two buds indicate that all damage will be light. Bud counts leading to defoliation in the bush sampled in 1986 were lower than 1987, indicating that environmental factors may play an important role. It is not known why the plot trees in Smokey House were not defoliated, in spite of average plot counts as high as 2.7 thrips/bud.

Spruce spider mite, Oligonychus ununquis, was a serious pest to fir and spruce Christmas trees again this year, in widely scattered locations. Heavy damage was seen in Springfield, Bennington, Townshend, and Dummerston. Scattered young balsam fir trees with heavy damage were also seen in a mixed-wood forest stand in Plymouth.

Figure 2. Percent defoliation of 5 plot trees in 6 sugarbushes by number of thrips in developing buds of adjacent understory maples (average of 20 buds). Correlation coefficient (r)=.46, significant at p=.05.



● 1987 sugarbushes, except Smokey House

▲ Smokey House: 1987

X Landgrove Sugarbush: 1986

Numbers of mites increased dramtically on infested trees by mid-summer in some northern Vermont locations. In southern Vermont, mite numbers were very high early in the season and subsequently, tapered off. Heavy rains may have been the cause of this decline.

Because the availability of Kelthane was uncertain, other chemicals were tested against spider mites in balsam fir plantations. Twenty trees each were sprayed with two chemicals not yet registered for use on Christmas trees (Omite-CR and Savey), or unsprayed. Results from the Springfield test are in Table 10. Although Omite caused a faster knockdown, there was no difference between the sprayed treatments 27 days after spraying. Populations on the unsprayed trees declined as well, but mite counts on treated trees were significantly lower. Results were similar in a test in Elmore, although mite numbers there increased on the unsprayed trees. Since neither of the tested products is currently registered, Kelthane continues to be the recommended product for controlling spider mites on Christmas trees.

Table 10. Pre- and Post-spray spruce spider mite counts on trees treated with Omite or Savey on 7/2, and on untreated controls.

Treatment	# Mites/cm^2 of Shoot		
	Pre-spray	Post-spray	
	6/30	7/8	7/29
Omite	1.2	$0.1^{A,a}$	0.0^{B}
Savey	1.3	0.4^{A}	0.0^{b}
Control	1.2	0.5^{a}	$0.1^{B,b}$

A,a=sig. at p=.01; B,b=sig. at p=.05

OTHER SAPSUCKING INSECTS, MIDGES & MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Aphids Many unidentified species	Many	Widespread	Heavy populations of many aphids this year.
Aphids Cinara sp.	Balsam Fir White Pine	Bakersfield Morristown	Moderate damage to balsam fir Christmas trees; heavy on ornamental white pine.

OTHER SAPSUCKING INSECTS, MIDGES & MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Balsam Gall Midge *Paradiplosis tumifex*	Balsam Fir	Widespread in northern Vermont	Only trace to light populations on Christmas trees but increasing compared to 1986.
Balsam Twig Aphid *Mindarus abietinus*	Balsam Fir	Widespread	Mostly light to moderate Christmas tree damage. Populations up in some plantations and down in others, but overall, little change from 1986 levels. Moderate damage recorded for 128 acres out of 343 Christmas tree acres where twig aphid was detected.
Balsam Woolly Adelgid *Adelges piceae*	Balsam Fir	Grafton	Gouty twigs in several trees.
Beech Scale *Cryptococcus fagisuga*	Beech		See Beech Bark Disease.
Cooley Spruce Gall Adelgid *Adelges cooleyi*	Douglas Fir Blue Spruce	Bennington Springfield Barton Essex	Damage to Douglas Fir Christmas trees could be controlled by late September/early October spray and re-spray in spring.
Cottony Maple Scale *Pulvinaria innumerabilis*	Sugar Maple	Throughout Windham & Bennington Counties	Associated with lecanium scale in some stands.
Eastern Spruce Gall Adelgid *Adelges abietis*	Red Spruce White Spruce	Widespread	Remains common; heavy damage to individual Christmas trees and ornamentals.

OTHER SAPSUCKING INSECTS, MIDGES & MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Kermes Scale Allokermes galliformis	Oak	Woodstock Pownal Sandgate	On Ornamentals, causing dieback, and on regeneration.
Lecanium Scale Lecanium sp.			See narrative.
Linden Aphid Myzocallis tiliae	European Linden	Bennington	Ornamental.
Maple Spindle Gall Mites Vasates aceris-crumena	Sugar Maple	Throughout	Common.
Norway Maple Aphid Periphyllus lyropictus			See narrative.
Oystershell Scale Lepidosaphes ulmi			See narrative.
Pear Thrips Taeniothrips inconsequens			See narrative.
Pine Bark Aphid Pineus strobi	White Pine	Widespread	Remains common.
Pine Fascicle Mite Triseticus alborum	White Pine	Widespread in northern Vermont	Trace to light shoot damage observed.
Pine Leaf Adelgid Pineus pinifoliae	White Pine	Widely scattered	Some adults observed on white pine needles but not numerous and damage down from 1986.

OTHER SAPSUCKING INSECTS, MIDGES & 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.
Pine Needle Scale *Chionapsis pinifoliae*	White Pine Mugho Pine	Rutland Springfield Dummerston Middlebury	Individual Christmas trees with heavy infestations. Some with sooty mold.
Pine Spittlebug *Aphrophora parallela*	Conifers	Widespread	Less common than 1986.
Pine Thrips *Gnophothrips sp.*	Scots Pine	Lincoln	Moderate damage to scattered Christmas trees.
Pine Tortoise Scale *Toumeyella parvicornis*	Scots Pine	Dummerston	Heavy damage to Christmas trees.
Root Aphid *Prociphilus americanus*	Balsam Fir Fraser Fir	Lamoille County	No new locations found; damage lessening.
Spruce Bud Scale *Physokermes piceae*	White Pine	Springfield	Light infestation.
Spruce Spider Mite *Oligonychus ununguis*			See narrative.
Treehoppers *Membracidae*	Oak Maple	Manchester	Abundant.
White Pine Needle Midge Unknown species, possibly *Cecidomyia pinifoliae*	White Pine	Walden Brookfield	Heavy needle droop and defoliation of scattered Christmas trees.

BUD, SHOOT, & STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Ambrosia Beetle Scolytidae	White Birch	Sherburne	
Balsam Shootboring Sawfly Pleroneura bruneicornis	Balsam Fir	Berkshire Morristown	Only very light damage to Christmas trees detected.
Butternut Curculio Conotrachelus juglandis	Butternut	Jericho	
Locust Borer Megacyllene robiniae	Black Locust	Dorset Rutland	
Maple Petiole Borer Caulocampus acericaulis	Sugar Maple	Franklin Chittenden Addison Lamoille Counties	Light damage, down from 1985 levels.
Northern Pine Weevil Pissodes pproximatus	White Pine	Springfield	Causing mortality of scattered Christmas trees.
Pales Weevil Hylobius pales	Scots Pine	Widespread in northern Vermont	287 acres of mostly light damage to Christmas trees detected; little change from 1986.
Pine Gall Weevil Podapior. gallicola	Red Pine	Thetford	Light damage to mature pine at Thetford State Forest.
Pitted Ambrosia Beetle Corthylus punctatissimus	Sugar Maple Seedlings	Franklin Chittenden Addison Orleans Counties	Scattered light mortality of seedlings.

BUD, SHOOT, & STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Round-headed Apple Tree Borer *Saperda candida*	Apple Mountain Ash	Caledonia Windsor Counties	Ornamentals.
Twig Pruner *Elaphidionoides villosus*	Red Oak	Fair Haven Chester	Ornamentals.
White Pine Weevil *Pissodes strobi*	White Pine Scots Pine Blue Spruce Norway Spruce White Spruce Red Spruce Douglas Fir	Widespread	Remains common; heavy damage to a Norway spruce stand in Albany. Unusual top kill of red spruce in Lewis. Light damage to 70 acres of Scots pine and 115 acres of white pine Christmas trees.
White Spotted Sawyer *Monochamus scutellatus*	White Pine Logs	Newfane	Emerging in new log home.

BARK BEETLES

INSECT	HOST(S)	LOCALITY	REMARKS
Balsam Fir Bark Beetle Unidentified, probably *Pityokteines sparsus*	Balsam Fir	Northeast Kingdom	Commonly attacking trees previously weakened by spruce budworm.
Bronze Birch Borer *Agrilus anxius*	White Birch	Essex	One tree affected.
Eastern Larch Beetle *Dendroctonus simplex*	American Larch	Widespread	Associated with larch decline.
Elm Bark Beetles *Hylurgopinus rufipes* *Scolytus multistraitus*	American Elm	Widespread	See Dutch Elm disease.
Hemlock Borer *Melanophila fulvoguttata*	Hemlock	Windsor	Associated with post-logging decadence.
Pine Engraver *Ips pini*	White Pine	Poultney Plymouth Weathersfield	Ornamental pines stressed by compaction, overcrowding, or road salt.
Red Turpentine Beetle *Dendroctonus valens*	White Pine	Poultney	Ornamentals.

Root Insects

The Conifer Swift Moth, Korsheltellus gracilis, formerly called the Ghost Moth, continues to be found associated with feeding wounds on the roots of balsam fir and red spruce at high elevations in northern Vermont. A larva was found in the soil around dying spruce and fir, near the summit of Mt. Snow, in early August. Identification was confirmed by the University of Vermont.

A research project on this insect at the University of Vermont, led by Dave Wagner, found that larval density at 3400 feet elevation on Camels Hump averaged 40 per square meter or 160,000 per acre this summer. Similar densities of the insect were found on three other Vermont mountains as well as on Whiteface Mountain in New York and Mt. Mooselauke in New Hampshire. Preliminary results from feeding assays show that early instar larvae will gain weight when fed exclusive diets of either spruce, fir or moss, especially the latter. Although late instar larvae are more common on tree roots, their food preference has not yet been determined. Exclusion experiments in the field, containing planted spruce with and without larvae around the root ball, were conducted this year, but the results have not yet been analyzed. Other experiments planned include feeding preference tests with late instar larvae, determination of adult emergence and parasitism rates, and correlations of severely damaged spruce-fir zones with density of larvae.

Adult moth traps were set out in mid-June, and collected in early August, but no swift moths were trapped. Clusters were in the Mt. Snow stand, and similar stands near the summits of Mt. Equinox and Killington. A cluster consisted of five .25m plexiglass squares, coated with tanglefoot, and erected verticially, with the bottom 6" from the ground. Since 1987 was the off-year for the adult stage in northern Vermont, negative catches do not mean the insect is absent in these locations.

OTHER ROOT INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Broad Necked Root Borer Prionus laticollis		Springfield	Dozens of adults emerging from buried stump in lawn.
Conifer Swift Moth Korsheltellus gracilis			See narrative.
White Grubs Phyllophaga sp.	Various conifers	Essex	Continuing to cause some seeding mortality at state tree nursery.

FOREST DISEASES

Stem Diseases

Beech Bark Disease, caused by Cryptococcus fagisuga and Nectria coccinea var. faginata, was increasingly visible. Lemon-yellow beech crowns were observed during aerial surveys throughout the Green Mountain range. Nectria perithecia were commonly seen.

Scale populations, as indicated by the amount of wax cover, increased in all three of the beech monitoring plots (Figure 3), while tree condition and Nectria fruiting showed no consistent trends.

Data from the Vermont Hardwood Tree Health Survey on dominant/codominant trees show that mortality from past infection was fairly low in 1986 (1.6 percent dead), but 11 percent of the beech trees were severely declining (with more than 50 percent crown dieback), and only 55 percent were healthy. Only American elm had a lower percentage of trees healthy. Not all the dieback is due to Beech scale-Nectria. Lecanium scale and Oystershell scale, particularly the latter, is contributing to the observed crown dieback.

Butternut Canker, caused by Sirococcus clavigignenti-jugland-acearm, (Figure 4) was found to be the cause of heavy mortality in one stand in Berlin discovered late in 1986 and has since been detected causing dieback and mortality of butternut in Craftsbury, Lyndon, and Pomfret.

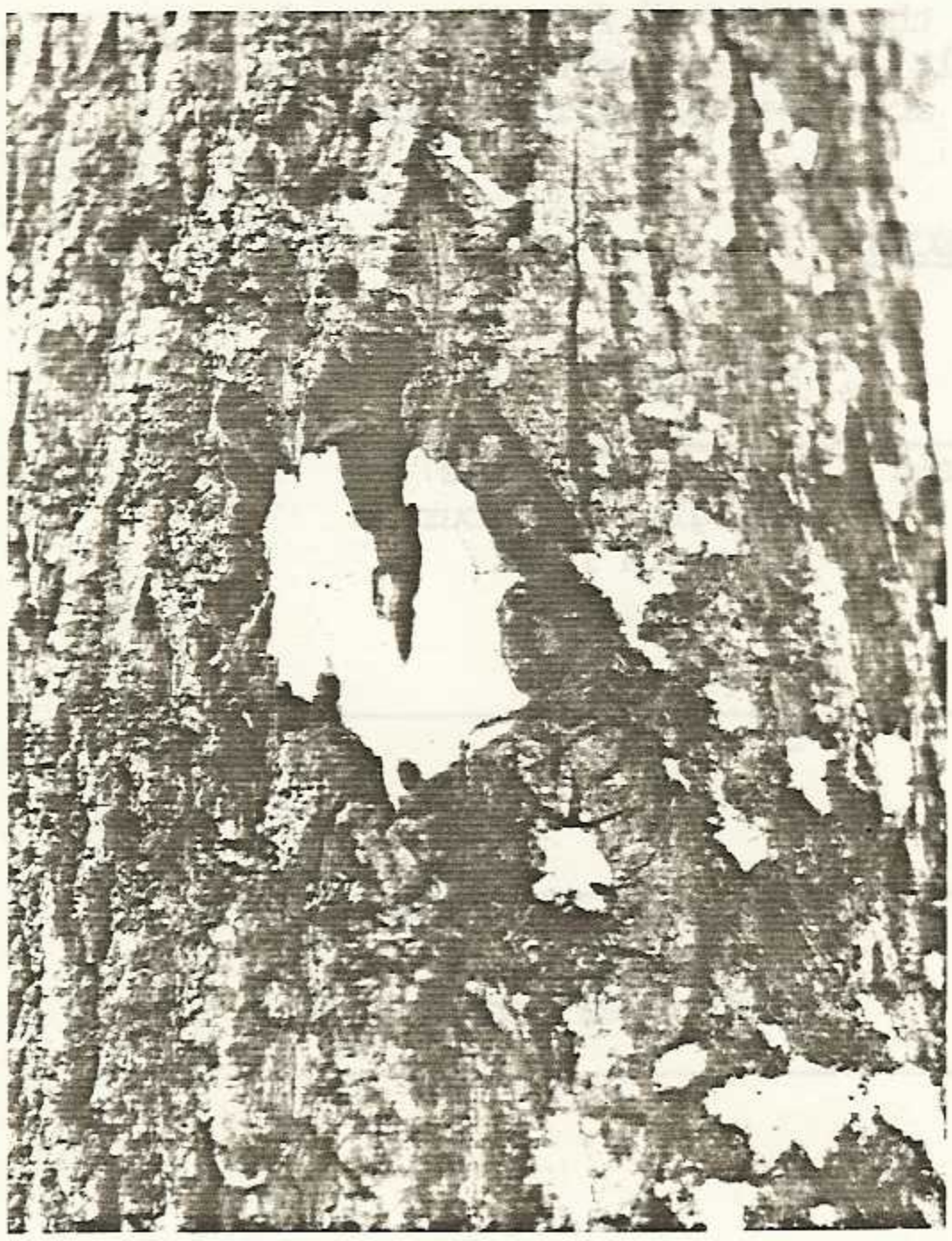


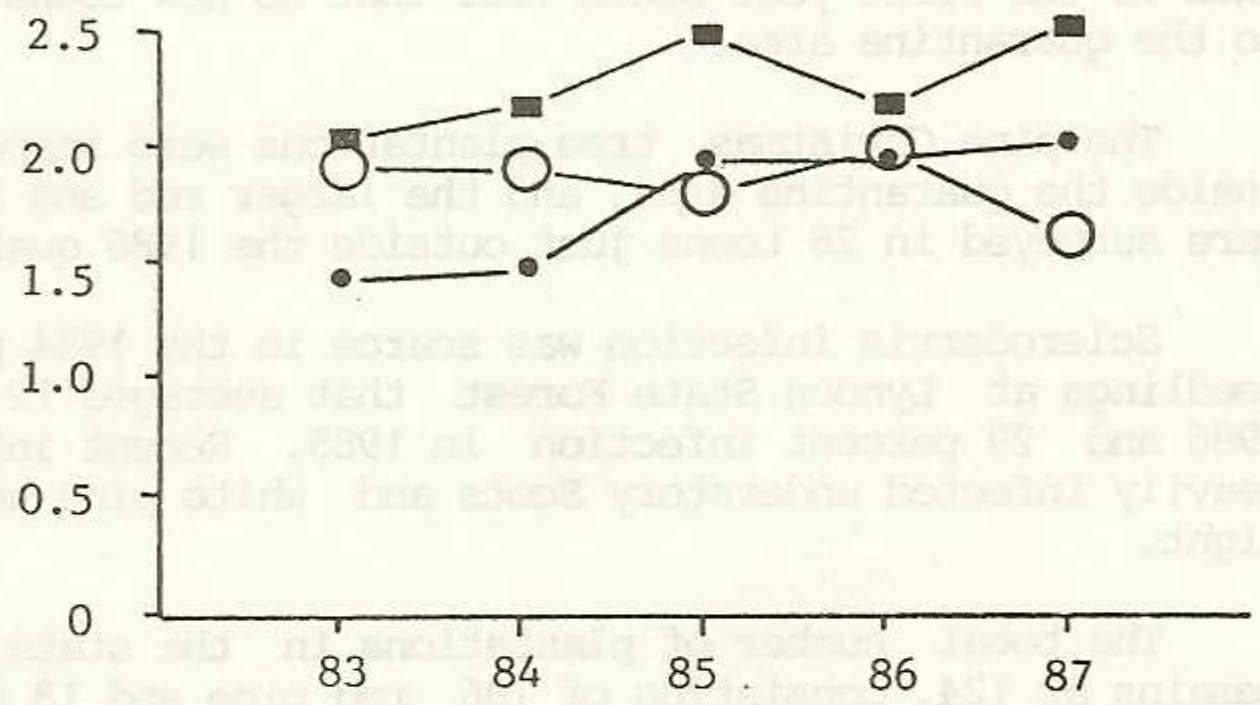
Figure 4. Butternut Canker with the bark partially removed to reveal the characteristic black wood behind a bleeding stem canker.

Figure 3. Summary of Beech Bark Disease Monitoring Plots 1983-1987

Plot Location: • Sherburne ○ Ludlow ■ Woodford

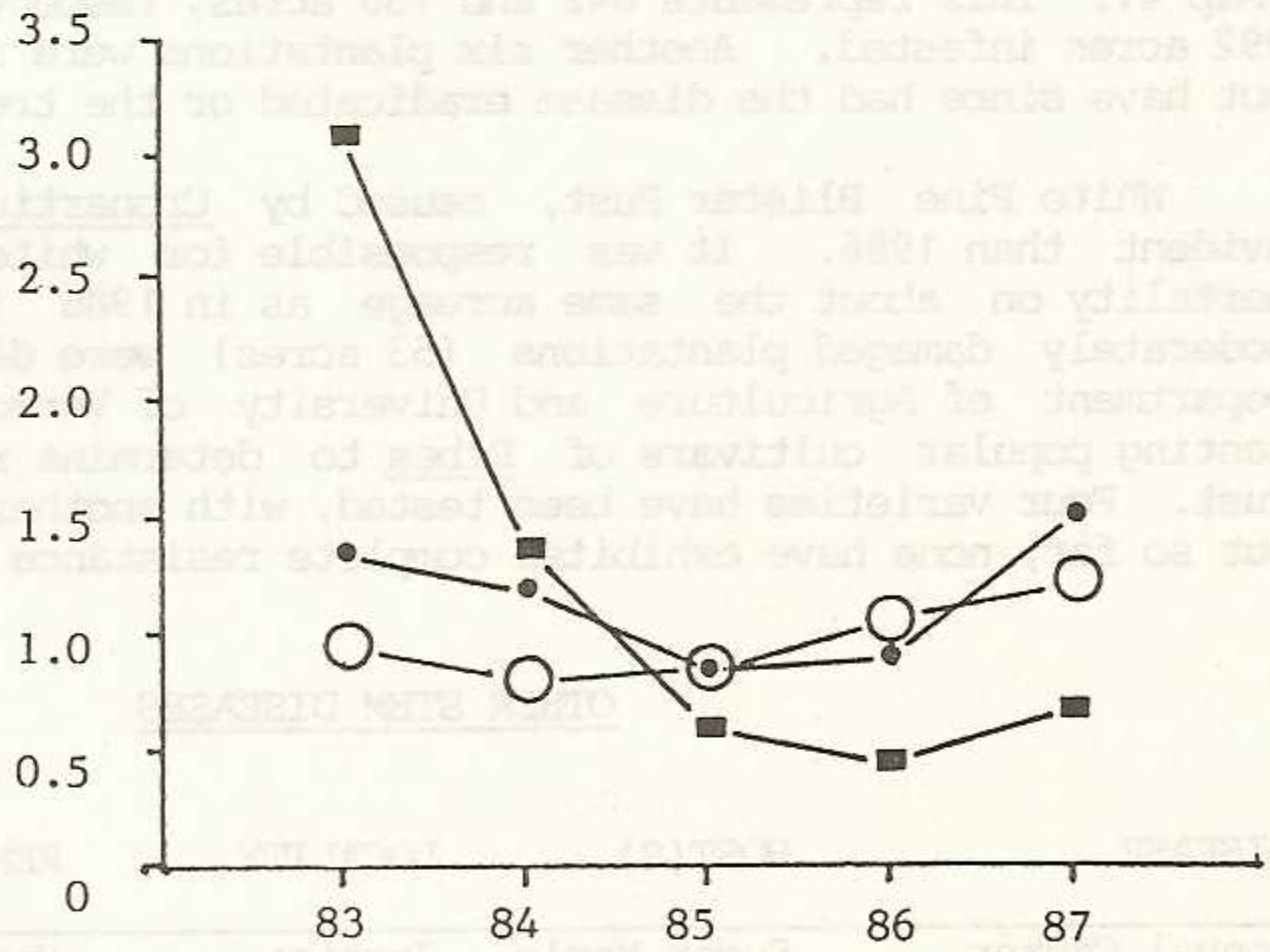
Average Tree Condition

1 Good
2 Fair
3 Poor
4 Dead



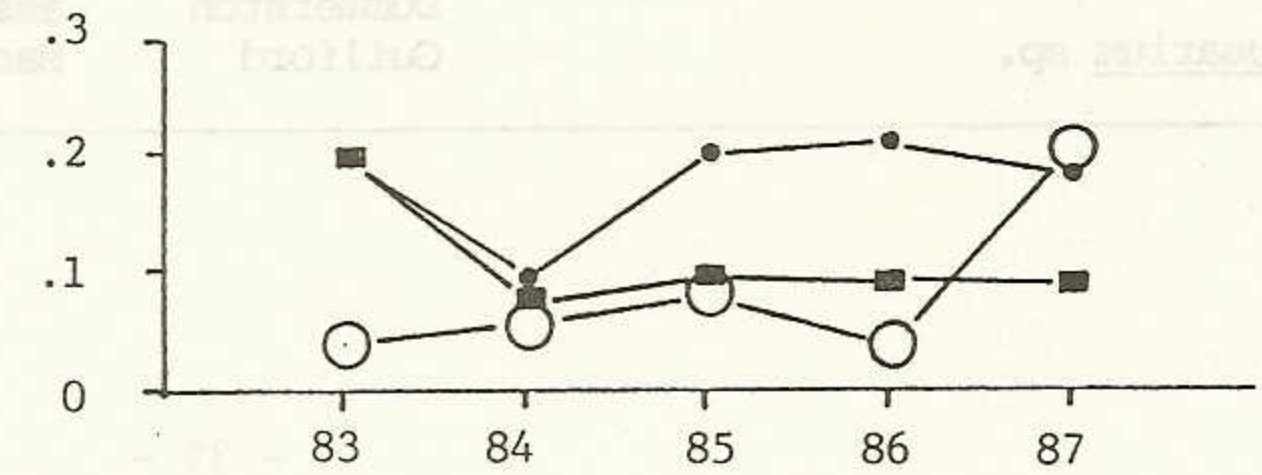
Average Wax Cover

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



Average Nectria Fruting

0 Absent
1 Sparse
2 Moderate
3 Heavy
4 Very Heavy



Year

Dutch Elm Disease, caused by Ceratocystis ulmi, cased a greater than usual amount of mortality again this year. 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.

Scleroderris Canker, caused by Ascocalyx abietina (formerly Gremmeniella abietina), was not found in any previously uninfected plantations this year during a survey of 53 Christmas tree plantations and 134 red and Scots pine plantations. New infections were difficult to find in many of the plantations that were heavily infected in the past. This is the first year since 1983 that no new towns will have to be added to the quarantine area.

The pine Christmas tree plantations were inspected within 28 towns inside the quarantine area, and the larger red and Scots pine plantations were surveyed in 28 towns just outside the 1986 quarantine zone.

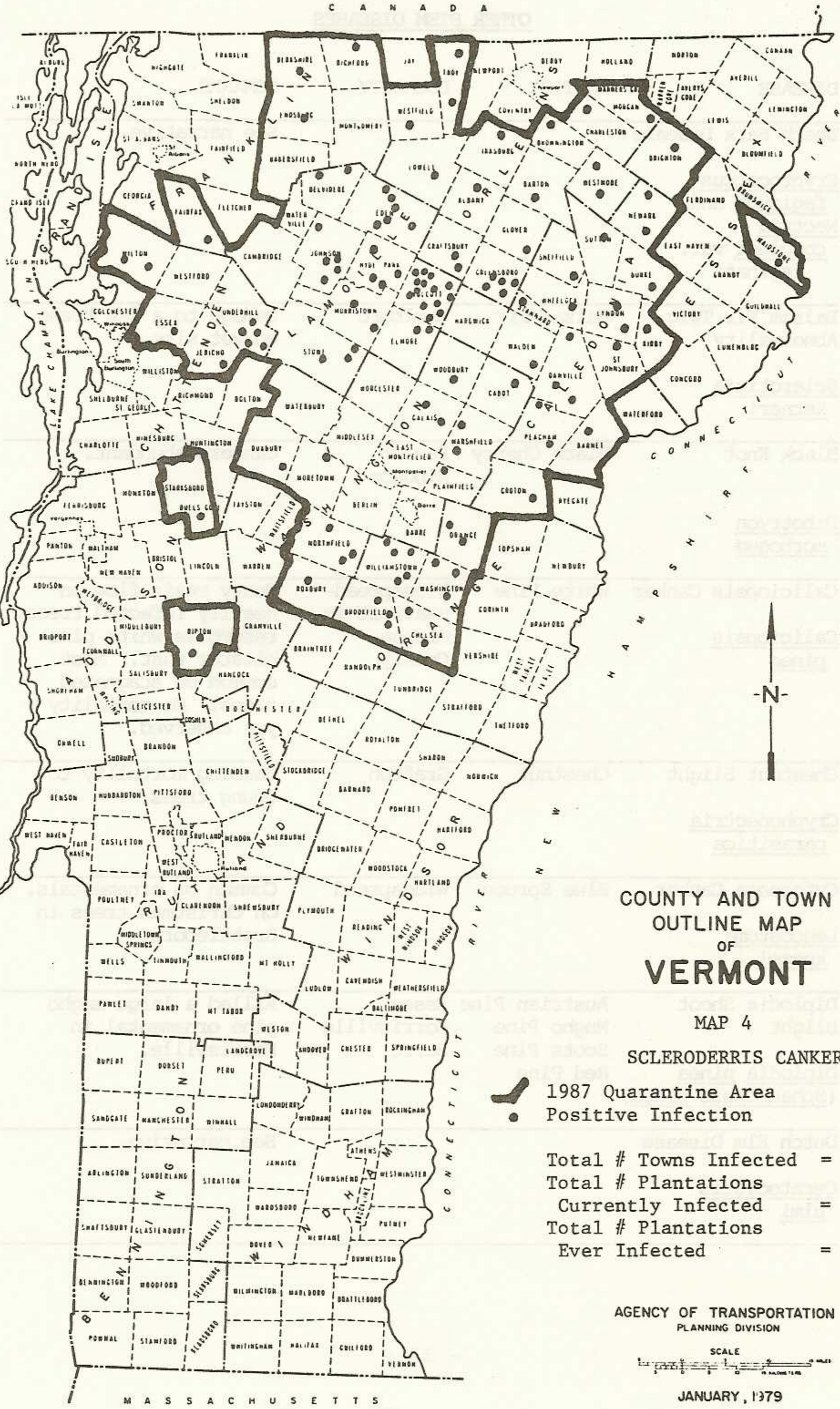
Scleroderris infection was scarce in the 1984 planting of white pine seedlings at Lyndon State Forest that averaged 12 percent infection in 1986 and 29 percent infection in 1985. Recent infection of previously heavily infected understory Scots and white pine here was also extremely light.

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 (Map 4). This represents 842 and 150 acres, respectively, for a total of 992 acres infested. Another six plantations were infected at one time, but have since had the disease eradicated or the trees cut.

White Pine Blister Rust, caused by Cronartium ribicola, was more evident than 1986. It was responsible for white pine Christmas tree mortality on about the same acreage as in 1986 (109 acres), but more moderately damaged plantations (53 acres) were detected. The Vermont Department of Agriculture and University of Vermont are cooperatively testing popular cultivars of Ribes to determine resistance to blister rust. Four varieties have been tested, with another 10 planned for 1988, but so far, none have exhibited complete resistance to infection.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Annual Canker Fusarium sp.	Sugar Maple	Jamaica Dummerston Guilford	Heavy cankering associated with Taconic-Macomber soils.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

MAP 4

SCLERODERRIS CANKER

1987 Quarantine Area

Positive Infection

Total # Towns Infected = 64

Total # Plantations Currently Infected = 124

Total # Plantations Ever Infected = 130

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SCALE

JANUARY, 1979

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Beech Bark Disease Cryptococcus fagisuga and Nectria coccinea var. faginata			See narrative.
Balsam Fir Twig Abnormality Sclerotinia kerneri	Balsam Fir	Marlboro	Damage to a few trees on wet site.
Black Knot Dibotryon morbosum	Black Cherry	Pawlet Windsor	Cankers abundant.
Caliciopsis Canker Caliciopsis pinea	White Pine	Widespread-heaviest in Orange County	Heavy resin flow on heavily infected trees, resembles white pine blister rust. Most common on stagnated trees. No mortality yet observed.
Chestnut Blight Cryphonectria parasitica	Chestnut	Grafton	Causing mortality to young trees.
Cytospora Canker Leucostoma kunzei	Blue Spruce	Widespread	Common on ornamentals. On Christmas trees in Brattleboro.
Diplodia Shoot Blight Diplodia pinea (Sphaeropsis pinea)	Austrian Pine Mugho Pine Scots Pine Red Pine	Essex Morrisville Barre	Killed a large mugho pine ornamental in Morrisville.
Dutch Elm Disease Ceratocystis ulmi			See narrative.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Eastern Dwarf Mistletoe *Arceuthobium pusillum*	Red Spruce		No new locations discovered.
Fir Broom Rust *Melampsorella caryophyllacearum*	Balsam Fir	Plymouth	Brooms common, caused death of a single tree.
Fireblight *Erwinia amylovora*	Mountain Ash Crabapple	Widespread	Common again this year in northern Vermont. Intensity increased by fertilization.
Hypoxylon Canker *Hypoxylon pruinatum*	Quaking Aspen	Throughout	Light to moderate mortality.
Nectria Canker *Nectria galligena*	Norway Maple	Poultney	Ornamentals.
Oak Wilt *Ceratocystis fagacearum*	Oaks	Absent	No suspects seen by trained observers during aerial flights.
Red Ring Rot *Phellinus pini*	White Spruce Red Spruce Norway Spruce	Cavendish Brookline Shrewsbury Chester Hartland	Associated losses in timber value sometimes extensive.
Sapstreak *Ceratocystis coerulescens*	Sugar Maple	Coventry Landgrove Whitingham	Associated with wounded trees in sugarbushes, especially on shallow soil. Sapstreak symptoms common in Washington and Orange Counties, but causal agent not confirmed.
Scleroderris Canker *Asocalyx abietina*			See narrative.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Sirococcus Shoot Blight *Sirococcus strobilinus*	Red Pine	Plainfield	Strongly suspected as the cause of regeneration mortality in Jones' State Forest (Figure 5).

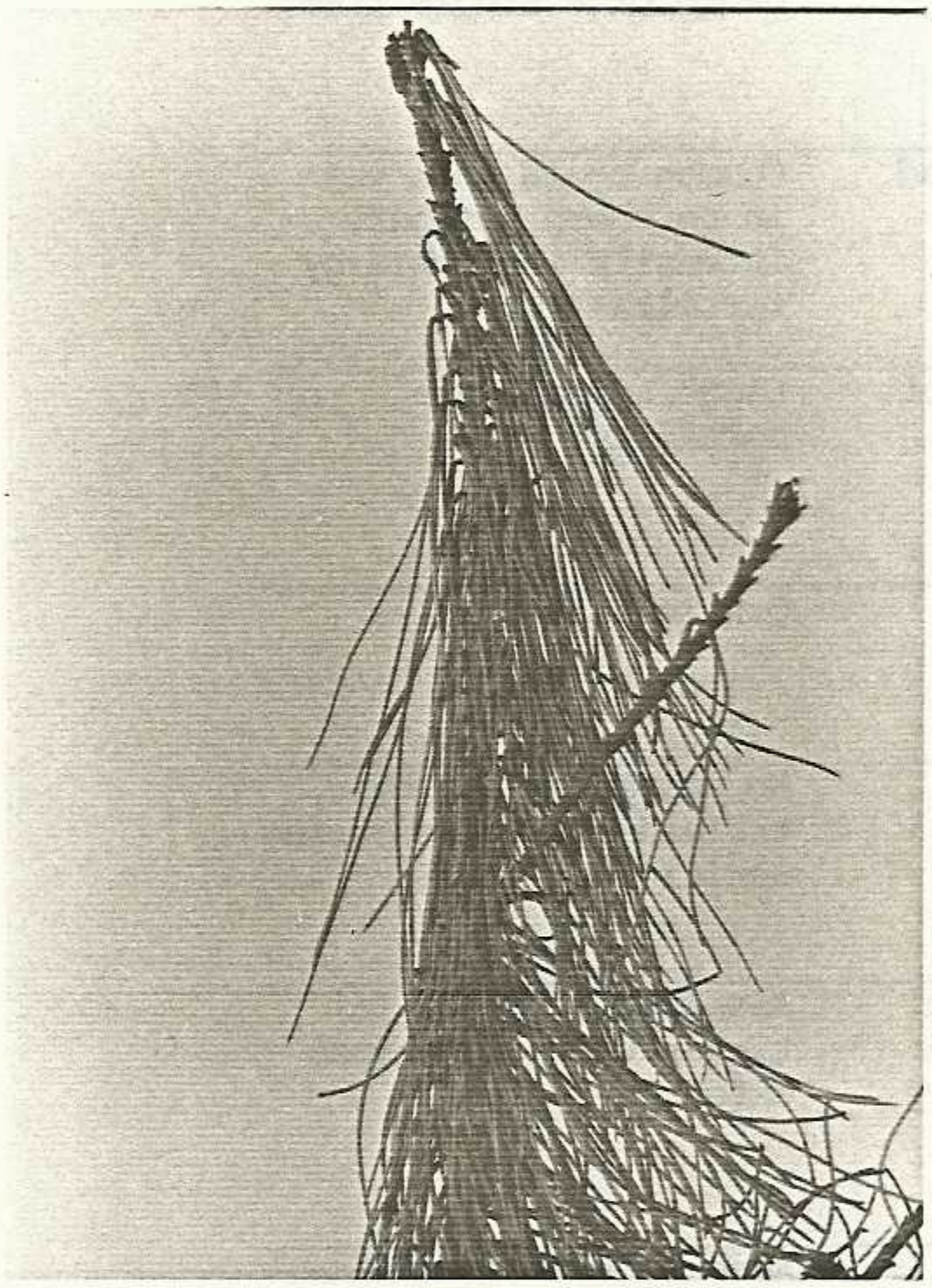


Figure 5. Sirococcus Shoot Blight of red pine, showing the characteristic drooping of needles on an infected branch.

Verticillium Wilt *Verticillium albo-atrum* or *V. dahliae*	Sugar Maple	Craftsbury	Killed an ornamental.
Woodgate Gall Rust *Endocronartium harknessii*	Scots Pine	Widespread	Detected in 16 Christmas tree plantations comprising 233 acres. About 100 acres had heavy shoot and branch mortality similar to 1986.

Foliage Diseases

Foliage diseases that were common during the past few years were much reduced this year, with a return to drier weather.

FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Anthracnose *Gloeosporium* spp.	Sugar Maple	Lamoille Washington Orange Counties	Light damage only.
Cedar-Apple Rust *Gymnosporangium juniperi-virginianae*	Eastern Red Cedar Apple	Chittenden	More reports than in 1986.
Cyclaneusma Needlecast (formerly Naemacyclus) *Cyclaneusma minus*	Scots Pine	Widespread	Christmas tree damage is mostly light. Study initiated to determine infection period and spray timing in Vermont.
Fir-Fern Rust *Uredinopsis mirabilis*	Balsam Fir	Widespread in northern Vermont	Dropped to very light levels in Christmas tree plantations this year.
Lophodermium Needlecast *Lophodermium seditiosum*	Scots Pine	Widespread in scattered locations	Mostly light damage to Christmas trees, similar to 1986 levels.
Rhabdocline Needlecast *Rhabdocline pseudotsugae*	Douglas Fir Christmas trees	Scattered	Needle blotch showed up in winter. Damage was occasionally heavy. Affected needles dropped by late June. Fungicide provided good protection to new foliage.
Rhizosphaera Needlecast *Rhizosphaera kalkhoffi*	Blue Spruce	Widely scattered in northern Vermont.	Causing light to moderate needle loss in a few Christmas tree plantations. Not increasing.

FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Sooty Mold Perisporiaceae	Ornamentals Christmas trees Lower crowns of overstory trees	Throughout	Commonly heavy this year because of aphid infestations.
Swiss Needlecast Phaeocryptopus gaumani	Douglas Fir	Widespread in northern Vermont	Causing heavy damage to scattered Christmas tree plantations. More common than Rhabdocline, in the northern portions of the state.
Tar Spot Rhytisma acerinum Rhytisma punctatum	Red Maple Silver Maple Sugar Maple		Not detected despite abundance in 1986.

Root Diseases

Annosus Root Rot, caused by Heterobasidion annosum, was found in two new locations, causing mortality of red pine in small areas of Jones' State Forest in Plainfield and Coolidge State Forest in Plymouth.

Feeder Root Rot, caused by Pythium sp., was associated with dying Fraser fir Christmas trees in Weston. The fungus may be a secondary organism, since the trees were already stressed by the shallow, poorly drained site. Identification of the fungus was done by Dr. Robert Bruck at North Carolina State University.

Shoestring Root Rot, caused by Armillaria spp., continues to be common on declining trees. It was associated with stand opening in spruce stagnated beyond age 40 in Chester, Shrewsbury and Windham, and post-logging decadence of hemlock in Windsor and Vernon. In one sugarbush in Sharon, basal bleeding on several dozen trees occurred in an area where Armillaria was fruiting. The cause of stress in that sugarbush is unknown.

Shoestring Root Rot was also found to be killing scattered balsam fir Christmas trees within plantations in Dummerston, Johnson, Windham, and Walden. The problem usually occurs where trees are adjacent to stumps, particularly hardwood stumps. Where this is a problem of seedlings next to stumps of cut Christmas trees, interplanting of seedlings prior to cutting of nearly mature adjacent trees should reduce the mortality. This allows the new seedlings to become established before Armillaria becomes abundant in new stumps, making them more resistant.

Some additional mortality was discovered among the white pine seedlings planted in 1984 at Lyndon State Forest. Armillaria infection of scattered seedlings first became noticeable here in 1986, associated with stumps of cut pine.

DIEBACKS, DECLINES & ENVIRONMENTAL DISEASES

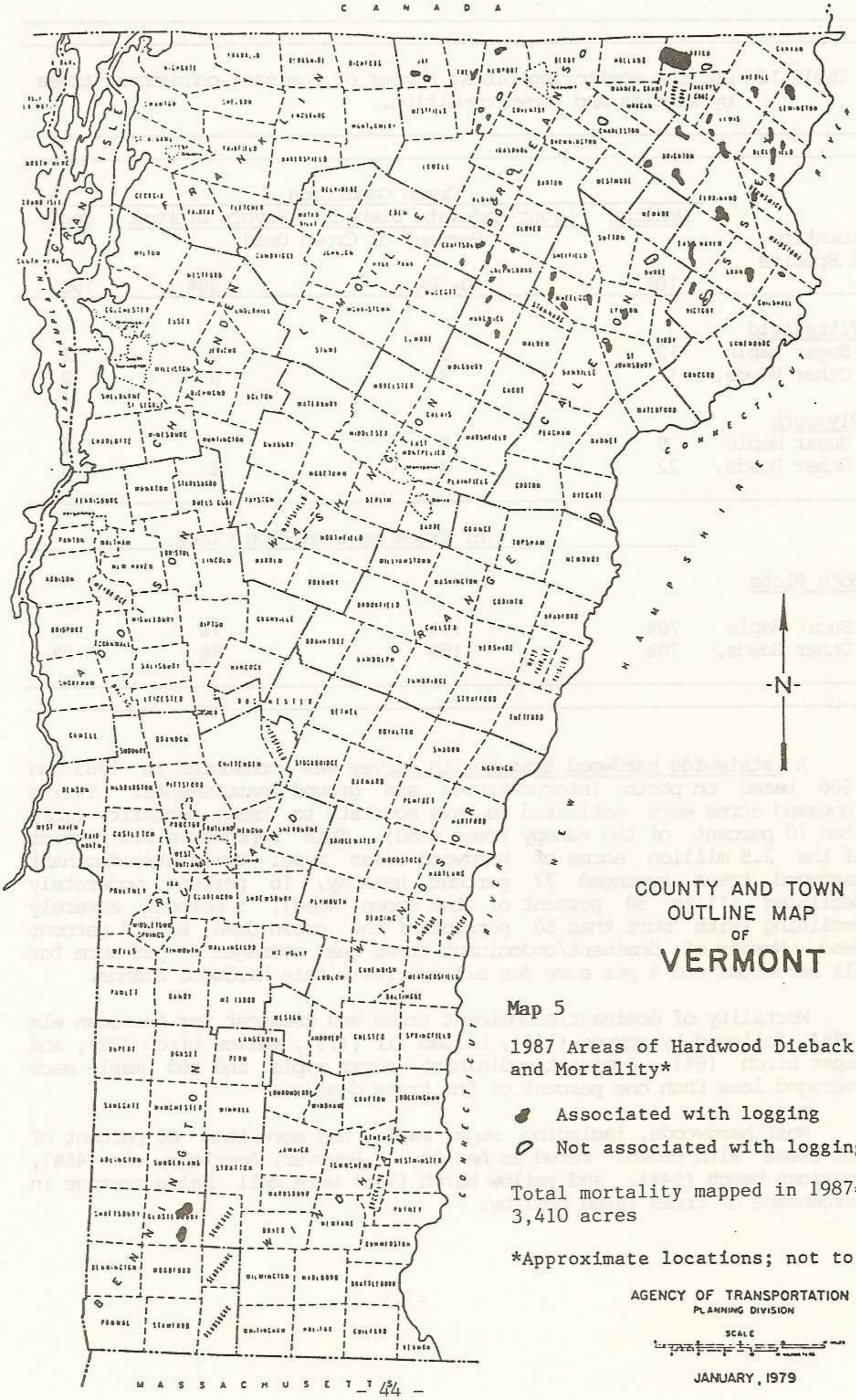
Hardwood Decline of a number of species remains a major concern in the state. Over 3,000 acres of hardwood decline were detected in Bennington, Caledonia, Essex, and Orleans Counties during the annual aerial survey, but most of this was associated with past logging (Table 11, Map 5). Declining trees had either been damaged during logging or were cull trees that had been left because of their poor quality. Most of the cull trees had decay present at the time of logging.

Table 11. Acres of hardwood dieback and mortality.

County	Associated with logging	Not associated with logging	Total
Bennington	990	-	990
Caledonia	310	90	400
Essex	1,280	40	1,320
Orleans	480	220	700
Total	3,060	350	3,410

Hardwood decline areas not associated with logging were either sugarbushes, areas previously defoliated by forest tent caterpillar, or areas containing a lot of beech dieback due to scale insects and Beech Bark disease.

Permanent decline monitoring plots were established, in two known areas of heavy dieback, to monitor changes in stressed stands. The protocol used was that of the 1986 Hardwood Health Survey. Tree condition in those plots is summarized in Table 12.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

Map 5

1987 Areas of Hardwood Dieback and Mortality*

- Associated with logging
- Not associated with logging

Total mortality mapped in 1987= 3,410 acres

*Approximate locations; not to scale

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SCALE

JANUARY, 1979

Table 12 Decline monitoring plots: Number of dominant-codominant trees by species and crown condition.

Location & Species	Crown Condition: Healthy	Light-Moderate Dieback	Severe Dieback	Dead
		Percent of Crown Dead		
	<10%	10-50%	>50%	100%
Pittsfield				
Sugar Maple	12	3	0	2
Other Hdwds.	15	4	0	0
Plymouth				
Sugar Maple	9	2	2	0
Other Hdwds.	22	4	4	4
		% of Trees by Condition Class		
Both Plots				
Sugar Maple	70%	17%	7%	7%
Other Hdwds.	70%	15%	8%	8%

A statewide hardwood tree health survey was conducted in 1985 and 1986 based on photo interpretation and ground measurements. Twelve thousand acres were estimated to have moderate to heavy mortality (more than 10 percent of the canopy trees dead). This represents 0.5 percent of the 2.5 million acres of hardwood cover type. Dominant/codominant hardwood trees averaged 77 percent healthy, 16 percent moderately declining (11 to 50 percent of the crown dead), 5 percent severely declining (with more than 50 percent of the crown dead) and 2 percent dead. Number of dominant/codominant trees dead averaged 3 per acre for all hardwoods and 4 per acre for all species within hardwood stands.

Mortality of dominant/codominant trees was greatest for American elm (34%), followed by spruce (14%), balsam fir (11%), yellow birch (7%), and paper birch (6%). Dominant/codiminant sugar maple and red maple each averaged less than one percent of the trees dead.

Most hardwoods, including sugar maple, had more than 80 percent of the trees with crowns rated as healthy. However, American elm (48%), American beech (54%), and yellow birch (70%) were well below average in percentage of trees rated healthy.

The number and volume of dead trees is not considered alarming and appears similar to that reported in past surveys. However, nearly 21 percent of all living dominant/codominant hardwoods had crown dieback in excess of 10 percent. This seems higher than expected, but most of this dieback is light enough that the trees should be able to recover is environmental stresses are reduced.

Additional data from the survey specific to certain tree species can be found under Beech Bark Disease, Dutch Elm Disease, Birch Decline, and Red Spruce Decline in this report.

This survey provides the baseline data against which future survey results can be compared so that conclusions on tree condition trends can then be made. A report on the survey results has recently been completed and is available from the Department.

ASH DIEBACK and mortality remains a problem throughout the state. it was detected during aerial surveys on 1370 acres in Bennington County (Map 6). Ash dieback is most common in southern Vermont and the Champlain Valley, with some dieback in the central part of the region, and very little dieback in the Northeast Kingdom.

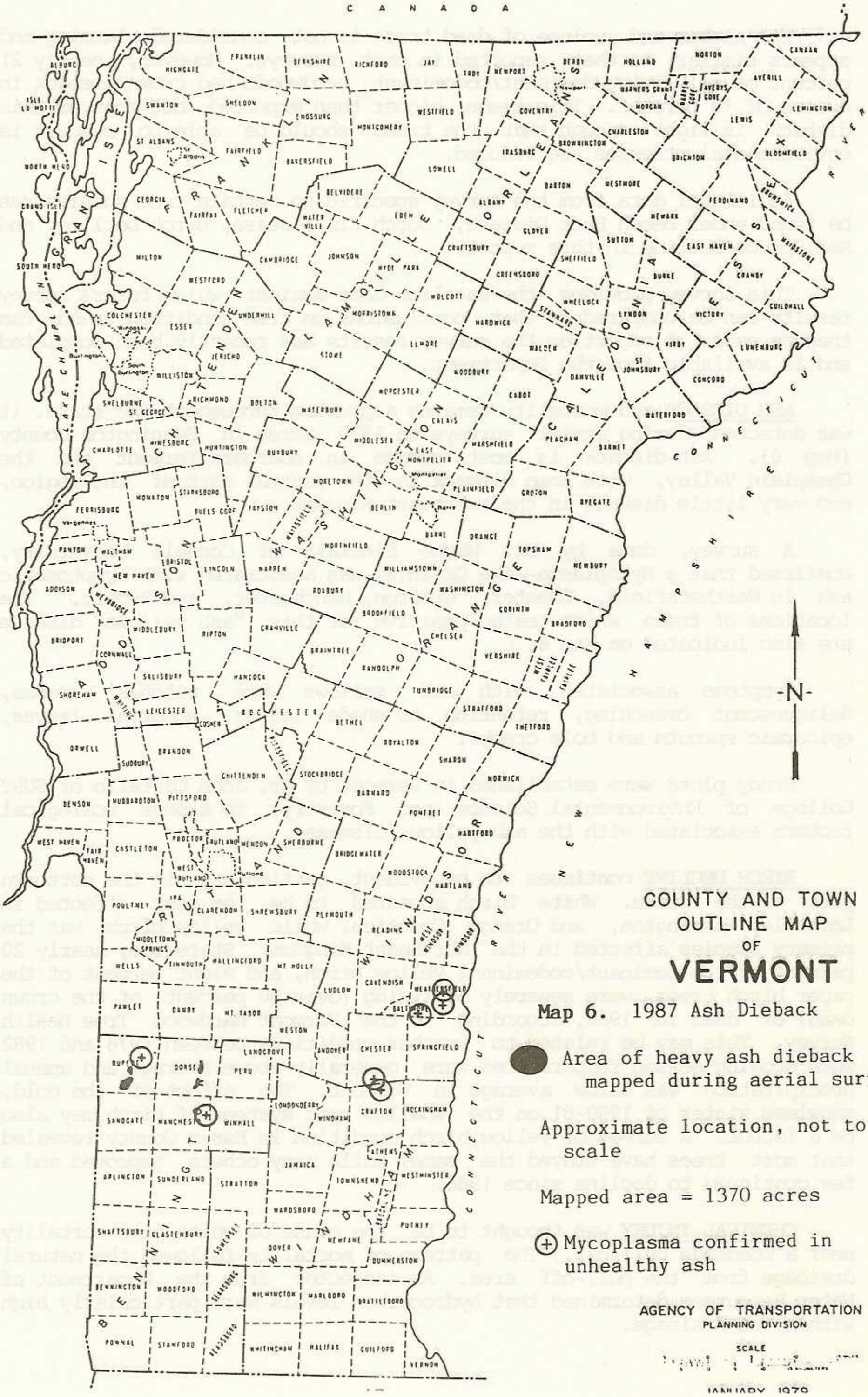
A survey, done by Dr. Wayne Sinclair of Cornell University, confirmed that a Mycoplasma-like Organism was associated with symptomatic ash in Weathersfield, Chester, Grafton, Manchester, and Rupert. The locations of trees which tested positive for this "ash yellows" disease are also indicated on Map 6.

Symptoms associated with ash yellows were witches' brooms, deliquescent branching, retention of shade leaves, abnormal leaves, epicormic sprouts and bole cracks.

Study plots were established in Vermont by Dr. John Castello of SUNY College of Environmental Science and Forestry, to assess ecological factors associated with the ash yellows disease.

BIRCH DECLINE continues to be evident, particulary in the northern part of the state. White birch appeared to be the most affected in Lamoille, Washington, and Orange Counties, while yellow birch was the primary species affected in the Northeast Kingdom. Statewide, nearly 20 percent of the dominant/codominant yellow birch, and eight percent of the paper birch trees were severely declining (over 50 percent of the crown dead) or dead in 1986, according to the Vermont Hardwood Tree Health Survey. This may be related to weather conditions between 1978 and 1982 when growing season temperatures were generally above average and annual precipitation was below average in Vermont. The effect of the cold, snowless winter of 1980-81 on the shallow root systems of birch may also be a factor. A survey of yellow birch condition in Essex County revealed that most trees have stayed the same, while many others improved and a few continued to decline since 1986.

CHEMICAL INJURY was thought to be the cause of white pine mortality near a roadside pull-off. The pattern of mortality followed the natural drainage from the pull-off area. An inspector from the Department of Water Resources determined that hydrocarbon levels were particularly high within the drainage.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

Map 6. 1987 Ash Dieback

● Area of heavy ash dieback mapped during aerial surveys

Approximate location, not to scale

Mapped area = 1370 acres

⊕ Mycoplasma confirmed in unhealthy ash

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PLANNING DIVISION

SCALE

JANUARY 1979

FROST DAMAGE occurred again this year from several late May frosts, but damage was much lighter than in 1986. Some nursery beds at the state tree nursery in Essex received significant damage. Frost damage to forest stands was most prevalent at higher elevations in the Northeast Kingdom. Frost injury to balsam fir Christmas trees was recorded for 24 plantations, comprising 308 acres. Damage was mostly light to moderate except for a 20 acre plantation in Bakersfield that was heavily damaged. The cumulative effect of damaging the same trees that were heavily damaged last year in some locations resulted in some very poor-looking trees that will require at least another year to recover.

HAIL INJURY from a storm on May 31, with 50 mph winds and two-inch hailstones, damaged plant shoots in Williston, Essex, and Jericho. Another such storm in late July caused moderate to heavy defoliation of over 40 acres of hardwood in the Cram Hill area of Roxbury State Forest.

HERBICIDE INJURY to scattered ornamentals was reported in urban areas of Chittenden County, mostly due to the use of Scotts +2.

IMPROPER PLANTING was the primary cause of problems to numerous shade trees and some highway interchange plantings in Caledonia County, as well as some scattered Christmas tree plantings throughout the state.

LARCH DECLINE appears to be expanding in many stands with previous decline, following several years of decreasing intensity. Increasing damage was most noticeable in Orange, Caledonia, Orleans, and Essex Counties and may be related to the dry summer weather. Fifty-three acres of larch decline were aerially mapped in the Northeast Kingdom, but actual acreage exceeds this amount.

MAPLE DECLINE continues to be a concern to sugarbush owners, shade tree owners, and other woodlot owners. Maples looked thin thoughout Bennington and Windham Counties, and in southern portions of Rutland and Windsor Counties due to scales, aphids, and pear thrips.

Ninety-one acres of sugarbush decline was reported for Orleans County, but most of this was attributed to improper sugaring practices. A stand of unhealthy sugar maples in Plymouth was stressed by a wet site. A sugarbush in Bethel was stressed by thinning, which dramatically opened up the stand. The cause of widespread Armillaria infection in a sugarbush in Sharon is unknown.

A variety of stress factors can be identified in most problem areas, including soil drainage, weather factors due to topography and aspect, past defoliation, site and stand character changes, poor sugaring practices, and off-site. Improper planting practices are also associated with decline of some shade trees. Many trees that exhibited dieback during the recent past appeared to be recovering this year.

A laboratory examination of 20 sugar maple increment cores from a dieback area in Belvidere that was defoliated by forest tent caterpillar in 1980-82, showed that most trees with less than 25 percent crown dieback had begun a growth recovery in 1985 or 1986, following a dramatic slow-down in growth between 1982 and 1985.

A pilot project to provide root starch analysis to landowners was initiated, involving a dozen sugarbushes and sugar maple stands. Six to twelve trees in each stand were chosen by early September, and their crowns were rated. Trees were selected because they represented the overall health of the stand. Starch samples were taken after leaf fall. This project will continue in 1988.

RED MAPLE DECLINE was noticeable in parts of southern Vermont, associated with a heavy seed crop.

RED SPRUCE DECLINE continues throughout the state, particularly on high-elevation sites. Spruce decline was aerially detected on 300 acres in Essex County. Red spruce, with 68 percent healthy, was the only conifer occurring in hardwood stands that did not have nearly 90 percent of the dominant/codominant trees healthy during the Vermont Hardwood Tree Health Survey. Research being conducted by Don DeHays at the University of Vermont, shows that red spruce is much less genetically diverse than other conifers investigated and, therefore, may be less able to adapt to environmental changes.

SNOW DAMAGE was severe following a storm on October 4 which dumped up to 16" of snow, accompanied by high winds (Figure 6). Bennington County was hardest hit, although breakage and windthrow occurred in scattered locations throughout the state.

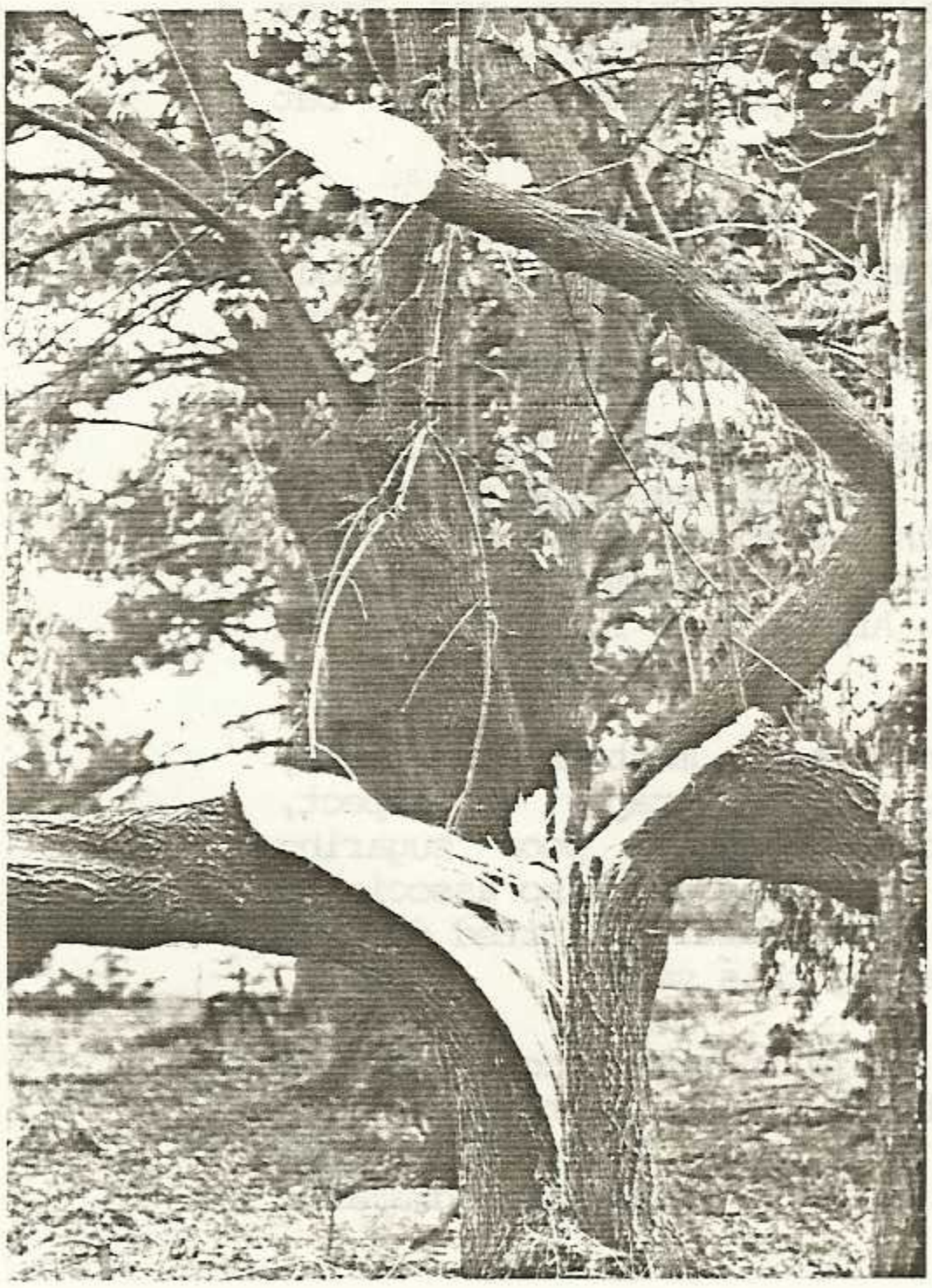


Figure 6. Severe damage caused by the October 4 snowstorm.

Damage to forest stands was irregular. Early leaf fall saved many trees, and restricted the worst breakage to elevations below 1200'. Severely affected stands were scattered within a 168,300 acre impact area in 16 towns (Map 7). East-facing slopes had more damage.

Trees of all species were damaged, with the most severe impact on red oak, beech, larch, popple, hickory, boxelder, ash, and willow. Shade trees were hardest hit. Forest trees were more likely to sustain severe damage in recently thinned stands. The pole size-class was the most likely to have serious damage to the mainstem, being too large to bend, but lacking the strength of larger trees.

The storm impact was evaluated in two damaged mixed-hardwood stands in Pownal and North Bennington. Damage was rated according to current and potential affect on tree health and quality as none (no significant effects), light (minimal potential for long-term effects), moderate (potential exists for long-term effects) and severe (tree is already seriously affected). Results are summarized in Table 13.

Table 13. Number of trees by damage rating and species in seven 10 BAF plots.

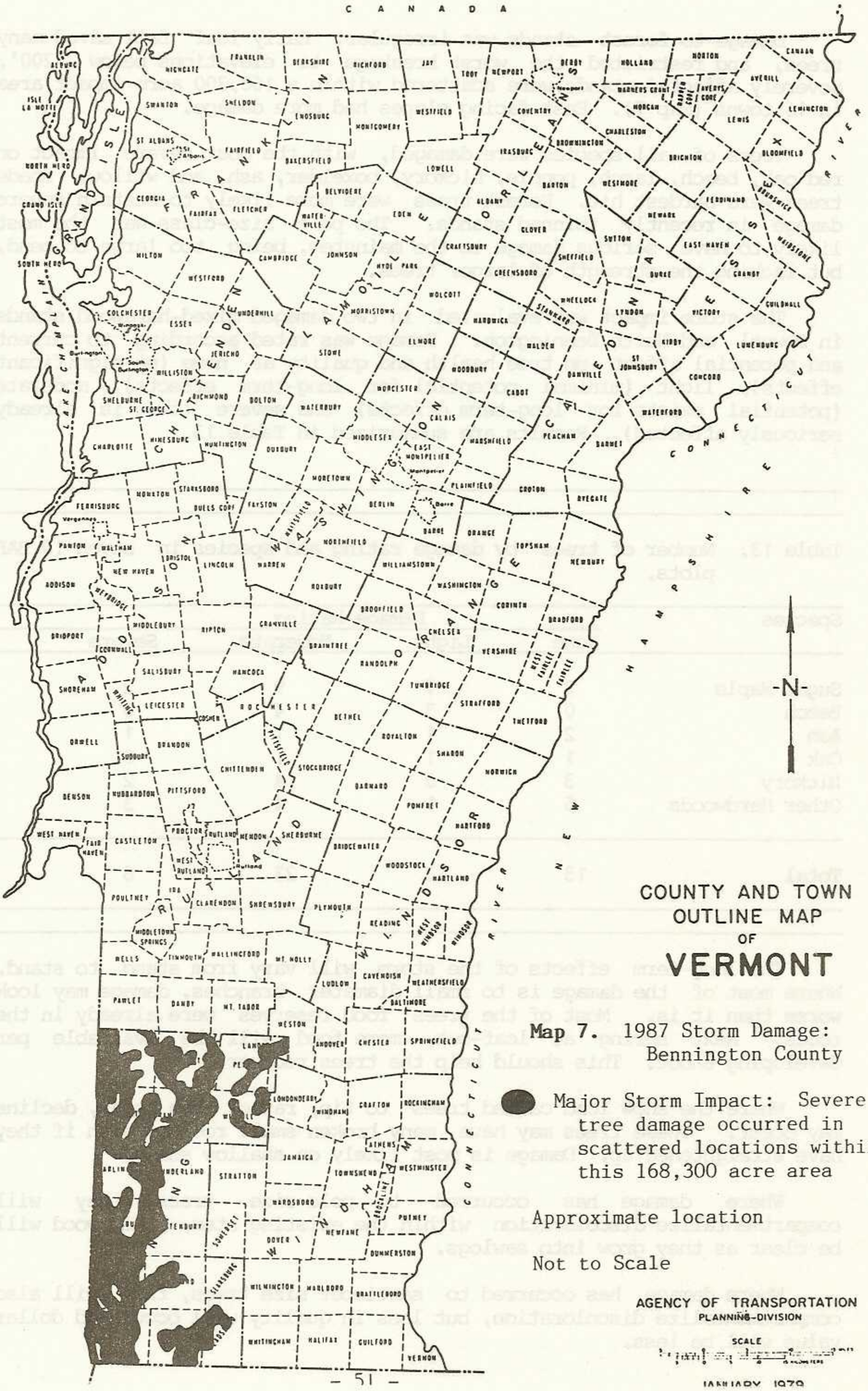
Species	Damage Rating			
	None	Light	Moderate	Severe
Sugar Maple	2	7	9	2
Beech	0	3	4	0
Ash	2	1	1	1
Oak	1	1	1	0
Hickory	3	0	4	2
Other Hardwoods	5	1	4	3
Total	13	13	23	8

The long-term effects of the storm will vary from stand to stand. Where most of the damage is to small diameter branches, damage may look worse than it is. Most of the trees' food reserves were already in the roots. Next spring at leaf-out, more food will be available per developing shoot. This should help the trees recover.

Where the snow load caused trees to tip, rather than break, decline may occur. These trees may have many broken small roots, even if they have straightened up. Damage is most likely on shallow soils.

Where damage has occurred to pole-size trees, they will compartmentalize discoloration within the existing stem. New wood will be clear as they grow into sawlogs.

Where damage has occurred to sawtimber size trees, they will also compartmentalize discoloration, but loss in quality will occur and dollar value will be less.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

Map 7. 1987 Storm Damage: Bennington County

● Major Storm Impact: Severe tree damage occurred in scattered locations within this 168,300 acre area

Approximate location

Not to Scale

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JANUARY 1979

A storm on April 28 dropped 2-12" of snow and damaged trees in the southeastern mountains. Most heavily damaged were willow, red maple, birch, and white pine.

WHITE PINE NEEDLE BLIGHT showed up again in current foliage of scattered pines mostly in southern Vermont. Christmas trees and forest trees were affected. Commonly, browned and unaffected trees would be side by side.

Affected trees have some needles in a fascicle with brown tips, and other needles green. Banding and dwarfing are also symptoms.

Ozone levels measured by the Department of Environmental Conservation show that the federal one hour standard (.12 ppm) was not exceeded during the period between April 1 and June 30. Concentrations of .10 ppm occurred on 6/19 and 6/23. Other high days included 5/11 and 6/29.

Research, being done by Dr. William Merrill at Pennsylvania State University, includes study trees in Vermont. A variety of fungi have been isolated from symptomatic needles.

WHITE PINE BROWNING along highways was mostly salt related. Symptoms are most noticeable in late winter-early spring until brown needles fall off. Trees which have been damaged repeatedly may be completely defoliated.

ANIMAL DAMAGE

ANIMAL	SPECIES DAMAGED	LOCALITY	REMARKS
Beaver		Lye Brook Wilderness	Flooding damage.
Mouse	Scots Pine	Guilford	Christmas trees.
Moose	Hardwoods	Worcester Elmore	Heavy bark stripping reported.
Porcupine	Many	Scattered	Moderate damage to trees on private land in Marshfield from colony on state land. Populations building in District III.
Sapsucker	Ornamental Spruce, Larch	Springfield Rockingham	
Squirrel	Maple Tubing Balsam Fir Seed at State Nursery	Widespread	A few complaints but damage down from past years. A 1986 survey conducted by D. Howard and N. Pelsue from the University of Vermont concludes that annual damage to maple tubing systems in Vermont exceeds $200,000 (Agr. Exp. Sta. UVM Res. Rept. 52, June 1987).