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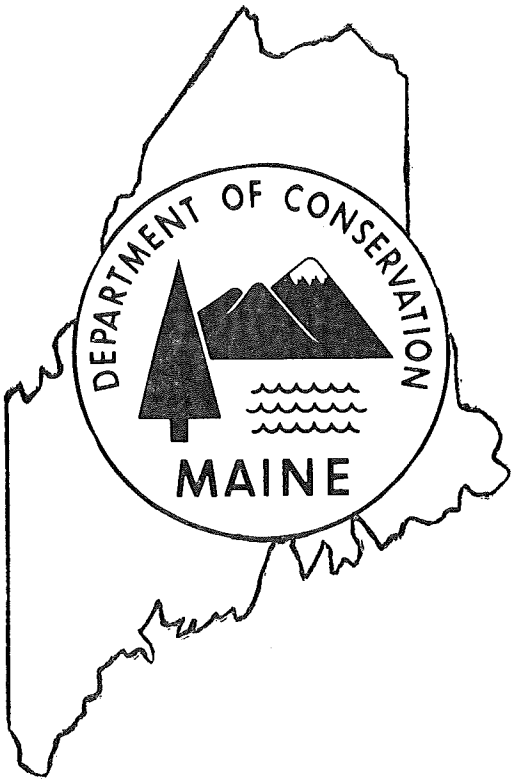
FOREST & SHADE TREE INSECT & DISEASE CONDITIONS

FOR MAINE

A Summary of the 1989 Situation



Insect & Disease Management Division
Summary Report No. 4
March 1990

Maine Forest Service
MAINE DEPARTMENT OF CONSERVATION
Augusta, Maine

MAINE

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Forest & Shade Tree Insect & Disease Conditions for Maine
A Summary of the 1989 Situation

C O N T E N T S

Cont'd.

C O N T E N T S
(Continued)

Quick Finder Index
(For Major Pests and Programs other than special reports)

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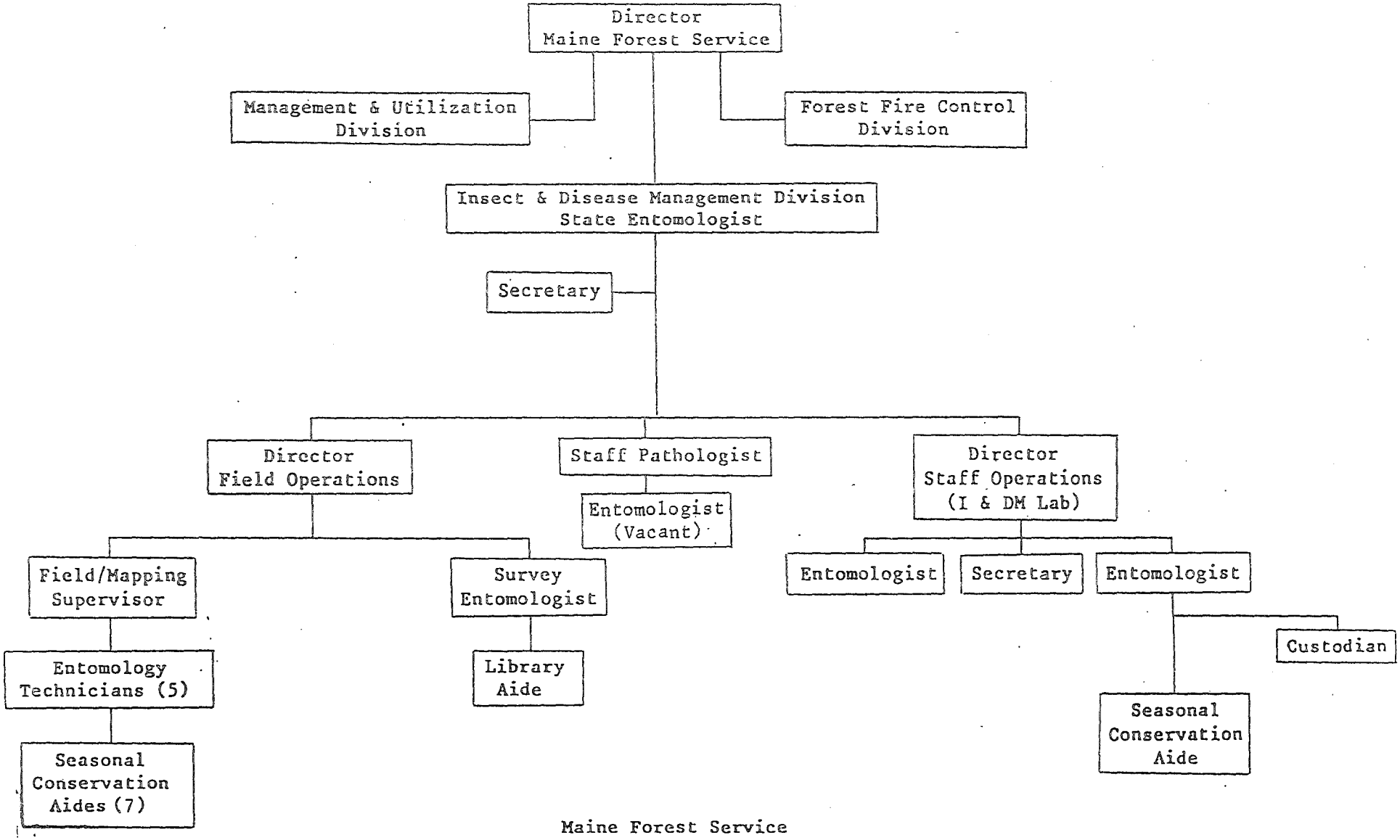
FOREST & SHADE TREE INSECT & DISEASE CONDITIONS FOR MAINE
A SUMMARY OF THE 1989 SITUATION

Insect and disease problems encountered over the past year continued to provide challenges and frustrations as well as surprises, and as usual the year ended with a few potentially serious problems and some welcome relief from others. Bark beetles on spruce and larch probably pose the most serious and widespread current threats to the forest resources of the State, although some specific pests such as gypsy moth, hemlock looper, shoestring root rot and white pine blister rust are certainly of major concern. Christmas tree growers continue to suffer losses due to various pests and physiological problems. Some of the long standing problems of the past such as spruce budworm, saddled prominent and scleroderris canker have either dropped to or remain at very low levels while the hemlock woolly adelgid has not yet reached Maine. Gypsy moth seemed to experience a resurgence while the late season hardwood defoliator complex diminished in intensity. The pinewood nematode continues to show up in new areas as surveys continue. The European larch canker was found in one new town in 1989. The newcomer to the problem scene in 1989 was the hemlock looper. Others such as white pine weevil, white pine blister rust, various hardwood defoliators and a number of foliage diseases continued at roughly 1988 levels.

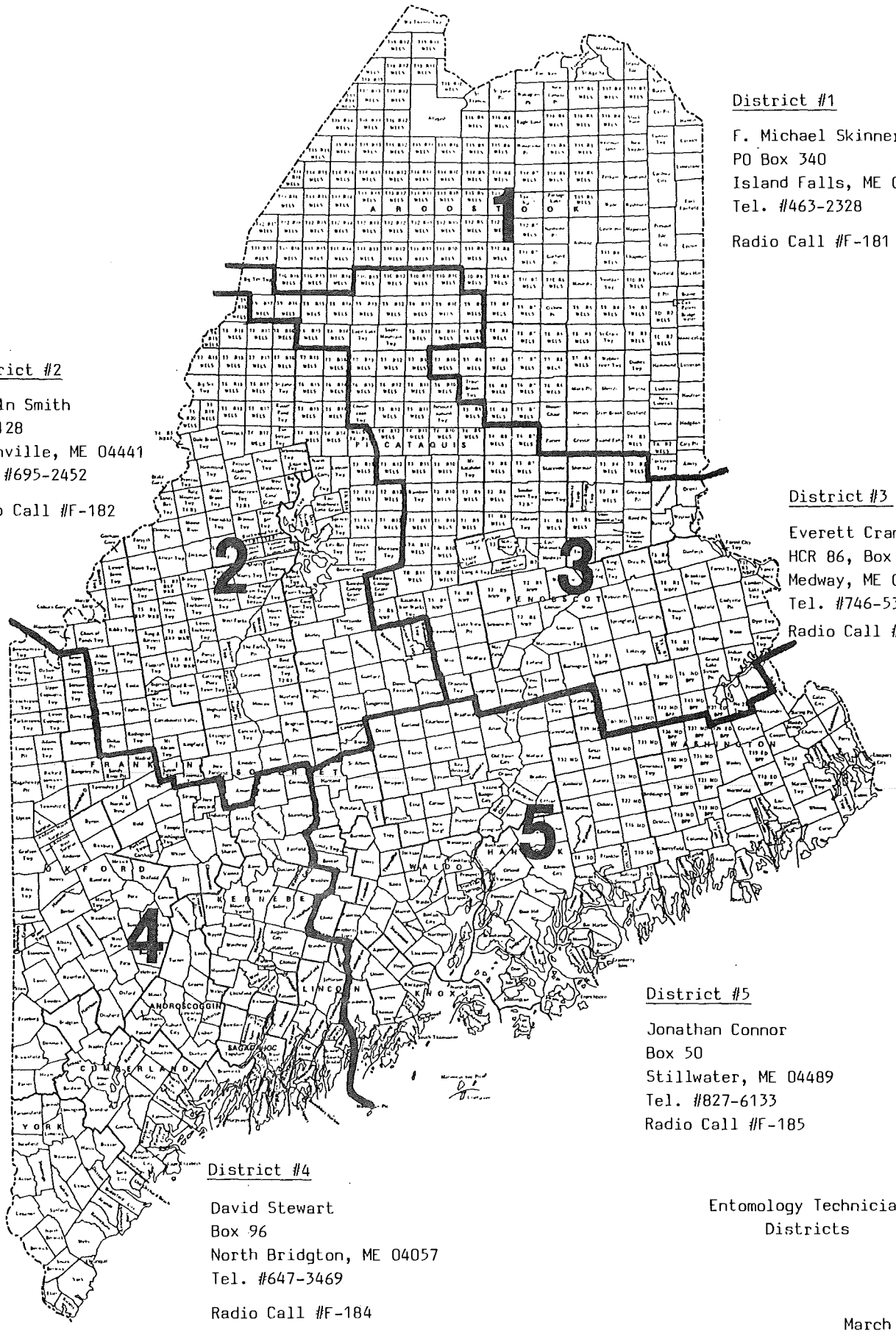
Highlights of Division Activities for 1989

After the significant staff changes of 1988 (see Summary Report No. 3), the 1989 season seemed rather uneventful although it was very busy as far as activities were concerned. A few personnel changes did take place, however. On April 10 David Struble was officially appointed State Entomologist and division director. Dave had served in the position in an acting capacity since the fall of 1988. Dave joined I&DM as a regional entomologist in Island Falls in 1973. He completed requirements for an M.S. degree in entomology at the University of Maine in Orono in 1974 and moved to Augusta as a staff entomologist in 1980. Dave brings entomological expertise to the position as well as administrative experience and we hope that he will provide the strength of continuity to the position in the future. Many of Dave's former responsibilities have been assumed by Richard Bradbury. Doug Stark was brought back on special contract to provide specialized pathology training, diagnostic work and to bring our tree disease information file up to date. The organization chart and technician district map which follows this section represents our staff as it presently exists.

Insect and Disease Management (I&DM) personnel became more involved in cooperative projects in new and diverse areas in 1989 in addition to their regular survey activities. Recent changes in forestry laws relating to forest practices, increased involvement in forest health monitoring and environmental studies, intensive management studies on beech and continued involvement in the Baxter Park post-budworm regeneration study provided some new challenges and frustrations for field and professional staff alike. These challenges are being met. The information being generated will benefit management of our forest resources. Updates on these evaluations will be included in future issues of this report. The Forest Insect Survey (FIS) remains an integral part of the I&DM program.



Maine Forest Service
MAINE DEPARTMENT OF CONSERVATION
Insect & Disease Management Division
Organizational Chart
March 1990



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Entomology Technician
Districts

March 1990

Gold Leaf Award

The I&DM Division was awarded the Gold Leaf Award by the New England Chapter of the International Society of Arboriculture at their annual meeting in late October. This award was presented "for Outstanding Landscape Beautification Activities" in appreciation for the "Conditions Reports" which are widely used by arborists, nursery, landscape people and others. This recognition is greatly appreciated.

Acknowledgments

Although this summary and our seasonal conditions reports are compiled and edited by **Richard Dearborn** and **Clark Granger,** there are many others who are essential in making these reports a success. We are very grateful for the meticulous efforts and infinite patience of our secretary **Betty Barry** who manages to decipher the handwriting of a number of individuals and come up with something readable. **Dot Arbour** maintains our mailing list and sees that we have the proper envelopes for our mailings so that she and Betty can speed our copies through the mailing process. **Dave Struble** not only serves as State Entomologist but also as proof reader for most reports which prevents us from sticking our proverbial feet in our mouths. **Richard Bradbury, Henry Trial, Jr., Don Ouellette** and **Dan Pratt** of our staff provide many items for inclusion in these reports as well as comments on others. Thanks to our excellent field staff: Supervisor: **Mike Devine;** Technicians: **Jody Connor, Skip Cram, Mike Skinner, Grayln Smith** and **Dave Stewart** and Conservation aides: **Kathy Murray, Wayne Searles** and **Dave McLeod** who scour the State for information and records on the various insects and diseases. And old pathologists don't die or fade away, they stick around and keep those who are left on course. **Doug Stark** continues to be a faithful and reliable source of encouragement and support. And last but certainly not least are other department personnel and cooperators in: the Me. Dept. of Agr., USDA-APHIS and the Univ. of Me. at Orono. This is our team.

Publications

The I&DM Division continues to maintain and upgrade a file of published reports, bulletins, brochures and information leaflets and sheets on programs and pests of importance to Maine's tree resources, both forest and urban. This file includes such publications as: Field Book of Destructive Forest Insects (Bull.25, 1980); Insect Primer (Circ. 9, 1974) and The Planting and Care of Shade Trees (Bull. 10, 1985). Through seasonal condition reports, readers are apprised of current pest developments, and the summary issues provide information which can be useful for planning purposes.

In addition to the standing file of materials, the following new items have been published over the past year:

Bradbury, R., W.D. Ostrofsky, and C.A. Granger. 1989. White pine blister rust control. p.233 in Forest and Wildlife Management in New England - What Can We Afford? Maine Agric. Exp. Sta. Misc. Rept. 336. SAF Publ. 89-05. 262 pp.

Insect & Disease Management Division. 1989 (March). Forest & Shade Tree-Insect & Disease Conditions for Maine - A Summary of the 1988 Situation. Me. Dept. of Conserv., Me. For. Serv., I&DM Division. Summary Rpt. No. 3. 29 pp. Compiled and edited by R.G. Dearborn.

Insect & Disease Management Division. 1989. Forest & Shade Tree-Insect & Disease Conditions for Maine. 8 issues from April 28 through September 15. Compiled and edited by R.G. Dearborn and C.A. Granger.

Insect & Disease Mangement Division and USDA-APHIS. 1989. European Larch Canker. Color foldout leaflet. 6 pages.

Irland, L.C., J.B. Dimond, Judy L. Stone, J. Falk and Ellen Baum. 1988 (Issued July 1989). The Spruce Budworm Outbreak in Maine in the 1970's - Assessment and Directions for the Future. Me. Agr. Expt. Sta. Bull. 819. 119 pp. and Appendix A (Maps).

Trial, Henry, Jr. 1989. Spruce Budworm in Maine: The End of the Outbreak : Biological Conditions in 1986, 1987 and 1988, and a Look at the Future. Me. Dept. of Conserv., Me. For. Serv., I&DM Division. Tech. Rpt. No. 28. 50 pp.

1989
PEST SUMMARY

What's New in This Report

In order to streamline these reports so that as many constituents are reached as efficiently as possible, the reporting format has been slightly modified beginning with this Summary issue. The most notable change is the inclusion of a new special reports section which contains more lengthy discussions of some of the more important problems such as spruce budworm and gypsy moth. These are intended to serve as the complete published annual reports for these pests and will reduce the need for duplicate mailings. As in the past, special information and pest alerts will be included with future mailings to reduce labor input and mailing costs. We welcome your comments on any and all changes.

Weather

Weather in 1989 did not seem to be as newsworthy as it has been, although conditions varied from one extreme to another and from one part of the State to another. After a cold, wet start in 1989 conditions changed rapidly with portions of northern Maine experiencing near drought-like conditions and other areas to the south becoming wetter-than-normal. Plant development, held back by the cold, flushed quickly in May with a warm spell. It may be premature to say that Maine is out of the drought cycle and drought related effects are continuing to show up. Aside from these situations, weather related damage to trees in 1989 was limited to winter browning in the spring and very local ice, hail and wind damage.

Useful Suggestions

The following summary and special reports section in this issue are rather lengthy. To avoid getting "bogged down" in items of little or only passing interest the reader should proceed to the particular pest or section of pertinent interest and fill in with other sections or pests as time warrants. The page containing the **Contents** and **Quick Finder Index** are intended to aid in this selection process. For example, **Arborists** should find nearly everything they need in Sections B (beginning on page 12) and D (beginning on page 27). **Christmas tree growers** should find items of interest in Section C beginning on page 20. **Foresters** on the other hand might want to skim Sections A through C. All sections will include cross references to items of pertinent interest in other sections. All readers should refer to the special reports section for items of interest. Pages of all of the special reports are double numbered so that each one can be reprinted for distribution as a separate item.

The following report has some new ideas. All are intended to be helpful. We hope you like it and find it useful. Your suggestions for improvement are always welcome.

(A) Forest Pests - Softwoods
(See also Section C)

Insects

Aphids (*Cinara* spp. and others) - Populations of these dark, bead-like aphids were very common on the boles and branches of many conifers this season. In many cases infestations would have gone unnoticed had it not been for the presence of sooty mold fungus blackening the foliage or the presence of large numbers of yellowjackets which were drawn to the honeydew. Several Christmas tree plantations were treated to control the problem.

Arborvitae Leafminer (A complex of 4 species) - Defoliation by this complex of species continues to be spotty with very light populations over most of the northern half of the State and locally higher in the southern half. Some small forest stands of arborvitae and some ornamentals were heavily defoliated in 1989 especially in southeastern Maine but populations appear to be stabilizing.

Although populations may generally be headed down, damage from arborvitae leafminer is locally heavy in central and eastern Maine and in some areas the foliage is in such poor condition that it could not support large populations if they were present. Some mortality has begun to show up in a few of the more heavily defoliated stands.

Balsam Fir Pests (general) - See also Section C

Balsam Woolly Adelgid (*Adelges piceae*) - There appear to be changes developing in populations of this adelgid in Maine. In 1989, for the first time in many years, two areas in central Maine totalling several hundred acres which were infested with the trunk phase were reported. The gout phase continues to be the more common phase especially in coastal areas, however, the frequency of the flat-topped, gouted trees which have begun regaining apical dominance appeared to increase noticeably in 1989 in a number of areas in central and eastern Maine.

Eastern Larch (Bark) Beetle (*Dendroctonus simplex*) - This very important component of the larch decline complex continues to exhibit large population fluctuations and causes locally heavy mortality of larch. Larch attacked by this species often die suddenly the year of attack. The bark of infested trees is quickly picked apart by woodpeckers and/or falls away leaving the yellowish wood or inner bark making the trees highly conspicuous and visible. More on this insect may be found in the special report section.

Hemlock Borer (*Melanophila fulvoguttata*) - Hemlock under stress are frequently attacked by larvae of this species and as more stress is added to the hemlock resource, this species may become a more important contributing factor in increased tree mortality. Heavy populations of this species in 1989 were most frequently encountered in east central Maine.

Hemlock Looper (Lambdina fiscellaria) - This insect proved to be one of the big surprises of the 1989 season as populations increased noticeably. The first evidence of increasing populations occurred in 1988 when large numbers of moths became obvious in many wooded areas in August and September. Moths were also very common in spruce budworm pheromone traps that year. Several reports of higher-than-usual numbers of looper larvae and moths were again reported in 1989. Extremely heavy moth activity was reported in several locations in Washington, Hancock, Penobscot and Kennebec Counties. Ground and aerial checks in the late summer and fall of 1989 showed approximately 450 acres of severe defoliation in the Sebago Lake area in Cumberland County and in Lakeville in Penobscot County. Both the Sebago and Lakeville areas have high hemlock components and in both areas hemlock mortality is expected to occur in 1990 as a result of 1989 defoliation. Damage experienced in Maine in 1989 exceeds previous Maine Forest Service records. However, larger areas of heavy defoliation have occurred in the past in other New England States and eastern Canadian Provinces. This situation will be monitored very closely in 1990 and survey methods are being studied and refined for Maine conditions. A "Pest Alert" has been prepared for this species and is being mailed out with this report.

Hemlock Needle Miner (? Coleotechnites sp.) - Moderate to high populations of a species of needle miner caused noticeable defoliation to understory hemlock in Sebago in 1989 in the vicinity of the hemlock looper infestation. Webbed clusters of straw-yellow, mined-out needles containing brownish larvae were readily visible in October. Needle miners similar to this were also seen at other locations throughout the range of the resource in Maine but generally in much lower numbers. Populations did, however, appear to be higher in 1989 than in 1988 especially in Cumberland and Kennebec Counties and locally east of the Penobscot River.

Hemlock Woolly Adelgid (Adelges tsugae) - This insect has not yet been found in Maine even though surveys have been conducted to detect its presence. Surveillance efforts to monitor planting stock and native stands will be continued. A quarantine on hemlock to prevent artificial introduction from southern New England and south remains in effect (see special reports section).

Jack Pine Sawfly (Neodiprion pratti banksianae) - Several hundred acres of jack pine along the immediate coast in Hancock and Washington Counties from Steuben to Mt. Desert were found to be moderately to heavily infested with this species. Populations caused the most severe damage over roughly 100 acres on Dyer Neck in Steuben. Numbers of this insect and resultant damage were up strikingly in 1989 from 1988 levels. This species has not been much of a problem in Maine in the past because of the limited availability of its favored host, jack pine. As more plantations of jack pine become established, the situation could change.

Larch Casebearer (Coleophora laricella) - "Scorched" larch resulting from feeding by this species was easily visible in late May and was heavy locally in southern Maine in 1989. Damage appeared to be heavier in 1989 than in 1988 and populations appeared to be on the rise generally. This species is of concern due to its involvement as an additional stress factor in the decline complex affecting larch.

Larch Sawfly (Pristiphora erichsonii) - There were no reports of defoliation by larch sawfly in 1989 and only scattered larval collections were received. Increasing populations and damage are still possible within the next several years in spite of last seasons (1989) low numbers. The I&DM Division will continue to monitor larch for this sawfly.

Mites - See Section C

Pine Leaf Adelgid (Pineus pinifoliae) - Smooth, terminal, compact, cone-like galls of this adelgid were readily visible on red and black spruce in June of 1989 but appeared to be generally less abundant and more scattered than in 1987. Populations appear to be down noticeable from the past cycle and damage to the alternate host, white pine, was very light where found. This insect has a complex two year life cycle and in Maine, galls appear on red or black spruce almost exclusively in odd years. Damage to pine can occur in any year, however.

Sawflies (Various species freefeeding on conifers) - Other than those mentioned in this section (Jack pine, larch and white pine sawflies) there were no reports of noticeable populations or damage by any other species in Maine in 1989.

Spittlebugs - See Section C (Pine and Saratoga Spittlebugs)

Spruce Beetle (Dendroctonus rufipennis) - Aerial survey methods developed during 1988 supplemented by extensive ground evaluations were used by I&DM to more intensively evaluate the spruce beetle problem in 1989. These surveys revealed a significant expansion of the infestation both in extent and severity. The increase included expansion of known areas and identification of new ones. While infestations of this beetle are scattered over much of the resource and often involve single trees or trees in very small groups, aerial and ground surveys have defined seven areas of heavy concentrations of beetle attack. The combined total acreage of these areas exceeds 7,500 acres. Losses appear to be accelerating and will probably continue to do so as long as there is an ample supply of large, overmature white spruce to give the beetle populations their needed initial surge. A more complete report on this species is included in the special reports section.

Spruce Budmoth - See Section C

Spruce Budworm (Choristoneura fumiferana) - The spruce budworm population continued to drop in 1989 as it has since the steep decline began in 1985. Only 4,800 acres of defoliation were mapped in 1989, down from 65,000 acres in 1988. The infestation was limited to six towns in southern Hancock and Washington Counties: Waltham, Gouldsboro, Steuben, Columbia, Columbia Falls and Jonesboro. These towns were also infested

in 1988. In 1989 most of the defoliation was light (3,500 acres) with only 1,300 acres of moderate defoliation. This pest will continue to be monitored due to its potential for damage and the presence of rising populations in some parts of eastern Canada. The complete 1989 spruce budworm report is included as a special report at the back of this issue.

Spruce Coneworm (Dioryctria reniculelloides) - Coneworm populations continued their downward slide, paralleling those of the spruce budworm. Populations were barely detectable in most areas again in 1989 and are expected to remain low in the near future.

Stillwell's Syndrome - See disease section following.

White Pine Sawfly (Neodiprion pinetum) - Populations of this species were low again in 1989 although I&DM did receive several scattered reports of very local defoliation of eastern white pine in August.

White Pine Weevil - See Section C

(A) Forest Pests - Softwoods (See also Section C)

Diseases and Injuries

Annosus Root Rot - See Section C

Armillaria Root Rot (caused by Armillariella mellea) - This disease continues to play a significant role in nearly every problem where tree stress is involved. Investigation of Stillwell's syndrome on balsam fir stressed by spruce budworm shows a high degree of association with this fungus disease as do larch and spruce hit by bark beetles. Decline of maple and oak also involve A. mellea. While older trees, especially in forest situations, seem to exhibit more striking and readily visible symptoms, serious losses occur in young, recently planted trees in plantation or specimen tree situations where proper care is not exercised.

This highly opportunistic fungus disease certainly needs to be seriously reckoned with in any forest management program.

Balsam Fir Needle Rusts - See Section C

Eastern Dwarf Mistletoe (caused by Arceuthobium pusillum) - No new infestations of this parasitic plant were reported during 1989. Severe damage is still occurring to stands of white spruce in coastal areas. Occasional trees of landscape value succumb each year in the yards of coastal residences as this parasite gradually drains trees of their vigor.

Diplodia Tip Blight (caused by Sphaeropsis sapinea) - The incidence of this disease in 1989 was observed at only three locations in southern Maine: Union, Westbrook and Windham. A total of three acres of pitch pine and several Austrian pine were involved. In these areas there was some mortality of current seasons buds and shoots and occasional branch

mortality. Infected parts may be pruned from affected trees to improve their appearance but this practice alone is usually not sufficient to prevent reinfection the following year. This disease tends to recur on the same trees year after year.

European Larch Canker (caused by Lachnellula willkommii) - One new town, Lamoine, was found to be infested in 1989. This will likely result in four towns; Ellsworth, Lamoine, Hancock and Trenton, being added to the quarantine area (see Summary Report No. 3 - March 1989). This will be the first change in the quarantine since 1985. At the two epicenters; Cutler-Jonesboro and Friendship, the infection rate is heavy while it is light to moderate elsewhere. No mature tree loss has been observed and damage is heaviest on sapling and pole-sized trees. I&DM continues to conduct surveys to detect new locations and the rate of spread of this disease. With the new towns added the quarantine will include: all of Knox County and most of Lincoln County, and southern portions of Waldo, Hancock and Washington Counties. See also quarantine information in the special reports section.

Pine-Pine Call Rust (caused by Endocronartium harknessii) - Four areas of infestation by what appears to be this gall rust were investigated in 1989. Approximately 50 acres of Scotch pine Christmas trees showed light (45) to moderate (5) infection rates at T19 MD, Farmington and Mt. Vernon and more than 100 acres of jack pine in Steuben showed moderate to heavy infection rates. The jack pine in Steuben had been infected for several years and galls were very abundant on some trees, on both branches and main stems. This area is beginning to undergo development stimulating more concern for the aesthetic aspect of the problem. Some mortality (< 10%) of heavily infected small trees was evident at Steuben.

See also Section C

Pinewood Nematode (caused by Bursaphelenchus xylophilus) - The pinewood nematode has now been isolated from samples taken from many areas of the State. Approximately 30 sites were surveyed in 1989 spread over much of the State and nine new positive samples were added from a number of new areas and one new (for Maine) host, red pine. The most common positive host to date has been balsam fir. The only other host had been white pine at five locations. As surveys continue, this nematode is expected to be found statewide and from other conifer hosts as well.

Red Pine Needle Rust - See Section C

Scleroderris Canker - See Section C

Sirococcus Shoot Blight - See Section C

Stillwell's Syndrome or "Red Fir" (associated with Armillariella mellea) - The incidence of "red fir" in Maine's spruce-fir region was probably the lowest in 1989 that it has been since the I&DM Division began studying the problem in the mid 80's. Scattered mortality attributed to this problem was seen throughout northern and central areas but "red fir" were not common in any particular region. While working on spruce beetle surveys in the Allagash River area, I&DM staff did note the presence of

"red fir" scattered among beetle infested spruce. These fir trees were not especially abundant but, they were very large and seemed to be vigorous prior to the rapid onset of the disorder. The foliage compliment on these trees was excellent and its rapid change to red made the trees very striking. Both spruce beetle and Stillwell's are usually found in areas heavily damaged by the recent budworm outbreak. As in past years all "red fir" examined showed evidence of A. mellea, however, unlike many past observations these trees did not seem to have other stress factors such as frost crack or other physical injury.

The future trend of this problem is not predictable but almost certainly some level of loss will continue in 1990.

White Pine Blister Rust (caused by Cronartium ribicola) - A total of 30,707 acres of white pine control area was mapped as part of the 1989 white pine blister rust control program and 25,665 acres were scouted for Ribes using 11 project conservation aides under the direction of David Stewart, seasonal acting Entomology Field Supervisor. In the course of the scouting, 9,444 acres were greenlined (moved to a lower risk category in which no additional scouting is scheduled) and specific control projects eradicating concentrations of Ribes were conducted on 56 acres.

Presently the Blister Rust Program includes 1,833,091 acres in the pine protection area, of which 1,211,561 acres (66%) have been greenlined. This percentage is expected to increase in future years.

White pine blister rust continues to be a very serious disease of white pine in Maine and seriously limits the successful production of white pine timber when no control program exists.

White Pine Needle Blight (SNB) - Symptoms of SNB seemed to be less striking than usual for the second consecutive year in 1989. The long term trend of this problem also seems to be downward. Both ozone and sulfur dioxide as air contaminants are possible causes for this disorder. Ozone occasionally still builds to phytotoxic levels during periods of stagnant Bermuda highs. However, sulfur dioxide levels in Maine have generally trended down in recent years.

Winter Browning - Winter browning of red spruce in forested situations, and many conifers, and rhododendrons in nursery and ornamental plantings, was evident in the spring of 1989. (Present indications are that winter browning will be even more conspicuous as we approach spring 1990, especially on yews and rhododendrons in foundation plantings.)

(B) Forest Pests - Hardwoods
(See also Section D)

Insects

Alder Flea Beetle - See Section D

Aphids (various) - Although present in various degrees on different hardwoods statewide in 1989, aphids did not seem to be as much of a problem on hardwoods as they have been in previous seasons.

Ash Defoliators - (primarily Palpita magniferalis) - Defoliation of scattered green (?) ash near Burlington in east central Penobscot County in mid to late July was caused by larvae of this apparently introduced species. Defoliation ranged from light to severe (over 75%) on individual trees. This species occurs widely in Maine but this is the first record we have of noticeable defoliation to this extent. Populations of the **promethea moth** (Callosamia promethea) were also more noticeable in 1989 than usual but defoliation was insignificant. Larvae of these beautiful silk moths are normally a rare curiosity in Maine and feed on ash, cherry and other hosts.

Aspen Defoliators (various) - Defoliation of aspen by insects in 1989 was spotty and appeared lighter than in 1988. The complex of insects found, however, was similar to that listed in our last summary report (No. 3, pp. 12 & 13) for 1988. See also Forest Tent Caterpillar, Gray Willow Leaf Beetle and Satin Moth.

Balsam Poplar Leafminer (?Lyonetia sp.) - Reddening of balsam poplar caused by the mining activities of these tiny sawfly larvae covered roughly 5,500 acres of mixed growth in Aroostook County in 1989. This was the fourth consecutive year of defoliation in this area. Although the area remained roughly stable at 1987 levels, populations and damage did appear to decrease somewhat in intensity in 1989.

Bark Lice or Psocids - See Section D

Beech Problems (various) - Beech continues to support more than its fair share of insect pests. Although the severity of the problems in total seemed to be slightly reduced in 1989 from 1988, noticeable defoliation was still very evident across central Maine. Defoliation by the **variable oakleaf caterpillar** (Lochmaeus manteo), **orangehumped mapleworm** (Symmerista leucitys) and the **flat leaftiers** (Psilocorsis sp.) again headed the list. **Beech scale** (Cryptococcus fagisuga) continues to be a problem in most areas (see Beech Bark Disease in the following section) while damage from the **oystershell scale** (Lepidosaphes ulmi) appears to be declining in severity. Due to the prolific nature and widespread distribution of beech in Maine, there is growing interest in managing this species.

Birch Casebearer (Coleophora serratella) - Populations of birch casebearer continued to remain stable and endemic (low) in 1989 except for scattered local hot spots in central Aroostook County and in the Rangeley area. Little change is expected in 1990.

Birch Leafminer (primarily Messa nana) - Locally moderate to heavy browning of white birch occurred primarily across interior south central Maine in 1989. The area infested was analogous to that of 1987-88 although damage in 1989 did not seem as severe. No mortality was noted in infested stands. This may signal a downswing in populations.

Fenusa pusilla which has been the more common leafminer species on gray birch and Profenusa thomsoni remained at relatively low populations again in 1989.

Birch Problems (various) - In addition to drought, casebearers, leafminers, fall webworm and sawflies, birch defoliation by several other insects was reported in 1989 as well. **Birch tubemaker** (Acrobasis betulella) populations were locally heavy and the tight, hard, bullet-shaped larval cells of black frass could be found within tangled webs of leaves. Those white-marked black moths known as the **spearmarked black** (Rheumaptera hastata) were common again in 1989. The larvae of this species are black loopers with light side markings and are found within folded, rolled or webbed leaves of birch or free feeding. Populations of this species appeared to decline slightly in intensity in 1989 although they did appear more widespread. Further declines are expected in 1990. **White marked tussock moth** (Orgyia leucostigma) caterpillars were also locally common on white birch in central Maine. The **mottled or birch stink bug** (Meadorus lateralis) was also locally abundant and appeared to have caused minor feeding damage.

Two large silkworm moths, the **luna** (Actias luna) and **polyphemus** (Antheraea polyphemus), were especially abundant in some areas this season. Numbers of the large, pale-green, reddish-marked luna moth with its "tails" and eye spots were especially high in central and eastern Maine in late June and early July. The large, green larvae of both species are similar. They feed solitary on many hardwoods but especially birch.

Lacebugs (Corythuca sp.) populations were high again in 1989 at roughly the same levels experienced in 1988. Yellowed and mottled foliage covered with brown flecks and lacebugs on the under surface were common again in many areas of central and northern Maine.

Bronze birch borer (Agrilus anxius) damage continues to show up with increasing frequency but no extensive damage in any one area has yet been detected.

Blackheaded birch leaffolder (Acleris logiana) populations and damage were very low in 1989.

Hemlock Looper (Lambdina fiscellaria) - Although populations of this potentially destructive insect are on the rise, no damage was reported on birch in 1989. Damage to birch from this species would most likely occur in forested situations where there was a high hemlock or balsam fir component.

Birch Sawfly (Arge pectoralis) - Defoliation of white and gray birch by this species was widespread again this season in forested areas across central Maine. Populations seem to have expanded further north than in 1988. This species is one of the major components of the hardwood defoliator complex (see the discussion which follows).

Browntail Moth - See Section D

Cankerworms and Loopers - The spring feeders; **bruce spanworm** (Operophtera bruceata), **spring cankerworm** (Paleacrita vernata) and **fall cankerworm** (Alsophila pometaria) were again very low in numbers in 1989 with no defoliation detected. Populations of these insects are expected to

remain low again in 1990 except for possible hot spots. Populations of the **cleft-headed spanworm** (Biston betularia cognataria) were also low in 1989 but populations of the **hemlock looper** (Lambdina fiscellaria), however, were higher although no defoliation by these species was evident on hardwoods. Hemlock looper larvae feed on a number of hardwoods especially birch and when populations are high, noticeable defoliation can occur (see Section A).

Eastern Tent Caterpillar - See Section D

Fall Webworm (Hyphantria cunea) - Although populations of this insect appeared to decline slightly in 1989, feeding and webbing was still heavy in central and southwestern Maine for the second consecutive year. Damage so far has been primarily aesthetic but trees severely stripped for two years often show stress and isolated mortality associated with this problem has been reported. It appears that trees heavily "festooned" with webs may carry the messy web residue for two or more years.

Forest Tent Caterpillar (Malacosoma disstria) - Although populations and defoliation are increasing to the west of Maine, no noticeable defoliation of woodland poplars occurred in Maine in 1989. Although the total moth catch statewide was down slightly in 1989, several traps in the north showed slight increases for at least the second year in a row.

Gray Willow Leaf Beetle (Pyrrhalta decora decora) - Adults and larvae of what appeared to be this species were very common in some areas this season and defoliation of willow and poplar was locally moderate to heavy.

Greenstriped Mapleworm (Dryocampa rubicunda) - Populations of this species remained extremely low in 1989 with no noticeable defoliation reported. This species is primarily a feeder on red maple in Maine.

Gypsy Moth (Lymantria dispar) - Population levels of the gypsy moth exhibited a significant increase in 1989. Typical of past infestations, the damage in 1989 occurred in southern, and primarily southwestern, Maine. Populations throughout many other areas of southern Maine and along the Penobscot River Valley north to Millinocket were variable and small hot spots of noticeable (but generally less than 30%) defoliation were observed. Areas sustaining 30% or more defoliation rose from 100 acres in 1988 to 34,280 acres in 1989. This was the heaviest defoliation reported in Maine since 1982. Defoliation by county was as follows: Androscoggin (1,134), Cumberland (546), Hancock (908), Oxford (23,240), Washington (372), and York (8,080). Defoliation in 1990 is expected to increase in and around most areas defoliated in 1989. In addition there is likely to be noticeable defoliation in other areas such as Augusta, Woolwich, Topsham and Greenbush where egg mass counts were high in the fall of 1989. A more complete report on gypsy moth may be found in the special reports section.

Hardwood Defoliators (late season complex) - Defoliation of primarily northern hardwoods beginning in late July by this complex of more than 25 different species of insects dropped strikingly in 1989. Although trace to light defoliation could fairly easily be found almost anywhere throughout much of the central part of the State (see Figure 1), moderate

to heavy defoliation fell from more than 120,000 acres in 1988 to roughly 29,500 acres in 1989. Further declines are expected in 1990.

The four major components of this complex were: **birch sawfly** (discussed separately), orange-humped mapleworm, **spearmarked black** (discussed under birch problems), and variable oakleaf caterpillar. The **orangehumped mapleworm** (Symmerista leucitys) and **variable oakleaf caterpillar** (Lochmaeus manteo) were again the more widespread species in the complex even though populations were much reduced from 1988 levels in most previously infested areas. A few areas not heavily infested in 1988 had higher populations in 1989 especially eastern sections.

Egg parasitism was extreme on both species but heaviest on S. leucitys. Many S. leucitys egg masses were totally parasitized whereas most L. manteo masses had some viable eggs.

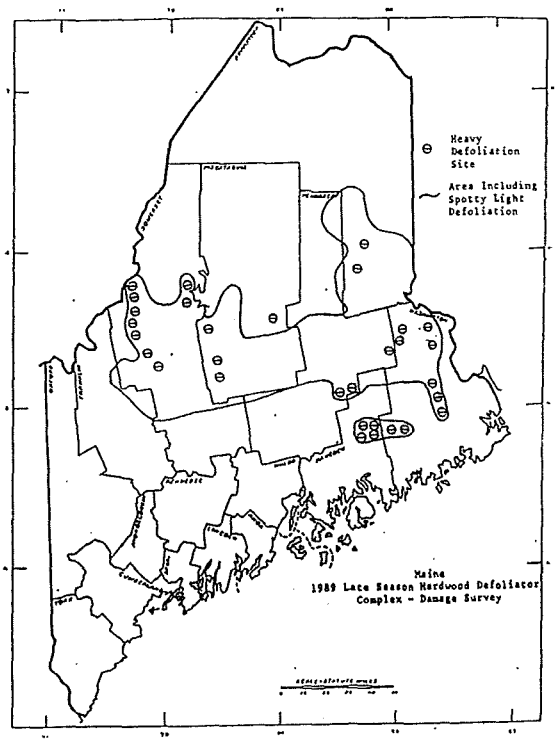


Figure 1

There was considerable larval parasitism of both species as well in many of the older infested areas.

Parasitism rates seemed higher in 1989, especially in areas defoliated for two or more years. A "wilt like" disease was also noted in late instar larvae in some areas.

It was interesting to note that many areas had L. manteo populations in the early larval instars but this species was scarce or absent by the time mid and late larval instars should have appeared. Populations of S. leucitys also dropped off between instars in a few areas.

Populations of both species are expected to decline further in 1990.

Hemlock Looper - See Section A and Birch Problems in this section

Maple Leafcutter (Paraclemensia acerifoliella) - Sugar maples in some areas of central Maine showed noticeable feeding from the maple leafcutter in 1989. Damage seemed to be higher than usual.

Maple Leafroller (Sparganothis acerivorana) - Defoliation of roughly 23,300 acres of red maple east and south of Ellsworth in southern Hancock County (see Figure 2) drew comments from residents and tourists alike in 1989. Defoliation averaged 30-60% but there were some hot spots where it exceeded 75%. This is the second year of noticeable defoliation and although the acreage was up from 17,670 in 1988, there did appear to be a drop in overall intensity. No tree mortality has been observed.

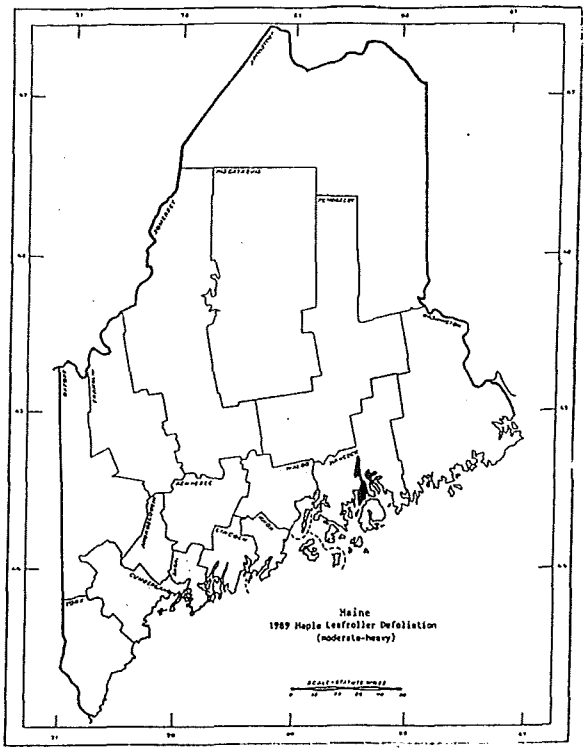


Figure 2

Oak Leaftier (Shredder) (Croesia semipurpurana) - Local hot spots of heavy defoliation by the leaftier and associated leaf rollers were again reported from oak throughout most of its range in Maine in 1989. Populations were still generally low.

Oak Skeletonizer (Bucculatrix ainsliella) - Populations of oak skeletonizer were low in 1989 and it was difficult to find larvae or signs of feeding even in areas previously defoliated.

Oak Treehoppers (several species) - The abundance of treehoppers on oak was reduced strikingly in 1989 and no damage was reported.

Oak Twig Pruner (Elaphidionoides villosus) - Populations of the twig pruner remained fairly stable at low levels for the fourth consecutive year. Damage to individual trees, however, was occasionally heavy.

Obliquebanded Leafroller (Choristoneura rosaceana) - This versatile feeder on a wide variety of deciduous hosts was relatively abundant again in 1989. Defoliation was still negligible even though it was recorded from aspen, birch, beech, balsam poplar and maple in the course of FIS surveys.

Orangehumped Mapleworm - See Hardwood Defoliators

Oystershell Scale (Lepidosaphes ulmi) - This pest is still with us in beech stands across central and eastern Maine although populations continue to subside overall and fresh damage is not as evident. Several small pockets of high populations were detected in 1989 but these seem to be subsiding. Light branch and twig mortality is evident in most areas which are or have been infested.

Pear Thrips (Taeniothrips inconsequens) - This species has now been found statewide on sugar maple but populations are so far extremely low and damage ranges from none to barely detectable. Soil samples taken from

several sugar bush areas in the fall of 1989 yielded very low (< 1 thrip per sample) numbers of thrips. Field samples from tree foliage in these and several other sugar bushes also yielded low numbers of thrips but in only a few cases were any traces of feeding injury noted and these were barely detectable.

There does not appear to be a threat from this problem at this time but low level surveys will continue to some extent for the immediate future.

Saddled Prominent (Heterocampa guttivitta) - Only scattered individual larvae of this and related species of Heterocampa were reported in 1989 and no defoliation was observed.

Satin Moth (Leucoma salicis) - Scattered pockets of defoliation of woodland aspen by larvae of the satin moth were reported across central Maine again in 1989 for the second year in a row. Populations and defoliation in these areas, however, were light and limited to only a few trees each. Eastern cottonwood (Populus deltoides) around farms and rural homes, however, were severely defoliated in a number of cases.

Tussocks and Dagger Moths (various spp.) - Numbers of these usually fuzzy caterpillars were generally very low in 1989 as compared to 1988. The attractive yellow and black larvae of the **spotted tussock** (Lophocampa maculata) which have been so common throughout central and northern Maine for the past two to three years occurred only locally heavy and as scattered individuals in 1989. The only species which seemed to be more abundant in 1989 were; a species (or two) of **dagger moth** (Acronicta spp.) on various northern hardwoods and the **whitemarked tussock** (Orgyia leucostigma) on birch (see Birch Problems).

Variable Oakleaf Caterpillar - See Hardwood Defoliators

(B) Forest Pests - Hardwoods
(See also Section D)

Diseases

American Chestnut and Chestnut Blight (caused by Endothia parasitica) - Interest is still being expressed by many in continued efforts to try and isolate a potentially resistant strain of American chestnut. Doug Stark has been continuing some of his work, even though retired, and is being assisted by Don Ouellette (I&DM).

Armillaria Root Rot (caused by Armillariella mellea) - Occasional reports of infection of hardwood by this fungus were received in 1989. No change in past trends were readily apparent.

Ash Dieback (cause unknown) - Extensive areas of brown ash (Fraxinus nigra) in and around the Ashland area exhibited severe crown dieback and mortality in 1989. Typically the top half of the crown was nearly or completely dead, while the lower half consisted of weak branches with poor growth.

Epicormic branches were common at various points along the bole. Cankers were common on branches, and were associated with cambial mortality. The weakened trees were susceptible to shoestring root rot and many dead trees exhibited typical mycelial fans and rhizomorphs. However, trees in various stages of decline but not yet dead generally did not show signs of the Armillariella fungus at the root collar. While this problem just came to our attention in 1989, the advanced decline symptoms for some trees indicate that the disease has been present for at least several years. We estimate that a total of approximately 800 acres are presently affected.

Brown ash typically inhabits poor, wet sites especially along the banks of brooks and streams. Although trees of high timber quality are not abundant, those individuals which are of high quality command a premium price on the market. While the value of brown ash where it occurs in scattered pockets probably does not warrant special salvage harvesting efforts, this species should be salvaged where dieback is occurring near or within areas presently being harvested.

Ash Leaf and Twig Rust (caused by Puccinia sparganioides) - Very few reports of this disease were received in 1989 and levels appeared to continue low.

Ash Yellows (MLO) - This disease has not yet been found in Maine so far as we know.

Beech Bark Disease (caused by Beech Scale and Nectria spp.) - The incidence of both organisms appears to be on the rise again in some areas. The red fruiting bodies (perithecia) of the Nectria fungus seemed to be more obvious on the tree boles in 1989 than they have for several years. Management studies in beech stands to enhance the prevalence of resistant clones is being conducted cooperatively by I&DM and Dave Houston of the USFS.

Birch Deterioration - Deterioration of birch, attributed by some workers to acid fog, has been reported from limited areas along the southeast Maine coast.

Dutch Elm Disease (caused by Ceratocystis ulmi) - Flagging and dieback of residual elms caused by this fungus disease was widespread and quite conspicuous in 1989. Although mortality of elms is extremely high throughout southern Maine, an occasional healthy individual stands out in striking contrast as a remnant of a once widespread resource.

Hardwood Anthracnoses (caused by various fungi) - Leaves of ash and maples with brown or black blotches were very conspicuous in many localities this past season. Considerable defoliation was also apparent. The heavy infection was a result of long rainy periods.

Hardwood Decline - The I&DM Division is currently engaged in a number of forest health monitoring efforts evaluating the nature and extent of various problems with the hardwood resource. The 1990 season will mark the third year in the North American Maple Project, and should also see the final report on the Western Maine Hardwood Dieback/Decline Survey.

Our annual revaluation of white birch stands in Western Maine and in Eastern Washington County showed increased incidence of twig mortality in 1989. There were no unusual insect or disease causal agents noted; drought is believed to be the major predisposing factor.

The hardwood resource is also a major component of the newly implemented New England Forest Health Monitoring Project. The Maine Forest Service has been a charter member in efforts to establish this regional monitoring network which will serve as a prototype for the nation.

Oak Mortality (cause unknown) - Several small (less than 25 acres) areas of oak mortality have been observed in southern Maine. These stands consisted of large mature trees which seemed to die over a couple of years. The history of insect outbreaks in these stands was not known and they have not yet been sampled for disease.

Oak Wilt (caused by Ceratocystis fagacearum) - There have been no reports of this disease from Maine.

Poplar Ink Spot (caused by Ciborinia whetzelii syn. Sclerotinia bifrons) - The incidence of this common foliage problem of poplar was higher in 1989 following two years of decline. A medium to heavy outbreak was noted in late July over at least 700 acres in T9R9 WELS with lower infection levels apparent from that point northeast to Chandler Lake.

(C) Plantation, Regeneration, Nursery and Christmas Tree Pests Conifers Only - (See also Section A)

Insects

Aphids (mostly Cinara spp.) - Aphid populations rose noticeably on conifers in 1989 and several Christmas tree growers found it necessary to treat their plantations to reduce the problem. See also Section A.

Armyworms - See Section D

Balsam Gall Midge (Paradiplosis tumifex) - Numerous plantations throughout the State sustained moderate to severe defoliation by this species in 1989. While this insect does not cause tree mortality, defoliation resulting from moderate to heavy populations has a significant impact on the marketing of Christmas trees, wreath brush and on ornamentals. Balsam gall midge populations are highly cyclic and vary greatly from one area to another but the steady increase in the area of infestation and intensity since 1986 would indicate the likelihood of high populations in 1990.

Balsam Shootboring Sawfly (Pleroneura brunneicornis) - Populations of this pest were again high in 1989 and although damage is considered primarily aesthetic, the impact on Christmas tree shape has caused some concern. Control success has been quite variable and no control strategy for this specific pest has yet been developed. No method of population prediction or timing has yet been divised.

Balsam Twig Aphid (Mindarus abietinus) - Populations of and damage from this aphid continued to increase again in 1989. Although somewhat spotty in some seasons, this is a continuation of the rise begun in 1985. Many Christmas tree growers continue to find it necessary to treat for this pest. Accuracy of predictions for populations of this pest continue to be quite variable.

Fir Coneworm (Dioryctria abietivorella) - Dark colored larvae of what appeared to be this species were found feeding in buds and shoot tips of young balsam fir Christmas trees in northern Maine in early September. Damage to some trees could significantly reduce tree grade. The fir coneworm and related species continue to cause moderate to heavy damage to developing spruce cones in some areas as well and the situation in balsam fir could have developed from a moderately infested adjacent spruce plantation.

Grasshoppers (species not determined) - We suspect that grasshoppers may have been responsible for at least some of the wounding of tender terminal shoots of balsam fir apparent in July and August. Although grasshoppers have not been observed actually chewing leaders, at least one Christmas tree grower noted very large numbers perched on fir leaders when illuminated during nighttime spray operations. Grasshoppers are known to have caused extensive damage to plantation fir trees in other states. Grasshopper populations have been unusually high in Maine for several years.

Gypsy Moth (Lymantria dispar) - As populations of this species increase, damage to adjacent plantations of spruce, white pine and even balsam fir may occur. See Section B and Special Reports Section.

Hemlock Looper (Lambdina fiscellaria) - Hemlock loopers is not likely to be a problem in young or managed plantations at this time although growers are urged to watch for this pest. See Special Reports Section.

Jack Pine Sawfly - See Section A

Larch Problems (see also Section A and Special Reports section) - Interest in planting and managing larch in Maine has been increasing in recent years and with this has been rising concern over the potential pests of larch. There are a number of known insect and disease problems affecting larch in Maine at this time. The more serious, European larch canker, Armillaria root rot, and eastern larch bark beetle, are primarily affecting the existing and usually older resource at this time although some plantations are certainly involved. Problems such as larch casebearer, larch sawfly, sirococcus shoot blight and porcupine damage, however, appear to be even more of a threat to younger plantations. Management of larch in forest situations is possible if care and consideration is given to potential problems. Larch does have a future in Maine, given the proper attention.

Mites (various species) - Mite populations were heavy again in 1989 in some conifer plantations. While spruce seemed to be the favored host, noticeable populations and damage could also be found on balsam fir and pines.

Pales Weevil (Hylobius pales) - This weevil continued to maintain a low profile in 1989 and for the second consecutive year no reports of damage were received.

Pine Gall Weevil (Podapion gallicola) - Several reports of minor damage by this pest were received in 1989 but most were aesthetic. Several areas of high populations which have been reported in the past continue to exhibit light mortality where no corrective action has been taken.

Pine Spittlebug (Aphrophora parallela) - This species was more common this season than it has been for many years and spittle masses containing nymphs literally festooned various conifers in southern Maine in June.

Pine Tortoise Scale ? (Toumeyella numismaticum = ? parvicornis) - Populations of what appears to be this scale were very high over two acres of nine foot red pine in T25 MD in 1989. When visited in late June, heavy sooty mold was observed on many trees.

Red Pine Bark Miner (Cydia inopiosa) - In May of 1989 a number of reports of what appeared to be "bark beetle" activity on the boles of 6-10 foot tall plantation red pine were received at the Maine Forest Service I&D lab. The areas involved ranged from Kingfield to Sangerville and south to Newport and included more than 100 acres of stock potentially destined for balled and burlap sales. The first sample brought in included signs of activity but no insects. On May 31, two of the areas in Sangerville and Newport were checked and it became evident that the insect involved was lepidopterous. Material from the larger and more heavily infested plantation on the Libby Hill Road in Newport was collected for rearing. On June 14 and 16 tiny moths emerged from the sample and on June 20 more material was collected for rearing. A total of 15 moths of Cydia inopiosa and several parasites were reared through July 2. Larvae, pupae and pupal cases were collected as well.

As this species had not been collected in Maine before and there were very few reports of its habits available, the plantation in Newport was studied more closely. Over 75% of the trees in this plantation seemed to be affected to one degree or another. In some more heavily infested pockets there were 30 or more activity sites noted on each tree bole. Activity sites were visible as small piles of reddish, sawdust-like material extruded by larvae from the galleries. Larvae were tiny light colored caterpillars which fed beneath bark flakes in the outer bark. Bark was peeled from a number of trees and in no case did the larvae bore into or through the cambium layer. Some larvae seemed to move from one site to a new one before pupating. Pupation seemed to occur either within the galleries or partially exposed (pupa sticking out of the bark).

This species generally seems to fall in the category of nuisance pest more than anything else and no serious damage to the red pine host was observed. Even the more heavily infested trees seemed to show no

signs of injury. This is, however, our only year of experience with this insect. Because of a perceived problem, however, infestations of C. inopiosa did result in several thousand dollars worth of balled and burlap stock being refused entry into other States and thereby loss of revenue.

Saratoga Spittlebug (Aphrophora saratogensis) - This insect continues to be a chronic problem on some sites and varies in intensity from year to year. Populations in 1989 seemed to be slightly higher than in 1988. All infested areas were in eastern Maine and totaled around 250 acres. Damage was so severe on one 15 acre plantation in T19 MD that it was essentially destroyed. Pockets of mortality occurred in other areas as well.

Sawflies - See Section A

Seedling Debarking Weevil (Hylobius congener) - No reports of damage by this weevil, often referred to as the **regeneration weevil** were received in 1989.

Spruce Budmoth (Zeiraphera canadensis) - The total acreage of white spruce infested by this species remained at roughly 1,000 acres for the second season. As plantations mature, the intensity of attack by this pest increases. Little actual tree mortality has occurred from this and associated species, but growth suppression and stem deformation is a problem in many of the plantations checked. Continued damage may seriously affect the value of more heavily infested plantations.

Spruce Budworm - See Section A and Special Reports section

Strawberry Root Weevil (Otiorhynchus ovatus) - Locally high populations of the small, white, c-shaped larvae in the soil continue to cause serious damage to softwood (especially balsam fir and spruces) seedlings especially in transplant beds or other concentrated situations. Control of this problem has been essential for seedling survival in some cases but had to be tailored for each particular situation.

White Pine Weevil (Pissodes strobi) - This remains one of the most serious insect pests of eastern white pine in Maine with heavy leader losses (more than 10% of the stems affected) in many areas. Private landowners annually treat more than 1,000 acres to control this pest. Efficacy trials were conducted on approximately 30 acres in 1989 using Dimilin. This was a cooperative project between the University of Maine and the Maine Forest Service testing both ground and aerial applications of the product. Control was excellent with ground application methods. Similar tests are planned for 1990.

White Spruce Faunistic Survey (plantations) - Because time constraints prevented regular visits, a regular survey was not conducted in 1989. However, plantations were sampled more than twice each during the 1989 season. The results were very similar to those found in 1988 (see Summary Report No. 3 for 1988). Table 1 summarizes the results.

Table 1.
Insects from White Spruce Plantations - 1989

On Foliage

Found in nearly all plantations checked - Often abundant - Damage evident
- Spruce Budmoth, Zeiraphera canadensis
- Eastern Spruce Gall Aphid, Adelges abietis
- Aphids, Cinara spp.

Found in local hot spots - Damage evident
- Spruce Twig Midge, Mayetiola piceae
- Spruce Bud Scale, Physokermes piceae
- Orange Spruce Needle Miner, Coleotechnites piceaella
- Mites - ? species

Found as Scattered Individuals - Damage none to trace
- Spruce Gall Adelgid, Pineus similis

In Cones - Damage evident - Variable
- Fir Coneworm, Dioryctria abietivorella

As in 1988, sawflies were noticeably absent. Plans are being made to extend this survey to other plantation species in 1990 if time and manpower permits.

(C) Plantation, Regeneration, Nursery and Christmas Tree Pests Conifers Only - (See also Section A)

Diseases and Miscellaneous Problems

Animal Damage - Tender shoots were heavily pruned from fir in several Christmas tree plantations during the winter of 88-89 by hungry deer and moose. In one balsam fir seed orchard the damage was particularly devastating as grafted scions were lost. Small bars of Ivory soap (available from the Department of Inland Fisheries and Wildlife) hung from the branches of particularly valuable trees seemed to provide some measure of protection. Use of simazine often seems to favor substantially higher levels of browse damage.

Porcupine Damage - Larch and jack pine continue to receive heavy damage in some areas from porcupine damage.

Squirrel Damage - Damage thought to be the result of current and past squirrel feeding was noticeably heavy to individual trees in a Norway spruce plantation containing 35-40 foot trees which was checked in Edinburg in mid June. Similar damage to red spruce was reported from several other localities in southern Maine in 1989. Squirrels prune various lengths of twigs, which often lack buds, as well as dismembered cones and this litter is concentrated around the base of scattered individual trees. Squirrel damage should not be confused with ice damage mentioned in earlier reports. With ice damage only the short, past seasons tips with buds are broken off at the nodes and litter the ground in a more continuous mat throughout the stand.

Annosus Root Rot (caused by Heterobasidion annosum) (syn. Fomes annosus) - No new infestations were reported in 1989 but several older plantations were re-examined to note the progress of this disease. These stands had been thinned many years ago and no stump treatment had been practiced. The insidious nature of this disease was readily apparent. Fomes "holes" had developed around the stumps of many previously harvested trees. Where considerable time (many years) had elapsed since harvest, holes were stagnant or enlarging only slowly. But their numbers were substantial and it was apparent that another thinning would result in extensive mortality of the remaining crop trees due to the abundance of inoculum on the site. It appears that while land managers may get away with one thinning in red pine plantations without stump treatment, management options after that are likely to be severely limited due to this disease.

Armillaria Root Rot (caused by Armillariella mellea) - This disease continues to cause serious losses in plantations which are poorly planted (i.e., with a high incidence of "J" root), planted off site (cold pockets), or in crop conversions (i.e., hardwood sites to Christmas trees). Most losses reported in 1989 were scattered and in one of these three categories. Several were from balsam fir plantations where three to four foot trees had died over the winter.

Atropellis Canker (caused by Atropellis tingens) - No new reports were added in 1989. However, two plantations of Scots pine in southwestern Maine which contained trees heavily infected with A. tingens were re-examined recently. Owners of both plantations were advised several years ago to practice thinning and low pruning as an aid in disease control. One owner thinned and pruned trees conscientiously; the other did not. Where the control prescription was followed, trees are strikingly more vigorous and pleasing in appearance. The disease organism is still present, but it is being successfully managed. In the unmanaged plantation, trees are weak, growing slowly and are essentially worthless.

Balsam Fir Needle Rusts (caused by Uredinopsis mirabilis and other fungi) - Needle rusts were present on balsam fir Christmas trees in many plantations checked in 1989. Damage seemed generally somewhat less pronounced that in 1988 in most of these plantations. The marketability of trees was probably not reduced in the majority of plantations. Control of alternate hosts was recommended to several growers.

Bud Abortion - In 1989 balsam fir Christmas tree growers experienced a reprieve from the bud abortion problem which has been so severe during the previous two years. This problem seems to be caused by low spring temperatures, killing buds as they develop within enclosed bud scales. It seems to be worse within Christmas tree plantations than in wild stands, and may result in trees which are seriously deformed and completely unsaleable.

Chlorosis in Balsam Fir Plantations - In recent years, many Christmas tree growers have noted an increase in the number of yellow or off-color balsam fir trees in their plantations. In many cases, a substantial economic impact has resulted as growers discarded unsaleable trees, or left chlorotic trees uncut in hopes their color could be restored the following year.

The cause remains elusive, but in some cases the plant nutrient manganese is strikingly deficient. But there are many causes of chlorosis, and manganese levels are ample in some other plantations with chlorotic trees. Until the cause (causes) is pinned down, growers of balsam fir would be wise to use herbicides (especially simazine) judiciously, keep trees well fertilized with nitrogen (foliage should contain about 2% nitrogen), and be careful with lime (pH of 5.5 to 6.0 is high enough for balsam fir).

Conifer Shoot Blights - Scattered shoots on a wide variety of conifer species turned suddenly brown this spring. In most cases fungi were responsible; frost damage was not widespread.

Balsam fir in several Christmas tree plantations were affected. We isolated Botrytis sp. from fir tips, but suspect Botrytis may be a secondary rather than primary pathogen.

Several specimens of blue spruce were also received with blighted shoot growth. In one case Rhizosphaera kalkhoffii was the apparent cause. The other specimens showed evidence of infection by Sirococcus conigenus.

Larch tip dieback is common again this year as in 1988. Although no causal organism was isolated, it is suspected that Sirococcus is involved. This shoot blight was particularly conspicuous throughout much of Washington County, but is apparent in many other areas of the State as well. While it does occur in areas where larch canker is known to exist, larch tip dieback has distinctly different symptoms.

Diazinon Injury? Diazinon AG 500, applied by mist blower for control of balsam gall midge (Paradiplosis tumifex Gagne), seemed to cause moderate to severe chlorosis of new growth of balsam fir in several Maine Christmas tree plantations this year. Chlorosis did not appear immediately after application, but took about two months to develop.

Trees in affected plantations were sprayed in late May-early June. Good control of gall midge was achieved. Diazinon AG 500 applied for control of twig aphid in early-mid May did not cause perceptible chlorosis.

Plantations affected were sprayed with tractor-mounted or backpack mist blowers with concentrated mixtures (about one part AG 500 to 10-16 parts water). While the total volume of pesticide used per acre was within label guidelines, concentrated deposits apparently occurred on trees nearest mist blower orifices. Another grower using a dilute mixture of about 1 part diazinon to 320 parts water in a tractor mounted mist blower experienced little or no chlorosis.

More study is necessary to fully define the nature and extent of this problem. Observations to date suggest that diffusers be attached to orifices of backpack mist blowers to broaden air streams, that increased volumes of water be applied by growers using tractor mounted mist blowers, that only minimum effective dosages of Diazinon be applied (1-1

1/2 pts. per acre), and that surfactants be kept out of spray mixtures. It may be that adjuvants in the formulation of AG 500, rather than the active ingredient itself, are responsible for the chlorosis observed. Other formulations of diazinon may be equally effective and less phytotoxic.

Mechanical Injury - Christmas tree growers appear to be exercising more caution in mowing operations and reports of mechanical injury from such activities was down in 1989.

Pine-Pine Gall Rust (caused by Endocronartium harknessii) - Approximately 50 acres of Scotch pine Christmas trees in Mt. Vernon, Farmington and T19 MD showed light to moderate damage from this disease in 1989. Infection was generally light with some branch mortality, but a few seriously infected Christmas trees were destroyed. Losses were estimated to be about $1,000. See also Section A.

Red Pine Needle Rust (caused by Coleosporium asterum = solidaginis) - The incidence of this disease appeared to be down in 1989 although one light to moderate infestation was observed on red pine in a plantation in Newport.

Scleroderris Canker (caused by Ascocalyx abietina) - This disease appeared to remain fairly stable in 1989 although no formal surveys of infested areas were conducted.

Sirococcus Shoot Blight (caused by Sirococcus conigenus) - The incidence of this disease was up considerably in 1989. Infection was particularly heavy on red pine and blue spruce, the latter in ornamental situations. A tip blight of native larch which was fairly common and widespread in eastern Maine in 1989 may have also been caused by this fungus disease.

Weed Competition - Heavy rains this spring and resulting wet fields made it difficult for Christmas tree growers to apply herbicides in a timely manner. Simazine does not control established grass sod well unless applied prior to greenup in the spring. Late applications this past spring seemed to have almost no effect. Growers who applied fusilade when grass was 4 to 8 inches tall experienced excellent grass control, and effectively offset the poor response to simazine. A caution though - the use of fusilade without simazine or another broadleaf herbicide allows non-grassy weeds, especially clover, to grow extremely vigorously and overtake small seedlings or transplants on fertile sites.

White Pine Blister Rust - See Section A

(D) Shade Tree, Ornamental and Miscellaneous Pests

Insects and Ticks

Alder Flea Beetle (Altica ambiens alni) - Populations and damage by this nuisance pest have remained at roughly the same levels since 1987. Damage was relatively light and spotty.

Aphids (various species) - Aphids on shade trees did not generally appear to be much of a problem in 1989 and haven't been for several years.

Arborvitae Leafminer - See Section A

Armyworm (Pseudaletia unipuncta) - Masses of dark, non-hairy caterpillars were on the move in a number of isolated localities in early July. One landowner reported that one newly reseeded field in Sedgwick was literally covered with these creatures. Although the phenomena was certainly striking and reflected tremendously high local populations, no damage to trees was observed. One Christmas tree grower who experienced similar conditions had a few anxious moments.

Bark Lice or Psocids - These interesting creatures were common again in southern Maine in 1989. There are several species which occur in numbers in Maine. Our most common species on tree bark appears to be Cerastipsocus venosus. These psocids first appear as patches of tiny tan specks on the bark of various hardwoods and conifers in July. As they mature they turn gray with lighter cross-banding and may reach 3/16" in length at maturity. They remain together as tiny "herds of grayish bugs" through much of July and August. Adults have dark smoky-gray wings with a triangular light spot on each forewing. After they develop wings in August they lay eggs and "disappear." Bark lice feed on lichens and fungi on the tree bark and not on the tree itself so they do no harm.

Birch Leafminer - See Section B

Browntail Moth (Euproctis chrysorrhoea) - Known populations of this pest continue to be confined to the Casco Bay area. The infested area remains at roughly 40 acres, on Long, Vaill and House Islands. Two to three acres of heavy to severe defoliation was reported on Long Island in 1989. Vaill Island also showed high web counts on twelve acres in the spring. One web was found on the nearby mainland at Stockbridge Point, Freeport in the spring of 1989. Pheromone trapping, web scouting (spring) and light trap monitoring will continue in 1990. The distribution of this pest originally spread along the entire Maine coast and inland for some distance. It seems likely that a spread of populations to some mainland areas could occur in 1990. Because of the health aspects as well as defoliation, this pest bears watching.

Cherry Midge (possibly the Chokecherry Midge (Contarinia virginianiae) - Swollen, deformed fruit of wild black cherry were obvious at one locality in South Berwick in early July. When the fruit were saved in alcohol to send for problem diagnosis, as many as 30-40 salmon colored midge larvae dropped from a single fruit.

Cottony Maple Scale (Pulvinaria innumerabilis) - Very low populations of this insect were still present on red maple in the Scarborough area in 1989 but were light and scattered. Predation and parasitism were high.

Eastern Tent Caterpillar (Malacosoma americanum) - Populations of this tent maker appeared to be slightly higher in 1989 than in 1988.

Fall Webworm - See Section B

Gypsy Moth - See Section B and Special Reports Section

Lyme Disease and its Vector (Ixodes dammini) - There has been little change in the status of this problem in Maine since 1988. Lyme disease is not a major problem here at this time. An ambitious program is underway to further determine the potential of this disease in Maine. A report on this problem in Maine has been prepared for this summary and is included in the special reports section.

Maple Problems - See Section B

Mountain-ash Sawfly (Pristiphora geniculata) - This species appears to be on our list of perennial problems affecting ornamental mountain-ash. The 1989 season was no exception with the usual complaints in spite of the fact that control of the problem is fairly easy to achieve.

Ticks (various) - Seven species of ticks were identified at the I&D Lab in 1989 which were removed from humans. The **American dog tick** (Dermacentor variabilis) was the more common species especially in southwestern Maine. The **groundhog tick** (Ixodes cookei) was the more common small tick. Neither have been shown to transmit lyme disease.

Willow Insects - Defoliation of willow by a variety of insects was reported again this season. The **imported willow leaf beetle** (Plagiodera versicolor) and the **willow flea weevil** (Rhynchaenus rufipes) were the most common but populations seemed to be at roughly 1987 levels.

(D) Shade Tree, Ornamental and Miscellaneous Pests

Diseases and Miscellaneous Problems

Horsechestnut Leaf Blotch (caused by Guignardia aesculi) - Browned foliage of horsechestnut (Aesculus hippocastanum) caused by this fungus was quite conspicuous again this year. Damage, although aesthetically objectionable, is not generally considered serious. This should not be confused with physiological leaf scorch.

Dutch Elm Disease (caused by Ceratocystis ulmi) - Flagging and dieback of residual elms caused by this fungus disease were widespread again in 1989. It is amazing that we have any elms left at all but a few do manage to survive in isolated situations.

Mechanical Damage - Mechanical damage to shade trees and ornamentals continued to be a problem but in most cases this was due to carelessness and is therefore correctable. Weed whips or "weed wackers" appeared to be the number one cause of damage around homes although lawn mower related injuries continued to rank very high.

Hardwood Anthracnoses - See (B) Forest Pests-Hardwoods

Sirococcus Shoot Blight - See Section C

Winter Browning - Winter browning of red spruce in forested situations, and many conifers, and rhododendrons in nursery and ornamental plantings, was evident in the spring of 1989. (Present indications are that winter browning will be even more conspicuous as we approach spring 1990, especially on yews and rhododendrons in foundation plantings.)

Compiled and Edited by Richard G. Dearborn and Clark A. Granger

89-9 Insect & Disease Management Division Augusta, Maine

(Issued May 16, 1990)

Forestry Related Quarantines in Maine

There are four forestry related quarantines which are in effect in Maine. They are: White Pine Blister Rust, Gypsy Moth, European Larch Canker, and Hemlock Woolly Adelgid.

I. The White Pine Blister Rust Regulations and Quarantine are listed under Title 12 MRSA 1988, Subchapter III, Section 803:8305 Shipment Prohibited.

The director may prohibit, prevent or regulate the entry into or movement within the State, from any part thereof to any other part, of any plants of the genus Ribes or other nursery or wildling plants, stock or parts of plants which may cause the introduction or spread of a dangerous forest insect or disease. The director may issue the necessary orders, permits and notices necessary to carry out this section which shall not be considered to require or constitute an adjudicatory proceeding under the Maine Administrative Procedure Act, Title 5, Chapter 375.

Regulation: White Pine Blister Rust, Quarantine on Currants and Gooseberry Bushes.

A. The sale, transportation, further planting or possession of plants of the genus Ribes (commonly known as currant and gooseberry plants, including cultivated wild, or ornamental sorts) is prohibited in the following Counties in the State of Maine, to wit: York, Cumberland, Androscoggin, Kennebec, Sagadahoc, Lincoln, Knox, Waldo, Hancock, and parts of Oxford, Franklin, Somerset, Piscataquis, Penobscot, Aroostook, and Washington.

B. The planting or possession of European Black Currant, Ribes nigrum or its varieties or hybrids anywhere within the boundaries of the State of Maine is prohibited. This quarantine is administered by the Insect & Disease Management Division of the Maine Forest Service, phone 289-2431 or 289-2791.

II. The Gypsy Moth Quarantine is listed under 7 CFR Part 301, United States Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection and Quarantine as printed in the Federal Register.

A. This quarantine designates the infested area in Maine as quarantined for the movement of regulated articles, which includes wood such as logs, pulpwood, chips, etc., and requires the inspection and certification of such material if movement is to non-infested states and foreign countries. This is administered by the USDA-APHIS, PPQ in Bangor, Maine, phone 945-0479.

B. Inasmuch as Maine is not completely infested and quarantined, wood or regulated articles moving from the infested area of the state to the non-infested area must be accompanied by a certificate or go to a mill under state compliance agreement which allows the reception of such articles. Regulated articles moving from the non-infested area of the state to other non-infested states or countries must be accompanied by a state permit stating that the regulated article originated outside of the infested area of the state. This is managed by the Insect & Disease Management Division of the Maine Forest Service, phone 289-2431 or 289-2791.

III. The European Larch Canker Quarantine is listed under 7 CFR Part 301 of the United States Department of Agriculture, Animal & Plant Health Inspection Service, as published in the Federal Register, and also under Title 12 MRSA, Section 8305 of the Laws of the State of Maine.

A. This quarantines all parts of larch (Larix spp.) including logs, pulpwood, branches, twigs, etc, as regulated articles.

B. Also any other product, article, or means of conveyance whatsoever, when it has been determined by an inspector that it presents a risk of spread of the disease.

C. Designates parts of Hancock, Knox, Lincoln, Waldo, and Washington counties as the quarantined area from which movement is restricted.

This is managed by the USDA-APHIS, PPQ in Bangor, Maine, phone 945-0479, and the Insect and Disease Management Division of the Maine Forest Service, phone 289-2431 or 289-2791.

IV. The Hemlock Woolly Adelgid Quarantine is listed under 7 MRSA, Chapter 409, Section 2301-2303 of the Laws of the State of Maine.

This quarantine was adopted to attempt to prevent the introduction of the Hemlock Woolly Adelgid (Adelges tsugae Annand) into Maine. This pest has been found to cause mortality of Eastern Hemlock (Tsuga canadensis) in infested states. Since hemlock is a major component of Maine's forest on over one million acres, protection of this valuable resource from damage by the Hemlock Woolly Adelgid is essential.

A quarantine is established against the following pest and possible carriers.

A. Pest:. Hemlock Woolly Adelgid (Adelges tsugae Annand).

B. Area Under Quarantine: The States of Connecticut, Delaware, Maryland Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, Alaska, California, Oregon, Washington, and the District of Columbia.

C. Articles and Commodities Covered: Hemlock seedlings and nursery stock, logs, lumber with bark, and chips..

D. Restrictions: All articles and commodities covered are prohibited entry into the state from the area under quarantine unless specified conditions (listed below) are met.

1. Hemlock seedlings and nursery stock are: admissible into Maine provided each lot is accompanied by a certificate issued by the Department of Agriculture or Conservation of the State of the origin with an additional declaration that said material is free from Hemlock Woolly Adelgid.

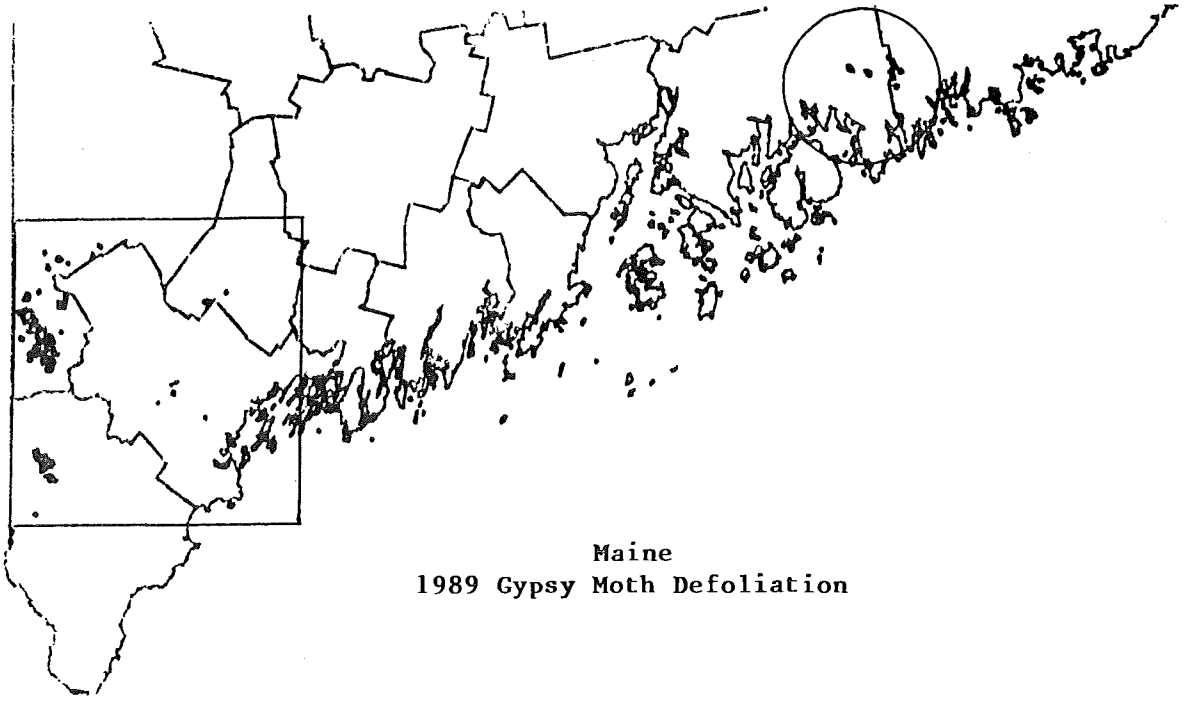
2. Hemlock logs, lumber with bark, and chips are: admissible provided that said material is only shipped to preapproved sites within Maine. Such shipments must be made under a compliance agreement between the shipper and the Maine Forest Service, Department of Conservation. If said material is shipped to other sites, it must be accompanied by a certificate issued by the Department of Agriculture or Conservation of the state of origin affirming (a) the material was grown in the state of origin, and that either (b) the material is free from Hemlock Woolly Adelgid, or that (c) the material originated from an uninfested area in the state of origin.

This quarantine is administered by the Maine Department of Agriculture, phone 289-3871 and the Insect and Disease Management Division of the Maine Forest Service, phone 289-2431 or 289-2791.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 4 - March 1990

GYPSY MOTH IN MAINE - 1989
Prepared by Richard Bradbury
Maine Forest Service

Gypsy moth (Lymantria dispar (L.)) population levels exhibited a significant increase in 1989. Typical of past infestations the defoliation occurred in southern, and primarily southwestern Maine (see Figure 1). Populations in undefoliated portions of southern Maine and along the Penobscot River Valley north to Millinocket were variable, with small "hot spots" of noticeable (but generally less than 30%) defoliation observed.



Maine
1989 Gypsy Moth Defoliation

Figure 1

Areas sustaining 30% or more defoliation rose from 100 acres in 1988 to 34,280 acres in 1989 (see Table 1). This was the most defoliation reported in Maine since 1982.

Table 1.
Acres of Gypsy Moth Defoliation (30%+) Occurring in 1989 by County

Androscoggin	1,134	Oxford	23,240
Cumberland	546	Washington	372
Hancock	908	York	8,080

Winter temperatures in 1988-1989 were mild and did not result in the usual level of egg mortality. Incubation of egg masses collected in late March of 1989 revealed below normal winter mortality both above and below snowline.

Populations in 1989 were generally healthy with the exception of Washington and Hancock Counties, and very locally elsewhere. Disease was noted in these areas, but did not impact populations seriously. Diseased larvae were collected and sent off for determination. These proved negative for the "new" fungus disease organism, Entomophaga sp. ? maimaiga, reported from elsewhere in New England.

Prediction for 1990

Egg mass sampling was done at 69 locations throughout the southern half of the state in the fall of 1989. Twenty-eight of the locations revealed greater than 500 em/acre. Egg mass densities of 500 or more in a new infestation are expected to result in heavy defoliation the following year. High numbers of egg masses were found in all those areas checked which had experienced defoliation in 1989. This would indicate another year of heavy defoliation in 1990 at these locations. Areas not defoliated in 1989, but exhibiting high egg mass numbers included Augusta, Woolwich, Topsham and Greenbush. These data indicate that defoliation will expand into central portions of the state in 1990. Data collected from the Millinocket area indicate a collapse in previously infested stands, but potential for defoliation to occur within peripheral hardwood stands. Various indicators of population vigor such as egg mass size and abundance and parasitism appear to be quite variable especially in eastern Maine. Egg masses collected from several areas of southwestern Maine in the fall of 1989 yielded fairly high numbers of what appears to be the egg parasite Osencyrtus kuvanae. As a result, egg masses will be collected from a number of representative areas in March of 1990 to determine overwintering survival and parasitism.

Population levels and defoliation for 1990 are difficult to accurately predict due to the large number of variables involved. Based on the increase in 1989 and the density and health of overwintering egg masses, it is likely that the population levels of gypsy moth in Maine will remain in an epidemic phase. The Maine Forest Service has no plans to conduct a suppression program against gypsy moth in 1990, but will continue to provide technical advice and assistance to public and private groups concerning any aspect of this problem.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 4 - March 1990

LARCH BARK BEETLE/DECLINE IN MAINE - 1989

Prepared by Richard Bradbury and Richard Dearborn
Maine Forest Service

Dead and dying larch continue to draw much attention and comment from landowners and passersby alike. Although there is a great deal of debate over what precipitated this very real problem, the damage of associated bark beetles is eyecatching. Mortality continues to appear in new areas especially to the north but there are still questions as to how fast these losses are mounting up overall. Previously many of the sites initially infested most often seemed to be those affected by drought or other similar stresses such as casebearer. In 1989, however, the problem had spread from such sites to more vigorous trees on better sites, often some distance away. The question now appears to be how soon this problem will stabilize. This will greatly affect the extent of losses.

Background

An increase in the number of larch stands containing individual or small groups (< 1/4 acres) of moribund trees, was first noted in Maine in the Sheepscot River Valley in the early 1970's. Since then, this phenomenon has been observed statewide, and has become known as larch decline. Larch decline has been documented throughout the northeastern states and Maritime Provinces, as well as in Alaska.

Both eastern larch beetle, Dendroctonus simplex, and shoestring root rot Armillariella mellea have been identified as contributory agents of larch mortality. Historically, these agents have been considered secondary mortality factors attacking trees weakened or stressed by some primary factor. At this time it appears as though some stress or complex of stresses predisposed a critical volume of larch to attack from either or both the bark beetle and A. mellea. Bark beetle populations then increased significantly enough to provide an invasion force that could overcome more healthy trees nearby. How far the bark beetle can proceed without additional predisposing stress to the larch resource is not known.

Present Status

Dead trees resulting from bark beetle attack are highly visible due to the sloughing of bark, which gives the boles a reddish appearance, and the copious pitch flow from the tops. In spite of the relatively high frequency with which these trees are noticed data collected by the Maine Forest Service, from both ground and aerial surveys, indicate losses average less than 2% of the stems. An aerial survey of coastal larch (see Figure 1) has been conducted annually since 1988 from the Kennebec River east to the Machias River. In 1989 data collected from the Kennebec east to the Penobsoct revealed 75% of the coastal larch stands had 10% or less tree mortality; data collected from the Penobscot east to the Machias revealed 98% of the stands had 10% or less tree mortality. These figures are comparable to 1988 data. A system of larch mortality monitoring plots have been established (see Figure 1) to aid in tracking the development of this problem.

Landowners concerned about losses may reduce the impact by harvesting the dead and dying trees. Any larch trees which exhibit pitch flow from the trunk, and which are near dead larch, are likely to be infested with bark beetles and should be removed from the site even if they appear healthy. Prompt removal of any trees infested by the bark beetle will reduce the danger to nearby trees.

Predictions for 1990

Losses of larch due to this problem are expected to continue for some time before stabilizing. How extensive these losses will become depends for the most part on the vigor of the resource, and locally on the success of sanitation cuttings (removal of infested trees promptly before beetle emergence). Problems, similar to this, have occurred in the past and in other areas and the larch resource has survived. Proactive management of larch stands, and rapid removal of infested material when discovered, should lessen the long term impacts of this problem.

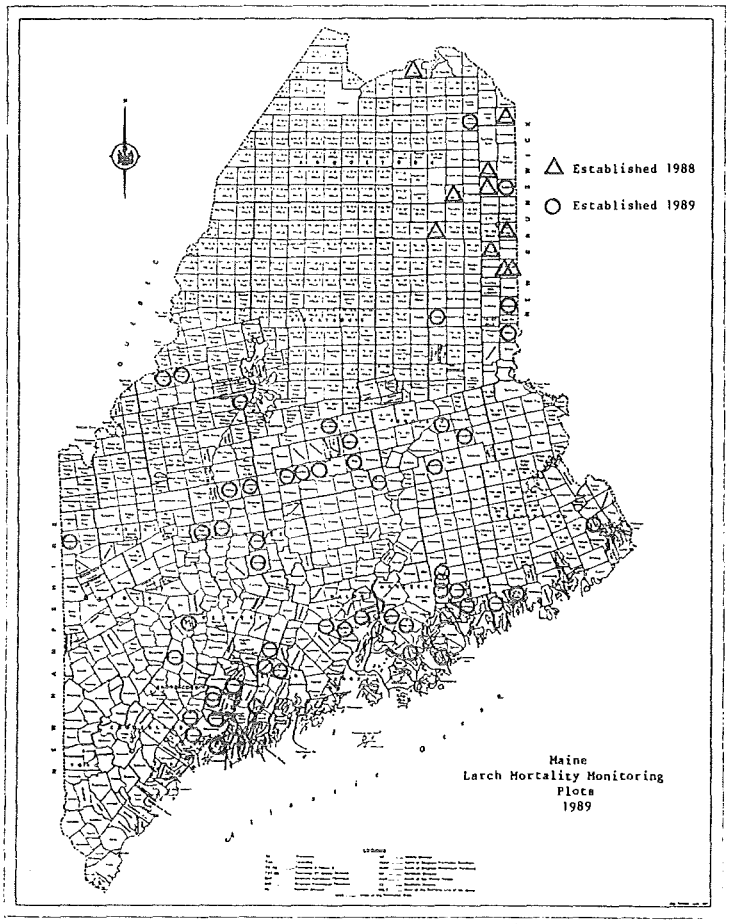


Figure 1

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 4 - March 1990

Lyme Disease in Maine, 1990

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Lyme disease is an infection caused by a tick-transmitted spirochete, Borrelia burgdorferi. If not treated in its earliest stage, the disease may lead to debilitating arthritis or to a variety of neurological, cardiac, or other problems. Reservoirs of the spirochete are maintained in small mammals in nature, particularly the white-footed mouse, which serves as host to the larval stage of the deer tick, Ixodes dammini. Once infected, the tick may then transmit the spirochete to new hosts, including man, as it feeds during each of its subsequent two stages - small nymphs in the late spring and early summer or larger adults in the fall. Expanding from its first site of recognition at Lyme, Connecticut in 1975, Lyme disease has now become established along the New England coast as far north as Ipswich, Massachusetts, 25 miles from Maine. In Maine, eight of several cases reported to the Bureau of Health have been definitely established as contracted within the state.

In 1989, we conducted surveys to determine the distribution of I. dammini in Maine by examining ticks removed from small mammals live-trapped during the late spring and summer, from deer examined at tagging stations during the November hunting season, and from pets, humans and the environment. Of approximately 1,700 ticks examined, 563 were I. dammini, all but two of which were from towns within 20 miles of the coast or its estuaries. Although deer ticks were more frequently found in the southern two counties of the state, specimens were submitted from as far east as Washington County and as far west as Oxford County. Microscopy of specimens from selected coastal areas revealed that up to 16 percent of nymphs from one York County coastal site were infected with B. burgdorferi, but data from other areas is incomplete.

At the same time, recognizing that dogs are at higher risk of exposure to Lyme disease than humans, a canine seroprevalence survey was conducted with the collaboration of 16 veterinary clinics statewide. Blood samples drawn from 833 dogs for heartworm examination were also analyzed for antibodies to Borrelia. Thirty-eight were found to be positive, all but four of which came from towns within the 20-mile coastal zone. Again, positive dogs were found as far east as Machias and as far west as the Rumford area.

From these studies it is apparent that the vector for Lyme disease is present in Maine; that a certain percentage - higher in southern coastal areas - are infected with the Lyme disease spirochete; and that some risk of human infection may exist all along the coast. Of all the ticks found on man, I. dammini is not the most common in Maine, however. In fact, in this study it rated a poor third after the dog tick, Dermacentor variabilis and the woodchuck tick, Ixodes cookei, neither of which are effective Lyme disease vectors. Nevertheless, individuals who work in outdoor Maine - particularly in southern coastal areas - should not dismiss the risk of contracting Lyme disease, and should carefully look for ticks on their skin at the end of the day.

Precautions to be taken when walking in woods, tall grass or marsh areas where ticks may be found include:

- Tuck your pant legs into your socks and your shirt into your pants.
- Wear light-colored clothing so ticks may be seen more easily.
- Use a repellant containing DEET particularly on shoes, socks, pant legs. Avoid applying high concentrations to the skin, particularly of children.
- Protect pets with dusts or sprays available from your veterinarian.
- Inspect yourself, your clothing, your children, your companion, and your pets for ticks when you get in from the field (they may be found in inconspicuous places like the navel or inside the ear).

If you find a tick that is attached, remove it promptly because it takes at least several hours of feeding before the spirochete is transmitted. Don't handle the tick with bare hands. Grasp it as close to the skin as possible, preferably with fine tweezers, and pull gently but firmly straight out. Do not squeeze the tick. Apply antiseptic. Save the tick in a small bottle of 70% alcohol or rubbing alcohol. Touted tick removal methods, such as scorching with a match or coating with vaseline, are ineffective and may cause infected body fluids to be expelled into the skin.

The first symptom of Lyme disease is usually an expanding red rash at the site of the tick bite which may occur a few days or several weeks later. The rash may be preceeded or accompanied by flu-like symptoms such as fever, headache, chills, nausea, facial paralysis, or pain in muscles and joints. If Lyme disease is suspected, call your doctor immediately. Early antibiotic treatment can avoid later, more serious complications. Not all patients develop the rash, however, and many do not recall a tick bite.

In most animals, the rash apparently does not occur. Lameness, loss of appetite, fever, and lethargy may be the first indications. As in people, animals usually respond to prompt antibiotic therapy.

If you find ticks that you think may be deer ticks and wish them identified, send them in a small vial of alcohol, along with information including the name and age if from a person, kind of animal or other source, the location acquired, and the date found to either of these laboratories:

Maine Lyme Disease Project
Maine Medical Center
Research Department
22 Bramhall Street
Portland, ME 04102

Insect and Disease Laboratory
Maine Forest Service
50 Hospital Street
Augusta, ME 04330

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 4 - March 1990

Spruce Beetle in Maine - 1989
Prepared by Henry Trial, Jr.
Maine Forest Service

The **spruce beetle** (Dendroctonus rufipennis) has long been a recognized pest of spruce throughout the northeast and has periodically caused appreciable losses. In spite of the lengthy history of outbreaks in the northeast, the nature of spruce beetle infestations in Maine is not well understood. I&DM Division personnel have been conducting surveys and working with landowners in order to better understand the situation.

History

In Maine, the most significant losses attributed to this species occurred around the turn of the century when millions of board feet of spruce were destroyed. The next outbreak was first detected in 1925-26 on spruce in the Rangeley area. Although not recorded until 1928, damage also apparently simultaneously developed in spots in Aroostook County. The outbreak spread and intensified throughout northern and western Maine, peaking in the mid 1930's. At that time infestations were detected as far south as central Maine. Populations then declined, and after 1940 only very localized infestations were noted.

The first indications of the current outbreak were increased beetle attacks occurring in 1985. Many new areas were found in 1986, due partly to increased survey efforts and partly to expansion of the outbreak. In 1987, although some new areas were found, many of the older areas showed few new attacks. In 1988, beetles seemed to be everywhere. By 1989, those trees attacked in 1988 were visible from the air and the extent of the expansion of the problem became apparent.

Symptomology

Observations from the current outbreak are beginning to provide information on the type of stand and host first attacked. In the large concentrations of heavy spruce beetle attack, initial infestation started in hill-and-valley stream areas. Attack usually began in low, wet areas which contained old, usually large, white spruce. As the attack intensified, it tended to move up the surrounding slopes where, in some areas, red spruce was also attacked. Within known heavily attacked areas, nearly all of the large (>15") spruce were killed.

Both new and older infestations were found to have many host trees attacked in 1988. Many of these trees had reddish crowns and retained some needles. More recently attacked trees still had green crowns and showed no evidence of infestation visible from the air. In older infestations, trees attacked three or more years before had lost all their needles and fine branches and had gray crowns.

In northern Maine, red spruce and smaller white spruce are less susceptible than large white spruce. Those smaller trees which are attacked are usually older than their size would indicate. However, in the west-central portion of Maine red spruce appears to be the favored host: in Township C, red spruce was attacked early in the outbreak and continues to be

the most susceptible host; in Lower Cupsuptic, only red spruce were attacked although white spruce were present in the stand. We have seen occasional successful attack on black spruce but we do not consider spruce beetle a threat to this species.

Apparently the rate of beetle attack does not proceed as a steady increase, but rather in surges which may be caused by favorable weather or host stress factors. The recent budworm outbreak may have been an important predisposing factor in current susceptibility. Possibly, drought conditions in 1988 weakened trees and greatly accelerated attack. There seems to be little recognizable pattern in the growth of the Maine spruce beetle infestation.

Survey Activities

Using the known characteristics of beetle infested trees (appearance, pattern and location of dying trees), during 1988 the I&DM Division developed formal survey methods to aerially identify foci of spruce beetle attack. After the general aerial survey in mid July 1989 first showed the infestation expansion, Division staff used this spruce beetle symptomology signature to conduct an enhanced aerial survey to intensively evaluate the spruce beetle problem in 1989. This survey and supporting extensive ground evaluation revealed a significant increase in extent and severity of the infestation. The increase included expansion of known areas and identification of many new ones. Although some of the areas were found due to improved aerial techniques, many were new infestations.

The intensive survey was designed to identify three categories of beetle infestation: none; scattered individual trees; and large, intense patches of damage. The scattered pattern of the host and infestation made aerial identification of infestation boundaries impractical. Survey efforts were therefore designed to identify the location of infestation foci.

The aerial survey revealed seven large concentrations of beetle attack (Figure 1). The combined total acreage of these areas exceeded 7500 acres. Some of these areas were previously known infestations which greatly intensified in 1989; Round Pond (T13 R12), Bluffer Brook (T8 R10), Robbins Brook (T13 R11), and Township C - Richardsontown. Other large areas of more recent origin were Beaver Brook (T16 R5), Fifth Musquacook Lake (T10 R11) and Russell Pond (T8 R14). The intensive survey also found small pockets of infestation and scattered individual trees throughout the northern third and in the west-central area of the State. Many of these small areas have significant potential to expand.

Research Projects

The I&DM Division began two small-scale research projects on spruce beetle in 1989. Division staff established plots in three areas to evaluate and characterize the spread of beetle in areas where infestation exists but where many uninfested host trees remain. Two of the plots contained an approximately equal mix of red and white spruce of variable size. The third plot was exclusively large white spruce. In each plot, up to 50 red or white spruce greater than 6" DBH were marked. These plots will be visited annually and new attack recorded. In 1990 the I&DM Division plans to establish

additional plots and also collect data from other large infested areas to evaluate tree and stand susceptibility. This information will be used to develop a spruce beetle risk rating system for Maine. This rating system will facilitate managing this pest.

The second project was conducted in cooperation with the U.S. Forest Service, State & Private Field Office in Durham, NH. This project was a small preliminary test of chemical baits being developed in the West. Five trees were baited with lures to determine whether the lures would attract beetles and if adjacent trees would be attacked. Three baits were placed in a moderately infested area, one each in a red, a white, and a black spruce. The other two baited trees were a red and white spruce in a more lightly infested area.

All baited trees except the red spruce in the moderate area were attacked. The two white spruce trees seemed to be more heavily attacked than the other trees. No other trees within a 20 meter radius of any baited tree were attacked even though many acceptable host trees were contained in those areas. More work with spruce beetle baits is being planned for 1990. Hopefully, a "bait, concentrate, and destroy" method can be developed that will lessen the impact of spruce beetle on high value stands.

Training and Technical Assistance

The I&DM Division has had several contacts with landowners about spruce beetle damage on their holdings. A pest alert reporting the expansion of the outbreak and providing a general map of infested areas was issued in July 1989. As a result of the contacts and the pest alert, I&DM staff have worked with several landowner foresters to identify problem areas and to train interested staff. Seven field training sessions have been conducted and more than 40 landowner staff have been trained. In response to contacts and training, several landowners have implemented or planned salvage cuts in heavily damaged areas. More informational and training sessions are being planned for early 1990.

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I&DM Summary Report No. 4 - March 1990

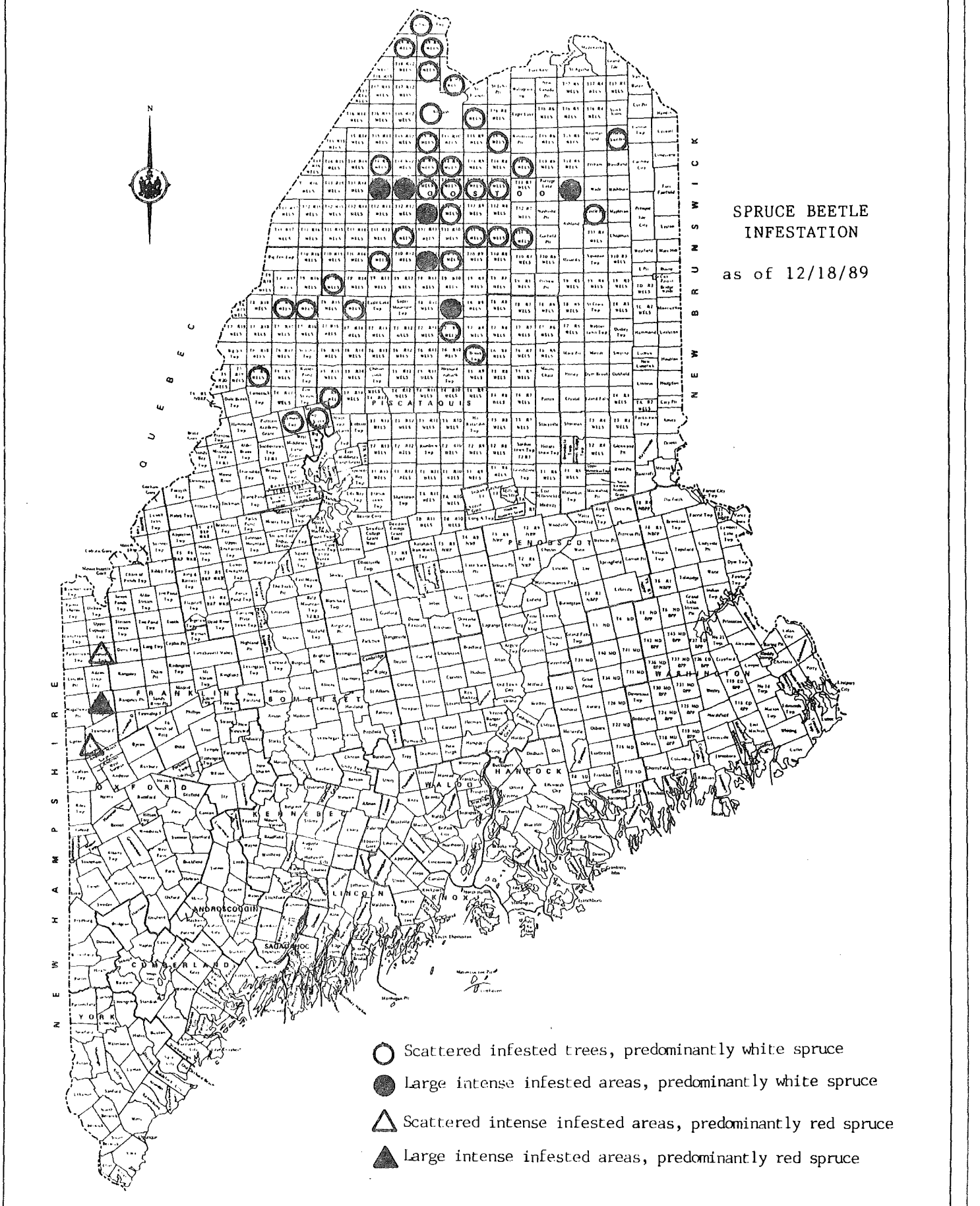
SPRUCE BEETLE
INFESTATION
as of 12/18/89
N
QUEBEC
NEW BRUNSWICK
NEW HAMPSHIRE
PISCATAQUIS
PENOBSCOT
WASHINGTON
HANCOCK
FRANKLIN
SOMERSET
WALDO
OXFORD
KENNEBEC
LINCOLN
KNOX
ANDROSCOGGIN
SAGADAHOC
CUMBERLAND
YORK
Scattered infested trees, predominantly white spruce
Large intense infested areas, predominantly white spruce
Scattered intense infested areas, predominantly red spruce
Large intense infested areas, predominantly red spruce

Figure 1

SPRUCE BUDWORM IN MAINE - 1989

Prepared by Henry Trial
Maine Forest Service

The spruce budworm (Choristoneura fumiferana Clem.) infestation which devastated Maine's spruce-fir forests from the early 70's through the mid 80's had nearly disappeared by the summer of 1989. Even a small pocket of population in the southeast coastal area which had persisted through the late 80's was nearly gone by the end of the 1989 season. Because of the potential of the budworm to kill trees and because of reports of population increases in neighboring Canadian provinces, the Maine Forest Service (MFS), Insect and Disease Management Division continued population monitoring efforts in 1989. These efforts included an aerial and ground defoliation survey, operational pheromone trapping, and a test of pheromone trapping efficiency. In 1989, more emphasis was placed on assessing larval populations, parasitism, and development. The increase in larval sample counts was initiated as a check on pheromone surveys which have given questionable results in the past. Parasite and development samples were taken in residual populations in the southeast to compliment the historical record.

Larval Populations

Larval population counts were made at 13 locations throughout the State. Locations chosen for sampling were, predominantly, traditional development and parasite points. Several 18" branch tips were examined at each site to assess larval populations. Larvae were found at only two of the 13 locations; Waltham and Jonesboro. Both locations are in the southeast (see Figure 1). The early larval count at Jonesboro was 3.5 per branch and Waltham had 13.7 larvae per branch. Both locations maintained some population throughout the season and were used to evaluate parasitism and development.

Development

Development of budworm larvae in 1989 started late and progressed very slowly due to cold, wet weather in late April and much of May. Proximity to the ocean and the resulting cooler spring temperatures caused the Jonesboro site to develop more slowly than the Waltham site. Overall, pupation occurred approximately five to seven days later than the 10 year average. Weather conditions did not seem to retard bud flush. Bud expansion of fir was rapid and nearly all fir buds reached class five (fully expanded and flat) by late May.

Parasitism

The parasite survey plan was to collect and process parasite samples at Jonesboro and Waltham at the peak of 3rd instar (early larval), peak 6th (late larval), pupation, and an egg sample. Insufficient numbers of larvae were found to process the pupal sample for Jonesboro. Also, the late larval sample from Jonesboro contained many diseased larvae which did not survive the rearing process. Many of the diseased larvae were affected by an unidentified fungus. The late larval sample from Waltham contained few diseased larvae. Results for the five samples processed are shown in Table 1.

Table 1.
1989 Parasitism of Spruce Budworm

Location	# Larvae	Rate of Parasitism (%)			
Early Larval					
		Apanteles	Glypta	Synetaeris	Total
Waltham	116	3.5	9.0	0.0	12.5
Jonesboro	33	6.1	0.0	0.0	6.1
Late Larval					
Waltham	80	Apanteles	Glypta	Meteorus	
		0.0	1.3	0.0	
		Lypha	Aplomya		Total
		6.3	2.5		10.1
Jonesboro	51	Apanteles	Glypta	Meteorus	Total
		2.0	0.0	2.0	4.0
Pupal					
Waltham	68	Itoplectis	Ephialtes	Agria	
		4.4	2.9	5.9	
		Omotoma	Mesopolobus		Total
		2.9	1.5		17.9

Crews were unable to find sufficient numbers of egg masses to warrant continuation of the egg parasitism survey.

Microsporidian Evaluation

All larval samples collected from Waltham and Jonesboro were saved for microsporidian disease analysis by Dr. John Dimond of the University of Maine. Analysis of larvae from several collections made at the two development sites showed low rates of infection. Collections made in southeastern Maine have not shown the high infection rates seen in other portions of the State.

Defoliation Survey

A combination of retarded insect development, lush foliage, and light or variable budworm populations made damage detection from the air difficult in 1989. Survey flights were made in the heaviest defoliation areas but only 1300 acres of moderate damage was mapped

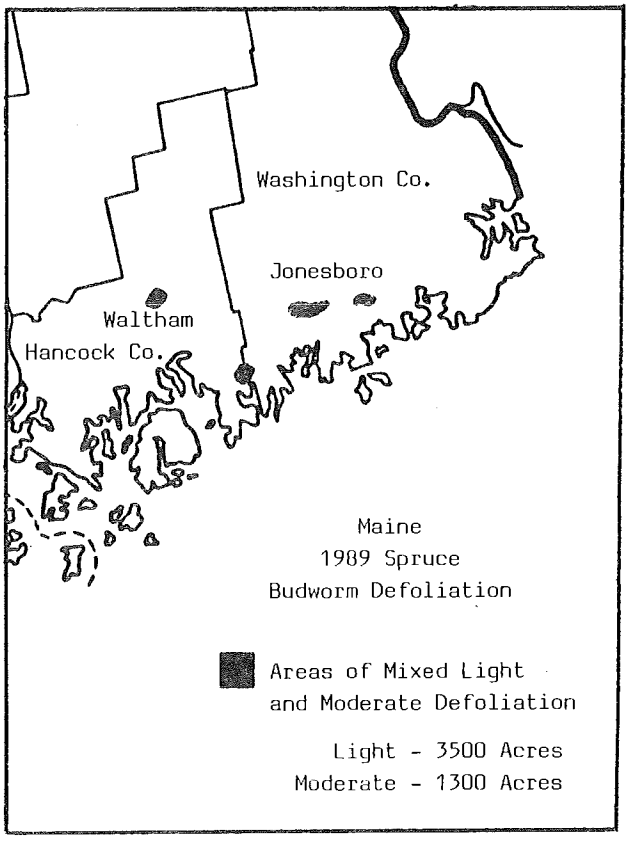

Figure 1

and even this required ground confirmation. Additional ground checks revealed 3500 acres of light damage (Figure 1). Towns in Hancock County that had areas of light or moderate defoliation were Waltham and Gouldsboro. Washington County towns with similar levels of damage were Steuben, Columbia, Columbia Falls, and Jonesboro. Defoliation in 1989 was extremely spotty and even adjacent trees were found to have very different levels of damage.

Pheromone Survey

Again in 1989, pheromone traps were deployed throughout the previously infested area in order to predict future budworm population trends. Recent experience with this survey method has not been satisfactory mainly because moths have not been trapped in areas of known infestation. Also, inter-trap variability has been high. To increase survey sensitivity, a new lure (Biolure), thought to have a greater ability to attract moths, was used in half of the traps. Both PVC lure and Biolure were used at each trap location.

In 1989 traps baited with PVC lure consistently caught more moths than traps baited with Biolure. In the southeast, where low to moderate populations persist (Figure 2), PVC lures and Biolures both caught moths, however, the catch in PVC baited traps was much higher than those baited with Biolure. PVC lures produced numbers of moths comparable with catches recorded by other jurisdictions with similar population levels. In areas of low population, PVC lures caught low numbers of moths but in most cases Biolure caught none. For example many PVC traps in the northeast caught one to five moths whereas Biolure traps caught none. Due to the great inconsistencies which have occurred between years we do not know if the catch in the northeast represents an increase in moths or an unexplained improvement in trap efficiency.

Pheromone Tests

Two pheromone tests were conducted in Maine in 1989. In the first test, 20 trap grids of PVC baited traps were established next to 20 trap grids of Biolure baited traps in order to compare trap catch and inter-trap variability. In the second test, three rates of PVC lure plus Biolure were compared in random grids of relationship among the four lures.

Results of both tests are currently being analyzed and results will be published as part of a report discussing four years of pheromone use and testing in Maine.

Light Trap Survey

The MFS has operated a system of light traps since 1943 to monitor moths of the spruce budworm and other insects. As budworm populations increased in the 40's, this trap system became a supplement to other types of population assessment data and it remains so today. In recent years the MFS has contracted for the operation of 20 traps distributed statewide. Four additional traps began operation in 1989. These traps were located in areas where increased data on low level budworm populations were desirable. A comparison of past light trap data with annual defoliation conducted in 1989 had shown an excellent relationship. Because of this relationship the MFS

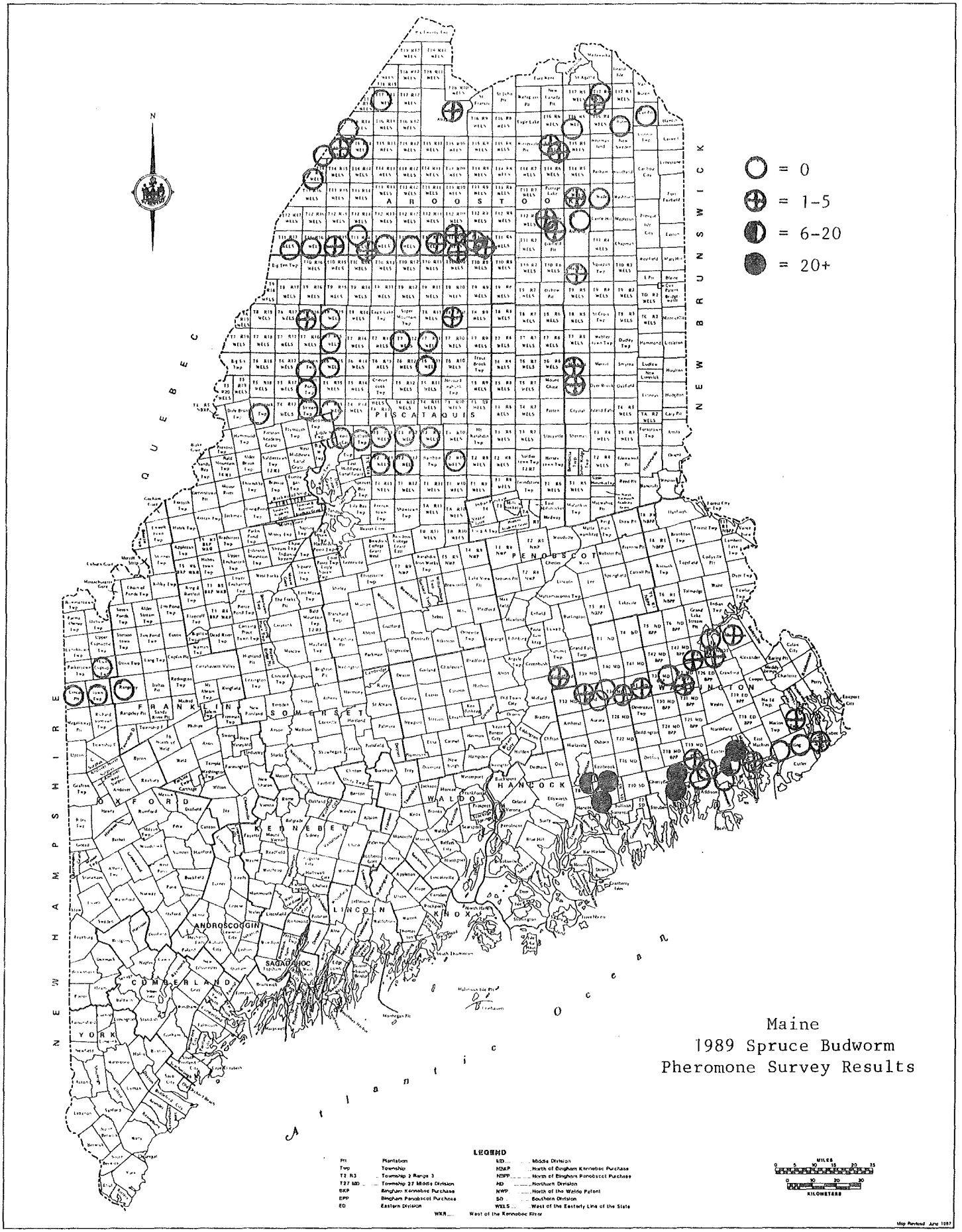
N
= 0
= 1-5
= 6-20
= 20+
QUEBEC
NEW BRUNSWICK
ATLANTIC OCEAN
PISCATAQUIS
AROOSTOOK
PENOBSCOT
WASHINGTON
HANCOCK
WALDO
KNOX
LINCOLN
SAGADAHOC
ANDROSCOGGIN
FRANKLIN
SOMERSET
KENNEBEC
OXFORD
CUMBERLAND
YORK
NEW HAMPSHIRE
Maine
1989 Spruce Budworm
Pheromone Survey Results
LEGEND
Pl ... Plantation
Twp ... Township
T2 R3 ... Township 2 Range 3
T27 MD ... Township 27 Middle Division
BKP ... Bingham Kennebec Purchase
BPP ... Bingham Penobscot Purchase
ED ... Eastern Division
MD ... Middle Division
NKP ... North of Bingham Kennebec Purchase
NPP ... North of Bingham Penobscot Purchase
ND ... Northern Division
NWP ... North of the Wilda Patent
SD ... Southern Division
WELS ... West of the Easterly Line of the State
WKR ... West of the Kennebec River
MILES
KILOMETERS

Figure 2

Table 2 .

Summary of the Number of Spruce Budworm Moths Collected at Light Traps in 1989

Trap Station	June Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Totals
Allagash	0					1					1		22			1		2	8						10	17	2				64
Ashland	0																													0	0
Blue Hill	0			1				1	1			2																	1		6
Brunswick	0						1			3	2		4	2		1	2				1										16
Clayton Lake	0														1		2	1					6	3	4	1					18
Dennistown	0					1																					1				2
Elliotsville	0																													0	0
Exeter	0			1	2	1		1						1	1	1										1					9
Greenbush	1	1								3	1			1	1	1										1					10
Guerette	0					1																									1
Haynesville	0													2										1	4						7
Kingfield	0																													0	0
Matagamon	0																													0	0
Meddybemps	0									1	1			2		1															5
Millinocket	0																													0	0
Mt. Vernon	0																													0	0
Musquacook	0																										1				1
No. Bridgton	0																													0	0
Rangeley	0				2	1								3							1									7
So. Berwick	0																													0	0
St. Aurelie	0																							1							1
Steuben	9	14	18	6	15	18	14	173	8	13	14	30	65	87	26	5	4		9	6		1	1		5	4	3				548
Topsfield	0					1		2		2				3		1						3	1			1	1				15
Washington	0							1	3	10	6		2			1					2			1							26
Totals	**10**	**15**	**18**	**8**	**19**	**24**	**15**	**178**	**12**	**32**	**25**	**32**	**93**	**101**	**29**	**12**	**8**	**3**	**17**	**6**	**4**	**4**	**8**	**6**	**23**	**25**	**8**	**0**	**1**	**0**	**736**

believes that light trap data may be a good predictor of low level population trends. The results of this survey are shown in Table 2. For more information on this program refer to I&DM Technical Report No. 28 (see Publication Section).

Results in 1989 are complicated somewhat by the addition of the four new traps and by a change of the location of another trap. In general, more moths were trapped in 1989 than either 1987 or 1988 and more of these moths were trapped in traditional infestation areas of the northern and central portions of the State. In 1988 much of the catch occurred in the south and south central area. In 1988, nine of 20 traps caught 209 moths with most of the catch coming from one southeastern trap (Meddybemps). In 1989, 736 moths were caught in 16 of 24 traps and again most of the catch came from one southern trap (Steuben). The Meddybemps trap was moved in 1989 and this move almost certainly reduced catch. The Steuben trap was new. If the results of these two traps are excluded from the 1988 and 1989 data respectively, approximately six times as many moths were caught by the remaining traps in 1989 as compared to 1988.

Examination of the statewide light trap catch over time shows two distinct peaks of moth activity. The first moth activity began about the 1st to the 3rd of July and ceased by the 18th. A second peak of activity occurred between the 22nd and the 26th of July. Examination of Maine budworm development tables indicate that local moth emergence had probably ended around the 18th and therefore the second peak of moth activity was probably not of local origin. Heavy moth activity occurred in and around the Quebec and New Brunswick infestation areas during the same time frame as the second Maine peak and this is probably the origin of the late moth activity in Maine.

Catches are far too low to be considered significant but they do indicate a more generally distributed low level population than was seen in 1988. Similar results in 1990 and 1991 would suggest an upward trend.

1990 Prediction

Prediction of the budworm population trend in Maine for 1990 is little more than a guess. Pheromone trapping results for 1989 show slight increases in catch from 1988 levels but the change is not significant. Considering the recent inconsistencies with pheromones any change could be due to the method and may have no relation to population. Light traps in the northern and central portions of Maine caught more moths than in 1989 but increases for two or three years would be needed to consider the change a trend. It is probably safe to say that any changes in the status of budworm in Maine in 1990 will not be drastic. Population and damage levels are likely to be similar to those seen in 1989.

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