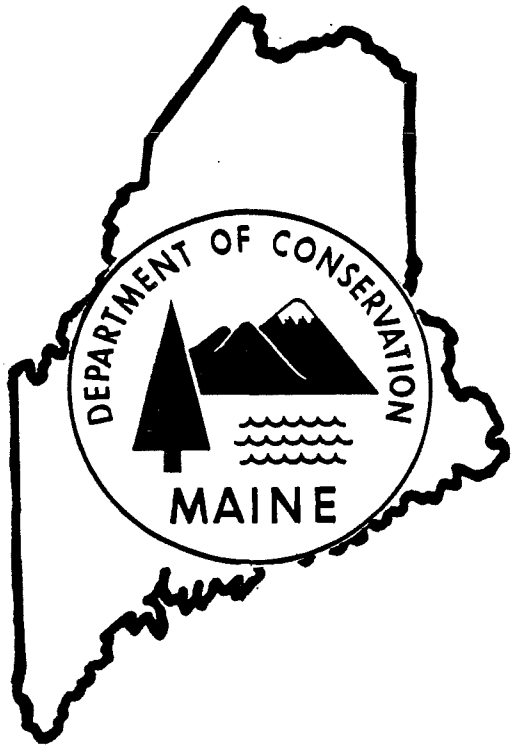
FOREST & SHADE TREE INSECT & DISEASE CONDITIONS FOR MAINE

A Summary of the 1990 Situation



Insect & Disease Management Division
Summary Report No. 5
February 1991

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 1990 Situation

C O N T E N T S

Continued

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 1990 SITUATION

Introduction

Pest conditions in 1990 continued to be a mix of the new and unusual along with the normal and expected. While gypsy moth and hemlock looper captured the largest share of the lime light, winter injury, browntail moth, Cristulariella leaf spot and a newcomer, the euonymus caterpillar, certainly drew their share of attention. Most of the significant defoliation in 1990 occurred in southern and eastern Maine as a result of feeding by the gypsy moth and hemlock looper. The larch bark beetle/decline, larch casebearer, spruce beetle and white pine weevil continued to take their toll while the spruce budworm all but disappeared. Winter injury to nursery stock, forest and Christmas tree plantations, and landscape plantings, together with a spectacular outbreak of Cristulariella leaf spot, led in the disease category. Reports of annosus and Armillaria root rots indicate their continuing impact. The balsam gall midge and mites dominated the Christmas tree pest scene again and needle rusts caused some local but minor problems in the north. "Tippers" were hard hit by high gall midge populations on wild balsam fir trees making it difficult to find good wreath brush. Mosquitoes and other biting flies continued to plague all but the hardy and committed early in the season. Quarantine programs changed little in 1990.

Highlights of Division Activities for 1990

Personnel assignments were stable in 1990 with no additions or losses while an ambitious schedule of projects kept crews busy throughout the season. Field work necessary to establish the Forest Health Monitoring (FHM) system (see following section) was probably the most demanding and drew heavily on the division manpower. Experience gained on plot work in the past, however, enabled I&DM staff to complete the work with minimum complications. Following completion of the FHM plot work in the fall, work was begun on expanded hemlock looper assessment surveys which continued throughout the winter months. The 1990 season was also the final year of the three year North American Maple Project (NAMP) although work on this project may be renegotiated for continuation. The White Pine Blister Rust program continued to draw support in 1990 although somewhat modified and reduced due to limited funding.

In addition to the major projects mentioned, general surveys continued to provide basic information necessary in support of many public assistance efforts as well as other programs. Throughout the year many of the I&DM professional staff conducted and attended meetings with entomologists and pathologists from other states and eastern Canadian provinces. Informational and training meetings were held with landowners and the general public on a wide variety of subjects but especially gypsy moth, hemlock looper and spruce beetle. Exhibits were set up and staffed at a number of forestry related events. An extensive file of information sheets, leaflets, and brochures were upgraded and maintained to support this effort in addition to our periodic conditions reports.

The I&DM staff for 1990 has been presented on the inside front cover of this report and in the organization chart and district map preceding the 1990 Pest Summary which follows.

Forest Health Monitoring System Established in Maine - 1990

In 1990 the Maine Forest Service cooperated with the USDA-Forest Service, the Environmental Protection Agency (EPA) and the other New England state forestry organizations in a study designed to monitor the health of New England's forest resources. After intense discussion among these organizations during the winter months, a plan was developed and implemented which provided for the establishment of 265 permanent plots throughout New England selected from a randomly established grid system. Maine has 137 of these plots distributed over the entire state, 118 in forested locations. Data collected so far include: physical characteristics of the plot location, tree measurement and placement within plots, measurement of regeneration, assessment of indices of individual forest tree health, and observations of specific plant species for signs of damage from airborne pollutants. Plot establishment began June 11 following a week-long training session for all participants in New Hampshire and was finished for 1990 with final data sent to the U.S. Forest Service in October. These plots will be reexamined annually to detect any change in the health of forest resources.

Data resulting from 1990 work is accumulated and processed by the USDA-Forest Service's Forest Inventory and Analysis group. Analysis has begun and will be reported in the winter of 1991. Initial findings show the forest health monitoring (FHM) data is comparable to that of earlier regional inventories. This validates that the FHM sample is of sufficient size to allow accurate conclusions to be drawn from its data. Throughout New England 26,718 trees in the dominant and codominant classes were examined, 10,752 softwoods and 15,966 hardwoods. Data show 82% of the softwoods and 80% of the hardwoods have high density crowns indicating good health and a high potential for photosynthesis. Measurement of dieback within the crowns of trees in these same classes show 96% of the softwoods and 87% of the hardwoods had 10% or less mortality of branches in the crowns.

This project will remain a very high priority of the I&DM division in 1991. All forested plots will be reexamined and additional variables may be sampled. Maine will continue to receive federal funding and technical assistance from the USDA-FS and EPA in 1991 to conduct field assessment and data analysis.

A New Publication Describes Forest Health Monitoring Activities in Maine

Last spring I&DM Division assembled a compendium of forest health monitoring activities currently being conducted in Maine. The work listed in this compilation is being conducted by several diverse public and private agencies, including the University of Maine, the Maine Forest Service, the USDA Forest Service, the Maine Department of Environmental Protection, and the

paper industry. Prior to this effort there was no central listing of forest health related projects which were underway at any one time. Without such a listing, it was difficult to assess the adequacy of Maine's efforts to protect the health of its forest resource.

The work of 26 scientists is described in the compendium which is entitled Forest Health Research and Monitoring Activity in Maine 1989-1990. Copies may be obtained by writing or calling us in Augusta.

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 again 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 within a critical time frame. **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 also go 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. **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 Maine Department of Agriculture, USDA-APHIS and the University of Maine 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.

Throughout the year I&DM staff frequently contribute to items for the news media and various association newsletters. Articles which were written during the 1990 season covered a diversity of pests ranging from those affecting ornamentals to pests of sugar maple, shade trees, Christmas trees and small woodlots. Increasing dependence on I&DM staff expertise have spread use of the results of our activities throughout the northeast.

In addition to items already mentioned, the following new items have been published over the past year or are in the process of being published:

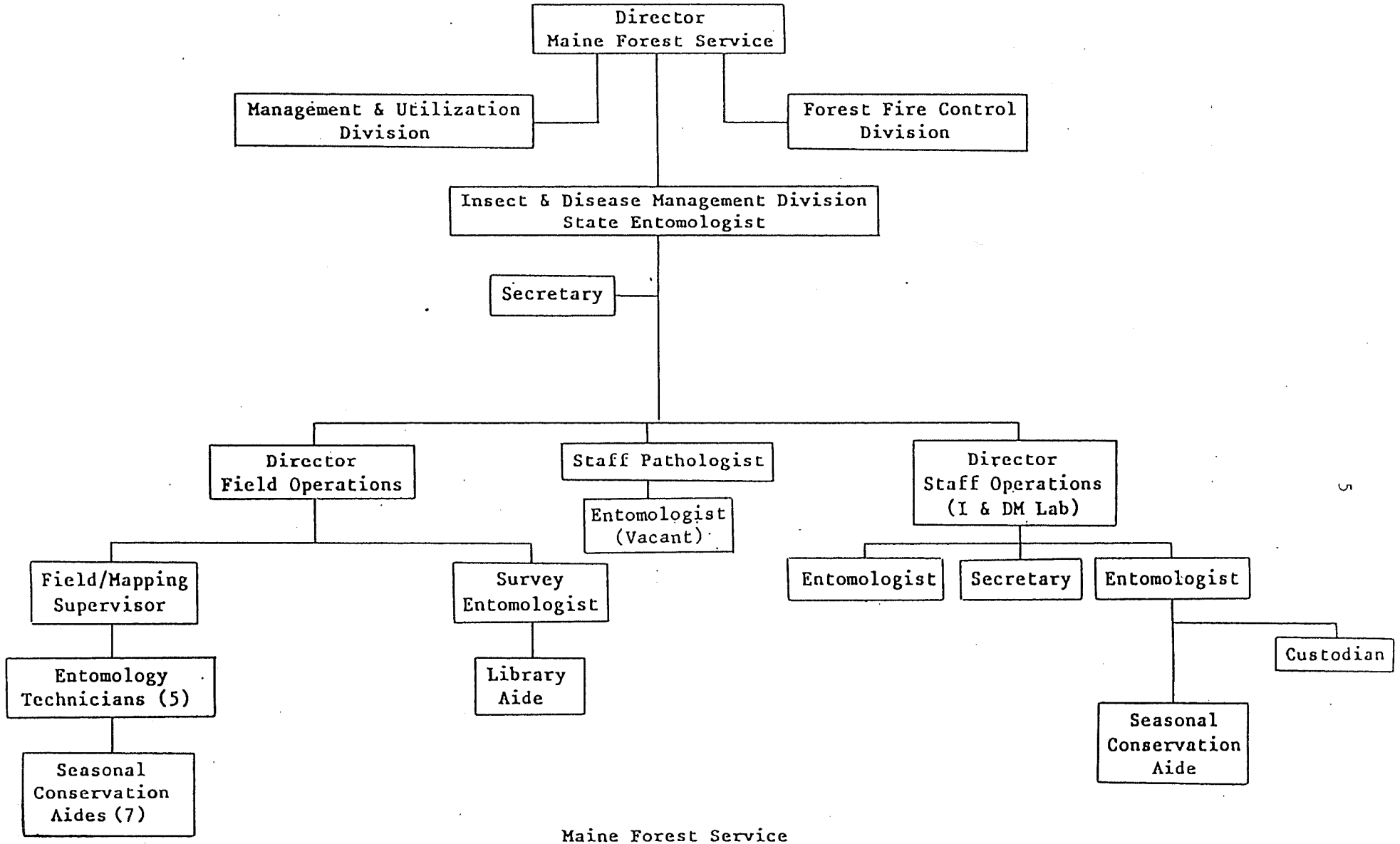
Granger, C.A. 1990 (April). Forest Health Research and Monitoring Activity in Maine 1989-90. Me. Dept. of Conserv., Me. For. Serv., I&DM Division. Tech. Rpt. No. 29. 30 pp.

Insect & Disease Management Division. 1990 (March). Forest & Shade Tree-Insect & Disease Conditions for Maine - A Summary of the 1989 Situation. Me. Dept. of Conserv., Me. For. Serv., I&DM Division. Summary Rpt. No. 4. 48 pp. Compiled and edited by R.G. Dearborn and C.A. Granger.

Insect & Disease Management Division. 1990. Forest & Shade Tree-Insect & Disease Conditions for Maine. 8 issues from May 9 through October 25. Compiled and edited by R.G. Dearborn and C.A. Granger.

LaBonte, George A. and R.J. Leso. 1990 (March). Cleaning Paper Birch in a Birch-Aspen Stand in Maine: A 34-Year Case History. Northern Journal of Applied Forestry. Vol. 7, No. 1. pp. 22-23.

Trial, Henry, Jr. and Joan G. Trial. In Press. The Distribution of Eastern Hemlock Looper [Lambdina fiscellaria fiscellaria (Gn.)] eggs on Eastern Hemlock [Tsuga canadensis (L.) Carr.] and Development of an Egg Sampling Method on Hemlock. Me. Dept. of Conserv., Me. For. Serv., I&DM Division. Tech. Rpt. No. 30. 12 pp.



Maine Forest Service
MAINE DEPARTMENT OF CONSERVATION
Insect & Disease Management Division
Organizational Chart
February 1991

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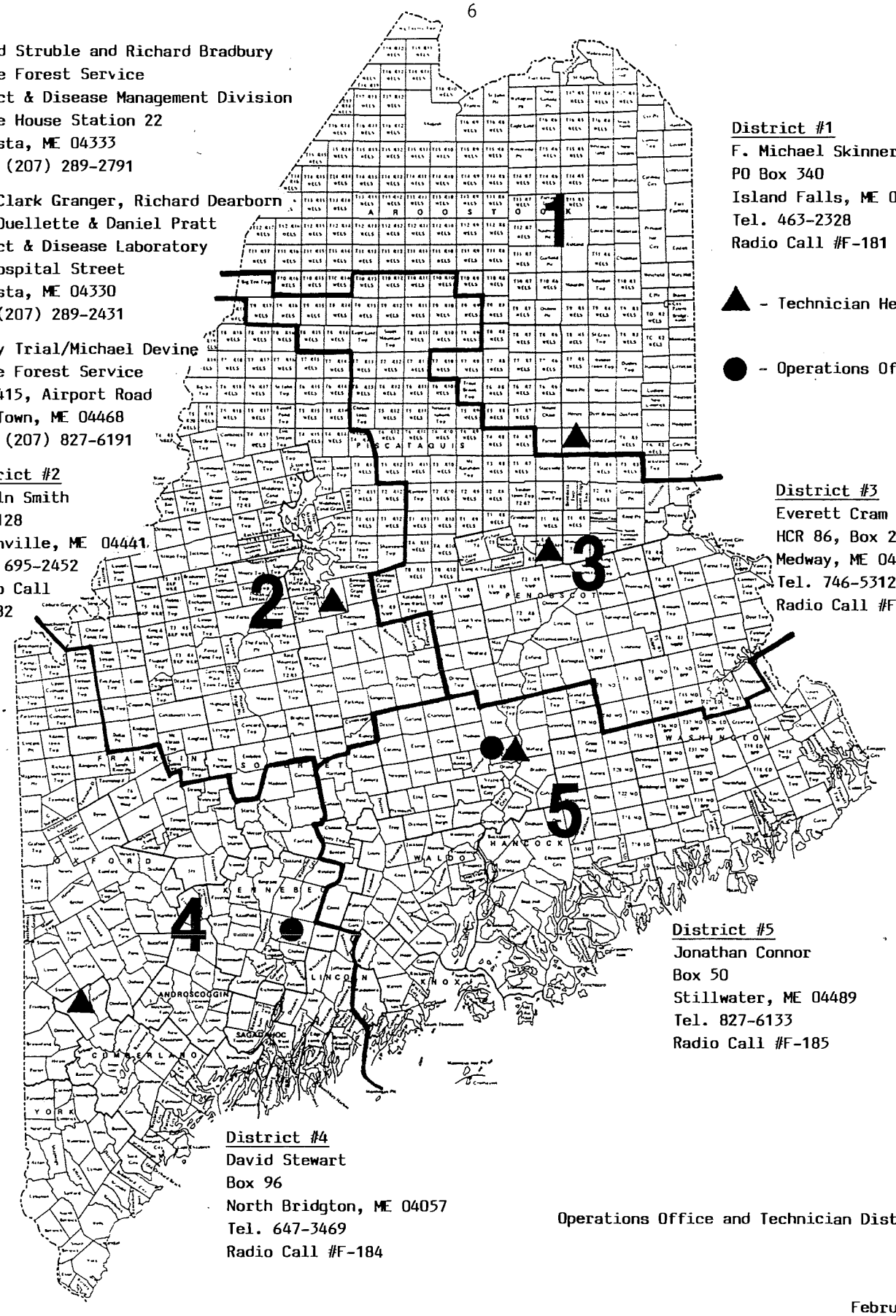

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February 1991

1990
PEST SUMMARY

What's "New" and Unusual

Although at least a few new or unusual pests occur each year, the 1990 season was unique in the unexpectedly greater number encountered. Some of the earliest reports came from I&DM field staff who observed numerous "orange spots" on fir foliage in January as they collected hemlock looper samples or checked for twig aphid. These turned out to be the balsam needle gall inquiline (see Sect. A-Balsam Gall Midge). In early April a home in Crystal was covered with tiny "fuzzy," dark caterpillars of the confused Haploa (see Sect. D) as the snows began to melt. In June many alarmed homeowners and municipal workers reported that tree forms of Euonymus were "festooned" with webbing containing light, spotted euonymus caterpillars (see Sect. D). In early August rusty-red colored black locust along a stream in Lewiston were literally covered with yellow-orange and black adult beetles of the locust leafminer (see Sect. D). Moths of the relatively uncommon (for Maine) conifer swift moth appeared briefly in large numbers in softwood stands, especially spruce stands, in eastern Maine in August (see Sect. A). Alarmed homeowners in Sanford reported "invasions" of colorful boxelder bugs during October. Although most of these species have undoubtedly been in Maine for some time, the euonymus caterpillar, locust leafminer and boxelder bug may be new confirmed records for the state.

Also of special or unusual interest in this report is the hemlock looper outbreak, confirmation of the "new" gypsy moth disease (Entomophaga maimaiga) from Maine, the status of Lyme disease and its vector in Maine, the Forest Health Monitoring system and anything else that might pique your interest as a reader.

Diseases also exhibit "ups and downs" and a better understanding of the species present in Maine also brings with it surprises. Although no new Maine records were found in 1990, several outbreaks or unusual host associations were experienced. Cristulariella leaf spot (see Sect. B) was one of more striking problems encountered. Leucostoma (Cytospora) canker has been a common problem of ornamental Colorado blue spruce for years in Maine but of little significance in forest or plantation situations. This year, however, the disease was found to be causing extensive damage in a Japanese larch seed orchard in central Maine. Some of the most susceptible clones represented have been almost completely destroyed.

The existence of certain micronutrient deficiencies in Christmas tree plantations is becoming increasingly evident. Two of the most commonly deficient elements are manganese and magnesium.

Weather

Following the unusually cold and windy December of 1989, Maine experienced a rather mild winter with light to moderate snow and then by a rather cold wet spring followed by a cool wet early summer and fall. Heavy wet snow fell into late May and was followed by frequent wet weather through June except in eastern Aroostook County which was rather dry. Dry periods were more frequent in July, and August was more typical. By September another

siege of wet weather began which continued with little letup through November. Fall rainfall was not only frequent but often very heavy. Potato harvests received a severe setback due to excessively wet field conditions.

Winter browning and mortality of evergreen trees and shrubs was much more severe than usual this season. Much of the damage was sustained in December 1989, the result of early and record breaking cold weather. Much foliage was brown by early January, 1990 with symptoms continuing to intensify throughout the remainder of the winter and spring. Several "cold snaps" in early June caused some late frost injury especially to balsam fir in western Maine and in the mountains.

Useful Suggestions

As in our last report 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 permits. The pages containing the **Contents, Quick Finder Index** and the preceding section **What's "New" and Unusual** are intended to aid in this selection process. For example, **Arborists** should find nearly everything they need in Sections B (beginning on page 14) and D (beginning on page 30). **Christmas tree growers** should find items of interest in Section C beginning on page 23. **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 - See Section C.

Arborvitae Leafminer (A complex of 4 species) - Populations of arborvitae leafminer continued to decline in 1990 overall even in small areas which were heavily defoliated in 1989. Defoliation was generally light and some recovery was evident in areas previously "hard hit." Populations are expected to continue their decline in 1991 and further host recovery should follow.

Balsam Fir Pests - See Hemlock looper in this section, the Special Reports Section, and Section C.

Balsam Gall Midge (Paradiplosis tumifex) - The foliage of balsam fir in many areas of northern and central Maine appeared to be "flecked" with numerous orange spots when checked in January 1990. These "spots" turned out to be larvae of the balsam gall inquiline (Dasineura balsamicola). Normally the inquiline drops from the galls in November. It has been speculated that they did not drop in November 1989 due to the cold weather but held off until a warm spell in January 1990. Unfortunately they were killed by the cold before reaching the ground. The impact of this phenomenon has yet to be determined. See also Section C.

Balsam Woolly Adelgid (Adelges piceae) - The incidence of both trunk and gout phase of this insect appeared to decline in 1990 based on general observations. The trunk phase which had come to our attention first in 1989 appeared to drop in intensity and many gout phase trees continued to outgrow their condition. It will be some time before it will become evident whether or not this trend is real or perceived.

Conifer Swift Moth (Korscheltellus gracilus) - This ghost moth has not often been observed in Maine, partially due to habits and partially to low populations, but moths were extremely common in some softwood stands in southeastern Maine in August 1990. The pale colored, medium-sized (1 1/4" long ±) larvae were very abundant within the moss beneath spruce trees in many areas of coastal Washington and Hancock Counties in June and early July. Pupation took place within the moss in mid to late July. The straw-yellow to tan, lightly spotted, moderately heavy-bodied moths emerged over a short period in August. These moths did not appear to be attracted to lights and stayed within infested stands for the most part. Although to the untrained eye they could be confused with hemlock looper, their habits differ and the wings of the hemlock looper moths have lines or bands rather than spots. The conifer swift moth takes two years to develop and moths will not be evident again in numbers before 1992.

Eastern Larch (Bark) Beetle (Dendroctonus simplex) - Little change was noted in the incidence and severity of this destructive pest of larch in 1990. Locally heavy populations of this beetle caused rapid and high mortality of larch in some stands throughout the state. These stands, although not individually extensive, were very visible. Little new information is available. For more details, refer to "Larch Bark Beetle/Decline in Maine-1989" in the I&DM Summary Report No. 4. pp. 35-36.

This problem is expected to continue in the near future and prompt salvage is the only recourse available at this time.

Fir Coneworm - See Section C.

Hemlock Borer (Melanophila fulvoguttata) - Several selectively cut areas in Hancock and Washington Counties which were checked in 1990 exhibited heavy hemlock borer populations in up to 10% of the stems. Some of the small (< 3/8" long), oval, flat, black beetles with lighter spots were still active on the foliage and boles in late July. Many of the infested trees were just turning yellow in mid July. In the stands checked, up to 70% of the infested trees showed some evidence of mechanical damage (although some was light).

This flatheaded borer is often associated with mortality of stressed hemlock and literally hundreds of flat whitish grubs can sometimes be found beneath the bark on the bole of a single infested tree. Successful infestations of this species are an indication of stressed host condition.

The significance of this insect in bringing down forest trees "on the brink" may not have been fully appreciated in the past. Although little can be done in most cases to protect individual trees, changes in harvesting practices may reduce the impact of this species on residual stands.

Hemlock Looper (Lambdina fiscellaria) and related problems - While hemlock looper appeared to be the primary cause of hemlock defoliation in 1990 a number of other pests were also involved in some areas. The hemlock looper is discussed in detail in the special reports section. Populations of the typical hemlock looper, L. fiscellaria, appear to be predominant in eastern and northern Maine where larvae defoliate balsam fir and white spruce as well as hemlock. A related species, Lambdina athasaria, is much less common in Maine although it becomes more common locally in southern Maine and appears to predominate in southwestern Maine near Sebago Lake. Roughly 1,800 acres of moderate/heavy (800 acres with 30-80% defoliation and scattered mortality of intermediate and suppressed trees) to severe (1,000 acres with 80-100% defoliation with 25% or more mortality) defoliation attributed to L. athasaria occurred in several towns around Sebago Lake in 1989 and 1990. Larvae of L. athasaria are very similar in appearance to L. fiscellaria but appear later (late July and August). Populations can apparently be equally as destructive but appear to be more limited to hemlock and less of a problem on fir and spruce. Both species of Lambdina have a rather broad and undefined host range which includes hardwoods and pine in addition to those hosts already mentioned. Their habits are also different and attempts to better define these differences will be made in 1991.

Hemlock needle miners (? Coleotechnites spp.) were again very abundant in some stands in 1990 although some decline in numbers may be developing. Stands around Sebago Lake which exhibited extremely high populations in 1989 exhibited only moderate numbers in 1990. Most larvae checked appeared to be the **Brown Hemlock Needle Miner** (Coleotechnites macleodi) although none were reared. Needle miners may exert more influence on hemlock, especially those under stress, and this complex needs to be better understood in Maine.

Hemlock stressed by heavy hemlock looper defoliation are often highly susceptible to other pests such as **hemlock borer** which is also increasing in intensity in Maine and very likely is responsible for much of the increased hemlock mortality.

Hemlock Woolly Adelgid (Adelges tsugae) - This insect has not yet been found in Maine even though surveys have been conducted to keep abreast of its movements. A quarantine against importation of this pest is still in effect (see Special Reports section).

Jack Pine Sawfly (Neodiprion pratti banksianae) - Infestations of this species in coastal Hancock and Washington Counties from Steuben to Mt. Desert remained fairly stable and destructive at 1989 levels. In addition, isolated, infested trees were also observed in plantations near Moosehead Lake in 1990.

Larch Casebearer (Coleophora laricella) - "Scorched" larch resulting from feeding by this species were easily visible in late May and damage was heavy locally in southern Maine in 1990. Damage appeared to be as heavy in 1990 as in 1989. This was the third consecutive season of such destructive populations. This species is of concern due to its involvement as an additional stress factor in the decline complex affecting larch.

Larch Insects - Several species of insects on larch were unusually common in some areas of eastern Maine in 1990. The most notable was the large and very attractive **larch silkworm** (Hyalophora columbia). This is a rare and beautiful species and is not a problem on larch. Another species was the small **brown larch tubemaker** (Spilonota lariciana). Larvae of this species tie needle clusters into tubes in which they live. Although this species can cause minor damage, it is seldom a serious problem.

Larch Sawfly (Pristiphora erichsonii) - There were no reports of defoliation by larch sawfly in Maine in 1990 although scattered larval colonies were observed.

Mites - See Section C.

Pine Fascicle Mite (Trisetacus alborum) - This species continues to affect understory white pine regeneration but damage was relatively light in 1990 as compared to levels in 1987 and 1988.

Pine Leaf Adelgid (Pineus pinifoliae) - Damage to pine from this species continued to show up across central Maine in 1990. Red and black spruce will be checked in the spring of 1991 for the smooth cone-like galls of the next generation.

Sawflies (Miscellaneous) - No destructive sawfly populations were reported other than those presented in this section.

Spittlebugs - See Section C (Pine and Saratoga).

Spruce Beetle - See Special Reports Section.

Spruce Budmoth - See Section C.

Spruce Budworm - See Special Reports Section.

Spruce Coneworm (Dioryctria reniculelloides) - Spruce 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.

White Pine Sawfly (Neodiprion pinetum) - Populations of this species remained low again in 1990. No reports were received.

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 spp.) (See also Section C) - This disease, known also as shoestring root rot, is caused by an opportunistic fungus which may attack and kill hardwood and softwood trees of all ages. Where softwoods are infected, the disease organism involved is usually A. ostoyae. This organism frequently infects balsam fir, black spruce, and red spruce in Maine, and is a contributing factor to the "sudden death" of balsam fir known as Stillwell's Syndrome (see below). The causal fungus is widely distributed in nature and disease management in natural stands is best approached by keeping trees vigorous. Dense stands should be thinned frequently, beginning early in the rotation.

Disease expression seemed to remain at normal levels during 1990.

Balsam Fir Needle Rusts - See Section C.

Eastern Dwarf Mistletoe (Arceuthobium pusillum) - No new infestations of this parasitic plant were reported in 1990. Severe damage is still occurring in stands of white spruce in coastal areas. Trees of landscape value succumb each year in the yards of coastal residences as this parasite gradually drains trees of their vigor. Removal of witches' brooms (infected portions of branches), together with appropriate fertilization, generally helps to maintain the vigor of affected landscape trees.

European Larch Canker (caused by Lachnellula willkommii) - Last year in this space we reported that a tree in the town of Lamoine was found to be infected by the larch canker fungus and thought it likely that the federal government would expand the quarantine area as a result. However, the disease specimen collected turned out to be insufficiently mature to conclusively prove the presence of larch canker in that town. As a result, the four towns projected for entry into the quarantine area (Ellsworth, Lamoine, Hancock, and Trenton) were not entered and the quarantine boundaries remain for now as previously designated.

At the two disease epicenters, Cutler-Jonesboro and Friendship, the infection rate remains heavy while it is light to moderate elsewhere within the infested area. No significant mature tree loss has been observed to date although severe cankering is present on many infected pole and sapling size trees. (See also quarantine information in the Special Reports section).

Pinewood Nematode (*Bursaphelenchus xylophilus*) - To date we have found this nematode infesting only three conifer species in Maine: balsam fir, white pine, and red pine. It is potentially present in the wood of some other coniferous hosts as well.

Although pinewood nematode (PWN) was not discovered in the United States until 1929, it is considered to be a native, not introduced, pest. There is no indication that PWN has ever caused large scale mortality of conifers in Maine or elsewhere in North America (NA). However, PWN is the number one pest of conifers in Japan, where it may have been introduced from NA in the late 1800's.

PWN is primarily significant here because its presence has the potential to seriously affect export markets. Quarantines barring import of coniferous wood from NA have already been implemented by certain Scandinavian countries, and concern is being expressed in other European markets as well.

This year a manufacturer in the Netherlands expressed concern with the importation of non-kiln-dried hemlock from Maine. There are apparently no records of PWN infesting hemlock, and recently an intensive search for evidence that PWN infests hemlock wood in New Brunswick and Nova Scotia turned up negative[1]. While kiln drying apparently will kill PWN, this organism will probably limit export markets for non-kiln-dried lumber for some time to come.

Scleroderris Canker - See Section C.

Sirococcus Shoot Blight - See Section D.

Stillwell's Syndrome or "Red Fir" (associated with *Armillariella mellea*) - In northern and central Maine the incidence of "red fir" has gradually decreased since the mid 1980's. The level in 1990 remained at less than 1% of the balsam fir affected, roughly the same as 1989. An area in southern and central Hancock County, however, showed a sharp increase in the number of red trees. In the area from Waltham south to the coast up to 5% of the fir were affected.

Losses to Stillwell's syndrome continue to be in the form of individual stems in and near areas heavily damaged by past spruce budworm feeding. After the needles drop from affected trees, mortality from Stillwell's cannot be differentiated from budworm mortality. This disorder will probably continue to kill a significant number of fir stems in the southeast for 3 to 5 years but, its significance is much reduced in northern and central Maine. In the future it is also possible that

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[1] Magasi, L.P. et al. 1990. Survey of eastern hemlock for insects and pinewood nematode in New Brunswick and Nova Scotia. Forestry Canada-Maritimes Region Technical Note No. 240. Fredericton, N.B.

Stillwell's will affect fir which have been heavily defoliated by hemlock looper as well.

White Pine Blister Rust (caused by Cronartium ribicola) - We continue to operate a white pine blister rust control program to manage this disease in the state's important commercial white pine production areas (see Special Reports Section). A quarantine remains in force which prohibits the planting and cultivation of currants and gooseberries (alternate hosts for the disease organism) in the blister rust control area (Southwestern and Central Maine). The planting of black currants is prohibited statewide because this particular currant species is an especially potent disseminator of the disease organism (see also Forestry Related Quarantines in Special Reports section).

In 1990 we received several inquiries about the control of blister rust on landscape trees in residential areas. Ribes eradication does not work well in such situations because the host plants may exist on the property of others. However, when pine trees in landscape situations do become infected, simply pruning the affected branches from the trees will eliminate the infections. If an infection (canker) has proceeded to the main stem, however, it may have to be excised. That procedure is briefly described in our white pine blister rust bulletin (Circular No. 10).

Winter Injury - Winter injury was widespread on conifers in Maine last season (see also Section D). While the most severe injury occurred in nurseries and forest plantations, there were reports of native evergreens in natural stands with severe foliage browning. Perhaps the most conspicuous example of this occurred to white pine in Andover and Rumford on Farmer's Hill and Whitecap Mountain. There, particularly on southwest slopes, pine foliage was conspicuously brown last spring when observed either close up or a mile away from Rt. 5. Buds and resulting new growth were unaffected, however, and trees recovered normally.

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

Insects

Alder Flea Beetle - See Section D.

Aphids (various) - Although present in varying degrees on different hardwoods statewide in 1990, aphids continued to be more of a nuisance than anything else. The **birch aphids** in the spring and **woolly alder aphid** were probably the more frequently reported species (see Section D).

Ash Defoliators (various) - Although **ash anthracnose** and **fall webworm** appeared to be the primary causes of ash defoliation (see Section D) in southern Maine west of the Penobscot River, insects such as Palpita magniferalis caused locally heavy defoliation of scattered trees in the east. The attractive silkworm larvae of the **promethea moth** (Callosamia promethea) were again more common than usual in 1990, especially in central Maine, but caused no damage.

Aspen Defoliators (various) - Defoliation of aspen by insects was generally higher in 1990 than in 1989 especially in central Somerset County and southern Hancock and Washington Counties. Although the complex of minor defoliators was still active on individual trees and in small stands statewide, much of the defoliation was due to **large aspen tortrix** around Jackman and **satin moth** in southeastern Maine. **Forest tent caterpillar** populations continued to remain low in 1990.

Balsam Poplar Leafminer (? Lyonetia sp.) - Populations of this leafminer appeared to drop in 1990 from 1989 levels. Damage was not as striking as it had been and the infested area in northern Aroostook County decreased in both size and severity of defoliation. Although some reddening was visible from the air, it was evident only over 2,000-3,000 acres, down from 5,500 acres in 1989. This was the fifth consecutive year of noticeable defoliation in the area.

Bark Lice or Psocids - See Section D.

Beech Problems (various) - Beech, seemed to be a favored host for a number of pests again in 1990. Although the severity of the problems in total seemed to be slightly reduced for the second consecutive year, noticeable defoliation was still very evident at least locally in all but southwestern Maine. Defoliation by the **variable oakleaf caterpillar** (Lochmaeus manteo) and the **flat leaftiers** (Psilocorsis sp.) 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) continues to decline in severity.

Birch Casebearer (Coleophora serratella) - Populations of birch casebearer continued to remain stable and endemic (low) in 1990 except for scattered local hot spots of noticeable defoliation in central Aroostook County and in the Rangeley area. Little change is expected in 1991.

Birch Leafminer (primarily Messa nana) - Blotch mines of this species were very evident on white birch and white birch hybrids across central and mid-coastal Maine again in 1990, especially west of the Penobscot River. Populations appeared to be locally higher in some infested areas in 1990 than in 1989 and many leaves had two or more mines. When mines were numerous on a single leaf, they often coalesced and the larvae fed together on green tissue around the margin of the newly expanded mine. The common, early **gray birch leafminer** (Fenusa pusilla) again appeared to exhibit low populations and only light to moderate damage where found.

Birch Problems (various) - Although the most widespread defoliation of birch in 1990 was caused by **leafminer**, birch exhibited locally high defoliation from **birch casebearer, fall webworm, gypsy moth** and **birch sawfly** (discussed elsewhere) as well. Several other pests were also encountered on birch during the season but were most often minor or restricted to a small number of trees.

Populations of the **spearmarked black moth** (Rheumaptera hastata) continued to decline in 1990 to nearly endemic levels. The colorful moths were very scattered early in the season and folded leaves containing the dark looper larvae were often difficult to find even in areas which were heavily infested in 1987 and 1988.

Yellow birch over roughly thirty acres in T5 R19 exhibited moderate to heavy defoliation from an **unidentified green looper** in July.

Japanese beetles (Popillia japonica) caused moderate to heavy defoliation of ornamental birch in infested sections of Androscoggin, Cumberland and Kennebec Counties in July and August.

Two large silkworm moths, the **luna** (Actias luna) and **polyphemus** (Antheraea polyphemus), were again abundant in some areas this season. Numbers of the large, pale-green, reddish-marked, luna moths with their "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 are solitary feeders on many hardwoods but especially birch.

Lacebugs (Corythuca sp.) populations were high again in 1990 for the third consecutive year. 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 but most damage is scattered. Some small areas of severe damage have been reported from mountainous sections of western Maine.

Blackheaded birch leaffolder (Acleris logiana) populations and damage were very low again in 1990.

Although populations of **Hemlock looper** (Lambdina fiscellaria) continue to rise, damage to birch was reported only in stands adjacent to or intermixed with heavily infested softwood. The heaviest damage was observed on two small heavily infested islands between Swans Island and Long Island (Frenchboro) near Mt. Desert Island. Local damage to birch was also scattered throughout the hemlock looper infested area.

The **mottled** or **birch stink bug** (Meadorus lateralis) was again a very localized problem but some minor feeding damage was observed. A **chafer beetle** (Serica tristis) caused light to moderate defoliation on scattered, isolated trees in northern Maine.

The **striped alder sawfly** (Hemichroa crocea) was more abundant in 1990 than it has been for a number of years and light to moderate defoliation of scattered birch trees was observed throughout a wide area south and west of Moosehead Lake. This species feeds along veins in the interior of the leaf rather than along the margin.

Birch Sawfly (Arge pectoralis) - Populations of this species dropped in 1990 but were still noticeable although spotty across north central Maine from Millinocket to Rangeley.

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 1990 with no defoliation detected. Populations of these insects are expected to remain low again in 1991.

Eastern Tent Caterpillar - See Section D.

Fall Webworm (Hyphantria cunea) - Locally high populations and heavy feeding and webbing were evident again in 1990 for the third consecutive year. Although populations remained at roughly 1989 levels in southern Maine, some minor extension of low populations were observed to the north and east. Populations east of the Penobscot River and north of the Old Town area still remain low.

Flat Leaftiers (Psilocorsis sp.) - Feeding by flat leaf tiers was heavy on beech in some areas in 1990. The "messy," tied foliage (flat not nested) was often visible from the road. Although damage from this species is evident nearly every year in some stands throughout the state, populations appeared to be up in 1990.

Forest Tent Caterpillar (Malacosoma disstria) - Although populations and defoliation continue to increase to the west of Maine, no noticeable defoliation of woodland poplars by this species occurred in Maine in 1990. The total moth catch statewide was down strikingly in 1990 from 1989 levels and trends in both larval and adult populations continue to be low and erratic.

The last outbreak of this species occurred in northern and western Maine in 1979-1983.

Greenstriped Mapleworm (Dryocampa rubicunda) - Populations of this species remained extremely low in 1990 with no noticeable defoliation reported. This species is primarily a feeder on red maple in Maine.

Gypsy Moth - See Special Reports Section.

Hardwood Defoliators (late season complex) - This complex of more than 25 species which made its surprising appearance first in 1987 and peaked in 1988 with 120,000 acres of defoliation, dropped sharply in intensity in 1990. Most of the 1990 damage was attributable to the **variable oakleaf caterpillar** (see discussion under that species). The **birch sawfly** (Arge pectoralis) and **pale tussock** (Halysidota tessellaris) were also abundant but damage was minimal by these species. The **orangehumped mapleworm** (Symmerista leucitys) all but disappeared.

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

Large Aspen Tortrix - (Choristoneura conflictana) - Large flights of the grey, budworm-sized moths of this species caused considerable comment in the Jackman area on July 1 of 1990. Moth activity was also high in a survey light trap at Elliotsville, south of Moosehead Lake on June 30 and in Dennistown, near Jackman on June 29 and 30 (See Figure 1). Aerial surveys and ground checks revealed roughly 12,000 acres of moderate to severe defoliation of aspen near Jackman (See Figure 1). Populations in 1990 were up strikingly across central Maine but especially in western portions of the State. The last high populations were observed in 1974 across much of the northern half of the state.

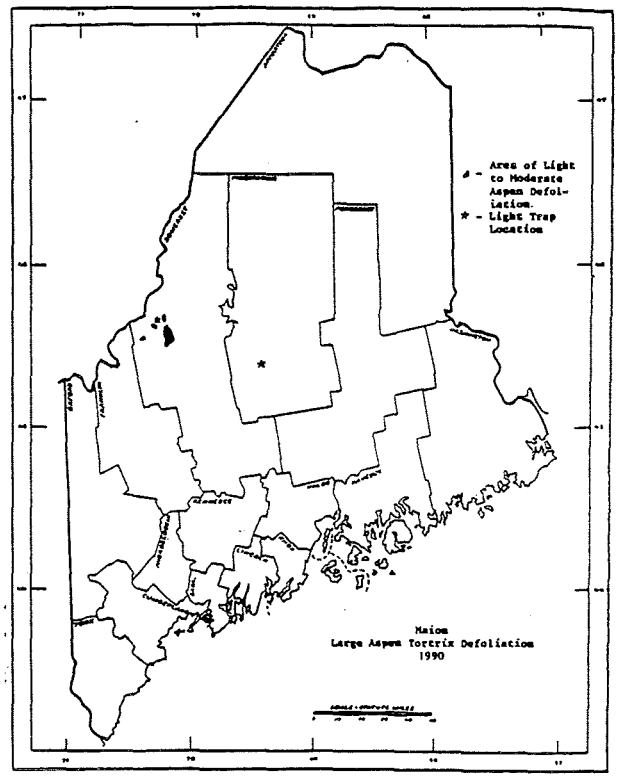

Figure 1

Locust Leafminer - See Section D.

Luna Moth - See Birch Problems in this section.

Maple Leafcutter (Paraclemensia acerifoliella) - Populations of this species were low in 1990 although some damage was still visible in areas infested in 1989.

Maple Leafroller (Sparganothis acerivorana) - The infested area in south central Hancock County expanded slightly again in 1990 from 1989 levels while defoliation continued to drop in severity making aerial surveys more difficult. Light to moderate defoliation of red maple was evident over 20,000-30,000 acres near Ellsworth (see Figure 2). Populations elsewhere throughout the state were detectable but generally very low.

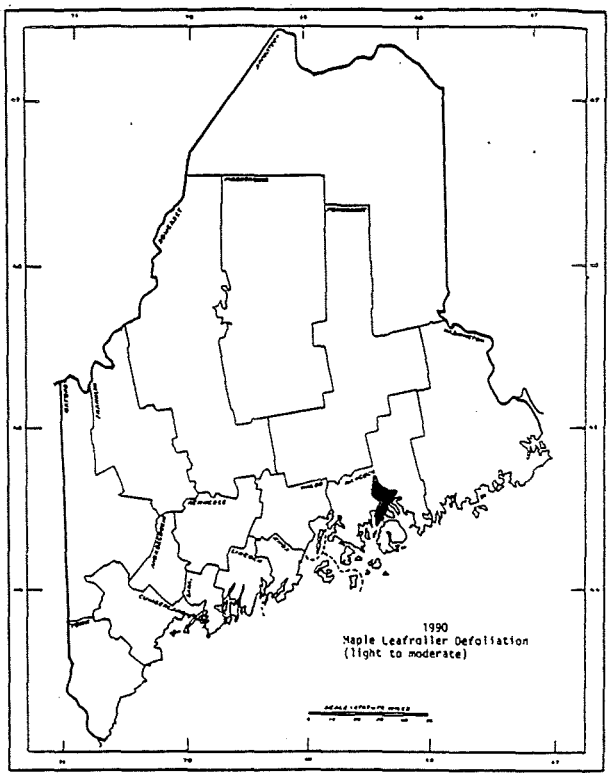

Figure 2

Maple Spanworm (Ennomos magnaria) - The attractive, medium-sized, stout moths of this large looper were much more noticeable at light in 1990 than they have been for a number of years. Only scattered larvae were found throughout the season, however, and no defoliation was observed. Larvae feed on birch, maple, aspen, ash and a variety of other hardwoods. The moths which are also called **notched-wing geometers** appear in September and October and were more common in 1990 in southeastern Maine..

Maple Trumpet Skeletonizer (Epinotia aceriella) - Folded or pleated leaves of sugar maple which contained the thin trumpet-shaped, frass larval tube of this species appeared to be more common in 1990 than in 1989, however, damage was primarily aesthetic.

Oak Leaftier (Shredder) (Croesia semipurpurana) - Populations of this species were still generally low in 1990 and only small hot spots of noticeable defoliation were reported.

Oak Skeletonizer (Bucculatrix ainsliella) - Populations of oak skeletonizer had all but disappeared in 1990 and it was difficult to find larvae or signs of feeding even in areas previously defoliated.

Oak Twig Pruner (Elaphidionoides villosus) - Populations of the twig pruner remained fairly stable at low levels for the fifth 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 not as abundant in 1990 as in 1989. Defoliation was negligible even though it was recorded from a number of hardwoods.

Orangehumped Mapleworm (Symmerista leucitys) - The most striking aspect of the situation with the late season hardwood defoliation complex in 1990 was the almost total absence of this species. Populations of the orangehumped mapleworm exhibited high levels of egg parasitism in 1989 and a resultant drop in larval populations. Total moth catches dropped strikingly from 986 in 1989 to 163 in 1990. Egg masses were few in number, scattered and highly parasitized in most areas in 1990 and larvae were almost nonexistent when areas were checked in August. Where the orangehumped mapleworm larvae were found they were most often gathered on scattered individual trees and probably came from single unparasitized egg masses.

Oystershell Scale (Lepidosaphes ulmi) - This pest is still with us in beech stands across central and eastern Maine although populations continue to subside overall. Fresh damage was not as evident in most stands in 1990.

Pear Thrips (Taeniothrips inconsequens) - Although pear thrips occur throughout the state, populations on sugar maple remained generally low in 1990. Moderate numbers of larval thrips were observed on the foliage of scattered individual trees in southwestern Maine in 1990 but damage was extremely light and often not detectable. Populations appeared to be highest on older, stressed and/or roadside maple.

Soil samples were taken from nine sites (see Figure 3) throughout the state in the fall of 1990 as a part of the Regional Pear Thrips Soil Survey. These samples were processed by Margaret Skinner at the University of Vermont. Only two sites; Farmington (Mean thrips/sample: 0.3 ± 0.7) and Carroll (Mean thrips/sample: 0.2 ± 0.4) yielded current year thrips. Both sites were in older tapped sugar bushes. All other sites were 0.

The level of damage by this pest appears to be accentuated by stressed host condition and influenced by spring phenology. Further surveys will be conducted in 1991.

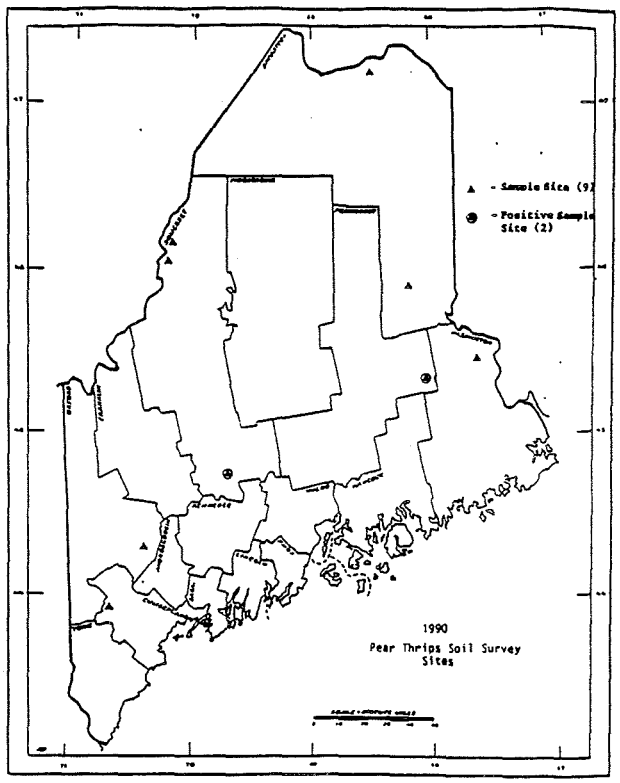

Figure 3

Saddled Prominent (Heterocampa guttivitta) - Only scattered individual larvae of this and related species of Heterocampa were reported in 1990 and no defoliation was observed.

Satin Moth (Leucoma salicis) - Scattered pockets of defoliation of woodland aspen by larvae of the satin moth were reported in southeastern coastal Maine in 1990. Heavy defoliation was limited to small isolated stands or clumps of trees primarily in Hancock, Addison and Jonesboro. The largest area totaled less than 30 acres in size in Jonesboro. Parasites were relatively abundant in all areas which were checked. Moths were common enough at lights in Addison to coat light poles and stimulate local curiosity.

Eastern cottonwood (Populus deltoides) around farms and rural homes statewide, however, continue to be the more common source of infestations and complaints.

Striped Alder Sawfly - See Birch Problems in this section

Tussocks and Dagger Moths (various) - Populations of these "fuzzy" caterpillars continued to decline in 1990 for the second consecutive year. The attractive yellow and black larvae of the **spotted tussock** (Lophocampa maculata), which were so common in association with the late season hardwood defoliator complex, became more scattered and solitary in 1990. The most common and abundant species in 1990 was the **pale tussock** (Halysidota tessellaris) the larvae of which appeared in moderate numbers on beech in August in association with the variable oakleaf caterpillar and on birch. No defoliation from this species was evident.

Variable Oakleaf Caterpillar (Lochmaeus manteo) - Populations of this pest of beech (in Maine) continued to decline and defoliation patterns became more discontinuous in 1990 (see Figure 4). Roughly 14,000 acres of moderate to heavy defoliation affecting all age classes of beech was recorded through aerial surveys, mostly in Washington County and near Island Falls in southern Aroostook County. Nearly another 100,000 acres of defoliation of generally lighter but varying insensity was also reported. This area was more difficult to define from the air as it involved primarily scattered and understory beech. In the past, the variable oakleaf caterpillar has usually been associated with the **orangehumped mapleworm.** Their combined defoliation was easy to map with aerial surveys as it was more continuous. In 1990 the orangehumped mapleworm had all but disappeared and defoliation was more restricted to beech and much less striking.

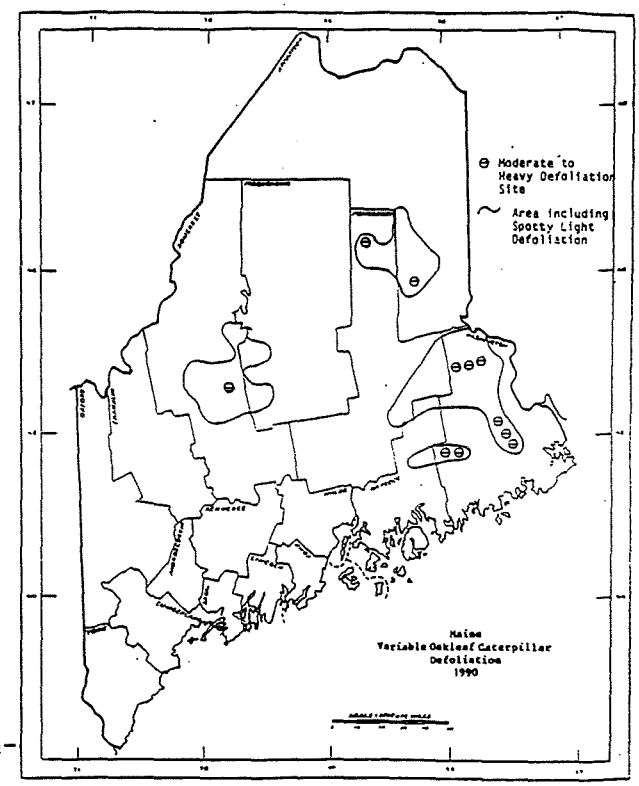

Figure 4

Parasitism and disease did not appear to be as evident in populations of the variable oakleaf caterpillar as in the case of the orangehumped mapleworm although prepupae (variable) counts were low in the fall of 1990. This pest is expected to continue to decline in numbers again in 1991.

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

Diseases

Ash Dieback (cause unknown) - The area of brown ash (Fraxinus nigra) dieback we first noted last year in and around Ashland has become more extensive. This problem is particularly severe along the Aroostook River, but dieback seems to present to some extent in brown ash stands wherever they occur in Aroostook County.

Affected trees exhibit severe crown dieback. Typically the top half of the crown is nearly or completely dead while the lower half consists of weak branches with poor growth. Epicormic branches are frequent along the bole.

Both paper company land managers and basket makers from local Indian tribes have expressed concern for the future of this resource. Ash dieback causes the wood of affected trees to become brittle and therefore unsuitable for basketmaking.

Beech Bark Disease [caused by Beech scale (Cryptococcus fagisuga) and Nectria coccinea var. faginata] - The frequency of sightings of beech heavily infested with scales continued to increase in 1990 for the second consecutive year and trees exhibiting heavy fruiting of the Nectria fungus were also more evident. Losses attributable to this pest complex are extensive but assessment has been complicated by the associated impact of drought (1988-89) and other insects such as the oystershell scale. All beech stands throughout the state exhibit some degree of beech bark disease although some indication of resistance can be seen nearly everywhere. If the past two years are any indication, however, a "new wave" of the disease may be underway.

Chestnut Blight [caused by Cryphonectria (Endothia) parasitica] - The American chestnut seedlings that the I&DM Division has grown from seed over the years and distributed around the state continue to thrive. Seedlings from this project outplanted in the early 1970's have since grown into trees as large as 12 inches dbh and 40 feet high. Many of these trees have exceptionally fine form and while most are so far free from infection, at this time we do not feel they possess any unusual resistance.

Trees from this project are now planted in the Pine Tree State Arboretum in Augusta where they serve as representatives of the species which was once such an important component of Eastern forests. Eventually we hope that this species will be restored to the forest through successful breeding programs for disease resistance and by exploiting the phenomenon of hypovirulence.

Ash Leaf and Twig Rust (caused by Puccinia sparganioides) - No specimens of this disease were received in 1990 and infection levels appeared to continue low.

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

Dutch Elm Disease [caused by Ophiostoma (Ceratocystis) ulmi] - See Section D.

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

Oak Wilt (caused by Ceratocystis fagacearum) - To date there is no evidence that this disease occurs in Maine.

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

Insects

Aphids (*Cinara* spp. and other related species) - Populations of these dark, bead-like aphids were again common on the boles and branches of many conifers. They were most noticeable on spruce and fir in plantations or on ornamental trees. The main concern involves the production of the sticky honeydew which attracts yellowjackets and ants and supports an unsightly buildup of sooty mold fungus.

Balsam Gall Midge (*Paradiplosis tumifex*) - The balsam gall midge populations have been increasing overall since 1986 and were at relatively high levels in 1990. Untreated fir in many areas of central and southern Maine experienced heavy needle gall production thereby reducing saleability of infested Christmas trees and wreath brush. A "pest alert" on this insect was sent to growers and interested parties early in the season to apprise them of a potential problem, how to assess their plantations and to suggest various control procedures.

This insect is likely to remain a problem in untreated stands of balsam fir but the impact on the host trees is primarily aesthetic unless trees are harvested for Christmas trees and wreath brush. See also Section A.

Balsam Shootboring Sawfly (*Pleroneura brunneicornis*) - Populations of this pest were spotty in 1990 but did not appear to be generally as high as in 1989.

Balsam Twig Aphid (*Mindarus abietinus*) - Twig aphid populations were variable in 1990. Christmas tree growers who treated for this insect appeared to have had little difficulty with damage while locally high populations and damage were observed on some untreated trees.

Fir Coneworm (*Dioryctria abietivorella*) - Mining of terminal bud clusters and current shoots of balsam fir by fir coneworm was observed in two Christmas tree plantations in 1990. One plantation in central Maine and one in northern Maine exhibited light damage. The fir coneworm continued to cause moderate to heavy damage to spruce cones and increasing cone production in either fir or spruce could result in further increases in fir coneworm populations and damage. Although damage to balsam fir from the insect has generally been insignificant in the past, a significant buildup in populations of coneworm could change the situation.

Grasshoppers (species not determined) - Continued reports of high grasshopper populations in Christmas tree plantations and associated nighttime activity on the trees themselves lend credibility to the assumption that associated feeding damage on the tender bark of new shoots is related.

Gypsy Moth (*Lymantria dispar*) - As long as populations of this species remain high, 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) - The hemlock looper is not likely to be a problem in young or managed plantations at this time although growers are urged to watch for this pest especially in plantations adjacent to heavily infested natural softwood stands.

Jack Pine Sawfly - See Section A.

Larch Problems (See also Section A) - Interest in planting and managing larch in Maine continues to remain high and with this has been concern over its potential pests. The more serious pests; European larch canker, Armillaria root rot, and eastern larch bark beetle are primarily associated with the older established resource. Problems such as larch casebearer, larch sawfly, Leucostoma canker, Sirococcus shoot blight and porcupine damage, however, appear to be even more of a threat to younger plantations. There are also many other presently minor problems affecting larch which bear consideration. Some of these may become more significant in the future.

Mites (various species) - Mite populations were heavy again in 1990 in some conifer plantations. This tends to be a perennial problem in some plantations. No trend is evident. (See also Pine Fascicle Mite in Section A).

Pales Weevil [Hylobius pales (Herbst)] - A 10 acre balsam fir plantation in Sangerville sustained damage as a result of feeding by adults of the pales weevil in the spring of 1990. Adults emerging from pine stumps which were cut two years before fed on the needles, buds and cambium of recently planted balsam fir seedlings. These weevils feed nocturnally, but may be observed during the daylight hours hiding under logging debris or in the litter around stumps. Plantation owners who have harvested pine in lots adjacent to young trees should be aware of this pest and periodically check in May and early June for feeding damage on seedlings. The weevils breed within the cut stumps of pines and have a prolonged life cycle. For these reasons, the plantation should be watched every spring for three years following harvest.

Pine Fascicle Mite - See Section A.

Pine Leaf Adelgid - See Section A.

Pine Spittlebug (Aphrophora parallela) - Spittle masses containing the nymphs of this species were very visible on a variety of conifers in 1990. Although populations were fairly high, damage was not noticeable and control was not necessary. The problem was more in the nuisance category.

Red Pine Bark Miner (Cydia inopiosa) - No reports of this species were brought to our attention in 1990 although no surveys were conducted. It is primarily a nuisance pest.

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 1990 seemed to be at roughly 1988 levels, down somewhat from 1989. All infested areas were in eastern Maine where pockets of mortality were observed. This problem continues to be site and ground cover related.

Seedling Debarking Weevil (Hylobius congener) - No reports of damage by this weevil, often referred to as the **regeneration weevil**, were received in 1990.

Spruce Budmoth (Zeiraphera canadensis) - Plantation surveys for this pest were not conducted in 1990. Although heavily infested white spruce plantations were still in evidence, the problem seems to have stabilized. Many landowners made the management decision to stay away from planting white spruce a number of years ago, thereby reducing the number of susceptible plantations. Those white spruce plantations which still exist will continue to be seriously affected by the **spruce budmoth**, **spruce gall midge** (Mayetiola piceae), **gall aphids** (Adelges spp. and Pineus spp.) and **spruce bud scale** (Physokermes piceae).

Spruce Budworm - See 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 in many areas. Where no control measures were applied, an average of 20% (range of 10-40%) of the white pine stems were attacked in 1990. Although most trees survive even multiple attacks, tree form is drastically affected and reduction in growth is significant. The greatest monetary loss is due to loss of sawlogs as the resulting pulpwood value of white pine is roughly only 7% of the sawlog value.

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. Dimilin 4 F has been found to be effective at 1-2 oz. AI/ac. Registration of this material is pending. The limited availability of registered materials continues to be a problem in controlling this pest especially for the homeowner.

Although white pine weevil is primarily a pest of white pine, both Norway and Colorado blue spruce experience heavy damage. In addition, jack, red and scotch pine can also become infested to lesser degrees. In 1990, red spruce over several hundred acres in one area of forest thinning near Moosehead Lake showed a high incidence of current weeviling (up to 10% of stems checked). White pine in this same area was also heavily weeviled.

Yellow-headed Spruce Sawfly (Pikonema alaskensis) - Defoliation of ornamental spruce, especially Colorado blue, by the gregarious yellowish-red headed larvae of this sawfly was more common in 1990 than it has been for several years. No woodland or plantation infestations were reported however.

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

Diseases and Miscellaneous Problems

Annosus Root Rot (caused by Heterobasidion annosum) (syn. Fomes annosus) - This disease was confirmed from three previously uninfested red (Norway) pine plantations in 1990. While white pine and Norway spruce are occasionally infected, this disease is primarily a concern on red pine in plantation situations in southern and western Maine.

The significance of this disease in Maine plantations is difficult for us to assess. In the southern states, where intensive plantation forestry has been practiced for years, this disease has been quite destructive. But only on certain sites. Whether Maine has sites likely to be conducive to very destructive losses from this disease has yet to be determined. Since the potential is there, we recommend stump treatment with borax at the time of all thinnings. However, we are not certain that this practice is cost effective on all sites.

Armillaria Root Rot (caused by Armillariella spp.) (See also Section A) - This disease caused occasional scattered mortality of young fir in Christmas tree plantations in 1990, especially where trees had been planted in recently cleared or cutover areas. Planted trees are considerably more susceptible to infection than naturally seeded trees since the root system is inevitably distorted during planting. Such distortion often results in seedlings which are less vigorous and therefore less able to resist infection. Trees planted in cutover areas are especially prone to infection because remaining stumps, particularly larger hardwood stumps, harbor the disease organism and send forth fungal strands (rhizomorphs) which attack nearby healthy seedlings.

Balsam Fir Needle Rusts (caused by various fungi) - The incidence of needle rusts (fir-fern and fir-fireweed rusts) was generally lower in 1990 on foliage of plantation Christmas trees in southern and central Maine. However we received several reports from Aroostook County of heavy needle rust infection on foliage of balsam fir which was sufficiently damaging to render the brush useless for wreath manufacture.

Bud Abortion - Bud abortion of balsam fir, caused by low ambient air temperatures occurring just prior to bud break, was not severe in most Christmas tree plantations around the state last year. This can be one of the most serious and least controllable problems affecting Christmas tree growers. 1990 was the second straight year where most vegetative buds flushed normally, and this helped trees to partially or substantially recover from the severe outbreaks of bud abortion we experienced in 1987 and 1988.

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.

Chemical analysis of needle tissue has revealed that one of two elements is commonly deficient in affected trees. Plantations of balsam fir growing on two well-drained, acid sites showed severe magnesium deficiencies, while plantations of balsam fir growing on three higher pH sites showed striking manganese deficiencies. Where magnesium deficiency symptoms were apparent, foliage magnesium levels ranged from 0.029 to 0.042 percent. We like to see foliage magnesium levels of about 0.1 to 0.15 percent. Where manganese deficiency symptoms were apparent, foliage manganese levels generally ranged from 3.45 to 6.55 ppm. We like to see this element present at levels above 100 ppm.

In our experience, trees respond readily to soil applications of magnesium when this element is deficient. Correction of manganese deficiency is quite a bit more difficult and seems to require steps to reduce soil pH along with timely and repeated applications of manganese chelates or sulfate.

Conifer Shoot Blights (caused by various fungi) - The incidence of shoot blights was generally down during 1990, although trees in one large balsam fir plantation in Presque Isle were heavily infected. Symptoms were similar to those caused by Rehmiellopsis shoot blight, but the causal organism was not positively identified.

Diazinon Injury - Symptoms of injury to balsam fir which seemed to accompany the application of Diazinon AG 500 in 1989 for control of gall midge were not conspicuous in 1990. However, some needles which turned yellow in 1989 in response to application of AG 500 were retained by trees as second year needles, rendering those trees slightly off color. At least one grower switched this year to Diazinon 50 W, a wettable powder formulation, and experienced no renewed phytotoxicity.

Deer Browse Injury - Browsing of nursery stock and Christmas trees by deer seemed to be worse than usual last winter and early last spring. Browsing of Christmas trees continued later into the spring than usual and was still occurring during "greenup."

Deer normally seem to prefer to browse seedlings or transplants which have been outplanted for just one year, leaving the older plantings pretty much alone. But last winter and spring they took to the older trees as well nipping many buds, especially from internodal branches. Such damage will not only devalue trees, but may render them unsaleable.

Fraser Fir Root Rot (associated with poor soil water drainage) - Trees in several Fraser fir Christmas tree plantations in southern and central Maine exhibited severe symptoms of root rot in the spring of 1990, particularly where they were growing in fields with wet areas. Fraser fir is an upland species and simply cannot tolerate "wet feet."

Some trees turned suddenly brown following freezing winter temperatures (weakened root systems cannot take up adequate water to rehydrate trees during thaw periods). Others had gradually weakened and died over a period of several years. Some affected trees had partially heaved from the ground and blown over in the wind. Even some fairly large trees could be easily pulled from the ground by hand because their root systems had deteriorated so badly.

A complex of disease and decay organisms are probably involved with this root rot syndrome. From a control standpoint, however, only one approach can be recommended. Growers shouldn't plant wet fields, or wet areas of fields, with Fraser fir. Many growers have done exactly this in an effort to avoid the late spring frost problems associated with balsam fir (wet areas tend also to be frost pockets). The best solution is probably not to plant wet fields or frost pockets at all, with any species.

Heavy Cone Bud Set on Balsam Fir (common preceding cone years) - Fir in many Maine Christmas tree plantations set large numbers of cone buds last summer. This means that 1991 will probably be a "seed year," which is good and bad news for Christmas tree growers. For those with seed orchards, or for growers needing a fresh supply of seeds, August of 1991 will likely provide a bumper crop. But for growers interested primarily in the production of quality Christmas trees, cones can be a big headache. Cone buds tend to replace vegetative buds at or near the tops of trees. When buds "break" the following spring, some trees will produce primarily cones at these locations and little or no vegetative growth. After the cones mature and disintegrate, the tree grows on, but a gap or "shelf" is left in the tree at the point where the cones were produced. Often this gap never fills and a cull tree results.

Heavy cone set takes a toll on the energy resources of trees, and commonly such trees will turn yellow at the top which in and of itself is sufficient to render some trees unsaleable in cone years. Removing the cones from trees the year of sale is extremely laborious and buys the grower very little. This practice will help keep otherwise saleable trees from yellowing at the top, but it will not replace lost vegetative growth to help fill the resulting gaps.

Our recommendation last season was for growers to be observant when flagging trees for sale. If a tree exhibited substantial numbers of cone buds but was otherwise suitable for sale, growers were encouraged to market that tree before cones could develop and "holes" result. We hope many growers took our advice.

Late Spring Frost - Three separate episodes of late spring frost damage to Christmas tree plantations were reported last season in southern and central Maine. All three episodes were relatively mild and occurred in traditional frost pocket areas. At least three separate farms were affected.

More severe frost damage occurred to balsam fir in forested situations in hilly and mountainous areas of west central Maine. However, since the majority of those trees were not being cultivated for Christmas trees or wreath brush, damage was of little consequence.

Leucostoma Canker [caused by Leucostoma (Cytospora) kunzei] - A serious outbreak of Leucostoma canker was noted in a Japanese larch seed orchard in central Maine last summer. This disease is fairly common on landscape trees, particularly blue spruce, where it usually causes slow but progressive loss of branches upward from the base of trees, often accompanied by profuse resin exudation. In the case of the larch seed orchard, resin production was less pronounced but cankers were widespread, affecting high as well as lower portions of main stems, together with many branches.

No effective chemical controls are known for this disease. Bordeaux mixture has been tried, but without much success.

Drought and the mechanical stresses of snow and ice predispose to Leucostoma infection. Drought is probably the more important factor. The seed orchard in question was deliberately established on a droughty site in order to provide the opportunity to stress trees if necessary to stimulate cone production. But instead of stressing trees during some preplanned optimal period, seed orchard trees on such sites are stressed continuously, or at least repeatedly, not just at opportune times. Trees often struggle on such sites and unless regular irrigation and careful cultural attention are supplied, they may become very susceptible to insects and disease.

Porcupine Damage - While porcupines continued to cause generally scattered damage to forest and plantation trees in 1990, their damage was devastating to a grafted balsam fir seed orchard in China, Maine. Porcupines commonly chew branches, needles and some bark from young outplanted fir, causing moderate to heavy damage to plantation trees near their dens. But it is their penchant for girdling trees by gnawing bark from main stems which makes them so potentially devastating to grafted seed orchards. If the bark is removed below the point of the graft union, the useful seed bearing portion of the tree is permanently lost.

Damage to the seed orchard in China occurred primarily during December of 1990. Upon discovery of damage, the owner sprayed main stems of seed orchard trees with a mercaptan based animal repellant. Browsing ceased following treatment, but it is unclear whether this was due to application of the chemical or a seasonal change in porcupine feeding habits.

Scleroderris Canker (caused by Ascocalyx abietina) - Basal needle discoloration symptoms were quite conspicuous early last June on red pine in a localized, unsanitized area in Eustis. However in other areas of Maine where control measures were undertaken several years ago (pruning of branches to 6 feet above the ground) trees remain symptomless and are apparently free of infection.

This disease is capable of infecting most or all species of pine, especially red, jack, and Scotch pines. Fortunately, however, to date Scleroderris canker has been a relatively minor problem here.

Sirococcus Shoot Blight - See Section D.

Winter Injury - See Section D.

(D) Shade Tree, Ornamental and Miscellaneous Pests

Insects and Ticks

This section provides a summary of those "other" problems which were encountered by I&DM staff over the past year. Most of the more common new, unusual or serious problems are discussed. There were, however, a large number of routine requests for information on such things as **carpenter ants, other ants, mosquitoes, black flies, earwigs, snowfleas, fleas, wasps, cockroaches, galls** (caused by mites, wasps, flies and aphids), **erineum**, etc. These were serious to those requesting advice and it is not our intent to slight the importance of these problems. More information on any of these items is available upon request.

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 again in 1990. Aside from the browning of alders, it is the wandering blue-black larvae in July or the metallic blue beetles in spring and fall which probably elicit the greatest response as they invade homes adjacent to alder thickets.

Aphids, Adelgids and Psyllids (various species) - Although aphids appear on a wide variety of trees and shrubs throughout the year, few infestations are brought to the attention of I&DM until someone notices large numbers of wandering or flying adults or sticky honeydew and associated sooty mold, wasps and ants. The situation in 1990 fit this scenario: Early in the season (May to mid-June) numerous reports were received as frail, winged adults of a number of aphid species filled the air in the vicinity of infested birch (**birch aphids**). Little was then noticed in the aphid world until late in June when some of the various **adelgid galls of spruce** begin to open and spill their tiny, winged occupants in the wind. In late July and throughout August various conifers began to draw ants and a variety of wasps and hornets and darkened in color due to the presence of sooty mold fungus. This was the outcome of **Cinara aphid** activities along the twigs and stems as they fed and produced honeydew. A last gasp of summer occurred in late September and October as numerous, tiny, bluish-green aphids with tufts of white wool attached drifted lazily through the air on calm, sunny days in the vicinity of alders (**woolly alder aphids**). Aphids in one form or another are always there but most of the rest of the time you have to look for them.

Arborvitae Leafminer - See Section A.

Armyworm (Pseudaletia unipuncta) - Large armyworm migrations again occurred locally in southern and central Maine in 1990. Although no tree damage was observed, concern was again expressed by Christmas tree growers who had planted their tree crop in old fields which gained the hungry eyes of these "creatures."

Bark Lice or Psocids - These interesting creatures were common again in southern Maine in 1990. 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 under tiny, white silk mats on tree bark 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 Insects - See Aphids (this Section) and Birch Insects in Section B.

Boxelder Bug (Leptocoris trivittatus) - Homeowners in portions of Sanford were alarmed in October of 1990 when large numbers of these red and black "bugs" of various sizes swarmed over their homes in search of places to spend the winter. Although boxelder, and probably homes, in the area had probably been infested for several years, this was the first official report of L. trivittatus which we have had from Maine. Both nymphs (in many sizes) and adults were present but only adults will survive the winter within debris or walls and attics of buildings. Another species with similar habits and appearances, the **smaller milkweed bug** (Lygaeus kalmii), is fairly common throughout the range of milkweed in Maine (primarily southwestern Maine east to the Penobscot River and north to Farmington). It too hibernates in numbers within buildings. Adults (3/8" long) of L. kalmii have a distinctive red, cross on their back which is lacking in adults (3/8" long +) of L. trivittatus.

Browntail Moth (Euproctis chrysorrhoea) - Known populations of this introduced pest continue to be confined to the Casco Bay area. Roughly 40 acres are known to be infested on Long, Vaill and House Islands plus an additional unknown amount on the mainland. For a number of years, the infestation was confined to the three islands until it was again reported from the adjacent mainland in Freeport in 1989. In 1990, seven additional mainland towns were found to be infested as well. At present two to three acres of heavy to severe defoliation occurs on Long Island while Vaill and House are both generally infested. Scattered overwintering webs were reported at 24 locations within the eight mainland towns in 1990. Although the infested area is likely to expand, it is not known at this point what the limits of this expansion will be. At one point earlier in this century, the infestation spread along the entire Maine coast and inland for some distance. However, for many years (since the early 1950's) the infestation has been confined to the Casco Bay area and vicinity.

Cankerworms - See Section B.

Confused or Lyman's Haploa (Haploa confusa) - Early in April (the 10th ±) while the snows were still on the ground, a home in Crystal (Aroostook County) was invaded by "hordes" of tiny, black, fuzzy caterpillars. Although they did not appear to feed, they grew and when removed from the exterior of the house, they were soon replaced by others. By late May the larvae had become full-sized (1" in length ±) and had begun to pupate. Early in June (from specimens reared indoors) the attractive brownish and cream colored moths of H. confusa emerged. Although particulars of this common, but not usually abundant, tiger moth (Lepidoptera, Arctiidae) are not known; it is suspected that tiny overwintering larvae (in some sort of nest web) emerged as the warming daytime sun reached them. As many species in the Arctiidae have versatile feeding habits, they probably survived on biennial low plants such as dandelion. The literature lists this species from aspen, willow and other hardwoods as well.

Conifer Swift Moth - See Section A.

Cottony Maple Scale (Pulvinaria innumerabilis) - Populations of this species all but disappeared in 1990.

Dogwood Sawflies (Macremphytus spp.) - Although these sawflies were not unusually abundant in 1990, it was because of their unique larval habits that I&DM was called frequently for advice. The yellow-green, black-spotted or banded larvae of these sawflies sometimes become startling in mid to late August as they bore a short distance into decks, wooden siding and other wooden objects near defoliated dogwood. They are apparently seeking a place to make their cocoons. Control at this time is not effective and homeowners panic in trying to eliminate what they fear is a serious problem. It would have been simpler to treat them earlier while the larvae were still feeding on foliage. Younger larvae usually appear whitish due to a white, waxy bloom or covering and should be visible on infested dogwood in July.

Eastern Tent Caterpillar (Malacosoma americanum) - Populations of this species were down strikingly in numbers in 1990 except very locally to the north.

Euonymus Caterpillar (Yponomeuta sp.) - This unusual (at least for Maine) species certainly generated a lot of interest in 1991 in addition to stripping foliage from tree forms of Euonymus in many ornamental plantings. This provided I&DM with a pretty good idea how much and where this form of Euonymus is grown in Maine. Calls were received from many towns throughout southern Maine south of Rte. 2 and west of the Penobscot River. These caterpillars were very active in early June and wherever found they occurred in high numbers and produced abundant webbing. Pupation occurred in silken nests on the hosts or clustered in silken "balls" suspended from the host. The whole scene was very unusual for Maine, very "ghostly" and very unpopular with those whose Euonymus was infested.

Fall Webworm - See Section B.

Gypsy Moth - See Special Reports Section.

Japanese Beetle (Popillia japonica) - Japanese beetle populations have continued to spread and now occur, at least locally, throughout much of southwestern Maine. Heaviest populations occur in Androscoggin, Cumberland, Kennebec and York Counties. These colorful but destructive, introduced beetles feed on a wide variety of trees and shrubs. They are particularly fond of roses, apple, crabapple, elm, mountain-ash, birch and Japanese knotweed. See Birch Insects - Section B.

Lacebugs (Corythuca spp.) - Butternut and birch seemed to have higher than usual numbers of lacebugs in 1990 especially in ornamental or shade tree settings. Infested leaves showed characteristic yellow mottling, especially along the veins. The flat, lacy looking adults and nymphs were visible on the underside of the leaves along with brown flecking from feeding, cast skins and waste material.

Locust Leafminer (Odontota dorsalis) - Black locust over 5-10 acres in Lewiston were scorched and red due to extremely heavy feeding by larvae (a blotch miner) and adults (skeletonizing) of this species in 1990. When trees were checked on August 10, most of the small orange and black beetles had emerged and were covering the foliage. This is the first time this species has been observed in Maine although the infestation in this area had probably been there for several years. Digitate mines still containing larvae of another interesting lepidopterous species (? Parectopa robiniella) were also found on black and bristly locust in Augusta, Lewiston and Mt. Vernon.

Lyme Disease in Maine - The current status of Lyme disease in Maine has been difficult to determine, due in part to the mobile and frequently changing human population and the nature of Communicable Disease Center diagnosis criteria for inclusion in this status. Maine records show 10 new cases (6 early or recently acquired, 4 late or established cases) of state acquired Lyme disease in 1990 bringing the total to 14 to date. There are many other persons who claim to have become infected. Some of these may have acquired the disease out of state while others may have begun treatment for suspected infections thereby eliminating the value of confirmation tests. Still others who were biten by ticks began prophylactic treatment and assumed that a tick bite meant that they had acquired the disease which is far from true. Maine still has relatively low and spotty vector tick populations and these are still primarily in the coastal areas of the state (see Ticks which follows). To date, most specialists feel that only one tick, Ixodes dammini is a primary vector in Maine. The more common Dermacentor variabilis and Ixodes cookei have not been shown to be vectors of Lyme disease. Lyme disease antibodies have been found in a small percentage of dogs primarily from coastal areas of the state. Antibodies have also been found in cats from selected coastal areas. Dogs appear to be more symptomatic than cats making detection easier in dogs.

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.

Rose Chafer (Macrodactylus subspinosus) - This species was very common again this season in southwestern Maine causing locally noticeable defoliation of a wide variety of trees and shrubs. Although rose chafers occurred throughout the area, locally high populations stripped greenery from everything from ferns to trees. These tawny, spidery looking native beetles occur earlier (June) than Japanese beetles although their damage in some cases is every bit as severe.

Ticks (various) - There are 11 species of hard ticks (Ixodidae) which have been reported from Maine over the past two years as a result of Lyme disease-tick surveillance efforts. Of these eleven, only four; Dermacentor variabilis, Ixodes cookei, Ixodes marxi, and Ixodes dammini, have been commonly involved with humans. Of these four only I. dammini is a confirmed vector of the Lyme disease bacteria. In 1989, I. dammini was thought to be restricted to a band along the coast east to Columbia Falls and rarely more than 20 miles inland. Records acquired in 1990 show scattered distribution much further inland than previously thought. Ixodes dammini was found in 1990 as far north as Bethel, Madison, New Sharon, Patten and Burlington. Coastal records have still not been found east of Columbia Falls. Research on ticks, their biology, host associations and relationship to the Lyme disease bacteria in Maine is being conducted by the staff of the Research Department of the Maine Medical Center in Portland. A conference to share in various aspects of this problem will be held in Portland on March 1, 1991.

White Pine Weevil (Pissodes strobi) - This insect is discussed in Section C. It should be mentioned here, however, that the greatest need at this point is to register an insecticide suitable for use by the homeowner to protect valued ornamental white pine and Colorado blue spruce from attack by this weevil.

Wild Riceworm (Apamea apamiformis) - Wild rice seed heads were devastated in Kennebec, Lincoln and Sagadahoc Counties in August and September of 1990 by larvae of this species. Records have shown periodic outbreaks of this species in these areas for many years.

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.

Yellow-headed Spruce Sawfly - See Section C.

(D) Shade Tree, Ornamental and Miscellaneous Pests

Diseases and Miscellaneous Problems

Ash Anthracnose (caused by Discula sp.) - We received numerous calls last spring from homeowners concerned with loss of leaves from ash trees.

Symptoms were typical of ash anthracnose. Affected leaves exhibited irregular light brown blotches and infections commonly extended to the rachis (central axis of the compound leaf).

Since the causal organism overwinters on blighted twigs and petioles, we recommend careful raking and destruction of leaves and twigs in the fall for control in ornamental situations. This disease is rarely fatal, but is unsightly. For those wishing to pursue chemical approaches to control next spring, benomyl or chlorothalonil applied at bud break and twice again at 10 day intervals is suggested.

Green ash is said to be less susceptible to anthracnose than most other ash species and seems to be resistant to ash leaf rust as well. Green ash is also highly recommended for street and ornamental planting, especially in its selected form 'Marshall Seedless' (Fraxinus pennsylvanica lanceolata).

Cristulariella Leaf Spot (caused by Cristulariella spp.) - This disease caused extensive leaf spotting and defoliation in south central Maine in 1990. Box elder was the hardest hit but ash, butternut, and Norway maple have been severely affected as well. The majority of affected specimens were received from Lisbon, Lisbon Falls, Lewiston, Livermore Falls and Norway.

This disease has not been common for several years. It is normally controlled in its development by fluctuating weather conditions. Last year's weather, however, apparently was ideal for disease development where we had many consecutive days with high dew points in late July and early August.

Cristulariella leaf spots may be small or large, and may occur as small distinct units or coalesce to form large necrotic areas. But typically spots are tan in color and distinctly zonate. Small spots tend to have light tan centers with darker margins, whereas larger spots have light tan centers surrounded with several alternating dark and light tan concentric rings. Symptoms are frequently more severe on leaves lower in the tree crown. Affected leaves tend to drop early and dramatically, the result of toxic enzymatic activity by the causal fungus.

Dutch Elm Disease [caused by Ophiostoma (Ceratocystis) ulmi] - Symptoms of Dutch elm disease were quite spectacular throughout Maine last summer. The onset of hot dry weather in mid season caused leaves on infected branches to dry rapidly. In some cases leaves turned brown right away, but more commonly leaves dried up while still yellow or green.

Many old elms which escaped the initial wave of infection are now succumbing each year, at least partially the result of the development of more aggressive strains of the disease organism.

Control of this disease remains a challenge for arborists and others in the green industry. Planting of resistant cultivars, derived from European or Asiatic sources, is a practical approach. While injections with systemic fungicides and sprays for bark beetle control may provide

some level of protection, these techniques should be combined with a systematic program of sanitation (removal of nearby dead or dying trees) in order to be really effective.

Horsechestnut Leaf Blotch (caused by Guignardia aesculi) - Browned foliage of horsechestnut (Aesculus hippocastanum) caused by this fungus was quite conspicuous again last year especially along coastal sections of Maine from Portland to Rockland. Damage, although aesthetically objectionable, is not generally considered serious.

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.

Sirococcus Shoot Blight (caused by Sirococcus conigenus) - This disease seemed to return to normal levels on ornamental species in 1990. In 1989 disease incidence had been high, infecting especially Colorado blue spruce in landscape situations. But in 1990 such infections seemed to be relatively rare.

Sirococcus continues to be a serious problem in certain older red pine plantations. In one Montville plantation, more than 75% of mature trees have succumbed to this disease over the years. This disease is also widespread in the Eustis area, where it is especially damaging to reproduction among the Cathedral Pines.

Winter Injury - Brown foliage on evergreen trees and shrubs was much more severe than usual this past winter (1989-1990). Much of the damage was sustained in December, 1989, the result of early and record breaking cold weather. Much foliage was brown by early January, with symptoms continuing to intensify throughout the winter season.

Symptoms were most severe on exotic species, particularly dwarf Alberta spruce, rhododendrons, yews and Scotch pines. But even some native species were affected, especially white pines in Christmas tree plantations. This was the second year of severe browning on many rhododendrons and some other shrubs as well. Damage in such cases is often more severe the second year, other factors being equal, because many shrubs sprout considerable replacement foliage which may not harden sufficiently before cold weather.

Several factors have exacerbated the situation for many growers and nurserymen. The most important relates to the health of plant root systems. Trees and shrubs outplanted for one year or less and therefore not well established were commonly the most affected by winter browning. But even some trees thought to be well established burned quite badly, often the result of marginal root systems. Fraser fir in Christmas tree plantations was conspicuous in this respect. This species is sometimes planted in frost pockets because its late flushing characteristic

provides resistance to late spring frosts. But such sites are often wet, and Fraser fir cannot tolerate "wet feet." Root systems develop poorly in such situations, often become diseased, and are unable to provide sufficient water to the tree during stress periods such as we experienced last December. Browned Fraser fir were very conspicuous in the spring of 1990 in low spots in many plantations.

Snow provides some protection to tree roots by insulating the ground and reducing frost penetration. But it also reflects considerable sunlight and provides a "double whammy" of desiccating rays from the sun. If you're unsure whether the browning you observe is due to winter weather or something else, compare browning on the north and south sides of your trees. If it's considerably worse on south exposures, winter injury is the likely cause.

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90-9 Insect & Disease Management Division Augusta, Maine

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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. 5 - Feb. 1991

GYPSY MOTH IN MAINE - 1990

Prepared by
Richard Bradbury

Gypsy moth (Lymantria dispar) larvae defoliated 270,432 acres in 1990, continuing its epidemic phase which began in 1989 in Maine. Populations remain high in the southwestern portion of the state in areas where hardwoods, particularly red oak, are the predominant species.

Overwintering survival of eggs is often low in Maine, but mild winter temperatures and consistent snow cover on the ground have combined to allow a high percentage survival of eggs since the winter of 1988-89. Egg hatch above and below the snowline was very high in both 1988 and 1989, approaching 100% in many areas. Overwintering survival will be measured in March and April of 1991 to assist in prediction of the 1991 population levels. Results of this study should be available in late April.

Aerial surveys conducted during July of 1990 to determine the size and intensity of the infestation revealed 46,506 acres of light (less than 30%) defoliation, 82,473 acres of moderate (31-60%) defoliation and 141,453 acres of heavy (greater than 60%) defoliation. Defoliation was recorded from 82 townships. The breakdown of acres by county are shown in the following table:

Acres Defoliated by Gypsy Moth in Maine in 1990

County	Acres Defoliated			
	Light	Medium	Heavy	Total
Androscoggin	2,495	3,971	6,301	12,767
Cumberland	19,089	23,267	31,873	74,229
Franklin	16	190	42	248
Hancock	0	0	1,466	1,466
Kennebec	300	284	231	815
Lincoln	0	96	0	96
Oxford	15,562	27,840	52,103	95,505
Sagadahoc	0	1,003	399	1,402
Washington	734	1,736	638	3,108
York	8,310	24,086	48,400	80,796
State Total	46,506	82,473	141,453	270,432

The health of gypsy moth populations was highly variable in 1990. Larval mortality was high due to starvation and disease in many locations, particularly in areas sustaining the second year of heavy defoliation. Egg masses in these areas were often small and parasitism by Ooencyrtus kuvanae appeared to be high again this year. In addition to NPV induced wilt, a disease of gypsy moth larvae new to Maine was confirmed in 1990. Samples containing dead larvae from Norway, Lovell and Gorham which did not appear to have been killed by the wilt virus were examined by Dr. Ann Hajek of the Boyce Thompson Institute of Ithaca, New York. The fungus Entomophaga maimaiga was isolated from all of these samples. This organism has been previously reported from other New England states and was introduced to the U.S. in the Boston area in the early 1900's.

Fifty-nine sites were examined throughout the infested region of the state in September and October to determine the level of overwintering egg masses. Thirty-three of the plots had over 500 egg masses/A, an indication that trees in these locations have the potential to receive heavy defoliation in 1991.

Population levels and resulting defoliation in 1991 are very difficult to predict accurately because of the high variability of natural control agents. However, a conservative estimate would indicate total defoliated acreage may equal or exceed 1990 levels with many of the populations shifting to or developing in nearby stands not defoliated in 1990.

At this time the Maine Forest Service is continuing to pursue federal monies to aid in municipal suppression projects. The response to this type of suppression program has not been high, but some assistance will likely be available to those who have already applied for inclusion.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 5 - Feb. 1991

SPRUCE BEETLE IN MAINE - 1990

Prepared by
Henry Trial, Jr.

The spruce beetle [Dendroctonus rufipennis (Kirby)] continued to kill mature white and red spruce in many parts of the northern half of Maine in 1990 but the incidence of freshly attacked trees was less than in 1988 and 1989. The incidence of beetle attack has fluctuated considerably since it was first seen in 1985 and the rate of attack may increase again before the infestation finally subsides. Spruce beetle outbreaks often persist until most of the available host in the favored size class are attacked.

Status of the Outbreak

Spruce beetle can now be found throughout northern Maine (Figure 1) where stands of large (greater than 14") mature white spruce persist. In parts of western Maine, the spruce beetle rapidly attacks red spruce but in the north, red spruce continues to compose less than 20% of tree mortality.

Several areas of intense beetle attack where 25% or more of the host trees have become infested have been identified. These severely infested areas cover more than 9,000 acres and portions of this area have lost more than 80% of the white spruce component. The most notable areas are (Figure 1); T8 R10 and other areas near Munsungan Lake, an area in T13 R5 near Beaver Brook, several areas near 4th and 5th Musquacook River, T13 R11 and T13 R12 near Round Pond on the Allagash River, T13 R11 and T12 R11 near Robbins Brook and areas of red spruce near Richardson Lake in western Maine.

Management Activities

The Maine Forest Service (MFS), Insect and Disease Management Division (I&DM) has conducted several training sessions to educate landowners about the insect, damage symptoms, survey methods, and probable impact of spruce beetle. Several large landowners have used this information to locate infested or susceptible stands on their holdings. Some industry foresters are using aerial surveys or, even more effective, color infared photography to map infested areas.

Most of the heavily infested areas have been or are being salvaged. Usually, spruce beetle killed trees salvaged within 3 years of death have been merchantable, but many trees show some degrade if not cut within 2 years. Trees attacked by spruce beetle are often the most valuable saw logs in affected stands and owners have been aggressive in attempts to salvage them.

Even though much of the timber affected by this species has been marketed to date, the infestation has resulted in major disruptions in management plans and significant dollar loss to some owners. Also, several infested areas are in or near critical areas such as deer yards and the Big Reed Pond preserve. Cutting in or near deer wintering areas to salvage beetle killed spruce has caused problems for owners but often agreements can be reached with IF&W staff through variance procedures. Historically, critical areas such as Big Reed Pond are not cut even when heavy mortality occurs.

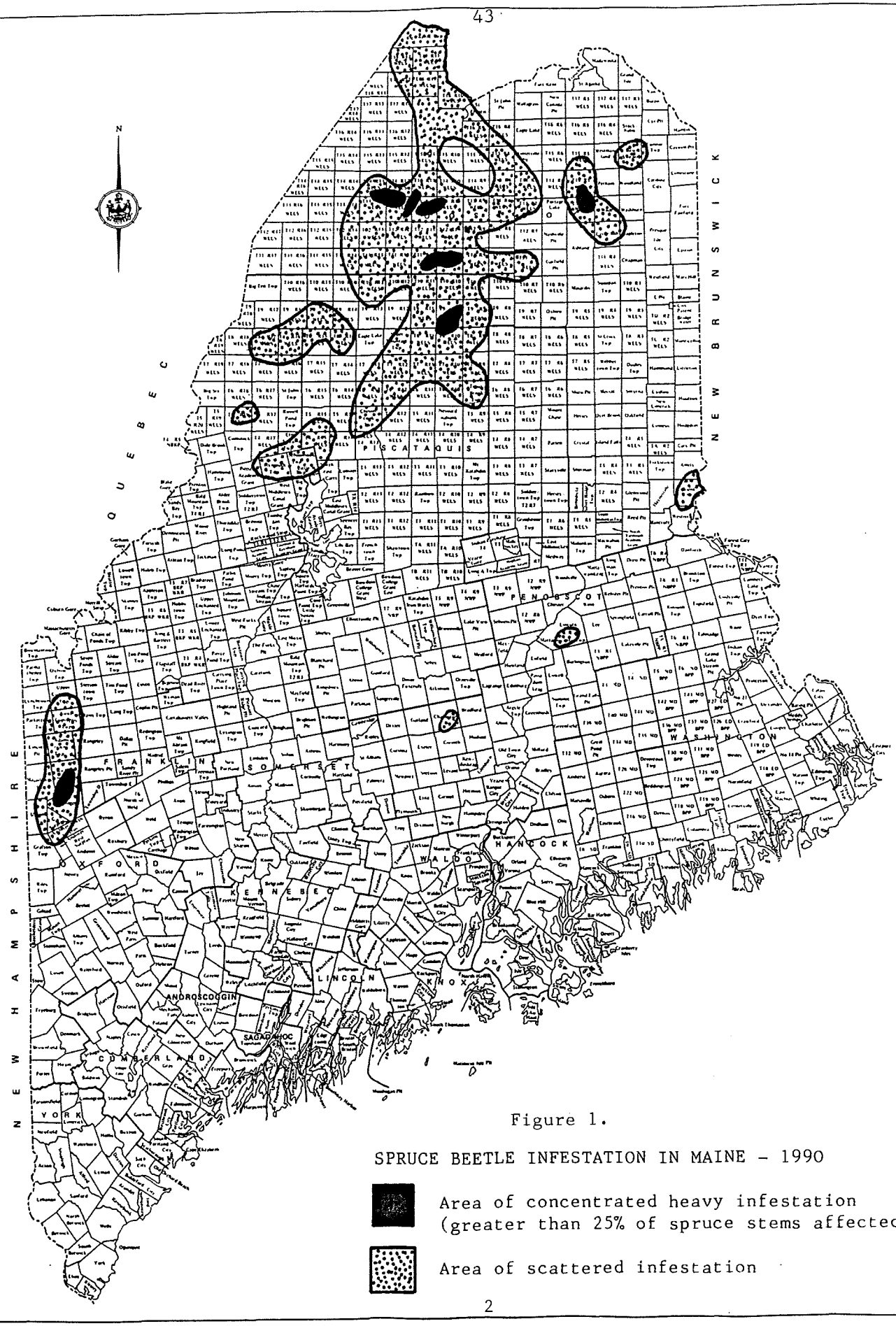

Figure 1.

SPRUCE BEETLE INFESTATION IN MAINE - 1990

Area of concentrated heavy infestation (greater than 25% of spruce stems affected)

Area of scattered infestation

Risk Rating Research

The MFS, I&DM Division surveyed many beetle infested areas in 1990 to gather data necessary to develop a spruce beetle risk rating system for Maine forests. Survey plots in large areas of intense attack (Figure 1) were sampled on a one time basis. Smaller plots were established in more lightly infested areas for ongoing study. Surveys of one or two additional large areas are planned for the winter of 1991-92.

Based on preliminary analysis, white spruce trees less than 10" DBH are rarely attacked. When trees less than 10" DBH are attacked they are usually found in areas which have been infested four or five years. In areas where the rate of attack is less than 3%, nearly all trees attacked are very large (>18" DBH). This suggests that very large trees are attacked first, and smaller trees only later in the infestation.

Where small trees are attacked, they are more likely to be red spruce than white. Of the red spruce attacked in the survey area, several trees in the 8" to 12" DBH range were tallied. Generally, red spruce in the mixed stands was much smaller than the white spruce. In most areas where white and red spruce occur together, white spruce is attacked at a much higher rate than red spruce. In the stands analyzed, white spruce was attacked 5 to 8 times more often than red spruce. Many of the red spruce attacked had other pests present or mechanical injuries which probably stressed the tree prior to spruce beetle attack.

An area surveyed in Richardsontown in western Maine was composed exclusively of red spruce. In this area, on average, 55% of the stems were killed by spruce beetle. Most trees over 14" were attacked and the majority of trees less than 11" were not attacked. Beetle was found on some 7" to 9" trees, but these were probably quite old.

In general the risk rating, when complete, will show that the highest risk areas have a high percentage (>25% of stems) of white spruce larger than 14" DBH. The highest risk areas also contain some very large white spruce (> 18" DBH). Stress factors such as spruce budworm defoliation do not seem to correlate well with spruce beetle hazard, but the most commonly attacked areas do tend to be low and wet.

Red spruce in mixed stands of red and white spruce is definitely at less risk than white spruce. Red spruce in relatively pure stands in western Maine seem to be an exception. White spruce less than 10" DBH and red spruce less than 8" DBH seem to be at low risk even if big spruce are present. White spruce between 10" and 14" DBH and red spruce less than 14" DBH are at moderate risk when very large white spruce trees are not present.

When data collection and analysis for this project are complete, more relationships may become apparent.

Tree Baiting Research

The Maine Forest Service cooperated with John Anhold of the USFS in Durham, New Hampshire on a test of spruce beetle baits attached to host trees and in funnel traps. The goal of this test was to determine whether or not beetles in an area could be concentrated on a few host trees or in traps thus preventing spread to other trees. Baits were deployed in a heavily attacked stand in T13 R5 near Beaver Brook.

A report on this test has been prepared at the USFS Durham office. A major difficulty encountered in the test area was the low number of new beetle attacks in 1990. This was probably due to reduced beetle activity in the area this past year. Activity had been high in 1988 and 1989. Baits provided by another manufacturer were very effective in attracting beetles to spruce trees in 1989. In 1990 some baited trees and some trees around funnel traps were attacked but the percentage of attacked trees was low. Spruce beetles specifically attacked baited trees and not surrounding trees.

A conclusion of the study was that baiting to concentrate beetle activity on a single or a few targeted trees shows promise and may be useful in high value areas. Further research is needed to verify this theory. The MFS may conduct further tests of beetle baiting if new, active infestation areas can be found.

Future Course of the Outbreak

The decline in the incidence of new beetle attack in Maine in 1990 when compared to levels in 1988 and 1989 was significant but may be temporary. The future course of the outbreak as a whole cannot be predicted, but a significant number of unaffected high risk trees still exist in many infested areas. Also, some high risk stands remain unattacked or have very low levels of attack. Damage in some of the older areas has probably peaked and the infestation there is probably declining. The MFS will continue to monitor the status of the infestation and report these findings to affected owners.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 5 - Feb. 1991

SPRUCE BUDWORM IN MAINE - 1990

Prepared by
Henry Trial, Jr.

The spruce budworm (Choristoneura fumiferana Clem.) infestation which devastated Maine's spruce-fir forest from the early 70's through the mid 80's has now ended. The 1990 aerial defoliation survey showed no moderate to severe defoliation due to spruce budworm for the first time since 1946. Larvae of the budworm were found in very low numbers in small sections of southeastern Maine but were totally absent from collections made in the rest of Maine. Light trap and pheromone trap moth catches decreased in 1990.

A low level spruce budworm survey was conducted in 1990 to monitor trends for the historical record. Survey efforts were generally centered around light trap locations because light traps have the longest data history and are probably the best available predictor of low level population trends. To supplement light trap data, larval population and pheromone trap data were collected from 20 sites. Development data was taken at two sites. A reduced aerial survey was also conducted.

Larval Populations

Larval population samples were collected and larvae counted in the field at 20 sites scattered throughout the spruce-fir type (Figure 1). The sites used were the same locations used to set pheromone traps and 15 of the locations were also near permanent light trap locations. A larval sample consisted of 10 branches from either fir or spruce. Samples were taken in late May when most larvae were in the third instar. Of the 20 locations evaluated for larvae, budworm were found at only two; Waltham and Jonesboro. High larval populations had persisted in both of these areas throughout the late 80's but the counts in 1990 were low. In Waltham the count was 1.3 larvae per branch while in Jonesboro it was only 0.3 per branch.

Development

Unusual weather conditions in 1990 had a noticeable impact on seasonal development of the spruce budworm at the two sample sites; Waltham and Jonesboro. The spring and early summer were very cold and wet, especially in southeastern Maine where the only residual spruce budworm populations were found. This adverse weather delayed larval emergence by seven to 10 days compared to the 10 year average and development stages remained late throughout the entire larval development period. Pupation was at least a week later than normal. Development at Waltham was several days ahead of development at Jonesboro. Jonesboro is closer to the ocean and is normally a colder and later site.

Weather conditions did not seem to retard fir bud flush and shoot development. Fir shoot development was normal and both sites reached class five shoot development (fully expanded and flat) by late May. As with larvae, Waltham shoot development was more rapid than Jonesboro.

Aerial Defoliation Survey

The annual budworm aerial defoliation survey effort was much reduced in 1990 even when compared to the limited 1989 survey. The only flights done in most of the spruce-fir area were part of the general pest detection survey. Flights timed specifically to detect budworm damage were conducted in the southeast but no defoliation was detected from the air. This is the first time that the aerial survey has not detected areas of moderate to severe defoliation since 1946.

Pheromone Survey

A budworm pheromone survey was conducted again in 1990 but the method was modified and the effort greatly reduced compared to other pheromone work in recent years. In 1989 the MFS reviewed the usefulness of past pheromone work done in Maine and found that past surveys had been ineffective as predictors of budworm population trends. This was largely due to frequent changes in methods and materials. Also traps failed to catch moths on many occasions in areas where populations were known to be high.

In 1990, the pheromone survey was reduced to 20 sites spread throughout the spruce-fir type. In previous years the MFS had established hundreds of sites. The 20 locations established in 1990 (Figure 1) are planned to be "permanent" and were placed either near an operating light trap or at sites traditionally used as budworm development points. The pheromone sites were the same sites as those used for larval population assessment. This format was developed so that all population assessment methods used can be compared at the same points. Three pheromone traps were placed at each site and baited with a lure which will theoretically be more consistent from year to year.

All plot establishment, trap placement, and trap retrieval was completed successfully in 1990. The 60 traps deployed caught a total of four budworm moths; two in Steuben and two in Waltham. Both points are in the southeast where the last remnants of budworm population persist.

Again in 1990, large numbers of hemlock looper moths were caught in some budworm pheromone traps. Nearly all of the traps caught some looper. The largest numbers of looper moths were caught in traps in Indian Purchase 3 near Millinocket. These traps were nearly full of male looper moths.

Light Trap Survey

The MFS has operated a system of light traps since 1943 to monitor spruce budworm moths and other insects. This trapping system is probably the most reliable means for the MFS to monitor trends in the current low level budworm population. Twenty four traps are operated throughout the state during the moth activity period in July. In 1990, one light trap location near Musquacook Lake was discontinued and a new site was added in T3 R11, west of Baxter Park.

The light trap survey has shown a steady decline in average total spruce budworm moth catch per trap and in total catch in individual traps since 1983 with the exception of 1989 when a small increase occurred (Figure 2). While

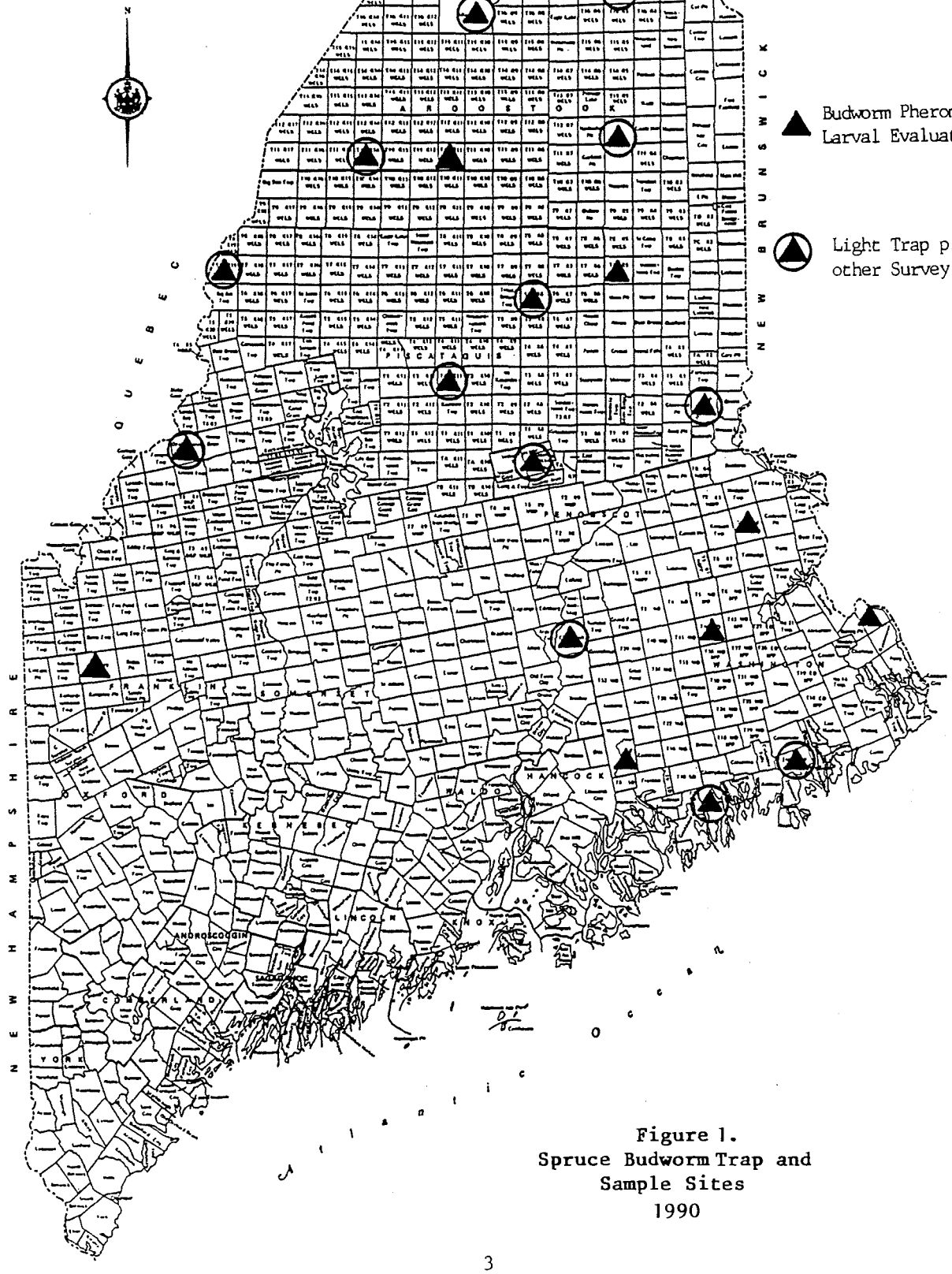

Figure 1.
Spruce Budworm Trap and Sample Sites
1990

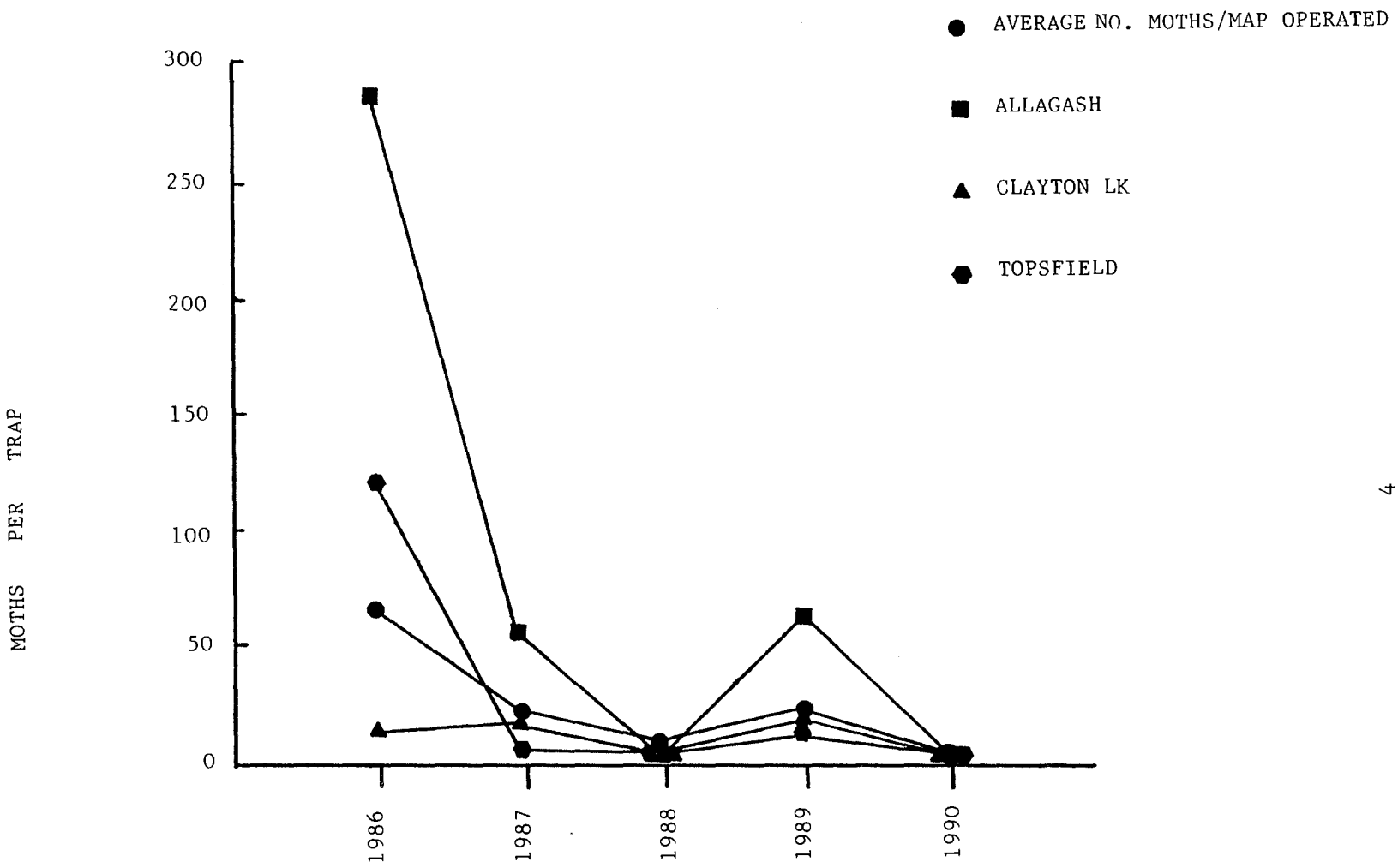

Figure 2. Average Annual Spruce Budworm Light Trap Catch per Trap Compared to Selected Light Trap Totals.

Figure 2 displays moth catches only for the period 1986-1990, the decline in moth catches actually began in 1983. Usually an increase or decrease in moth catch is not considered a trend unless the change occurs for three successive years or is of great magnitude. The total moth catch in 1990 was much less than in 1989 (4 per trap in 1990 compared to 24 in 1989). The 1990 catch was even lower than the low 1988 level (10 per trap). These data indicate that the small increase in 1989 was not the beginning of a trend toward higher populations in Maine.

Nearly 70% of the total 1990 moth catch (73 out of 107 moths) came from the Steuben trap in coastal southeastern Maine and it was the only trap that produced enough moths to evaluate the timing of moth activity. This coastal area tends to have erratic weather patterns which affect the timing of moth activity and therefore it is difficult to say if the 1990 moth activity period was normal or late. Significant numbers of moths were caught after July 20, however, which is slightly later than normal for that area.

Forecast

Light trap data and all other population indicators show that budworm populations in Maine have reached endemic levels in most of the previously infested area. Low level population indicators such as light traps and pheromone traps will be important tools in determining when the next outbreak will begin.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 5 - Feb. 1991

THE HEMLOCK LOOPER IN MAINE - 1990 AND A FORECAST FOR 1991

Prepared by
Henry Trial, Jr.

Introduction

In 1988, populations of the hemlock looper [Lambdina fiscellaria fiscellaria (Gn.)] in Maine began an unprecedented increase. This insect, though native to Maine, previously was most commonly found in low numbers. Damaging populations had been seen only three times in this century totalling roughly 150 acres; Bath area (1927), Wiscasset (1964), and Nobleboro (1966). Evidence of a building outbreak in 1988 was limited to numerous reports of higher than normal moth activity. In 1989, 450 acres of heavy to severe defoliation were mapped near Sebago Lake and on islands in several eastern Maine lakes near Springfield. Also in 1989, a significant increase in moth activity was noted in eastern Maine. Similar unprecedented increases in looper were also noted in neighboring New Brunswick.

In response to the threat of a growing hemlock looper infestation, the Maine Forest Service (MFS), Insect and Disease Management Division (I&DM) has planned surveys and studies for 1991 to evaluate the looper situation in Maine.

1989-1990 Egg Survey

In the fall of 1989, egg densities were estimated in and near defoliated areas and in areas where heavy moth activity had been reported. Eighteen egg samples were collected in Lakeville, Macwahoc, and near Sebago Lake and processed using an egg washing method developed in Newfoundland. Mean egg counts of 5 to 10 eggs per 200 cm branch were found in Lakeville and Macwahoc. All other areas surveyed had mean egg counts less than 2 per branch including areas near Sebago Lake where heavy damage was seen. Based on Canadian data derived from fir, the highest egg counts were expected to cause only light to moderate damage.

Development of a Population Prediction Method

In March and April of 1990 three research areas were established to determine the relationship between egg density, larval counts, and resulting defoliation. Basic research on population evaluation and prediction on hemlock had not been done previously, and this information was needed to evaluate this apparently worsening problem. A two phase study was designed to determine the egg to defoliation relationship on hemlock. In the first phase of the study, hemlock trees were dissected to determine egg distribution and thus where on the tree samples should be taken. In the second phase, egg samples were taken and the egg counts compared to resulting larval numbers and defoliation.

Results of these tests have been analyzed and a final report* written. The tests showed a good correlation between egg samples and resulting defoliation. Data show that egg counts of three to five eggs per branch resulted in heavy to severe defoliation on hemlock. Counts of one to three eggs resulted in light to moderate damage. These results were developed from a single year of data and further confirmation of the relationship in other years is necessary.

The egg to defoliation relationship for fir was not studied in 1990 but observations and Canadian data suggest that 10 or more eggs are needed to result in moderate to heavy damage.

Larval Observations

All evaluations of looper conducted during the summer of 1990 support the view that the hemlock looper infestation in Maine continues to move toward widespread outbreak conditions and consequently heavy damage. In late June, a survey of early larval populations was conducted in and around the known infested areas. Larval counts ranged from 10 larvae per branch in areas not showing looper damage to 170 per branch in Lakeville where damage was seen in 1989. Areas where heavy moth activity had been observed were surveyed and counts of 30 to 70 larvae were common. Late larval counts were taken in August on the same trees that had been sampled for eggs in March. By this time larvae were .5 to 1" in length and natural mortality and dispersal had reduced numbers to 10 to 25 per branch.

Defoliation

Observations of the pattern and intensity of hemlock looper defoliation were made throughout the summer. It was learned that the looper feeds on new foliage soon after egg hatch yet, at population levels seen in Maine in 1990, no significant damage was caused by these tiny larvae. Older larvae (2nd instar and older) had a definite preference for old needles and did not move back to new growth until nearly all old needles were gone. Most needles were not totally consumed but larvae nibbled the needles causing them to die and fall from the tree. In areas of moderate population, larvae never caused significant damage to new needles. In high population areas, 30 to 60% of the new needles were eaten or destroyed and 95 to 100% of the old needles were lost. In the most severe spots, hemlock lost 90 to 100% of the total needle complement and are not expected to survive. Damage to fir and spruce was far less intense in most areas. In areas where hemlock lost nearly 100% of its needles, fir lost about 50 to 70% of the old needles and almost no new needles. Fir and spruce on two small islands off Mount Desert Island lost 50 to 100% of the total needle complement and some trees will die.

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* Trial, Henry, Jr. and Joan G. Trial. In Press. The Distribution of Eastern Hemlock Looper [Lambdina fiscellaria fiscellaria (Gn.)] Eggs on Eastern Hemlock (Tsuga canadensis (L.) Carr.) and Development of an Egg Sampling Method on Hemlock. Me. Dept. of Conservation., Me. For. Serv., I&DM Division. Tech. Rept. No. 30. 12 pp.

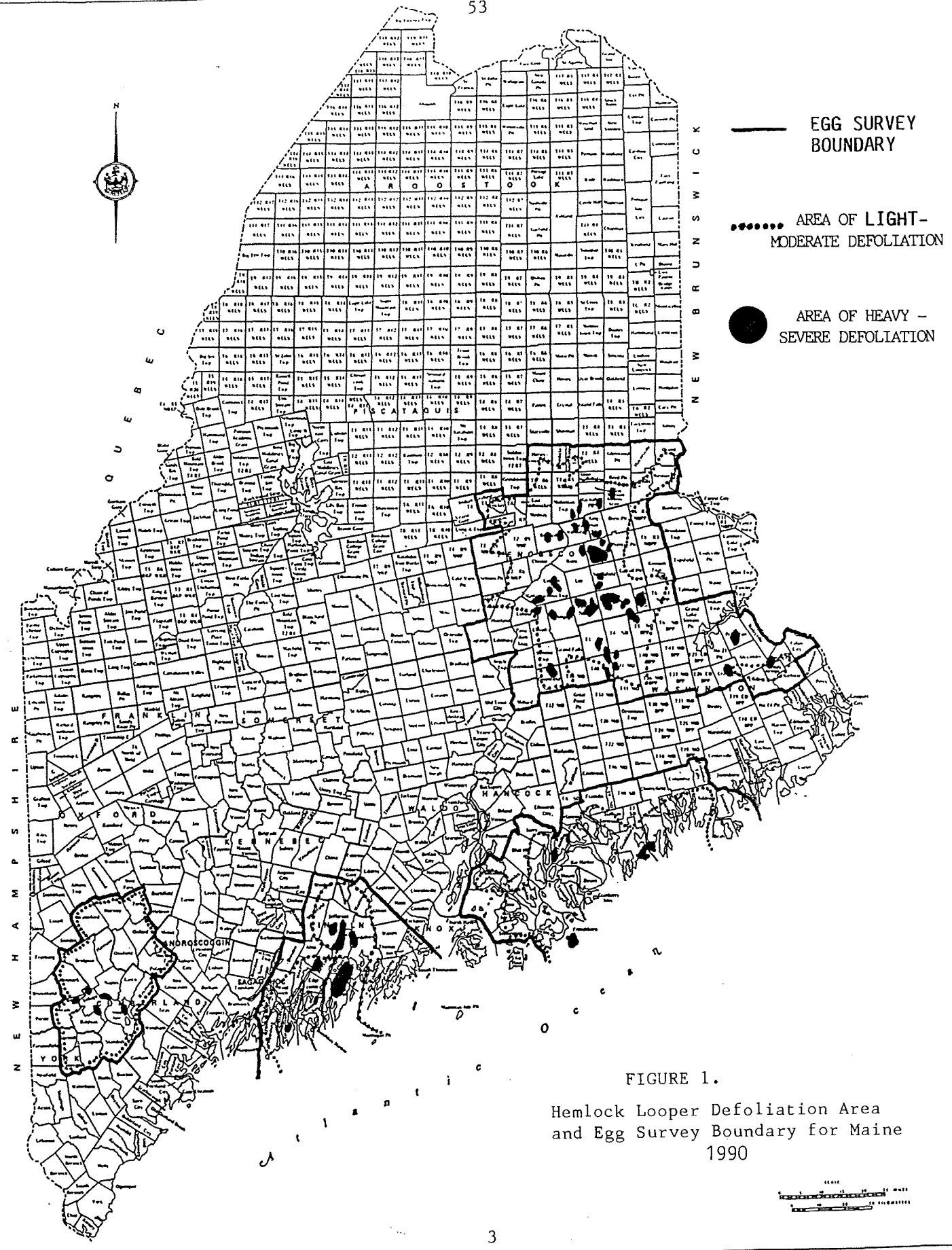

FIGURE 1.

Hemlock Looper Defoliation Area and Egg Survey Boundary for Maine 1990

An aerial survey was conducted during September of 1990 over much of Maine. More than 20,000 acres of heavy to severe damage was mapped. Light to moderate damage was not visible from the air but ground observation showed that the area containing light to moderate damage on hemlock and fir exceeded 500,000 acres. A map (Figure 1) was prepared to show the area of heavy to severe defoliation on hemlock mapped during the aerial survey and the area of light to moderate defoliation on hemlock and fir detected with the ground survey.

Light Trap Survey

Light traps have been used for many years in Canada to monitor looper moth activity and seem to provide a useful measure of population density. Because looper moths fly from August through mid October, and Maine light traps have normally operated in June and July, Maine has no light trap record of previous looper activity. In 1989, however, one light trap operator in Steuben voluntarily operated a trap in the fall and caught a relatively large number of looper moths compared to an average New Brunswick light trap catch. In 1990 the MFS extended the operating season of 7 of its traps to include September specifically to evaluate looper.

Moths were caught at all seven light traps (Table 1). The most significant result is the extremely high catch in Steuben (3,848 moths). Traps in Topsfield and Chesuncook also had catches considered to be high. North Bridgton and Haynesville had significant catch but Ste. Aurelie and Guerette only caught two and one moths respectively. Four of the five traps that caught significant numbers of moths were near areas known to be infested with looper in 1990. The Steuben trap was very near the area with the highest population level found in Maine in 1990. The looper infestation responsible for Chesuncook moths has not been found as yet, and no significant looper populations are known to exist in the vicinity of either the Ste. Aurelie or Guerette traps.

Of the five traps with significant catch, all except North Bridgton caught many more females than males. The moths from Steuben had a female to male ratio of 76:1. The ratios in Topsfield, Haynesville, and Chesuncook were 5:1, 5.5:1 and 4:1 respectively. North Bridgton had twice as many males as females (1:2).

Moth activity at the Steuben, Chesuncook and Topsfield traps was heaviest between the 10th and 17th of September with another smaller activity peak around the 25th to the 28th. Significant moth catch on the 1st at all three traps indicates that some moth activity was probably occurring in August. Heavy moth activity (mostly males) was observed in the field as early as August 20th in Lakeville. Some looper moths were active through mid October, especially near the coast.

Light trap data verifies numerous reports of extensive moth activity from all over southern and eastern Maine. Large numbers of moths have been reported by those working in the woods, on buildings near lights, and even by motorists driving at night. Higher levels of moth activity than that seen in 1989 have occurred nearly statewide.

Table 1.
Hemlock Looper Moth Catch in Light Traps
Maine - 1990

Station	Sex	September 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	30	Totals
Chesuncook	M	6	0	0	2	0	2	0	0	4	2	5	-	6	1	-	2	1	0	2	0	3	1	3	0	3	2	3	2	0	0	50
	F	7	0	0	0	0	1	0	0	0	0	16	-	100	29	-	9	0	0	0	0	3	9	3	0	5	10	2	2	0	2	198
Guerette	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haynesville	M	1	0	0	0	0	1	0	0	1	1	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	7
	F	2	0	0	2	1	3	0	0	1	2	0	6	6	10	3	0	0	0	0	0	0	0	0	0.	0	2	1	0	0	0	39
No. Bridgton	M	0	0	0	3	6	3	0	0	2	2	5	1	4	2	0	0	0	1	0	0	0	1	0	0	0	0	2	0	0	0	32
	F	0	0	0	0	0	0	0	0	0	0	0	10	1	2	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	15
St. Aurelie	M	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	F	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Steuben	M	1	3	0	0	0	2	1	0	2	7	5	8	4	1	1	5	0	0	5	3	0	0	0	0	1	0	0	0	1	0	50
	F	97	64	1	0	26	324	170	3	29	282	92	1114	182	485	192	46	0	1	42	20	2	68	24	10	112	146	48	118	84	16	3798
Topsfield	M	9	1	0	0	3	6	0	0	2	2	1	19	2	9	0	1	1	0	0	0	0	0	2	0	0	4	0	0	0	0	72
	F	15	2	0	0	6	7	0	0	5	6	2	103	6	53	33	61	1	0	0	1	0	0	4	0	6	23	1	0	2	2	339

The moths collected at Clayton lake were destroyed by water before they could be sent to Augusta, so there is no data from that station.

1990 Egg Survey

The egg to defoliation relationship on hemlock and survey methods developed by the MFS in 1990 were used as the basis for a general survey to predict hemlock looper populations and resulting damage for 1991. This survey was conducted in and near areas of defoliation detected during the 1990 aerial and ground defoliation surveys and in areas where heavy moth activity had been observed. Survey boundaries are shown in Figure 1. Egg samples were collected from 282 sites (approximately two per town surveyed). An egg sample consisted of one 100 cm branch from the mid crown of each of three overstory hemlock or fir trees and one 100 cm branch from each of three regeneration stems of the same species. These samples were taken to the MFS laboratory at Old Town where eggs were counted using an egg washing technique developed in Canada by Otvos and Bryant**. The egg survey began in November, 1990 and was completed in early January, 1991.

Egg counts were categorized based on the regression developed for 1990 data (Figure 2). Four categories were used for the 1991 prediction map: light, moderate, heavy and severe (Figure 3). Three of these categories; low, moderate, and heavy, were derived directly from early 1990 data but egg counts now called severe were not seen until egg laying was complete in the fall of 1990. The level of total defoliation on hemlock listed for each category was derived exclusively from 1990 data and differences in weather conditions in 1991, insect health, or different defoliation levels at the start of the 1991 season might change this relationship.

Egg density measured in the fall of 1990 was plotted on a map which was used to produce a map showing the expected infestation level and projected defoliation for 1991 (Figure 3). Looper population levels have increased greatly both in intensity and in the size of the area infested. Based on this prediction, the area of heavy to severe looper damage to hemlock is likely to exceed 200,000 acres in 1991 compared to 20,000 acres in 1990.

Another year of heavy feeding, as indicated by the preliminary egg survey, is likely to cause significant hemlock mortality in central Penobscot, northern Hancock, northern Washington, central Lincoln, and southern Aroostook Counties. High populations in portions of southern Washington County would probably cause significant defoliation to fir and possibly spruce in 1991.

The situation in the Sebago Lake area is more complex. While some stands of hemlock in this area are at high risk of heavy to severe defoliation by hemlock looper, others may experience defoliation by a related species. In some of the stands near Sebago Lake which had heavy to severe defoliation in 1990 egg surveys showed mostly low egg densities. Low egg densities in heavily defoliated areas probably occurred because the 1990 damage was caused by another similar looper rather than hemlock looper. This looper, Lambdina athasaria Walker, looks very much like hemlock looper in the moth and larval

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** Otvos, I.S. and D.G. Bryant. 1972. An Extraction Method for Rapid Sampling of Eastern Hemlock Looper Eggs, Lambdina fiscellaria fiscellaria (Lepidoptera: Geometridae). Can. Ent. 104:1511-1514.

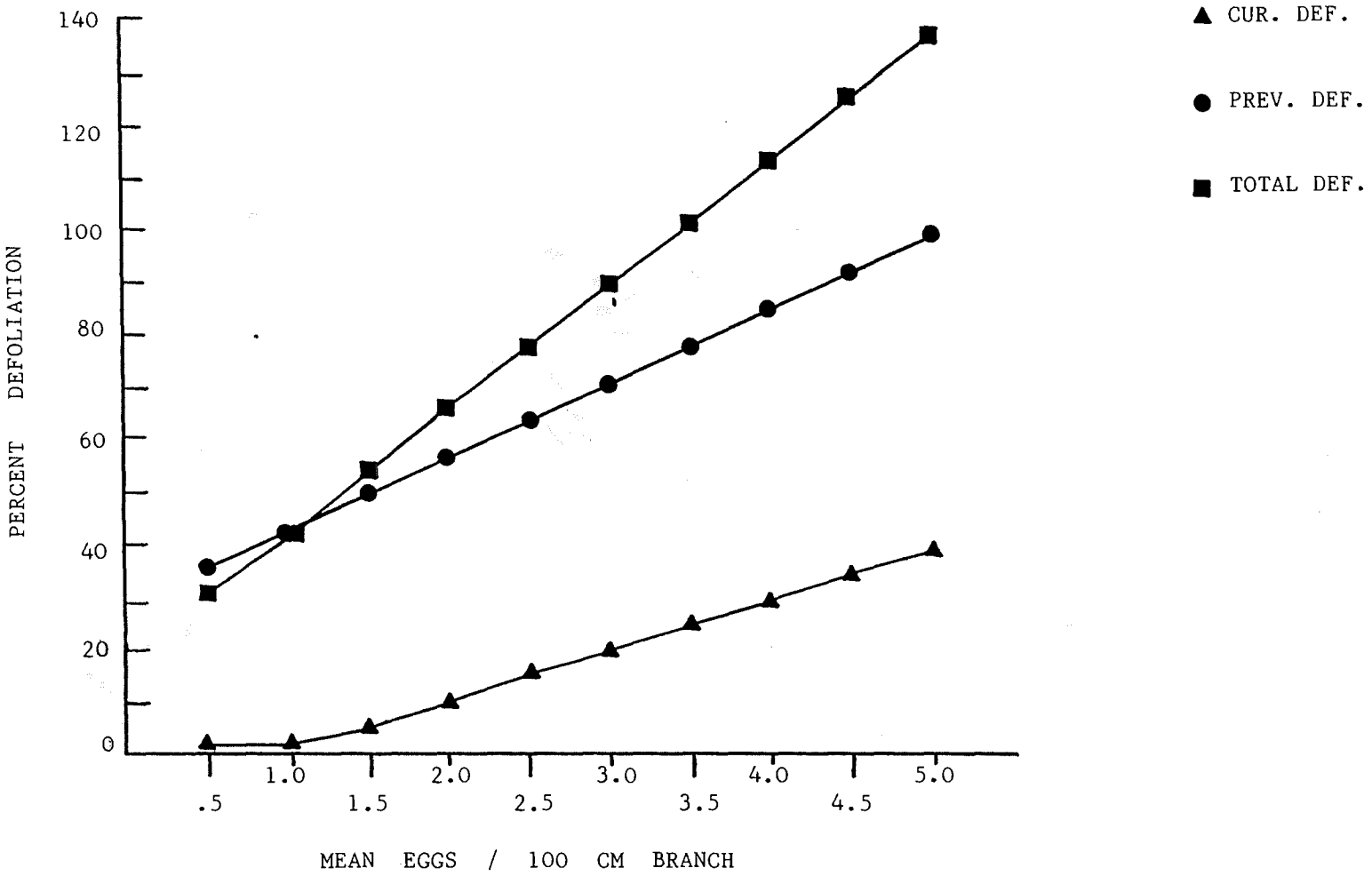

Figure 2. Predicted Defoliations on Hemlock based on the Average of Mid Crown and Regeneration Egg Density per 100 CM Branch-Maine-1990

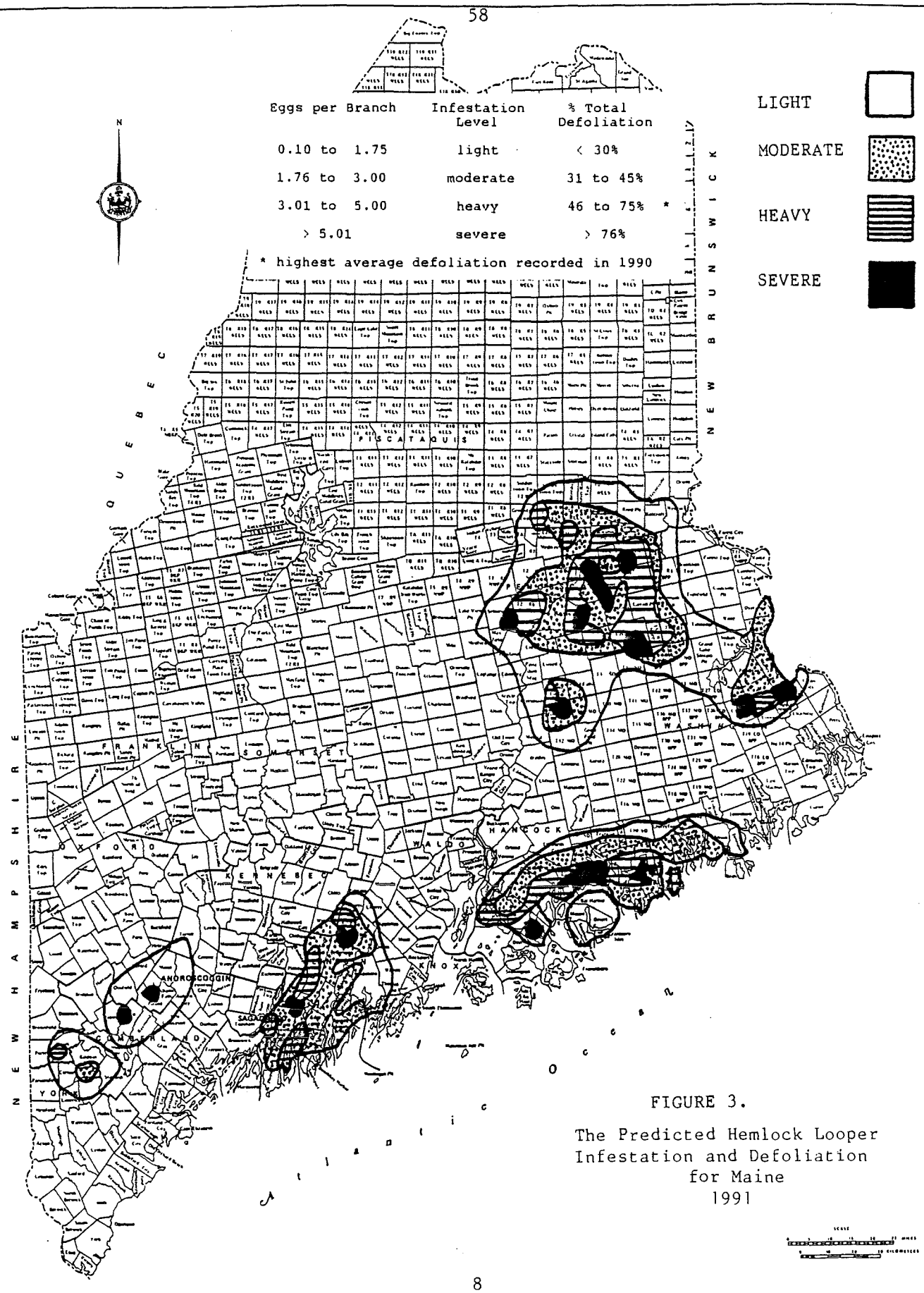

FIGURE 3.

The Predicted Hemlock Looper Infestation and Defoliation for Maine 1991

forms but, overwinters as pupae rather than as eggs. Because L. athasaria does not overwinter as eggs, its population can not be surveyed with the egg washing method. High numbers of L. athasaria moths and larvae were seen in the Sebago area in 1990. This species is probably the most significant defoliator of hemlock in the Sebago area and may contribute to hemlock damage in other areas as well especially in southern Maine. Surveys for this pest will be conducted in the spring of 1991 in areas showing unexplained heavy damage to hemlock.

Future Plans

Infestation levels will be reported to landowners along with an assessment of the risk to their stands in 1991. The MFS will work with large and small landowners to evaluate looper populations on specific stands. Several large landowners are considering changes in management strategies on many stands if egg surveys predict heavy or severe damage in 1991. Where small lots and multiple ownerships restrict management options, the I&DM Division will be working with groups to develop strategies. In many stands salvage will be the only acceptable option.

Survey method research conducted in 1990 must be repeated to verify preliminary relationships. The 1991 study will cover 12 sites and population levels ranging from none to severe. Also, survey methods for L. athasaria will be researched.

Looper populations will be monitored in 1991 throughout the state. Surveys will include larval population estimates early in the season, defoliation observations throughout the season, moth activity measurements, and egg surveys in the fall. As this is a relatively new problem for Maine, the future course will be monitored throughout the outbreak.

Little is known about the specific impact of looper on hemlock. To evaluate the impact, the MFS plans to establish impact plots in 12 stands which show varying degrees of damage. Infestation and host tree data will be collected annually and the impact determined over time.

The MFS is investigating the management possibilities for this potentially serious pest. The province of Newfoundland has extensive experience with the use of biological and chemical insecticides to control looper. In 1990, New Brunswick also used insecticide to control a growing looper infestation. The MFS will consult with scientists from both jurisdictions and with the Canadian and U.S. Forest Services. Looper outbreaks are generally intense but have usually been of short duration. This type of infestation pattern may lend itself to carefully targeted spraying.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 5 - Feb. 1991

WHITE PINE BLISTER RUST CONTROL PROGRAM - 1990

Prepared by
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The White Pine Blister Rust Control Program underwent significant operational and procedural changes in 1990. In recent years it had become increasingly apparent that new efficiencies of operation were needed if the program were to continue to effectively protect the pine resource in the face of declining supporting revenues. We were able to identify and implement several such economies of operation during this past project year. These may be summarized as follows:

(1) Mapping efficiency was improved. Maps (marked up aerial photographs) were not cut into blocks as in previous years but were left whole. While this made them a bit awkward for scouts to handle, orientation was easier for the mappers and where blocks being mapped were adjacent to each other, it was easier to continue pine type lines between blocks. Inking and acreage measurements were also facilitated by utilizing uncut maps.

(2) Control lines were not drawn around mature pine stands when maps were prepared. Since mature stands are not scouted anyway, a decision was made not to add this extra step.

(3) Where they were available, infrared aerial photographs were used to help pinpoint pine stands. Since white pine shows up conspicuously on infrared photographs, such photographs can aid significantly in the accuracy and efficiency of map preparation.

(4) The pine quality criteria necessary for stands to be considered for ribes eradication were tightened. For pole size stands (6-10" dbh) not only must there be a minimum of 100 healthy trees present per acre, but all trees counted as part of this minimum must now contain at least one potential 12 foot sawlog.

(5) Concentrations of ribes are now eradicated by scouts as they are encountered rather than being scheduled for return visits.

(6) Sprayers have been upgraded. The new Solo backpack sprayers are vastly superior in terms of portability, weight, and spray nozzle patterns.

For 1990, using the new measuring and mapping criteria, the following were accomplished:

Pine acres mapped	-	2,992
Control acres mapped	-	8,554
Pine acres scouted	-	2,338
Control acres scouted	-	3,660
Hours of scouting	-	1,197

The acreage figures reported are considerably lower than in past years. However, this reduction is to a great extent due to new methods of counting acreages rather than a reduction in the total blister rust control effort. Still, higher levels of program funding are needed for optimal protection of the white pine resource.

As in past years Tordon was the primary herbicide used to destroy currants and gooseberries. Trials were initiated in 1990 using trichlopyr (Garlon) as a possible replacement herbicide because trichlopyr, if equally effective, would seem to enjoy certain environmental advantages. In these preliminary tests trichlopyr has performed well. Expanded tests are planned for 1991.

Mapping for the 1991 control project is already complete and field work (scouting) is expected to commence in May.

From: Maine Dept. of Conservation, Maine Forest Service
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