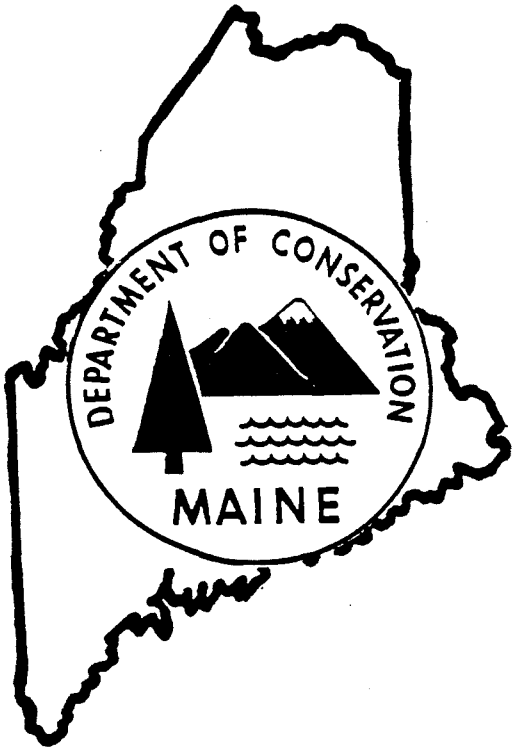
FOREST & SHADE TREE INSECT & DISEASE CONDITIONS

FOR MAINE

A Summary of the 1992 Situation



Insect & Disease Management Division
Summary Report No. 7
February 1993

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 1992 Situation

TABLE OF CONTENTS

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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 regular field staff: Supervisor: **Mike Devine** and Technicians: **Jody Connor, Skip Cram, Mike Skinner, Grayln Smith** and **Dave Stewart** who scour the state to provide us with information and records on the various insects and diseases. Thanks too go to our federally funded seasonal project staff: **Caroline Skinner, Christine Leighton, Kathy Murray, Dick Pierce, Dave Pierce, Jason Aziz, Jeff Wilder, Rex Waite, Wayne Searles** and **Greg Lord.** Without their commitment we could not have completed field plot work which was part of the Forest Health Monitoring (FHM), North American Sugar Maple (NAMP), and White Pine Blister Rust (WPBR) Projects. A federally funded biology aide position was ably filled by **Charlene Donahue** whose expertise was essential in processing much of our information and in organizing various laboratory computer and filing systems throughout the summer months. **Doug Stark** is back with us under a part time contract and was able to summarize for us information on many of the forest diseases of the state. Thanks too go to many other administrative and field staff in the Maine Department of Conservation who facilitate much of our work. And last but certainly not least we thank other department personnel and cooperators in the USDA-Forest Health Protection, USDA-APHIS, Maine Department of Agriculture, University of Maine at Orono, University of Vermont and cooperators in other New England States and Maritime Provinces of Canada. Without their generous help our efforts would have fallen far short of our goals. This is our team.

FOREST & SHADE TREE INSECT & DISEASE CONDITIONS FOR MAINE
A SUMMARY OF THE 1992 SITUATION

Introduction

Another season has come and gone, and in retrospect all went fairly well. While staffing levels have remained stable since the layoffs in 1991, state budgetary woes have continued to impact our operations, constraining activities and precluding the replacement of aging equipment. Nontheless, by developing appropriate project proposals and aggressively pursuing US Forest Service cooperative grants, we have been able to address the most pressing needs of Maine's forest resources while maintaining our forest health and pest monitoring capability. The specific cooperative MFS/USFS projects underway and their status are cataloged in the next section.

Regarding the future: As this Summary Report is being prepared the Administration and Legislature are investigating various possible changes in government structure with an eye toward cost savings and improved efficiencies. This process has just started, with no endpoint well defined. It is the position of the Maine Forest Service that any resulting changes in structure must leave an organization able to address the needs of Maine's forest and shade tree resource and its owners and managers. This is the backdrop against which we are developing 1993 I&DM division workplans.

Although we continue to be heavily dependent on cooperative federal projects to support our legislative mandates, we anticipate maintaining most I&DM activities at some level. We appreciate the strong support that you, our clientele, have shown for the Forest & Shade Tree Insect & Disease Condition Reports. These reports are the primary vehicle for relaying general information from us to you; it is critical that they be useful. We sincerely hope that you will read them, use them, and keep in touch with us regarding information or suggested improvements so that they will continue to meet your needs. We look forward to a close association with you again in 1993.

Change of State Forester

In October, State Forester John Cashwell resigned from state service to accept a position as president of Seven Islands Land Company. This action transferred a strong proponent of I&DM programs from government to the private sector. We wish John well in his new role.

Although John's management style and personal energy are inimitable, with the appointment of Susan Bell to the position of State Forester, the MFS and the I&DM Division continue to enjoy the benefits of strong, effective leadership. Sue was born and raised in northern Maine, and before joining state government worked in Oxford County. She is no stranger to the issues associated with Maine's forests. She served in the Legislature for three terms before becoming Deputy Commissioner of the Department of Conservation in 1987. Sue comes to her new job bringing considerable insight and expertise, and a personal appreciation for the importance of Maine's forest resource to the economy and quality of life of the state. Welcome aboard!

Highlights of Division Activities for 1992

Our regular staff spent a considerable amount of time during the field season on their respective projects and were generally able to visit representative forest stands throughout the State. Much of their work was made possible because of the efforts of federally funded short season project staff (see acknowledgments) who covered the responsibility for a number of our intensive plot surveys. A biology aide, Charlene Donahue, assisted at the Insect and Disease (I&D) lab. This was the first time in a number of years that we were able to have someone in this capacity and Charlene helped us bring a sense of order to a number of our neglected data processing problems as well as filing and collection efforts.

The personnel listing (see inside front cover), along with a map of field and lab operations, staff offices and districts (see inside back cover) outlines various functional responsibilities. While the browntail moth, gypsy moth, hemlock looper and white pine blister rust programs involved some coordination of field surveys and control assessment, most control efforts were privately funded and very local. The forest health monitoring effort continued to "forge ahead" and was supplemented with methods for collecting additional insect and disease data. This coordination is expected to undergo refinement as more specific needs are defined.

Cooperative MFS/USFS Projects

(More specific information is available on each of these cooperative projects).

North American Maple Project (NAMP)

The North American Maple Project was initiated in 1988 as a joint project between various states and provinces, as well as the United States and Canadian federal governments, to monitor and evaluate the condition of sugar maple stands in eastern North America. The United States Forest Service provided funding to the I&DM Division which subsidized establishing and annually monitoring nine pairs of sugarbush and wild stand plots in western Maine.

Although NAMP was designed to assess broad regional trends, the results have implications for Maine's local situation:

The vast majority of Maine's (and the region's) sugar maples, in both wild stands and sugarbushes, appear healthy;

Standard tapping practices show no significant adverse effect on the health of the trees;

Reports of a general sugar maple decline driven by airborne pollution are unfounded.

The project was reviewed and evaluated this past year by an international panel. As a result of this review, the project has been proposed for continuation for another ten years.

National Forest Health Monitoring Program (NFHM)

The prototype New England Forest Health Monitoring System, which was initiated in 1990 in response to concerns voiced by individual states, developed and continues to expand as a national cooperative monitoring program. Presently fourteen states are operationally monitoring the health of their forests using standardized methods developed under the NFHM program. Other states are asking to be considered for inclusion and are ready to go "on line" as soon as additional USFS funds become available to expand the effort.

In addition to subsidizing the collection of local information related to forest health, the NFHM program provides a mechanism for aggregating, analyzing, and reporting comparable regional data. The NFHM program has allowed MFS to access regional geobased information and take advantage of the total 250-plot New England forest response data set. In these tight budgetary times, the ability to share data to augment locally collected information is crucial to meeting resource needs.

The MFS has been very involved with developing the NFHM program from its inception. We continue to support the concept of an integrated cooperative monitoring program which provides longterm baseline information and a seamless communications network. I&DM staff are working to improve NFHM capabilities and to insure that products meet local needs. Much of the information in this Summary Report regarding forest and pest conditions was generated wholly or in part by this program.

Competitive Focus Funding Grants

The current outbreak of hemlock looper in New England and Atlantic Canada has generated questions regarding certain aspects of the infestation and its possible impacts. These regional questions stimulated financial support from the United States Forest Service for several studies and activities that the I&DM Division proposed to conduct. Much of our ability to provide information on the overall hemlock looper situation is the result of the following projects:

Hemlock Looper Population Prediction Model Development
MFS Hemlock Looper Egg Processing Lab Upgrade
Hemlock Looper Impact Study (joint project with NH, MA, VT)
Hemlock Looper Morphological/Behavioral Study (joint project with VT)

The scope of most of our activities is reflected in this report and we again hope that this speaks well for our accomplishments.

Publications

The I&DM Division continues to maintain and upgrade a file of published reports, bulletins, brochures and information leaflets 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 - limited copies available); 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. We also maintain an up-to-date supply of USDA-Forest Serv. Pest Alerts (Northeastern area). One new alert on the Common Pine Shoot Beetle was added in 1992.

Throughout the year I&DM staff frequently contribute to items for the news media and various association newsletters. Articles which were written during the 1992 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 or completed over the past year by I&DM staff:

*Dimond, J.B. and R.L. Bradbury. 1992 (March). New Approaches to Chemical Control of White Pine Weevil Damage. Me. Agr. Expt. Sta. Bull. 837. 13 pp.

Insect & Disease Management Division. 1992 (February). Forest & Shade Tree-Insect & Disease Conditions for Maine - A Summary of the 1991 Situation. Me. Dept. of Conserv., Me. For. Serv., I&DM Division. Summary Rpt. No. 6. 61 pp. Compiled and edited by R.G. Dearborn and C.A. Granger.

------- 1992. Forest & Shade Tree-Insect & Disease Conditions for Maine. 8 issues from April 15 through November 10. Compiled and edited by R.G. Dearborn and C.A. Granger.

*Osgood, E.A., R.L. Bradbury and F.A. Drummond. 1992 (August). The Balsam Gall Midge-An Economic Pest of Balsam Fir Christmas Trees. Me. Agr. Expt. Sta. Tech. Bull. 151. 30 pp.

Trial, H., Jr. and Joan G. Trial. 1992 (July). A Method to Predict Defoliation of Eastern Hemlock [Tsuga canadensis (L.) Carr.] by Eastern Hemlock Looper [Lambdina fiscellaria (Gn.)] Using Egg Sampling. Me. Dept. of Conserv., Me. For. Serv., I&DM Division. Tech. Rpt. No. 31. 12 pp.

Other publications which include MFS/I&DM input, and which apply to our situation include:

Brooks, R.T., et al. 1992 (October). Forest Health Monitoring in New England: 1990 Annual Report. USDA-FS-NEFES. Resource Bull. NE-125. 59 pp. and 53 Tables.

Burkman, W., et al. 1992. Northeastern Area Forest Health Report. USDA-FS-NA-TP-03-93. 57 pp. (Includes information through 1991).

Eagar, C., et al. 1992 (November). Summary Report-Forest Health Monitoring in the Northeast 1991. USDA-FS-NEFES. NE/NA-INF-115-92. 13 pp.

Millers, I., D.C. Allen, and D. Lachance. 1992 (January). Sugar Maple Crown Conditions Improve Between 1988 and 1990. USDA-FS-NA-S&PF. A foldout brochure.

Solomon, D.S. and T.B. Brann. 1992 (October). Ten-Year Impact of Spruce Budworm on Spruce-Fir Forests of Maine. USDA-FS-NEFES. General Technical Report. NE-165. 44 pp.

*Available from: Univ. of Me., Me. Agr. Experiment Station, Winslow Hall, Orono, Me. 04469-0163.

1992
Pest Summary

As concern over the health and productivity of our forest resources grows, the importance of the role of the Insect and Disease Management (I&DM) Division becomes more evident. Monitoring forest health has always been a role of I&DM but is becoming more refined as the results become more critical and our efforts become more integrated with those of other jurisdictions. In addition to monitoring a variety of local forest insects, diseases and conditions, I&DM personnel are developing a regional forest health monitoring network to draw upon. This network improves our information gathering, and your options. While direct control of a pest species may be a recommended option in some cases, in others a better understanding of the problem may offer several options tailored to anticipated impacts. It is the intent of this summary to present our findings for the 1992 field season and to encourage you, our constituents, to draw what you need from them.

As usual we dealt with a wide variety of pest problems in 1992. While each of them had significance locally some had a broader impact. For your convenience we have categorized the more important ones (Table 1).

Important Pest Problems of 1992

Those of special significance

Aspen Leafroller/tiers
Balsam Twig Aphid
Birch Skeletonizer
Browntail Moth
European Larch Canker
Gypsy Moth
Hemlock Looper
Large Aspen Tortrix
Satin Moth
Weather Related Injuries
Yellowhead Spruce Sawfly

Perennial Problems

Ash Dieback
Beech Bark Disease
Birch Leafminer
Caliciopsis Canker
Dutch Elm Disease
Eastern Dwarf Mistletoe
Fall Webworm
Larch Bark Beetle
Porcupine Damage
Sirococcus Shoot Blight
Spruce Budmoth
Stillwell's Syndrome
White Pine Blister Rust
White Pine Weevil

Problems to Watch (other than those already listed)

Annosus Root Rot
Bruce Spanworm
Bud Abortion of Balsam Fir
Fall Cankerworm
Forest Tent Caterpillar
Larch Sawfly
Oak Leaftier/Skeletonizer
Spruce Budworm

Table 1

Quarantines changed little in 1992 except for a proposal for a slight increase in the European larch canker quarantine boundary in eastern Maine. The pinewood nematode which is present statewide is monitored as needed. The hemlock woolly adelgid has not yet been found in Maine. Maine has no quarantine for the common pine shoot beetle at this time.

In the following sections, preceding the body of the pest summary, we will discuss several items of a general nature rather than try and weave them into the main report. The headings should be self explanatory. We have made a change in the format of the main report, however, so **all readers should read the Useful Suggestions section** which follows.

Light Trap Survey

The fiftieth annual insect light trap survey was conducted during 1992 at twenty three locations (Figure 1). Traps were situated throughout the State in stands representing both hardwood and softwood types. These were operated during the peak period of activity for adults of the various pests of the primary tree species in their respective areas. Only lepidopterous pests have been monitored regularly by this system so far. Roughly twenty pests are monitored on a fairly consistent basis and of these, eleven are compared annually. The results of seasonal catches are used to supplement data from other surveys such as those for larvae, damage or to compare to pheromone catches. These trap catches are also monitored for new and unusual species, especially in southwestern Maine at South Berwick where an oak-hickory forest type is present (one of the few such areas in Maine). A summary of the results of this survey for 1992 has been interwoven into the regular report under the specific pests involved.

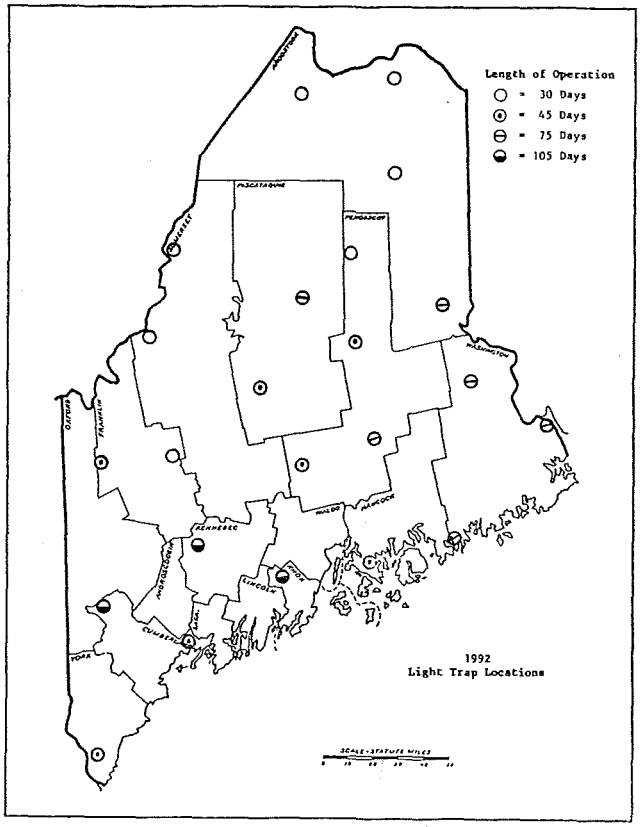


Figure 1

Biophysical Regions

A series of 15 **Biophysical Regions** was developed for Maine in 1990 by Janet S. McMahon under a grant with the Maine State Planning Office. These regions were developed using computer overlays of four sets of criteria: physiography, climate, surficial geology and soils, and vegetation and flora. Figure 2 should give you a rough idea of how these regions are arranged. An endeavor was made in 1992 to use this system in reporting pest conditions. Although we were only able to integrate pest occurrence within this system on a few occasions it was still felt that such a use is possible. We will be using this system again in 1993 so would appreciate your comments. A narrative definition of the regional criteria is available upon request.

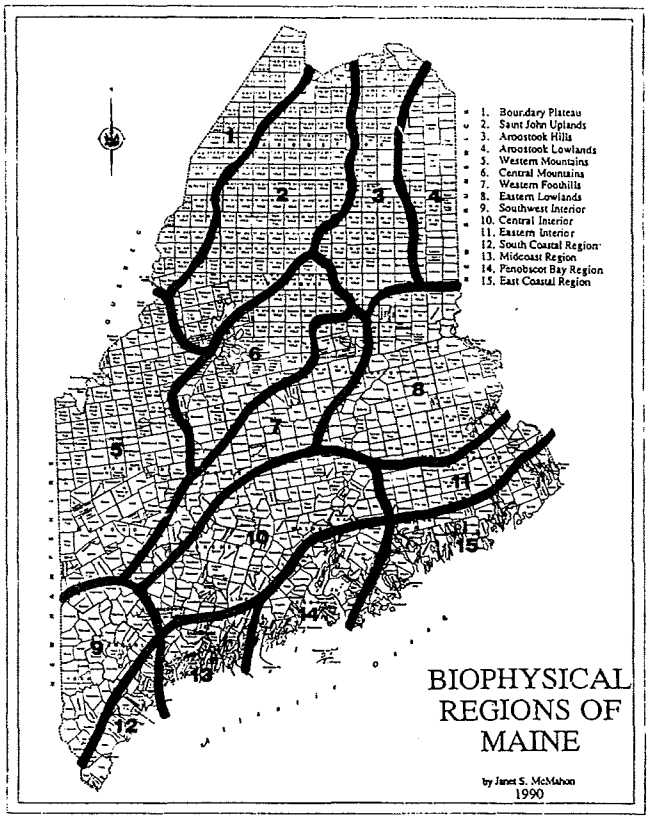


Figure 2

Weather and Phenology

The 1992 season started out on a rather "drab note" in many areas due to plenty of bare ground and few spring flowers but by late June things looked normal. Spring bulb crops were nearly decimated in southern Maine in 1992 due to the cold open winter. Bulb sales were up strikingly as most plantings had to be replenished. These were some of the heaviest bulb losses seen in years. Surprisingly, spring flowering shrubs such as forsythia and daphne did fairly well. Frost heaving was fairly evident in some plantations and with ornamentals as the spring frosts left. With little snow cover to back up low spring rainfall, some areas experienced near drought-like conditions until the weather turned cool and rainy in mid June. A late snow did blanket much of eastern Maine briefly on May 7. Cold snaps down into the low twenties occurred in many areas on May 19-20 and 26-28. Spotty damage occurred statewide especially in cold pockets. Oak and balsam fir seemed most commonly affected. The summer was generally cooler and wetter than normal after early June and winter began to appear in the form of freezing rain and sleet in early November. The effect of the odd season has not been determined in most cases except in the case of potatoes which grew too much and too fast resulting in hollow core and cracking problems. Tree foliage seemed to change to "muted" fall colors earlier in August in 1992 but fall coloration showed up on schedule and was said by some to be the most vivid in years.

Also noted during the 1992 season were further effects of 1991 hail storms and Hurricane "Bob." In the case of Hurricane "Bob," clean up of downed trees was still underway throughout the season. Aspen appeared to be hardest hit in most areas. Hail damage incurred during one or more severe

storms in 1991 in northern Maine was manifested strikingly especially on balsam fir in 1992.

What's "New" and Unusual

Although we experienced defoliation by some pests which we haven't seen in some time such as balsam fir and yellow headed spruce sawflies, few things of a truly "new" nature were reported to us in 1992. A few items of interest are listed in Section C especially under Medical Entomology and Miscellaneous problems.

Useful Suggestions

This report is again rather lengthy and many readers may only want to read selections of particular interest to them. We have set up the format in a different style this year in hopes of making it easier to target particular items. Read carefully the following suggestions which should assist you in your search.

1. Insects (and other arthropods) and diseases (including abiotic problems) have been organized separately this year. The Table of Contents and Table 1 highlight problems of special significance.

2. **Insect problems** are broken down into three categories. Unlike previous years, **all softwood insect pests** including those in plantation and ornamental situations, are grouped in one section (A). **Most hardwood pests** are discussed in Section B. **Pests of ornamentals and shrubs** are listed in Section C.

3. **Tree diseases** are listed together this year alphabetically in a separate section beginning on page 35.

We hope that you will find our changes helpful and not confusing. It seemed to be easier and more efficient to us to organize the material in this fashion. Any comments or suggestions are welcome.

INSECT PROBLEMS ASSOCIATED WITH TREES IN 1992

(A) Insect Pests of Softwoods (including plantations, nurseries and Christmas trees)

Aphids - Aphids were present on many conifers as they usually are but damage from most infestations was insignificant. The balsam twig aphid (see below) was one exception. Adelgids such as the pine leaf and red spruce adelgid are very similar to aphids and often confused with them. They are discussed elsewhere in this section. The more visible, typical, black Cinara aphids were common and widespread again but did not seem generally as abundant in 1992. As a result, there was less honeydew to draw ants and yellow jackets and less sooty mold in most cases. The pine bark aphid continues to be very spotty with only light populations and no damage reported in 1992. Reports of root aphids on balsam fir and spruce seedlings, especially in nursery settings, continue to "crop-up" occasionally as they did in 1992. In most cases control procedures were not recommended.

Arborvitae Leafminer (a complex of 4 species) - Populations remained generally low but variable again in 1992. As in the past some "hot spots" were reported and treatment of ornamentals was sometimes necessary. Although many stands defoliated in previous seasons continued to show recovery, some mortality continues to show up especially in conjunction with other undefined complicating factors. Hemlock looper defoliation occurred in some stressed stands in eastern Washington County posing further complications.

Twenty sites scattered throughout the resource (Figure 3) are surveyed for this pest each winter. The results are annually compared with the previous season to determine trends. The results for 1992 are summarized in Table 2.

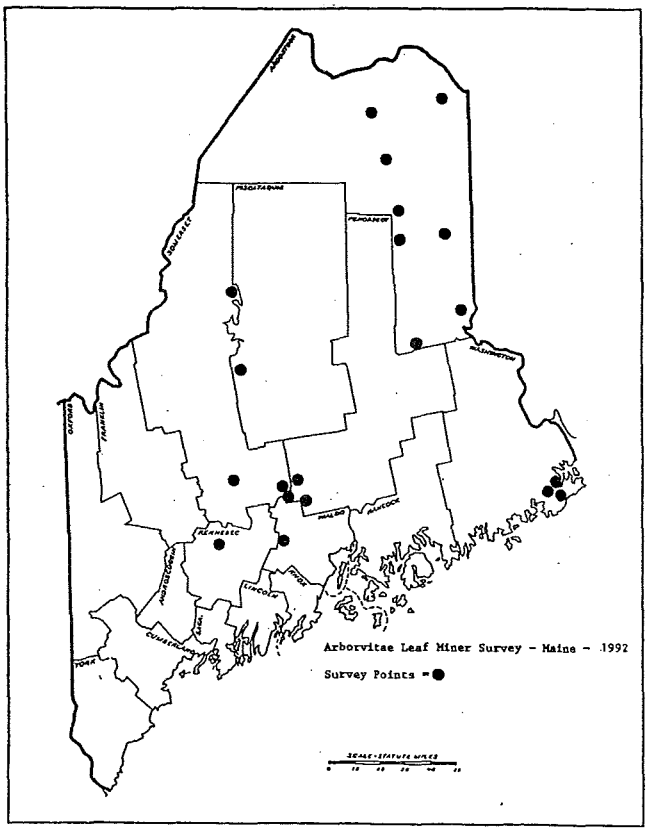


Figure 3

Balsam Fir Pests - All balsam fir insect pests encountered in 1992 are presented in this section and the Special Report Section on Hemlock Looper. **Balsam Sawfly, twig aphid** and **hemlock looper** were the more notable insect problems in 1992. Spruce budworm continues to remain rather scarce in Maine!

1992 Arborvitae Leaf Miner Summary

Location	# of Live Larvae Per 3" Twig-1992	# of Live Larvae Per 3" Twig-1991	Increase Decrease
Palmyra	1.03	0.48	+0.55
Belgrade	0.30	1.06	-0.76
Plymouth/Dixmont	1.03	1.00	+0.03
Cornville	0.66	1.27	-0.61
Newport	0.30	0.20	+0.10
Freedom	0.39	0.48	-0.09
Detroit	3.83	2.18	+1.65
Whiting	0.36	1.07	-0.71
Trescott	1.08	1.65	-0.57
Edmunds	0.41	1.08	-0.67
Ludlow	0.13	1.05	-0.92
Moro	0.75	0.60	+0.15
Nashville	0.27	0.28	-0.01
Connor	0.23	0.37	-0.14
T9-R5	0.06	0.22	-0.16
Winterville	0.40	0.42	-0.02
Orient	0.42	0.61	-0.19
Macwahoc	0.11	0.40	-0.29
Little Squaw	0.12	0.44	-0.32
Seboomook	0.17	0.13	+0.04

Table 2

Balsam Fir Sawfly (Neodiprion abietis) - This species is a natural component of the spruce-fir forest community but has seldom caused noticeable defoliation in Maine. During the 1992 season, larvae of the balsam fir sawfly caused heavy defoliation in scattered pockets over roughly 25,000 acres in the towns of Jonesport, Machiasport and Addison (Washington County). The presence of this species was not noticed at first because of the difficulty in separating the damage from that of hemlock looper which was also common in the area. Sawfly larvae feed almost entirely on old growth and are very messy in their habits leaving many dead reddish needle fragments. Sawfly infested trees generally have relatively green and healthy new growth and are not covered with the silk webbing characteristic of hemlock looper infestations. The contrast of green new growth and red prior season growth is striking even at a distance.

This was the first noticeable defoliation by this native species since the late 1940's when populations were high on balsam fir along the coast from Portland to Rockland.

Balsam Gall Midge (Paradiplosis tumifex) - Populations of this species were spotty and generally low in 1992. Although they continued a slight decline for the second year, some Christmas tree growers found it necessary to treat their plantations.

Balsam Shootboring Sawfly (Pleroneura brunneicornis) - The shootboring sawfly continues to be a perplexing problem for some Christmas tree growers especially along the coast in Cumberland, Sagadahoc, Lincoln, Knox and Waldo Counties. Damage is similar to that of late frost and growers find both problems difficult to avoid or control. This sawfly is a natural component of the forest and often creates more of a problem for growers who work with Christmas trees in pocket openings with wild fir nearby.

Balsam Twig Aphid (Mindarus abietinus) - Populations of this pest continued to increase noticeably in 1992 and damage was locally heavy (greater than 75% of current shoots distorted). The greatest concern was expressed by collectors of wreath brush ("Tippers") especially in Washington and Hancock Counties. Most Christmas tree plantations were treated in anticipation of a problem but results were variable. Treatment of wild lands to protect wreath brush is generally not practical and heavy twig aphid populations caused noticeable damage in many areas. Although concern was expressed over foliage quality (i.e. needle retention) and acceptability, consumers did not usually reject wreaths with a small amount of damaged foliage and needle retention seemed to be relatively unaffected. Losses were still fairly significant to tippers who were unable to find foliage considered suitable to wreath makers.

Populations of the balsam twig aphid have been increasing since 1989 and although they still appear to be high going into the winter months, they are expected to collapse soon. Surveys by I&DM staff in late winter are expected to show whether or not a problem may be likely again in 1993. Most growers, however, should expect at least some damage.

Balsam Woolly Adelgid (Adelges piceae) - The gout phase of this pest continues to predominate in most areas, especially coastal eastern Maine. The incidence of the woolly trunk phase seems to have continued to decline to barely detectable levels although scattered new areas of very light activity were observed in 1992.

Cedar (Arborvitae) Woodborers - Pockets of dead arborvitae were checked in several areas of central Maine in 1992 to try and determine the cause of the problem. No consistent cause was observed. Arborvitae had undergone stress in most of these stands in recent years from drought, leafminer and heavy winter browning but none of these in and of themselves seemed to be the primary "culprit" (except possibly drought). Also evident in most stands checked was a higher than usual incidence of what has been termed "pencil rot" and various woodborers. The **woodborers** (Atimia confusa and Semanotus ligneus), although obvious, are not responsible for death of the trees but will cause damage to the wood and rustic products made from it. **Northern cedar bark beetle** (Phloeosinus canadensis) adults were found in some trees but these too were considered secondary.

Common Pine Shoot Beetle (Tomicus piniperda) - This European species was in the trade news during much of 1992 because of its potential for damage to some pines. Although the threat of damage (branch tip mortality) appears to be most serious to Scotch pine, especially in Christmas tree plantations, damage could occur to other pines as well. Damage is apparently heavy in Europe.

Although the common pine shoot beetle has not yet been found in Maine, we encourage anyone who notices bark beetles associated with "flagging" damage to Scotch pine to report this to us and provide a sample. With the mobility of planting stock which exists today infestations can move around fairly quickly. Care should be taken not to bring infested stock in to Maine from states to the south and west of us. Quarantines which are proposed for infested areas could be imposed upon Maine growers should we develop a population here.

Conifer Sawflies (various) - Defoliation of conifers by sawfly larvae appeared to increase in 1992. The balsam fir sawfly and balsam shootboring sawfly as well as the jack pine, larch and yellow-headed spruce sawflies all caused noticeable defoliation during the season.

Conifer Swift Moth (Korscheltellus gracilus) - Moths of this species emerged from the "duff" in spruce-fir stands in Hancock and Washington Counties in August of 1992. Although few people ever notice this species, the prettily marked small to medium sized, "chunky" moths were evident at least briefly and were obvious to some because of odd flight habits. Larvae take two years to develop and purportedly feed on roots of red spruce (with which they appear to be closely associated in Maine) and other plants and moss.

Cooley Spruce Gall Adelgid (Adelges cooleyi) - In Maine this species alternates between galls on Colorado blue spruce and a free feeding woolly form on Douglas-fir. Although ornamental blue spruce are occasionally heavily galled by this species, feeding discoloration on Douglas-fir can be so heavy as to render them aesthetically worthless for Christmas trees or ornamentals. Populations vary little from year to year in Maine and seem to be chronic in some plantations or on some ornamentals. Growers who wish to raise Douglas-fir should be aware of this problem.

Eastern Larch (Bark) Beetle (Dendroctonus simplex) - Pockets of dead and dying larch are often striking and new reports of such occurrences continue to be received. However surveys conducted in 1992 indicate that the overall statewide incidence has stabilized with annual mortality currently estimated at less than five percent. This species in association with Armillaria root rot has often caused what has been sometimes referred to as larch decline in Maine. This problem appears to be stress related such as that produced by weather and/or various larch defoliators.

European Pine Shoot Moth (Rhyacionia buoliana) - This species continues to be a problem on red pine in Maine primarily in Sagadahoc and Lincoln Counties.

Fir Coneworm (Dioryctria abietivorella) - Tip mining activity by this species was not generally noticeable in 1992 and few reports of damage were received. Some damage to black spruce in plantations across central Maine also continues to come to our attention. This species continues to be a problem in cones collected for seed, however, and in at least one case high populations in some cone collections caused concern at one nursery which was endeavoring to collect viable seed.

Grasshoppers (species not determined) - Although grasshoppers were common again in many Christmas tree plantations in 1992, no damage was reported. Balsam fir plantations in converted fields appeared to be most often bothered by grasshopper feeding.

Gypsy Moth (Lymantria dispar) - Surprisingly little damage to softwood in plantations was reported in 1992. However, defoliation of eastern white pine in infested areas of southern Maine often ranged from moderate to severe. See Special Reports Section.

Hemlock Loopers (Lambdina athasaria and L. fiscellaria) - Although both of these species occur in Maine, it is L. fiscellaria, often referred to as the fall hemlock looper because of the time of adult activity, which causes most of our defoliation. During the 1992 season L. fiscellaria caused roughly 68,000 acres of heavy to severe defoliation as compared to 225,000 acres in 1991. Most of this defoliation was in eastern Maine. These figures might be somewhat misleading due to difficulties in interpreting aerial mapping data. See the special reports section for a more extensive discussion of this problem.

An effort to contrast larvae of L. fiscellaria and L. athasaria was conducted by John Grehan of the University of Vermont. This cooperative project between the University of Vermont, MFS (I&DM Division) and the Vermont Dept. of Forests, Parks and Recreation was supported by the USDA, Forest Service, Forest Health Protection. Larvae of these two species are very similar in appearance and habits and as a result of this study it appears that they show no consistent taxonomic differences in the late larval instars. A publication on this work should be available some time in 1993. More work contrasting the biology and taxonomy of these two species is needed to better determine methods of population prediction.

Light traps were used to monitor populations of both L. athasaria and L. fiscellaria in 1992. The result of catches from eleven traps used to monitor L. fiscellaria can be found in the special reports section (pg. 63). Four traps were operated from May 18 to June 22 for moths of L. athasaria. A total of 84 moths were caught (No. Bridgton-81, Mt. Vernon-2, So. Berwick-1, Washington-0).

Hemlock Problems (various) - Hemlock continues to experience stress from a number of problems although many stands did seem to improve in appearance in 1992. **Hemlock needle miners** were again locally noticeable although damage did seem down overall in 1992. Secondary problems such as the **hemlock borer** (Melanophila fulvoguttata) and **shoestring root rot** (caused by Armillaria sp.) were also noticeable in 1992 but the incidence of these problems seemed to decline slightly as well.

Hemlock Woolly Adelgid (Adelges tsugae) - There is still no evidence of any infestation of this species in Maine. In order to detect and prevent any possible introduction of the adelgid into Maine, the Maine Forest Service and the Maine Department of Agriculture continue to maintain and monitor a joint quarantine on importation of hemlock products from infested areas (see Quarantines pg. 50). During 1992 forest stands were again monitored for this pest in conjunction with hemlock looper surveys (Figure 4). Nursery stock and ornamentals were also monitored by staff of the Maine Department of Agriculture in conjunction with their regular inspection programs.

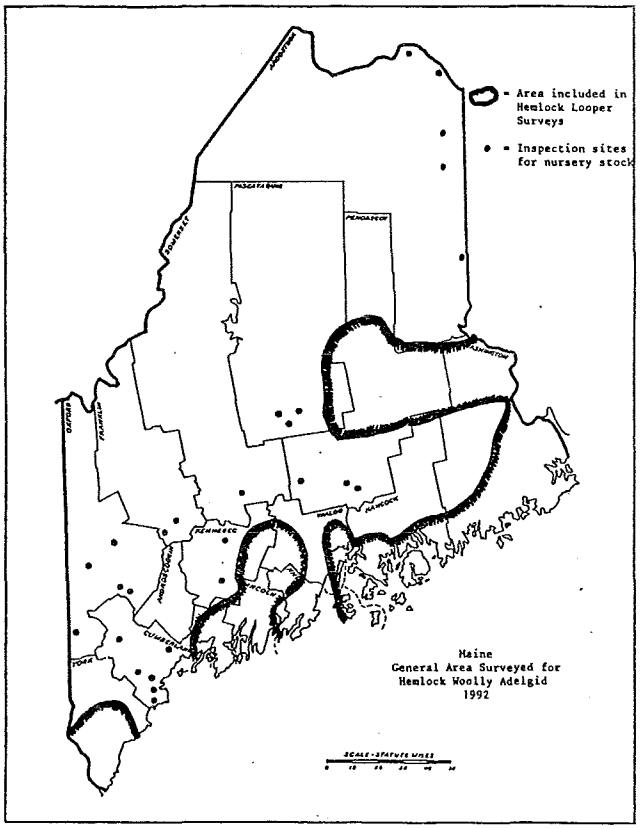


Figure 4

This pest could easily be transported into Maine and it is

important to take steps to prevent its introduction. Hemlock nursery stock should not be brought to Maine from infested areas. Ornamental plantings in Maine which include hemlock should be checked to see if the adelgid is present. Any woolly insects on twigs or foliage should be suspect. Suspected infestations should be reported immediately to either the State Horticulturist (Me. Dept. of Agr., State House Station #28, Phone 287-3891) or MFS, I&DM. Cooperation is needed to protect our hemlock resource from problems which could cause any further stress.

Jack Pine Sawfly (Neodiprion pratti banksianae) - Populations of this species appeared to be down somewhat in 1992 from 1991 levels in both area and intensity. Defoliation of mature jack pine in coastal areas of Hancock and Washington Counties from Steuben to Mt. Desert was more localized and ranged from light to moderate. Most of the infested trees are on rocky, poor growing sites and are therefore stunted (roughly 25 ± feet tall). These trees also frequently had other problems as well such as the **northern pitch twig moth** and one of the gall rusts.

Larch Casebearer (Coleophora laricella) - Stands of larch "scorched" by the feeding of this species were again very obvious throughout much of the southern half of Maine in late May and June of 1992. Damage appeared to have stabilized at roughly 1991 levels. This is the fifth consecutive year in the present outbreak. Damage varied greatly often ranging from light (<25% of the needles affected) to heavy (>75%) within the same stand. This species is often thought to be a serious stress causing factor on larch especially after two or more years of heavy defoliation.

Larch Sawfly (Pristiphora erichsonii) - The incidence of this species appeared to rise noticeably in 1992 from 1991 levels as many more reports of larval activity were observed. Although the incidence of reports was up, populations and defoliation were generally very local and very light (Figure 5). This is one to watch in 1993.

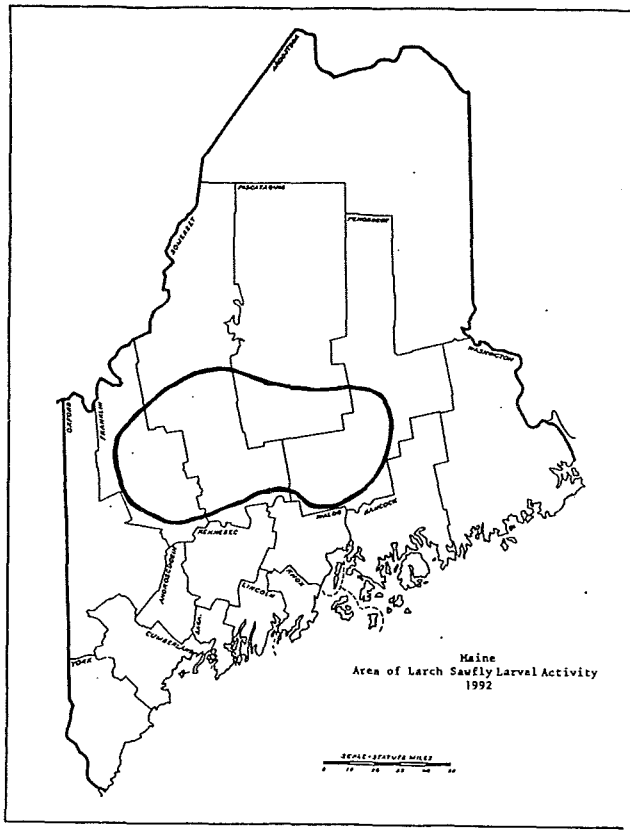


Figure 5

Mites (especially the spruce spider mite Oligonychus ununguis) - Mites continue to be a perennial problem in Christmas tree plantations although growers can manage populations with diligence. Mites also cause noticeable mottling or yellowing of foliage in woodland or forest plantation situations but control does not appear to be critical in these cases. One of the biggest difficulties in the control of mites appears to be the "on and

off again" availability of suitable acaricides. Determination of proper control threshholds can also be a problem.

Nesting (or Webspinning) Pine Sawflies (Pamphiliidae) - Over the years we have annually received scattered reports of various incidents of sawfly larval "nests" especially on red pine. These have seldom been a serious problem although in several cases involving shade trees and ornamentals, concern was expressed. Where nests are few and trees short, the easiest control is removal and destruction of nests and larvae. In 1992, however, we had two reports of moderate numbers of "nests" on plantation trees in central and eastern Maine. The larvae could not be identified. No further action was required.

Northeastern (Pine) Sawyer (Monochamus notatus) - No reports of unusual or excessive activity by this species was reported to us in 1992.

Northern Pitch Twig Moth (Petrova = Retinia albicapitana) - "Gobs" of pitch containing larvae or pupae of this species are still very common and unsightly on twigs and branches of jack pine especially in Hancock and Washington Counties. Most of these pitch masses are at the base of small branches or around buds. Damage by this insect is usually limited to minor twig and branch mortality and the unsightly pitch masses. This species has a two year life cycle.

Pales Weevil (Hylobius pales) - No reports of damage from pales weevil were received in 1992.

Pine Fascicle Mite (Trisetacus alborum) - Populations of this species were very low in 1992 and damage was barely detectable.

Pine Gall Weevil (Podapion gallicola) - This insect continues to show up wherever red pine is found but is seldom more than a nuisance. Occasionally, however, branches of some trees may be galled sufficiently to cause heavy flagging (caused by dead branch tips). This damage, when light, can be confused with that of the **red pine cone beetle** (Conophthorus resinosae). Look for galls.

Pine Leaf Adelgid (Pineus pinifoliae) - Damage to eastern white pine by this species did not seem to be serious or widespread in 1992. The smooth, cone-like galls of pine leaf aphid generally form on red and black spruce in odd years and 1993 should be the season for gall formation. Where white pine grows in with the alternate red or black spruce hosts, flagging damage to pine can sometimes be striking. Similar damage can be caused by other adelgids such as the red spruce adelgid (see below).

Pine Needleminer (Exoteleia pinifoliella) - This species appears to be primarily a pest of jack and pitch pine in Maine. Although populations have been known to brown up large areas of pitch pine in southern Maine at times, it is generally more of an aesthetic problem. Occasionally plantation jack pines become heavily infested as they did in 1992 over 150 acres in T3 R1 NBPP. Other areas across the State appeared to exhibit low populations this past year.

Pine Spittlebug (Aphrophora parallela) - Spittle masses containing the nymphs of this species were again very visible locally on a variety of conifers in 1992. This seems to be a perennial problem with occasional local outbreaks. Control is usually not necessary.

Pine Tip Boring Bark Beetles - The incidence of tip borers on pines appeared to be low in 1992. As concern is developing over possible introduction of the **common pine shoot beetle**, we are interested in learning of tip boring beetle activity especially on plantation or ornamental Scotch or eastern white pines.

Red Spruce (Gall) Adelgid (Pineus floccus) - Terminal galls caused by this species on red and black spruce are normally present in Maine but generally very scattered and few in number. During the 1992 season, however, galls on red spruce in some stands were so abundant that nearly every tip was affected. Especially heavy populations were observed at Phippsburg (Sagadahoc County) and Wellington (Piscataquis County). The galls were opening in most stands in late July and in heavily infested areas, the tiny adelgids literally filled the air and covered nearby foliage. This species alternates between red and black spruce and eastern white pine as does the pine leaf adelgid but P. floccus forms rough galls which bear needle tips and are on spruce on either odd or even years.

Saratoga Spittlebug (Aphrophora saratogensis) - This insect continues to be a chronic problem on some sites but especially in frost pockets, and varies in intensity from year to year. Populations in 1992 seemed to be at roughly the same levels as they have been since 1988. Most infested areas are still in eastern Maine where pockets of mortality have been observed. Planting has been curtailed in many areas on the barrens of eastern Maine because of this pest. 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 1992.

Spruce Beetle (Dendroctonus rufipennis) - This problem seems to have stabilized and new areas of beetle attack have been low since 1989, the last big year. The only new attacks that occurred in 1991 and 1992 were in the mid-coastal area of the state, predominantly on islands. An estimated fifty acres were added in 1992 bringing the total area of heavily infested (>25% of spruce stems dead) stands to roughly 9,100 acres (Figure 6).

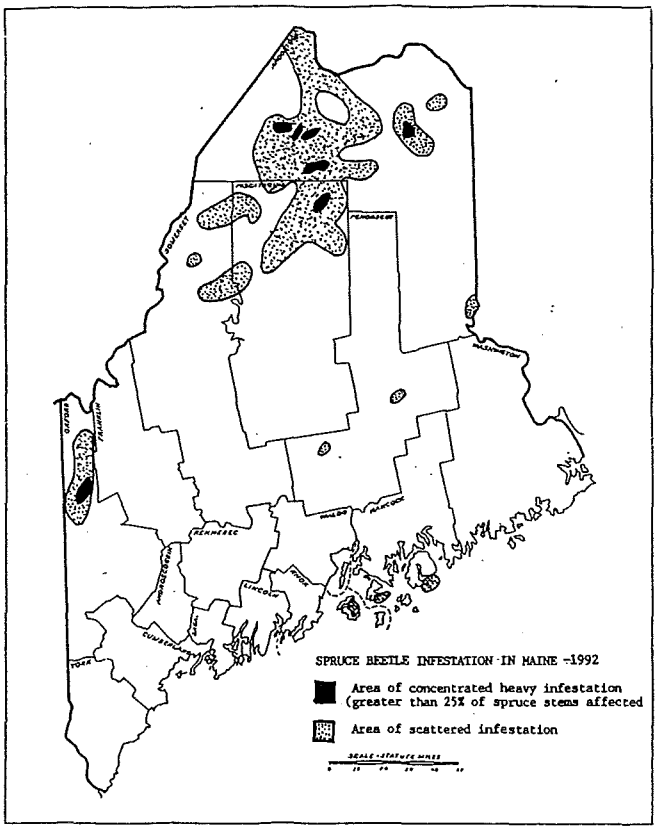


Figure 6

Spruce Budmoth (Zeiraphera canadensis) - Few plantations were surveyed specifically for this pest in 1992. However, we continue to receive new reports annually of problem areas. Most plantations which have become heavily infested remain so and no controls tried so far have shown much promise in reducing the problem. Although some growers have chosen to stay away from planting white spruce for this reason, others have expanded planting white spruce on some sites. All spruce have their share of problems so any management decision to change species should involve serious consideration of the potential to exchange one pest problem for another.

Spruce Budworm (Choristoneura fumiferana) - Spruce budworm populations remain very low in all of the spruce-fir type in Maine and no defoliation or significant larval populations were found in 1992. Our efforts to monitor for this pest have been dwarfed somewhat in recent years by those necessary to keep track of the hemlock looper, gypsy moth and spruce beetle. With the current rise in spruce budworm populations in Quebec and early evidence of possible resurgence in Maine a gradually stepped up effort is expected here over the next couple of years.

	Choristoneura fumiferana Year					
Location	87	88	89	90	91	92
Allagash	58	0	64	3	0	1
Ashland	0	0	0	0	0	0
Blue Hill	0	7	6	1	0	0
Brunswick	1	1	16	0	3	0
Calais	-	-	-	11	3	0
Chesuncook	-	-	-	0	1	0
Dennistown	0	0	0	0	0	0
Elliotsville	0	0	0	0	0	0
Exeter	-	-	9	10	4	5
Greenbush	9	19	10	0	1	0
Guerette	44	0	1	0	0	0
Haynesville	-	-	7	1	0	0
Kingfield	0	0	0	0	0	0
Matagamon	0	0	0	0	0	1
Millinocket	0	0	0	0	1	0
Mt. Vernon	0	0	0	1	0	0
No. Bridgton	0	0	0	0	0	1
Rangeley	-	-	7	1	0	2
So. Berwick	0	1	0	0	0	0
St. Aurelie	0	0	1	0	0	0
Steuben	-	-	548	73	8	0
Topsfield	7	1	15	0	0	0
Washington	0	0	26	2	0	6
Totals	464	209	737	107	21	16
Total Traps	17	17	21	23	23	23

Table 3

Surveys were conducted for the spruce budworm in 1992 using pheromone and light traps for moths and point sampling for larvae. A network of light traps were again operated over the state as they have been since 1943 (Figure 1). The total number of moths caught in these traps continued to slide in 1992 to sixteen, the lowest level yet (Table 3). Pheromone traps were placed in three-trap clusters at sixteen locations, twelve of these associated with light traps. Moth catches in the pheromone traps showed sharp increases in 1992 (Table 4). Twenty permanent locations scattered throughout the spruce-fir type were surveyed for larvae in June by collecting ten branch tips at each location. No larvae were found at these sites, however, casual observations of spruce and fir for other purposes (i.e. hemlock looper, FHM, etc.) did show increased incidence of larvae and pupae.

Spruce Budworm Pheromone Trap Catches
(Three trap average)
1992

Location	Moth Catch	Location	Moth Catch
*Calais	.67	Jonesboro	11
*Chesuncook (T3 R11 WELS)	5.67	*Matagamon (T6 R8 WELS)	18.33
*Dennistown	5.33	Oxbow	10
*Dickey Brook (T17 R5 WELS)	.67 (Guerette)	*Ste Aurelie (T6 R19 WELS)	2.33
Duck Lake (T4 ND)	.33	*Smith Pond (T3 Indian Purch.)	6 (Millinocket)
*Garfield	6.67 (Ashland)	*Steuben	32
*Greenbush	3.33	*Topsfield	1.33
*Haynesville	4.33	Waltham	25

* = Associated with a light trap location. If the light trap location is cited differently, the name used follows the catch in ( ).

Table 4

Although the spruce budworm is not expected to be a problem again in Maine in the near future, more surveys will be likely. More pheromone traps will be set out in 1993 to detect early moth activity. Should we experience similar elevated catches (>10 per 3 trap ave.) in 1993, L2 sampling may be reinstituted in late 1993 or early 1994.

White Grubs (?Phyllophaga sp.) - What appeared to be white grub injury to roots of balsam fir Christmas trees was observed in Windham this year. White grubs and adult May beetles were both unusually common at the site. Although white grubs have caused locally heavy damage to roots of conifers planted on old field sites in the past it has been many years since we have seen serious damage.

White Pine Weevil (Pissodes strobi) - The white pine weevil is one of those chronic problems in most areas of Maine and seriously limits growth of good straight white pine unless controlled. The number of requests for advice and assistance on this problem in 1992 was fairly normal. In addition, however, there were several requests for advice on how to deal with damage to Norway and black spruce. The white pine weevil prefers white pine and Norway and Colorado blue spruce in Maine. They will also

occasionally attack red pine and black spruce. They only rarely, however, attack white spruce in Maine and this characteristic is so consistent that it is often used to differentiate white spruce from Norway spruce in road scouting for plantations.

Yellowheaded Spruce Sawfly (Pikonema alaskensis) - One of the surprises of this season was the startling increase in destructive populations of the yellowheaded spruce sawfly. This species seems to be a perennial problem as a very local (1-5 trees) pest of ornamental Colorado blue spruce but has not been much of a problem elsewhere in Maine since the 1960's. This season, however, populations "blossomed" over a wide area of eastern, central and northern Maine and it was not uncommon to see white, Norway and Colorado blue spruce moderate to heavily defoliated by voracious larvae of this sawfly in June and July. Trees in all settings; forest, roadside, plantation and ornamental, were affected. Although more widespread than they have been for many years, few reports indicated a high level of intensity on other than a few trees at any one site reported. Populations appeared to be healthy and the potential is there for heavy defoliation again in 1993. This species can seriously defoliate forest stands and plantations as well as ornamentals. As usual, most areas checked also showed the presence of low numbers of the **greenheaded spruce sawfly** (Pikonema dimmockii). These two species usually occur together but it is the yellowheaded which is a problem.

(B) Insect Pests of Hardwoods

Aphids, Leafhoppers, Treehoppers and Scales (various) - Each season we encounter various plant sucking insects in the course of our activities. Most of these have been very local and seldom more than a nuisance, or at least so we've thought in the past. Of this group **aphids** appear to be the most common and diverse on trees. Although one or more species of aphids occur on nearly all trees it seems as though poplar and birch aphids are most often brought to our attention. This was true in 1992, and calls were "fielded" on both foliage feeding stages and winged "migrants." **Treehoppers** and the larger **scales** which are usually more common on oaks in Maine did not seem to be as much of a problem in 1992. **"Sooty mold"** which is a byproduct of feeding by these insects, was also not as commonly observed on hardwoods in 1992. A "new" observation in 1992 was the presence of large numbers of **leafhoppers** (? Erythroneura spp.?) associated with sugar maple stands. At this point no positive identification is available and the significance of these leafhoppers is not known. They were common in sticky traps deployed for **pear thrips** in Mount Vernon and Fort Kent.

See also **beech scale.**

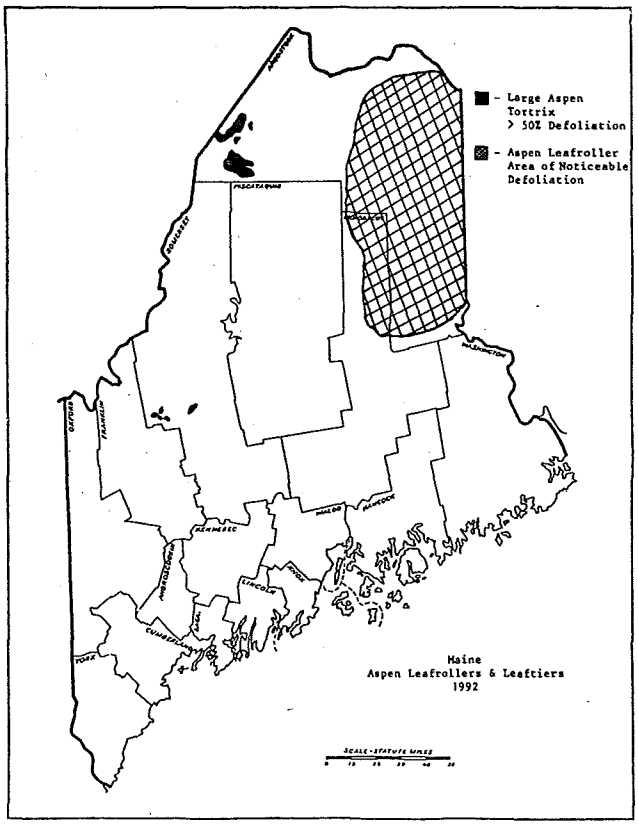


Figure 7

Aspen Leafroller (predominantly ? Pseudexentera oregonana) - The aspen leafroller/tier complex seems to be active in one form or to one degree or another every year throughout the state and 1992 was no exception. We estimate that as many as a dozen species could be found in nearly any stand surveyed although one or two usually predominated. However in 1992 we experienced moderate to heavy defoliation of aspen (=poplar) by both the large aspen tortrix (see discussion which follows) and what we feel is the aspen leafroller. Although some mixture of the two occurred on aspen statewide, the areas of noticeable defoliation appeared to be distinct (Figure 7). Aspen in these stands was very thin and larvae gone in late June when many of the trees were checked. Moths of the aspen leafroller should emerge very early in the spring as soon as the snow begins to soften (? April-May). We hope to define the significance of the aspen leafroller problem in Maine more clearly in 1993.

Balsam Poplar Leafminer (? Lyonetia sp.) - Populations of this species continued to decline to nearly endemic levels in 1992. Although damage was visible from the ground in some stands, it was spotty, light and lacked the reddening effect of previous years.

Beech Scale (Cryptococcus fagisuga) - This scale is widespread throughout the state and associated with the Nectria fungus and with other scales such as the **birch margarodid** (Xylococculus betulae) and the **oystershell scale** (Lepidosaphes ulmi). Populations of C. fagisuga vary from place to place and it is Nectria which causes the more serious damage (see Beech Bark Disease). The **twice-stabbed lady beetle** (Chilocorus stigma) is a very effective predator on beech scale.

Birch Casebearer (Coleophora serratella) - Populations of the birch casebearer were moderately high again in 1992 especially locally in Waldo, Hancock and Washington Counties. Levels were very similar to those experienced in 1991. Where these populations coexisted with **birch leafminer**, damage was the heaviest. The problem in the Rangeley area appears to have remained relatively stable at low levels. Many areas, especially in Aroostook County were not surveyed for this species in 1992. A series of birch plots were established in the mid 1980's in northern Oxford and

Franklin Counties to monitor **birch** for signs of **decline** following heavy birch casebearer defoliation. By 1990 the health of these stands had stabilized and started to improve. The health of white birch in these stands continues to improve. Stands monitored in Washington and Hancock Counties show similar improvement.

Birch Leafminer (primarily Messa nana) - The area of moderate to heavy damage from this leafminer has remained fairly stable since 1990 while low populations have become increasingly easier to detect over a wider area (Figure 8). It was estimated in 1992 that roughly 150,000 acres of birch type exhibited light to moderate populations (< 1 mine/lf. av.) while roughly 50,000 acres exhibited moderate to heavy populations (> 1 mine/ lf. av.). Damage was heaviest where this species was associated with birch casebearer. Some shifting within individual stands has occurred from year to year. This leafminer seems to have displaced other species as a problem on white birch over the past few years.

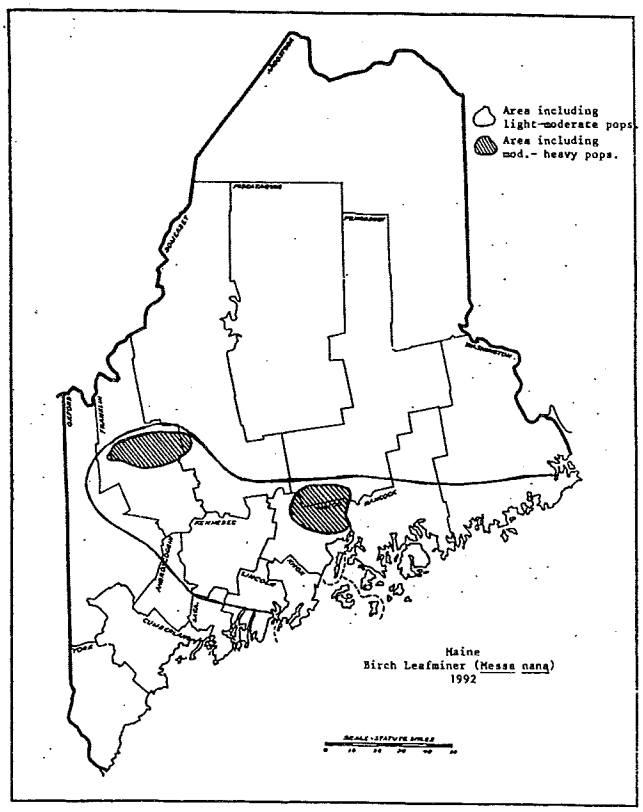


Figure 8

Birch Problems (various) - Some additional insect problems affecting birch this season were **fall webworm, gypsy moth** and **Japanese beetle** (see Section C) which caused locally significant defoliation in southern Maine. Populations of larvae of the **spearmarked black moth** (Rheumaptera hastata) remained very low in 1992. **Lacebugs** (Corythuca spp.) continued to cause noticeable mottling and yellowing of some trees especially ornamentals. **Bronze birch borer** damage continues to show up throughout the birch resource especially where stress factors have pushed birch to the "brink." This and other problems have been responsible for what has often been termed birch decline (see birch casebearer).

The **luna moth** (Actias luna) and the **polyphemus moth** (Antheraea polyphemus) were again abundant in some areas.

Birch Sawfly (Arge pectoralis) - Populations of this species were very low in 1992. No defoliation was reported.

Birch Skeletonizer (Bucculatrix canadensisella) - Populations of the birch skeletonizer have continued to rise since 1990 although estimates of intensity are rather rough. The impact of this late season defoliator is probably mainly aesthetic causing premature browning and yellowing of

foliage although in some seasons it may become another stress factor. In 1992 this species was found to some degree statewide and the small, pale yellow-green, elongate larvae and white molting webs were very characteristic and visible in late August. A wide variety of defoliation levels were seen but generally populations in southwestern Maine were light (< 1 larva/lf. av.); those elsewhere ranged from moderate (1-3 larvae/lf. av.) to heavy (> 3 larvae/lf. av.). Due to foliage discoloration from other causes at the time larvae were feeding, aerial surveys were inconclusive. The future trend of skeletonizer populations is not known.

Browntail Moth (Euproctis chrysorrhoea) - Although browntail moth populations in Maine increased in area and intensity in 1992, they still appear to be limited primarily to the Casco Bay area in southern Cumberland County. Heaviest concentrations are on the islands; especially Long, Vaill, Little Diamond, House and Chebeague. Scattered individual webs have been found on the adjacent mainland, however, as far east as Small Point (Phippsburg) in southern Sagadahoc County. A continued slow range extension is expected to the north and east of existing areas. At one point after its introduction into this country, the browntail occurred along the entire Maine coast and some inland areas. It has not been seen east of Rockland (Knox County) since 1960.

Survey methods utilized in 1992 included both road and foot scouting and the use of light traps. In the spring of 1992 a total of roughly 32 areas in ten towns were scouted by I&DM personnel for the presence of overwintering webs. Webs were found at seven locations (Table 5). Out of 23 light traps operated in 1992 only one (Brunswick) caught a single browntail moth (on July 28). Scouting for winter webs is already underway for 1993 and light traps will again be monitored for this pest. As soon as a suitable pheromone becomes available this will also be utilized to try and further define the movement and limits for the browntail moth in Maine.

Towns Scouted for Overwinter Webs of the Browntail Moth - 1992

Town (No. locations ckd.)	No. Webs	Location
Brunswick (3)	0	
Cape Elizabeth (1)	0	
Cumberland (3)	165+	Great Chebeague Isl.
Falmouth (5)	1	Bartlett Point
	4	Mackworth Isl.
	9	nr. Port. Country Club
Freeport (4)	0	
Harpswell (6)	1	Basin Point
	19	Potts Point
Phippsburg (4)	1	Small Point
Portland (1)	0	
So. Portland (1)	0	
Yarmouth (4)	0	

Table 5

Although larval activities, winter webs and defoliation by this species are undesirable it is the often serious skin irritation resulting from contact with larval hairs which causes most concern. Such contact can result in skin rash and if inhaled, respiratory problems. Out of concern for such problems, heavily infested areas of Little Diamond island were treated with Bt. in early June and again in early September in an effort to determine a suitable method of control. Results were not as satisfactory as expected. Further control efforts may be conducted in 1993.

Bruce Spanworm (Operophtera bruceata) - Larvae of this species feed on a variety of hardwoods including sugar maple, aspen and beech but seem to prefer sugar maple in Maine. Although larvae were difficult to find in May and June of 1992, numbers of moths were very high in some stands by November. Assessment of the significance of various population levels of moths of this species is difficult to make until defoliation begins to appear. We have not seen significant defoliation since 1975. Populations may be on their way up again. This species occurs statewide but seems to have been primarily a problem in west central Maine north to T8 R19 WELS. (See also Hunter's moths)

Fall Cankerworm (Paleacrita vernata) - Larvae of this species caused trace to light defoliation of individual elm and oak on the east side of Maine from Ft. Fairfield south to Bangor and along the coast west of Rockland. Although we observed more individual larvae in 1992 than we have for several years we have no indication of a serious "upturn" in populations at this time. The species bears watching. (See also Hunter's Moths)

Fall Webworm (Hyphantria cunea) - Locally high populations and heavy feeding and webbing by this late season tentmaker on a wide variety of deciduous hosts were evident again in 1992 for the fifth consecutive year. The level of damage, however, seems to have stabilized at slightly lower than 1991 levels, indicating that populations are possibly beginning to decline. There appears to be some mortality of portions of individual trees associated with fall webworm activities! Public concern over the "devastation" caused by this species is enhanced due to the highly visible and aesthetic degradation which occurs during peak travel and camping months (July and August).

Forest Tent Caterpillar (Malacosoma disstria) - Although reports of defoliation by forest tent caterpillar continue to come from adjacent areas of Canada, no noticeable defoliation of woodland poplars by this species was observed in Maine in 1992. Scattered reports of larval activity (low numbers) were, however, reported again in 1992 from northern Maine. Light trap catches of moths (Table 6) were fairly high but did not appear to reflect any concentration or consistent trend.

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

Greenstriped Mapleworm (Dryocampa rubicunda) - Populations of this species remained extremely low in 1992 with no noticeable defoliation reported. This species is primarily a feeder on red maple in Maine. Numbers of the medium-sized attractive, pink and yellow moths rose slightly in 1992 (Table 6).

	Malacosoma disstria Year						Dryocampa rubicunda Year					
Location	87	88	89	90	91	92	87	88	89	90	91	92
Allagash	10	93	155	65	39	54	1	0	0	0	0	0
Ashland	46	95	163	110	122	124	0	0	0	0	0	0
Blue Hill	2	16	4	20	27	43	21	57	82	115	24	46
Brunswick	31	105	155	54	69	17	25	19	12	20	13	16
Calais	-	-	-	7	11	23	-	-	-	20	7	4
Chesuncook	-	-	-	0	0	1	-	-	-	10	4	1
Dennistown	7	76	34	45	37	58	0	0	0	1	0	1
Elliotsville	28	148	39	36	49	78	21	69	8	58	7	11
Exeter	-	-	5	1	1	2	-	-	11	6	1	1
Greenbush	88	85	67	44	56	24	54	21	15	16	10	12
Guerette	6	31	12	20	28	8	-	0	0	0	0	0
Haynesville	-	-	68	45	56	36	-	-	2	5	8	2
Kingfield	14	24	16	1	4	18	0	0	1	0	0	0
Matagamon	49	123	175	46	63	126	0	0	0	0	0	0
Millinocket	6	35	20	14	20	43	68	74	43	61	8	27
Mt. Vernon	50	72	54	39	32	107	15	2	3	2	24	18
No. Bridgton	207	476	289	90	115	153	15	14	3	2	4	6
Rangeley	-	-	8	1	81	47	-	-	0	0	0	0
So. Berwick	69	256	198	245	352	324	39	16	16	95	41	373
St. Aurelie	0	6	1	6	18	13	0	0	0	0	0	0
Steuben	-	-	11	8	9	0	-	-	28	14	42	84
Topsfield	6	53	84	33	28	45	3	8	25	17	20	12
Washington	124	163	27	31	23	36	131	22	70	7	89	48
Totals	751	1890	1630	968	1240	1380	393	302	319	449	302	662
Total Traps	17	17	21	23	23	23	17	17	21	23	23	23

Table 6

Gypsy Moth - See Special Reports Section (pg. 51).

Hemlock Looper (Lambdina fiscellaria) - Damage to hardwoods by this species was again minimal in 1992 except in areas of the heaviest softwood defoliation. In such situations some feeding on hardwoods did occur, especially on birch. Damage appeared to be much less, however, than in 1991.

Hunter's Moths (adults of several species of cankerworms) - There are several species of fall flying moths which begin their flight activities just after the hemlock looper moths finish theirs. These male moths (females are wingless) tend to fly from mid October through November and due to the colder temperatures at that time of year do so mainly on sunny days and on warmer nights. Frail, lightly-marked, tan moths, with a one-inch wingspan which are often active in numbers in hardwood areas during hunting season (November) are most often adults of either the **fall cankerworm** (Alsophila pometaria) or **Bruce spanworm** (Operophtera bruceata). During the fall of 1992 the bruce spanworm was the more common species often flying in large numbers during daylight hours in northern hardwood stands across the northern two thirds of the state.

The fall cankerworm moths were less active and flew in smaller numbers and were more local and limited to stands containing oak or elm in coastal areas west of Rockland, along the Penobscot River and in pockets north to Fort Fairfield in Aroostook County. Heavier-bodied, often darker, moths which are less abundant but which also fly on warm nights in the fall are more likely adults of one of the cutworm species (Noctuidae).

Large Aspen Tortrix (Choristoneura conflictana) - Defoliation by large aspen tortrix continues to go through a series of "ups and downs" from roughly 12,000 acres in 1990 to less than 500 acres in 1991 back to 22,000 acres of heavy (> 50%) defoliation in 1992. Populations in central Somerset County (Jackman, Flagstaff Lake, etc.) which developed in 1990 have either subsided or are showing signs of decline [high numbers of parasites, predators (especially Calosoma frigidium and Lycosid spiders) and disease were very visible in most pockets of infestation which were checked in 1992]. The largest area detected in 1992 was in northwestern Aroostook County near the St. John River (Figure 7). Although larvae of this species occurred in low numbers on aspen throughout much of the northern part of the state, light trap figures for moths of this species (Table 7) show that moth activity has declined strikingly since 1990. However, moth catches were still higher than noted prior to 1990. We do not know where populations will go in 1994 and beyond but will be continuing to monitor this and other members of the leafroller/tier complex on aspen.

Light Trap Collections of Choristoneura conflictana

	Year		
Location	90	91	92
Allagash	13	1	0
Ashland	10	0	0
Blue Hill	0	3	14
Brunswick	0	0	3
Calais	6	14	2
Chesuncook	0	0	0
Dennistown	974	0	0
Elliotsville	159	33	42
Exeter	0	5	4
Greenbush	2	25	28
Guerette	0	1	0
Haynesville	15	257	3
Kingfield	2	0	3
Matagamon	0	0	3
Millinocket	11	14	5
Mt. Vernon	1	4	2
North Bridgton	0	0	2
Rangeley	1	5	47
South Berwick	0	3	4
St. Aurelie	8	0	0
Steuben	0	4	2
Topsfield	42	20	15
Washington	0	0	14
Totals	1244	389	193

Table 7

Maple Leafroller (Sparganothis acerivorana) - Populations of maple leafroller remained very low in 1992 and no defoliation of red maple was observed even in areas of Hancock County where defoliation had previously been heavy.

Maple Problems (various) - Maples looked generally healthier in 1992 than they have for several years and many of the problems of the past have now subsided. Larvae of **maple leafcutter** (Paraclemensia acerifoliella), **leafroller, petiole borer** (Caulocampus acericaulis), **spanworm** (Ennomus magnaria), **trumpet skeletonizer** (Epinotia aceriella), **greenstriped mapleworm** and **orangehumped mapleworm** were all present but scattered and at relatively low, endemic numbers. Where defoliation occurred it was usually very light and localized.

Oak Leaf Shot-Hole (caused by Japanagromyza viridula) - This problem which seemed to be so prevalent and obvious in 1991 was all but absent in 1992. This is probably due to a lack of coincidence of emerging flies with vulnerable stages of host leaf development. The need to have both host and pest in "sync" to have significant damage occur is especially critical for pests such as this, as well as **pear thrips** on sugar maple. Both of these insects can survive without this synchronization but damage is minimal.

Oak Leaftier (Shredder) (Croesia semipurpurana) and Oak Skeletonizer (Bucculatrix ainsliella) - Both of these species were more visible in 1992 although little defoliation was evident. In most cases reports dealt with very low numbers and at most light defoliation was observed on very few trees in a localized setting. The increased sightings may signify a rise in populations, however.

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

Orangehumped Mapleworm (Symmerista leucitys) - It was again difficult to find larvae of this species in most areas in 1992 and even more difficult to find signs of feeding damage. Light trap collections of moths of this and related species (Symmerista spp.) were also down for the third consecutive season in 1991 (Table 8).

	Symmerista spp. Year						Lochmaeus manteo Year					
Location	87	88	89	90	91	92	87	88	89	90	91	92
Allagash	0	0	0	0	0	0	0	0	0	0	1	1
Ashland	0	1	0	0	0	0	0	0	0	7	10	6
Blue Hill	0	2	2	0	0	1	0	0	0	7	4	5
Brunswick	0	81	31	4	8	0	0	3	80	4	2	0
Calais	-	-	-	5	1	3	-	-	-	2	4	3
Chesuncook	-	-	-	1	0	0	-	-	-	0	1	0
Dennistown	0	1	0	0	1	0	0	3	2	7	7	0
Elliotsville	0	285	155	44	10	5	12	19	37	87	175	42
Exeter	-	-	20	0	1	0	-	-	40	9	7	0
Greenbush	0	50	70	3	0	0	1	12	56	49	39	3
Guerette	0	0	0	0	0	0	0	0	1	2	1	0
Haynesville	-	-	12	1	0	0	-	-	15	94	86	21
Kingfield	0	8	11	0	0	0	16	49	70	192	158	14
Matagamon	0	2	7	2	0	0	0	0	10	17	13	1
Millinocket	0	342	211	9	0	0	1	51	276	169	310	122
Mt. Vernon	0	28	28	3	2	4	0	10	9	0	2	0
No. Bridgton	0	35	14	3	10	8	0	0	4	5	6	0
Rangeley	-	-	0	0	1	0	-	-	1	5	3	0
So. Berwick	0	45	32	18	13	30	14	16	14	11	15	3
St. Aurelie	0	0	0	0	0	0	0	0	1	0	0	0
Steuben	-	-	6	0	7	0	-	-	8	3	3	0
Topsfield	0	72	362	67	5	3	1	27	114	316	302	250
Washington	0	25	20	3	6	9	21	54	21	23	2	1
Totals	0	988	1002	163	65	63	66	247	768	1009	1151	472
Total Traps	17	17	21	23	23	23	17	17	21	23	23	23

Table 8

Oystershell Scale (Lepidosaphes ulmi) - Populations of this scale on beech remained endemic in 1991. Damage from this and other pests such as beech scale/nectria, however, continues to be obvious in most stands.

Pear Thrips (Taeniothrips inconsequens) - Pear thrips populations associated with sugar maple remained low again in 1992 and no feeding damage was reported. A cooperative monitoring project with the USDA-APHIS through the Pest Management Office in Orono was carried out at six sites in 1992 (Figure 9 - Mt. Vernon and Fort Kent were added to last year's list and Dedham was dropped). The numbers of thrips caught in a series of yellow, unscented sticky traps were relatively low (Baldwin-22, Carroll-141, Farmington-46, Fort Kent-0, Mt. Vernon-6, West Paris-57). In at least two traps (Fort Kent and Mt. Vernon), however, large numbers of a species of leaf hopper (? Erythroneura sp.) and lesser but noticeable numbers of a small sawfly (unidentified) were caught. No significance has been attached to the presence of these species at this point.

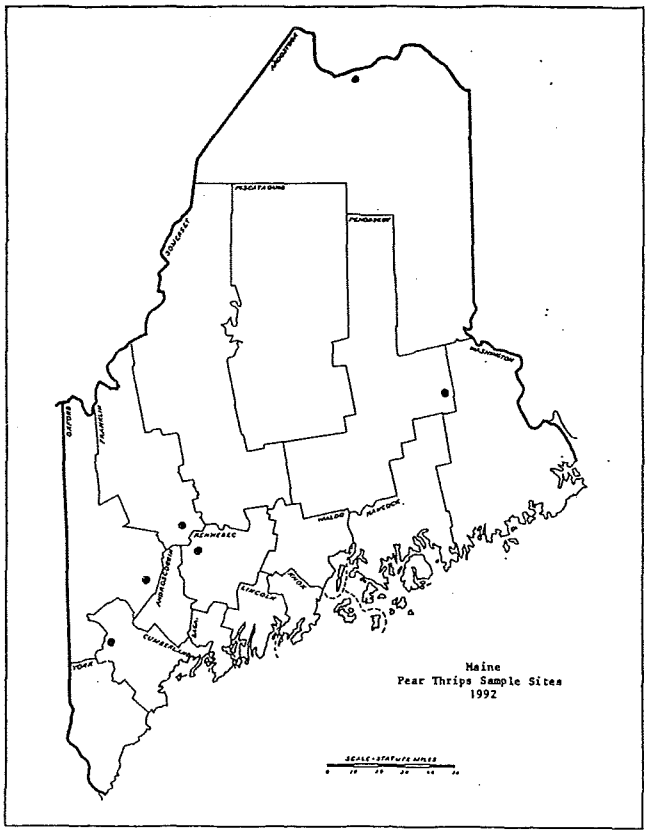


Figure 9

Saddled Prominent (Heterocampa guttivitta) - No damage was observed in 1992 and little change in numbers of adults (Table 9) or larvae.

	Heterocampa guttivita Year						Leucoma salicis Year					
Location	87	88	89	90	91	92	87	88	89	90	91	92
Allagash	6	14	13	8	4	1	1	5	11	3	3	2
Ashland	0	0	1	0	0	0	0	13	5	5	0	7
Blue Hill	6	1	0	6	2	1	0	0	0	0	0	0
Brunswick	53	18	10	42	34	0	1	4	0	2	0	0
Calais	-	-	-	2	4	3	-	-	-	6	5	0
Chesuncook	-	-	-	51	10	12	-	-	-	0	0	0
Dennistown	6	0	4	1	3	0	1	4	0	2	3	15
Elliotsville	13	2	3	6	5	4	1	1	0	0	1	5
Exeter	-	-	13	29	5	10	-	-	0	0	0	0
Greenbush	2	2	1	0	1	1	4	13	9	1	2	0
Guerette	1	0	0	0	1	0	1	0	24	4	3	3
Haynesville	-	-	3	0	0	0	-	-	1	3	0	2
Kingfield	9	2	1	0	0	1	0	2	0	0	0	1
Matagamon	1	4	3	7	0	1	3	4	0	0	0	0
Millinocket	7	7	13	10	21	10	0	1	1	1	5	17
Mt. Vernon	54	13	17	21	32	19	0	0	0	0	0	0
No. Bridgton	2	5	1	0	41	15	0	0	0	0	0	0
Rangeley	-	-	0	0	10	4	-	-	0	0	4	1
So. Berwick	4	14	5	29	15	53	0	0	0	0	0	1
St. Aurelie	0	0	0	3	0	0	0	0	0	0	0	0
Steuben	-	-	4	3	17	28	-	-	4	41	22	2
Topsfield	12	0	4	7	5	11	2	0	2	1	3	0
Washington	83	3	79	3	50	23	0	0	0	0	0	0
Totals	293	199	186	332	260	197	13	70	57	71	51	56
Total Traps	17	17	21	23	23	23	17	17	21	23	23	23

Table 9

Satin Moth (Leucoma salicis) - Defoliation of aspen by satin moth larvae increased sharply in 1992 compared to 1991. Small isolated spots of defoliation by this species have been observed each year since and including 1989 especially in central and coastal Washington and Hancock Counties but in 1992 most woodland defoliation was in northwestern Penobscot and east central Piscataquis Counties (Figure 10). A total of 2,600 acres of heavy (> 50%) defoliation was mapped from the air. This is the largest area of woodland defoliation seen since 1974. Although bigtooth aspen appears to be the preferred woodland host for satin moth in Maine, trembling aspen and willow are also defoliated. Scattered defoliation of ornamental and shade tree eastern cottonwood and white poplar was also much more prevalent in 1992, especially white poplar in Chesterville, Farmington and New Sharon in Franklin County and Vienna in Kennebec County. Many white poplar were stripped completely and larvae had moved to other hosts especially willow in a desperate search for suitable food.

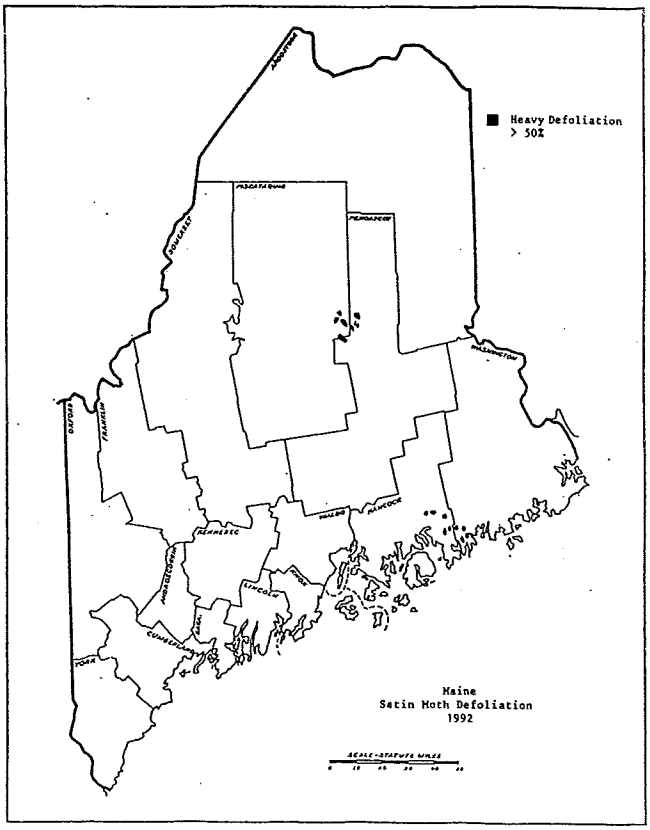


Figure 10

Moth catches of this species were low in 1992 (Table 9).

Tussocks and Dagger Moths (various) - Populations of these "fuzzy" caterpillars remained low in 1992. No defoliation was observed.

Variable Oakleaf Caterpillar (Lochmaeus manteo) - Populations of oakleaf caterpillar continued down slightly in 1992 and although they were at their lowest levels in several years (Table 8) they still remained slightly above what we generally consider to be endemic levels. A few areas of noticeable light beech defoliation were reported to us in 1992 within the area of more generally elevated populations (central Somerset and southern Piscataquis Counties).

(C) Shade Tree, Ornamental and Miscellaneous Insect (and Other Arthropod) Pests (See also Sections A & B)

Alder Flea Beetle (Altica ambiens alni) - Brown alders were again a common sight in many areas of southern Maine by late July. Populations appeared to hold roughly at 1991 levels and problems with wandering larvae and

adults around buildings continued to generate concern. Mortality of some clumps of alder appears to be associated with areas exhibiting three years or more of defoliation.

Ant Flights (Lasius spp.) - Ant flights made their annual appearance this season in August but did not seem as spectacular or elicit as much concern as they have in the past.

Aphids - Other than those aphids which have been already discussed in sections A & B, only the **woolly alder aphid** (Prociphilus tessellatus) was reported with significant frequency in 1992. It was the woolly phase on alder and the fall migrants that were brought to our attention. We received no reports of this species from its silver maple host in 1992. The migrants are a rather interesting sign of the "last gasp" of summer. On calm, sunny days in late September and October numerous, tiny, bluish-green aphids with tufts of white wool attached drift lazily through the air in the vicinity of alders.

Armyworm (Pseudaletia unipuncta) - No reports of unusual activity or feeding on trees or nursery stock by this species were received in 1992.

Bark Lice or Psocids - These interesting creatures were not as common in 1992 as in 1991 although they were present locally in small numbers. Of the several species which occur in substantial numbers in Maine our most common one 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 do not harm the trees.

Boxelder Bug (Leptocoris trivittatus) - Populations of this species in the Sanford area were still in evidence in 1992 but numbers appeared to be noticeably down. This still seems to be the only area where the boxelder bug occurs commonly in high numbers in Maine so far as we know. It is often confused in Maine with the more common and widespread **smaller milkweed bug** (Lygaeus kalmii).

Browntail Moth (Euproctis chrysorrhoea) - See Section B

Cottony Maple Scale (Pulvinaria innumerabilis) - We received no reports of activity by this species in 1992.

Eastern Tent Caterpillar (Malacosoma americanum) - Although scattered tents of this species were obvious and there were very localized pockets of high concentrations in central and eastern Maine, populations still remained relatively low in 1992.

Euonymus Caterpillar (Yponomeuta sp. prob. cagnagella) - This species was back again in 1992 in most areas where it has previously been a problem, although population levels appeared to be down. We did not receive as many calls as we have in the past.

Japanese Beetle (Popillia japonica) - Japanese beetle populations remained at roughly the same levels of distribution and abundance in 1992 as in 1991. It appeared that numbers and damage did dip slightly at least in Kennebec County where little-leaf linden (Tilia cordata) seemed to retain more of its green color. Perhaps some of the cold open winters are getting to larvae of the "little critters" as they did the bulbs! Seasonal development was also slightly different in 1992 at least in Augusta (Kennebec County) where beetles emerged about a week later than usual (July 6) and were active until around October 11 because of a mild September.

The heaviest populations of Japanese beetle still occur primarily in Androscoggin, Cumberland, Kennebec and York Counties. No new areas were reported in 1992.

Lacebugs (Corythuca spp.) - Butternut and birch continued to have high numbers of lacebugs in 1992, 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) - This species of leafminer was the predominant one on black locust in 1992 while populations of the digitate miner (Parectopa robiniella) dropped off strikingly, especially in southern Hancock County (Blue Hill, Deer Isle, etc.). Odontota dorsalis was confirmed from four new counties and eight towns in 1992 (Table 10). Aside from the presence of red and black beetle adults of O. dorsalis, this species can usually be distinguished from P. robiniella by the mines (digitate and whitish in P. robiniella and blotch-like and rusty-reddish in O. dorsalis).

Locust Leafminer (Odontota dorsalis)
Maine Distribution
1992

County	Town
Androscoggin	Lewiston
*Cumberland	Falmouth, Yarmouth
*Kennebec	Augusta, Benton, Mt. Vernon
*Penobscot	Bangor, Newport
*York	Kittery

* = New record in 1992

Table 10

Medical Entomology - Maine state government does not have a designated medical entomologist position. As a result MFS-I&DM staff still receive requests for advice and assistance in dealing with an array of insect and other arthropod related problems. Included in these requests are questions relating directly to such things as **black flies, bot flies, deer flies, horse flies, mites, mosquitoes, spiders, stinging insects** and **ticks.** Also included are vector related disease problems such as **eastern equine encephalitis, heartworm** and **lyme disease** and a series of **allergies, rashes** and **reactions.** As in the past, the actual numbers of requests are not high but individual concern is often great. Disease questions per se are referred to specialists.

Biting fly populations in 1992 ran very close to those of 1991 in severity but with some seasonal changes. The relatively dry spring seemed to hold back early emergence but with the return to cooler, wetter weather in mid June, populations of most species rebounded. Although the discomfort level ranged from tolerable to terrible, the biting season seemed generally shorter than usual. Populations of **salt marsh mosquitoes** also seemed to be down somewhat from high 1991 levels but were still a real nuisance in some areas. **Black flies** in the Penobscot River valley north to Medway were also very "pestiferous" again this season. Populations of this river breeding complex of species build as the season progresses and "cookouts" were again all but impossible even in early September especially north of Old Town. **"No see-um"** and **deerfly** populations appeared to be stable or down generally in 1992.

Bot Fly (Cuterebra sp.) - We received two reports of bot fly larvae in humans for the second consecutive year in 1992! One larva was removed from the eyelid of a girl in Hancock County, the other from a female (no age or site given) in Kennebec County. These fly larvae usually parasitize small rodents.

Stinging Insects caused a rash of complaints again in 1992 but numbers appeared to be down strikingly from the high 1991 levels. At this point we have no suggestion as to why this drastic drop in numbers occurred but nobody is complaining.

Reports of **rashes** associated with the hairs of caterpillars such as the **browntail** and **gypsy** moths seemed to be relatively infrequent in 1992 in spite of the high populations of these two insects. Hairs from a few other caterpillars such as the **rusty tussock** of Maine woodlands can also cause a serious rash on some people when populations are high. The browntail moth caterpillar hairs are generally the cause of the worst rashes. Although the mode of action of the hairs is somewhat different, chemical in the case of browntail and mechanical in the case of gypsy and rusty tussock moths, the treatment recommended is the same. In response to calls this year we encouraged people who react very easily to such irritants to stay away from heavily infested areas and caterpillars as much as possible. Those who had to venture forth could find some relief through proper use of protective clothing and use of over-the-counter

formulations of antihistamine (such as Benadryl) and hydrocortisone creams. Persons with severe reactions or who had mucous membranes or eyes affected were referred to their physicians. Fortunately rashes acquired from caterpillars generally do not last as long or spread as readily as rashes resulting from poison ivy.

Black Widow Spiders (Latrodectus sp.) - After the big "widow year" of 1991 it appears that the problems associated with importation have been rectified. Only one reported infestation of black widow spiders occurred in 1992 and this was in a compressor/boiler room of a building supply business in Sanford. Several spiders and associated webs were found when the room was checked in November. Treatment of the room apparently took care of the problem.

Ticks (Ixodidae) - The number of ticks received for identification in 1992 was down from 1991 although comments from our field staff still indicated high populations of adults of the **American Dog Tick** (Dermacentor variabilis) in June and July in southern Maine and larvae of the **moose** or **winter tick** (I. albipictus) in November in some areas. Increasing numbers of people now feel that they can accurately separate these species without our assistance from the **lyme or deer tick** (Ixodes dammini) which is of more concern (see Lyme disease). Deer tick records increased slightly in number in 1992 and minor range extension concentrations were observed. Ticks in Maine are still more common in the southern part of the state (Figure 11).

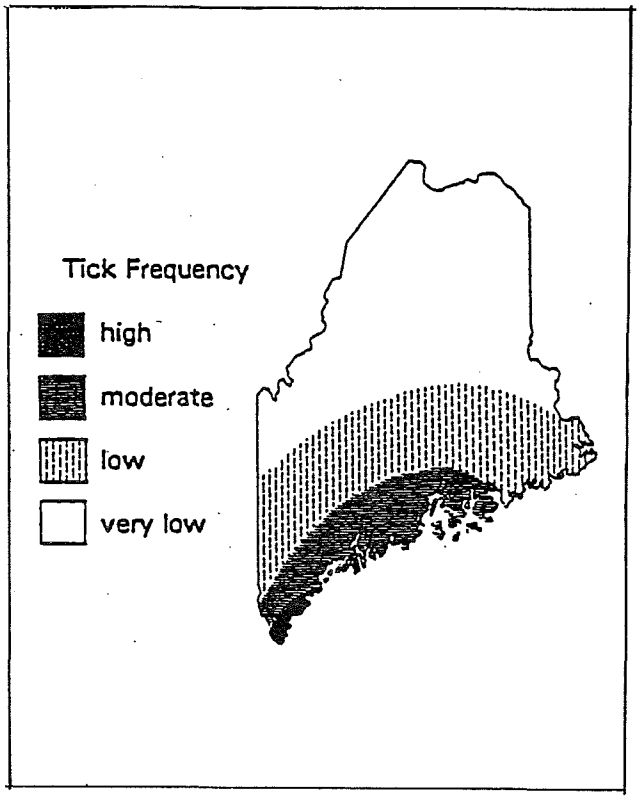


Figure 11

Lyme Disease in Maine - The official incidence of lyme disease in Maine is increasing but is still relatively low compared to other states. The figure for Maine-acquired cases hovers around 50, up from 26 in 1991. The counties officially involved are Cumberland, Hancock, Lincoln and York. No new counties were added in 1992. The cooperative task force involving I&DM, the Department of Human Services, the Department of Inland Fisheries and Wildlife, the Department of Agriculture, Food, and Rural Resources, the Maine Medical Center (Research Dept.) and representatives of the medical community is trying to address aspects of the situation and monitor any further progression of the problem within Maine.

Miscellaneous Problems - Each year the I&DM staff handle well over 1,000 different requests for advice and assistance in addition to specific project work. This involves the familiar such as **carpenter ants, dermestids** and **meal moths** but a number of additional interesting and unusual problems also come up in the course of our activities. A few of these are listed here for your interest.

Hairy Fungus Beetles (Mycetophagus ? bipustulatus) - Fungus beetles feed in a variety of situations and are often common in numbers at least briefly in response to available food such as moldy grain or moldy plant products. This species however has not been seen in such situations by our staff before. Large numbers were entering a home in Monticello in the fall. The food source was not determined.

Pseudoscorpions are very interesting tiny arachnids. Their crab-like appearance and movement often causes them to be mistaken for lice. Pseudo-scorpions however are generally considered beneficial, feeding on more destructive and often undetected pests such as **Psocids** and **silverfish.** In spite of their name, pseudoscorpions do not sting and what minute amounts of venom they do produce only affects their tiny prey.

Seed bugs sometimes become a problem in the fall as they try to come inside from heavily infested old fields. The red and black **lesser milkweed bug** (Lygus kalmii) is perhaps the most common. This past fall (November) a seed bug tentatively identified as **Kleidocerys resedae** was found in a home in Belfast. We had not seen this one before.

Spotted Mediterranean Cockroach (Ectobius pallidus) - This introduced outdoor cockroach now occurs locally in Maine along the coast from Belfast south and west to Kittery. In most cases populations occur within a very few (<5) miles of the coast. Heaviest concentrations of this pest occur in Waldo and York Counties. A new infestation was reported this season in July from Ogunquit. This species can be a problem either within or outside of buildings and can survive Maine winters outside.

Termites (Eastern Subterranean Termite Reticulitermes flavipes) - Termites have been known from a limited number of localities in southwestern Maine for many years but their spread has been minimal. Recently questions concerning their range in the state have come up and with that in mind the following information is intended to bring you up to date. Established and confirmed termite populations have so far been reported in Maine from Cumberland (Portland, S. Portland, Falmouth), Kennebec (Augusta), Oxford (Bethel) and York (Biddeford, Saco, Old Orchard Beach, Buxton, Hollis, Gorham) Counties. Populations have been fairly stable on established sites indicating that movement is limited unless transported by man.

Mountain Ash Sawfly (Pristiphora geniculata) - This species is on our list of perennial problems affecting ornamental mountain ash. The 1992 season was no exception with the usual complaints in spite of the fact that control of the problem is easy to achieve.

Rose Chafer (Macrodactylus subspinosus) - Populations of this species appeared to be down considerably this season in many areas of southern Maine but still caused locally noticeable defoliation of a wide variety of trees and shrubs. Locally high populations of rose chafers can strip 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.

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 and populations seemed to remain at roughly 1987 levels for the sixth season. Several reports of browning caused by mites were also received in 1992 for the first time in several years. These somewhat perennial problems are relatively easy to control.

DISEASES AND ABIOTIC PROBLEMS ASSOCIATED WITH TREES IN 1992

Air Pollution Injury (caused by various air contaminants) - Reports of air pollution injury to trees and shrubs were down in 1992, reflecting a generally downward trend in recent years. It appears that local and national efforts to reduce noxious air emissions are becoming increasingly successful.

Weather patterns in 1992 too had a generally mitigating effect as relatively few "Bermuda high" pressure areas set up off the east coast of the United States to pump high levels of air contaminants into our region. A plot established in South China, Maine, which was specifically designed to record ozone damage to five native species, displayed surprisingly few symptoms. White ash, blackberry, milkweed, and white pine foliage exhibited only trace to light ozone injury while black cherry exhibited no symptoms at all.

We did, however, receive specimens of Austrian and white pine from Portland which exhibited symptoms of probable sulfur dioxide injury.

Annosus Root Rot (caused by Heterobasidion annosum syn. Fomes annosus) - Every year we seem to confirm the presence of annosus root rot at one or more previously unreported sites. Last year was no exception. A plantation of red (Norway) pine in Leeds which was row thinned without stump treatment over a decade ago now exhibits many pockets of infection (fomes holes). Trees near the center of these "holes" are now dead but many trees at the margin are still declining and dying, indicating that infection centers have not yet stabilized. While we still don't fully comprehend the economics of stump treatment with borax, there is no question that this disease is capable of causing significant losses under Maine conditions.

This is primarily a disease of plantation pine in Maine. To date we have recorded infected plantations in the following counties: Androscoggin, Cumberland, Franklin, Penobscot, Somerset, Waldo, and York.

Apple Scab (caused by Venturia inaequalis) - Apple scab on ornamental crabs, like most other foliage diseases, was less pronounced in 1992. Since effective control of this disease through use of fungicides requires repeated and thorough applications of carefully timed sprays, we generally recommend that homeowners with existing trees simply rake leaves in the fall and spring to reduce inoculum and try to live with any infection which may result.

Homeowners who are contemplating planting ornamental crabs in the landscape are well advised to select from several varieties which exhibit lowered susceptibility to scab and other diseases. Please write for more information.

Ash Anthracnose (caused by Discula sp.) - Reports of ash anthracnose were down again this year, probably the result of dry weather during normal infection periods. We received specimens from Cumberland and Bar Harbor with typical ash anthracnose symptoms, but received no reports of infection from any of our forest health monitoring plots which are located throughout the state.

Ash Dieback (cause unknown but probably drought related) - The brown ash (Fraxinus nigra) dieback we first noted in 1990 in northern Maine along the Aroostook River has progressed to the point that crowns of nearly all larger trees are now dead, though many are hanging on by "pushing out" epicormic branches (water sprouts). Younger trees (about two inches in diameter) in the same area, on the other hand, look pretty good. This disease seems to be present to some extent in brown (black) ash stands wherever they occur in Aroostook County. In 1991 we noticed a similar problem on brown ash in the Kennebec County town of Mt. Vernon, but symptoms did not worsen significantly in 1992.

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.

The cause of this problem continues to elude us. Apparently, though, this is not a new disease. We find record of it in the Forest Commissioner's Reports for the years 1954-1956 where a brown ash dieback with similar symptoms was described but no cause could be identified. After 1956 there was no further mention of this disease.

At this writing we are establishing plots to help monitor the progress of this disease. We will have a report at a later date.

Ash Leaf and Twig Rust (caused by Puccinia sparganioides) - Ash leaf and twig rust levels presently remain low as we continue through this period between epiphytotics (epidemics). We received only one specimen with minor levels of infection (from Woolwich).

Ash Yellows (caused by mycoplasma like organisms) - To date we still have no reports to indicate that this disease is present in Maine.

Beech Bark Disease [caused by beech scale (Cryptococcus fagisuga) and Nectria coccinea var. faginata] - Cankered trees are common throughout the state and extensive mortality continues to occur. In 1992, we observed this disease in 30 of 128 forest health monitoring plots, making it the most common disease encountered in the forest health survey.

Black Knot of Cherry (caused by Apiosporina morbosa) - This disease is common in forest situations throughout the state on wild cherry trees and is particularly conspicuous on black cherry where galls a foot or more in diameter may occur. Where these galls occur on the main stem the value of cherry for lumber is considerably reduced. In 1992, we recorded this disease as present in 6 of 128 forest health monitoring plots.

Frequently we receive reports of black knot infections on cultivated cherry or plum trees in landscape or home orchard situations. All too often by time we are consulted the disease has progressed to such an extent that pruning knotted twigs and branches to remove infected tissue would essentially reduce the tree to a stump. It is important to diagnose this disease early, prune any knotted twigs each year before April 1, and spray if necessary with the fungicide thiophanate methyl in order to maintain healthy, productive fruit trees.

Boxelder Canker (caused by Fusarium lateritium) - This disease, so conspicuous in 1991, was barely noticeable in 1992. We had theorized that the heavy spring frost of May 19, 1991 could have played a role in the severity of the 1991 symptoms by increasing susceptibility of boxelder to infection by the causal organism.

We had no spring frosts in 1992 which approached the severity of that of 1991 and perhaps that explains the paucity of symptoms last season.

Bud Abortion of Balsam Fir (caused by low ambient air temperatures prior to budbreak) - Balsam fir in several Christmas tree plantations exhibited moderate symptoms of bud abortion in 1992 for the first time in several years. Though not as severe as in 1987 and 1988, its return follows three years where almost no serious bud abortion was apparent anywhere within the state.

In recent years we have come to attribute this problem to freezing of buds early in the season, before buds emerge from their bud scales but after they have lost most of their winter hardiness and begin to swell. If this etiology is correct, this year's damage most likely occurred early in the morning of May 6, when temperatures in the very low 20's were widespread in Maine.

Caliciopsis Canker (caused by Caliciopsis pinea) - This is a generally minor but occasionally important disease of eastern white pine which is often overlooked. Though we have known about this disease for many years we are only now becoming aware of its significance and widespread occurrence in Maine.

Caliciopsis canker is prone to develop in white pine plantations where thinning has been delayed or on overstocked sites where white pine has regenerated thickly and is attaining sapling or pole size. Cankers appear first on smooth-barked portions of affected trees, often as reddish-brown sunken areas. These cankers may be superficial or they may extend into the cambium, killing it, affecting future radial growth at that point and eventually affecting sawlog quality. Severe infections may extend to branches and stem tissue on most portions of affected trees, resulting in shortened annual growth, clumping of foliage, chlorosis, and ultimate tree death.

The disease organism gains entrance to trees through insect bore holes or by direct entrance through lenticels. However we strongly suspect that this disease is spread significantly within infected stands by pruning saw injury (inadvertent raking of internodal areas when branches are pruned from trees to improve eventual sawlog quality).

This disease may be controlled by thinning overstocked stands to prevent stagnation, slowing of growth, or reduction of individual tree vigor.

We received calls on this disease during the past year and a half from Edgecomb, Woolwich, Greenbush, Hampden, and China.

Chestnut Blight [caused by Cryphonectria (Endothia) parasitica] - Many of the chestnut trees the MFS has distributed to foresters and interested hobbyists over the years continue to thrive, thus far having escaped lethal infection. But they seem to possess no special resistance to chestnut blight and every year or so we have reports that one or more has succumbed to the disease.

We continue to be optimistic that hypovirulent strains of the causal organism will eventually make possible the restoration of American chestnut to eastern forests. [Hypovirulent strains are sublethal, and have the potential to convert the lethal (virulent) strains found in nature to sublethal status]. Thus far hypovirulent strains, when introduced into stands of chestnut in eastern North America, have apparently not spread sufficiently to reduce the infectivity of the virulent population. But there is evidence that this has indeed happened in parts of Michigan, outside the native range of American chestnut. There are at least 30 American chestnut stands in Michigan that are now surviving infection and, in fact, in several of these stands almost all signs of C. parasitica have disappeared.* Hopefully as we increase our understanding of the mechanisms of hypovirulence, a way will be found to facilitate the spread of hypovirulent strains in eastern forests.

*McDonald, W.L., and D.W. Fulbright, 1991. Biological control of chestnut blight: use and limitations of transmissable hypovirulence. Plant Disease 75(7): 656-661.

Cristulariella Leaf Spot (caused by Cristulariella spp.) - This disease, which caused extensive leaf spotting and defoliation especially of boxelder in south central Maine in 1990, all but disappeared in 1991, and we had no reports of it in 1992. Apparently the weather conditions which favor this disease, consecutive days and nights with high dew points, did not recur the last two summers.

Dogwood Anthracnose (caused by Discula destructiva) - Dogwood anthracnose is a relatively recently described disease which has been causing dieback and mortality of flowering dogwood in parts of the northeastern United States since the late 1970's. Symptoms include small, often purple-rimmed spots or large brown blotches on leaves, cankers and epicormic branches (water sprouts) on stems, and branch dieback which commonly progresses from the bottom to the tops of affected trees.

We have only recently become aware of this disease but note that it has gradually spread from the areas where it was first described in southeastern New York and southwestern Connecticut to affect much of the northeast. We call it to your attention because of a preliminary report of the disease in Kittery (York County) earlier this year. There is a possibility that this disease may spread on infected nursery stock. The Kittery infection was noted on plants in a landscape situation. We plan to monitor native stands of flowering dogwood in southern Maine this summer to determine the extent to which this disease may be present. The Maine Department of Agriculture has not found evidence of this disease on nursery stock in the state to date.

Drought Stress - We received several tree decline calls during 1992 which seem to be the result of drought stress. The last two springs were relatively dry in much of Maine and mature landscape trees on certain sites shallow to ledge, particularly in south coastal areas, have been adversely affected. Trees on such shallow soils frequently grow reasonably well until, due to their increased size, the site no longer has adequate moisture reserves to sustain them. Once stressed by drought, trees may take several years to recover and on naturally droughty sites, trees may never have a chance to fully recover.

Dutch Elm Disease (caused by Ophiostoma ulmi syn. Ceratocystis ulmi) - Dutch elm disease continues to take a steady toll of Maine's few older remaining large elms. These trees seemed to escape or resist the initial wave of infection which spread through the state several decades ago, but a new wave of an aggressive strain of the causal organism is proving too much for many of these older survivors. Even intensive efforts in certain southern Maine communities to save remaining large elms by targeting them for special protection are no longer very successful.

Eastern Dwarf Mistletoe (Arceuthobium pusillum) - Severe damage as the result of infection by this parasitic plant is still occurring in stands of white spruce in coastal areas of Maine. Trees of landscape value succumb each year in the yards of coastal residences as this organism 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.

Dwarf mistletoe also frequently occurs on black spruce, particularly in bogs, and on red spruce in forest lands. Brooms on red spruce are often more poorly developed than on white or black spruce and may be overlooked. However infected residual trees left during timber harvesting activity can result in the infection of spruce regeneration. Infected trees should therefore be identified if possible and removed during the harvesting operation.

In 1992, we observed this disease in 3 of 128 forest health monitoring plots.

Entomosporium Leaf Spot (caused by Entomosporium mespili syn. Fabraea maculata) - We commonly receive specimens of this disease for diagnosis on hawthorn but last year it was infection of mountain ash which commanded our attention. Specimens of mountain ash from Richmond and Augusta exhibited the small brown or gray spots characteristic of this fungal disease, and microscopic examination revealed the presence of thousands of characteristic, multi-celled "insect like" spores.

This disease may be controlled with sprays of benomyl as flower buds open, and once again immediately if spots develop.

European Larch Canker (caused by Lachnellula willkommii) - Surveys to determine whether this disease has spread from known infested areas were conducted again in 1992 and, for the first time in several years, we found the disease to be present in a township previously considered to be uninfested. That township is Baring Plantation in far eastern Maine. This new finding brings the total acreage in Maine known to be infested with European larch canker to 6,725.

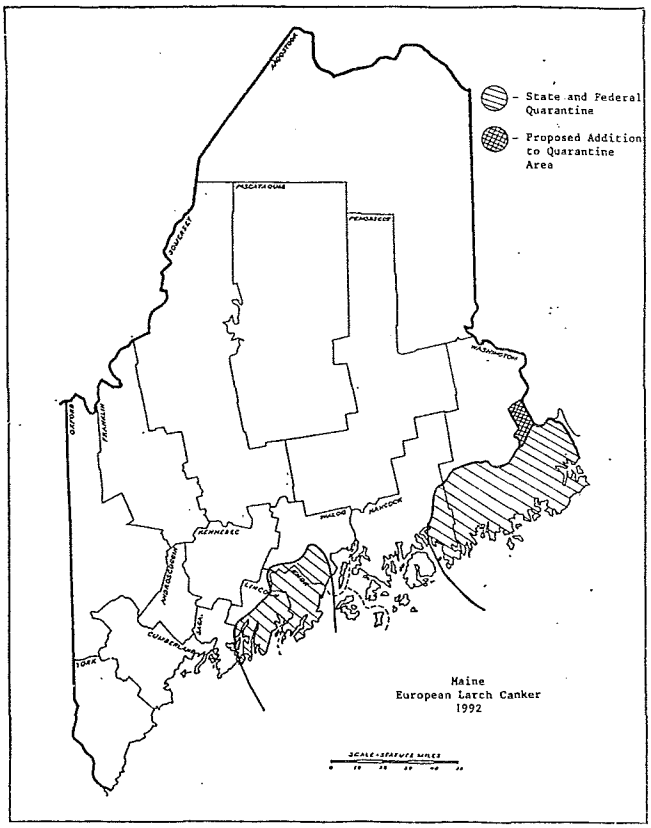


Figure 12

Although Baring has been designated within the quarantine area for some time now, it was included as a non-infested border town to serve as a buffer around known infested areas. Now that the town is known to be itself infested, it will be necessary to designate new buffer communities. Accordingly, MFS has recommended to the United States Department of Agriculture that Baileyville and Alexander be placed under quarantine to re-establish the necessary buffer zone (Figure 12).

In 1992 we continued to make mill site inspections for verification of conditions specified in compliance agreements. All mills were found to be in compliance and no larch canker infections (escapes) were found at any of the mill sites.

Inspections of the Scott Paper Company seed orchard in Unity and the International Paper seed orchard in Howland were completed in October. Both inspections were negative (no larch canker was observed).

Fir-Fern Rust (caused by Uredinopsis sp.), and Fir Fireweed Rust (caused by Pucciniastrum epilobii) - Levels of fir-fern and fir-fireweed rusts were a bit higher in 1992 than 1991 but did not cause a serious problem for most Christmas tree growers. One grower in Woodland, however, reported 12 acres of moderate infection (30-69% percent of needles affected). Both rust species were present at that site.

Fir-fern rust was reported from 10 of 128 forest health monitoring plots surveyed in 1992.

Frost Damage (low temperature injury) - Spring frost damage was common in the usual frost pockets around the state in 1992, but was mild compared to what Maine experienced in the spring of 1991. Temperatures as low as 26° F in the early morning of May 26, 1992 caused significant damage in certain balsam fir Christmas tree plantations and seriously damaged a few gardens in southern and central Maine.

Frost damage was noted in 10 of 128 plots in our forest health monitoring survey.

Hail Damage - "Hundreds" (and possibly several thousand) of acres of fir exhibited varying degrees of reddening in T6 R7 just south of Grand Lake Seboeis in 1992. This was attributed to severe hail injury which had occurred in 1991. Stems and branches of balsam fir were badly bruised and "pocked" on the west side from driving hail. The injury was sufficient in many cases to result in mortality of all growth exterior (distal) to the more extensive wounds. As many as 50% of the tips were flagged on some individual trees. White pine, maple, and other species in the area showed similar wounding but damage was not as striking.

Herbicide Injury (caused by various vegetation management chemicals) - We had a significant number of calls in 1992 where nontarget vegetation had been damaged by misapplication or overapplication of herbicides. The herbicide products most commonly causing problems were simazine and mixtures of 2,4-D and picloram.

Simazine is frequently overapplied by plantation growers in the mistaken belief that trees, particularly balsam fir, cannot be injured by that product. Typically simazine works well in producing a bare ground effect where applied as spots or bands in early years following plantation establishment. But this effect is eroded over time as resistant weeds develop and go to seed. Rather than rotating with other herbicides, many growers respond to the diminishing control response by

increasing the levels of simazine applied. The off color or chlorosis which results in trees is often misdiagnosed as nutrient deficiency. In fact nutrients may be deficient in the foliage of affected trees, but this is more apt to be the result of herbicide damaged root systems than a shortage of available nutrients in the soil.

Herbicides containing 2,4-D and picloram used to control sprout growth on cut stump surfaces in landscape situations also generated several inquiries of our staff this past year. Most of the problems were the result of homeowner applications, and the homeowners involved typically were incredulous that the small amounts of herbicide they used could have caused the amount of damage noted. Stump treatment, however, typically involves the application of concentrated product to cut stump surfaces and cut brush often presents the opportunity to treat a great number of small stumps in a concentrated area. This particular herbicide mixture moves relatively easily in the soil and is quite easily taken up by the roots of adjacent trees in the landscape. Hemlock was the non target species most frequently injured by 2,4-D-picloram mixtures.

Horse-chestnut Leaf Blotch (caused by Guignardia aesculi) - This disease seems to occur every year wherever horse-chestnut grows in Maine. In 1992, however, the expression of disease symptoms was milder than usual at most locations.

Hypoxylon Canker (caused by Hypoxylon spp.) - This is perhaps the most serious disease of aspen (poplar) in Maine and is present throughout the state. Cankers begin as sunken yellowish areas on the stem and enlarge rapidly. Bark frequently assumes a loose, blistered appearance at first then becomes gray-black and crusty as cankers age. Frequently trees break off at the point of cankers during ice, snow, or wind storms.

In 1992 this disease was reported from 4 of 128 forest health plots, but is present in most poplar stands wherever they occur within the state.

Lirula Needle Cast (caused by Lirula sp.) - Lirula needle cast symptoms were much more pronounced in Christmas tree production areas in 1992 than in most recent years. Though quite common in the woods where balsam fir grows thickly or as an understory tree, Lirula needle cast generally has not been a problem in more open situations or where trees are cultivated for use as Christmas trees. But in 1992 we received calls from growers who noted this problem in both Christmas tree plantations and managed wild stands. We also had reports from Milo and Rangeley where trees were growing in a landscape situation. This disease was noted in 8 of 128 forest health monitoring plots in 1992.

Lorsban Injury - The insecticide Lorsban 4E, like Diazinon AG500, apparently has the capacity to injure tender growth of balsam fir when applied at low dilutions using powered mist blower equipment.

In 1992 we had reports from two growers, one in Aroostook and one in Somerset County, who severely injured Christmas trees using tractor mounted mist blowers. Both were spraying Lorsban 4E for control of

balsam twig aphid but were late in their timing (spraying well after bud break in late May). One had sprayed previously using proper timing (buds showing 20% green) but had not achieved the desired insect population control and therefore repeated the treatment. Damage was in the thousands of dollars.

Growers should be cognizant of the risk of injury to the tender growth flush of balsam fir when using these chemicals. Risk is lowered by careful attention to application timing, greater dilution of the spray mixture (use of more water per acre), and selection of the proper application equipment. Tractor mounted mist blowers should deliver most of the spray volume above the crop canopy where it can settle into trees rather than blowing the bulk of spray materials through tree foliage.

Mechanical Damage - Misuse of string trimmers accounts for an increasing percentage of the tree problems we observe in residential, park, and industrial settings as well as in cemeteries and on golf courses. Often the damage to tree stems is relatively inconspicuous even when tree crowns have progressed well into advanced stages of decline.

Natural Occurrences (false disease problems) - Every year we receive several calls for assistance where a natural phenomenon rather than a disease is involved. The most common of these is fall coloration on evergreens where older needles turn yellow and are shed. This is a real and perennial concern of Christmas tree growers where many trees in plantations may color 3-7 year old needles in late September and October, often just as potential buyers are viewing tree quality. Even growers who recognize that this is a natural phenomenon need assurance that yellow needles will fall before harvest time, and the buyers need assurance that the trees are really "up to snuff." Generally we find that most of these older yellow (then eventually brown) needles "weather" or fall off before or during harvest but some progressive growers will mechanically shake trees or blow needles off with a power (backpack) mist blower (blowing air only) prior to sale.

The most common call we get from homeowners regarding fall coloration is loss of year old needles on white pine, but every now and then someone calls absolutely panicked that "pines" are dying everywhere as tamarack loses its needles for the season. Some of these callers are almost impossible to convince that nothing is wrong. And this year a "serious" disease of Scotch pine in Winthrop turned out to be simply a heavy set of male (pollen) cones.

Nitrogen Deficiency - During the course of 1992 we had the opportunity to review nutrient analysis levels in the foliage of balsam fir grown for Christmas trees from many parts of the state. One of the nutrients most commonly deficient was nitrogen, which is critically important for tree growth, color, and bud set. Of the 34 separate foliage analyses we reviewed, 18 were deficient in nitrogen (below our standard of 1.75% N).

We quizzed growers with low N levels to determine how much fertilizer they were using and many were applying only about 20 pounds actual N per acre (equivalent to 200 lbs. of 10-10-10 per acre or about 2

1/2 oz. per tree). We normally recommend 60 pounds of actual N per acre, or about one oz. of 10-10-10 per foot of height for individually fertilized trees.

Growers should use foliage analyses to determine whether the rates of fertilizer they are using actually provide enough nitrogen under their conditions. Samples submitted to the Plant and Soil Sciences Analytical Lab (407 Deering Hall, University of Maine, Orono, Maine 04469) in late September or early October should show N levels between 1.75 and 2.0 percent. More is not necessarily better as excessive N levels appear to promote bud abortion.

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

Pine Needle Rust (caused by Coleosporium asterum syn. Coleosporium solidaginis) - We had no reports of this disease in 1992, though we did not specifically look for it. In 1991 the disease was spectacular in a few areas in young red pine plantations, but even when foliage is heavily infected this disease usually does not seriously damage trees.

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 certain 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.

Porcupine Damage (caused by Erethizon dorsatum) - Porcupine injury to plantation trees appears to have become more common in recent years. While their depredations of fir in some Christmas tree plantations continued apace in 1992, we had several calls where porcupines had wreaked havoc on ornamentals, especially hemlocks in landscape situations. And a three acre red pine plantation in Cambridge sustained damage so severe that its continued management for forestry purposes is probably no longer practical.

Root Injury (caused by planting trees and shrubs too deeply or placing fill over roots of established trees) - Planting trees too deeply is a common mistake to which even employees of reputable nurseries are not immune. But most of our root injury calls in 1992 were from homeowners who had set the root systems of transplanted trees well below the soil surface

where they received inadequate root aeration, or were the result of landscape changes where the grade was raised around established trees during landscaping. By the time we received most of these calls, it was too late to effectively apply remedial treatments.

Root Rot of Balsam Fir (caused by an unidentified fungus) - The incidence of root rot in balsam fir Christmas tree plantations continued to increase in 1992, particularly on old potato land in Aroostook County. This disease is frequently associated with wet areas in otherwise moderately well-drained fields. Typically trees have been outplanted for several years before symptoms became apparent. Affected trees exhibit reduced growth and off color for a year or two, then turn red or brown as they finally succumb. At this point root systems have deteriorated so far that trees can be easily plucked from the field by hand.

Until we learn more about the etiology of this disease and develop control procedures, growers should be wary of expanding operations on problem sites.

Salt Injury (caused by sodium chloride) - Usually the calls we receive regarding salt injury to vegetation are the result of road surface applications of deicing products particularly as road salt runs off to affect roadside sugar maples and certain evergreen species. But in 1992 the effects of Hurricane Bob, which actually hit Maine in August of 1991, caused several complaints of dead and browned shrubbery in the Camp Ellis area of Saco. Ocean water had flooded yards and streets surrounding residences during the height of the storm and yews in particular succumbed shortly thereafter in great numbers.

The damage was striking but the residents of that area are tenacious, resilient and determined, and by fall of 1992 most of the affected shrubbery had been replaced and was performing well.

Scleroderris Canker (caused by Ascocalyx abietina) - No new infestations of this disease were reported during 1992.

Sirococcus Shoot Blight (caused by Sirococcus conigenus) - This disease has been increasing in recent years, and seemed to be considerably worse than usual in 1992 in the Cathedral Pines area in and around Eustis. It was also a problem in certain nursery beds on blue spruce seedlings.

Sirococcus shoot blight has the potential to kill entire plantations of red pine trees once the disease becomes established and begins to spread within a plantation. Recent Canadian research indicates that pruning young and pole-sized red pine plantations may be an effective control procedure, but the results at this time are still regarded as preliminary.

Sphaeropsis Blight (caused by Sphaeropsis sapinea syn. Diplodia pinea) - This disease, primarily of two-and three-needle pines, seems to be increasing in severity in recent years, especially on red pine in mid-coastal areas. Plantation pines seem especially hard hit with symptoms ranging from tip blight to death of entire trees.

In ornamental situations Scotch, Austrian, pitch, and mugo pines are often infected but control is possible through timely application of benomyl or copper fungicides. This approach is impractical in forest plantations, however. Since the disease seems to persist indefinitely once it is established, moving the harvest date ahead may be the most practical remedy for severely infected plantations.

Spruce Needle Rust (caused by Chrysomyxa spp.) - The incidence of spruce needle rusts seemed to be up in 1992. We received specimens of red spruce from T13 R11 in Aroostook County and white spruce from the Cranberry Isles near Mt. Desert Island which were very heavily infected. Determination of the precise rust species responsible was made difficult by the fact that we were unable to visit either site to inventory or examine the alternate host species present. Sizes of fungal aeciospores and other spore characteristics are helpful in diagnosis, however, and we suspect that both Chrysomyxa ledi and Chrysomyxa ledicola were involved at both sites.

Stillwell's Syndrome or "Red Fir" (associated with Armillaria spp.) - Expression of this disease has generally declined since the mid-1980's in the wake of the spruce budworm epidemic but there was a slight resurgence in some areas in 1992. Spruce budworm defoliation placed considerable stress on fir during the past outbreak and where mature trees were not killed outright they tend to "hang on" in a weakened condition. But they are rendered more susceptible to certain root pathogens, most notably Armillaria species, and as they finally succumb to root infection trees die and turn red in color, hence the name "red fir."

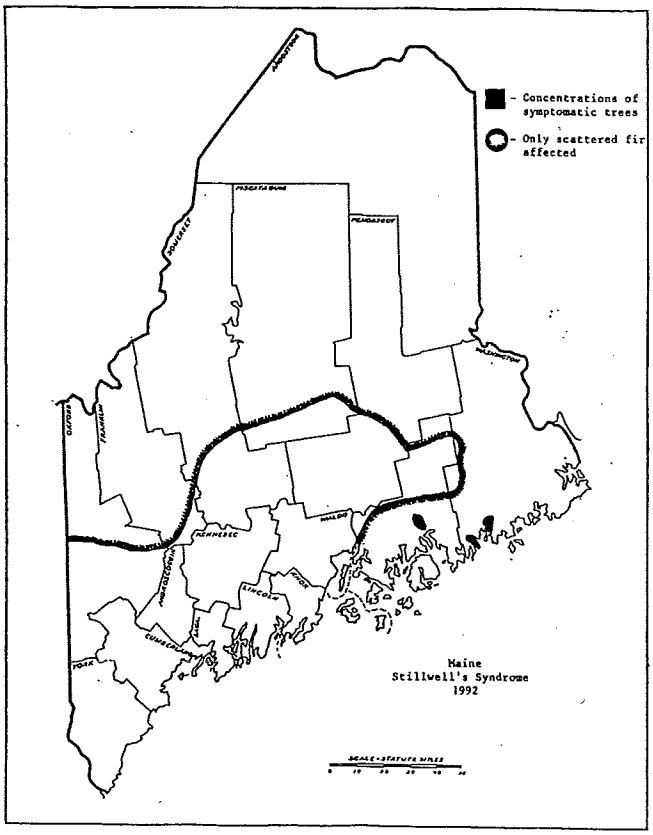


Figure 13

The reason for a resurgence last year in symptom expression of this disease is obscure, but it may be related to dry weather in 1991 which placed added stress on weakened trees. Most of this symptom resurgence was concentrated in or near areas where the budworm outbreak had declined the most recently, in certain coastal locales (Figure 13). In northern Maine Stillwell's syndrome was observed in its typical scattered pattern characteristic of recent years. Overall, losses of balsam fir to Stillwell's syndrome still appears to be less than 2% per year in affected stands.

White Pine Blister Rust (caused by Cronartium ribicola) - Though we continue to annually conduct a blister rust program to protect our white pine resource (see pg. 55), this disease generates a great number of homeowner calls as well-particularly as it affects landscape trees. In 1992 we had calls from homeowners in Portland, Brunswick, North Belgrade, and Richmond (among other locales) who had cankers in landscape trees. While our control program to protect the white pine resource does not extend protection to landscape trees, we can and do recommend pruning or excision of cankers from infected landscape pines to eliminate disease infections once they have occurred.

Our other calls related to white pine blister rust usually involve queries of quarantine aspects (see pg. 49), particularly where callers seek permission to plant currants and gooseberries at certain locales.

Wind Damage - Evidence of wind damage to trees was widespread in our forest health monitoring plots in 1992 (23 of 128 plots). Most of the damage reported, however, was probably residual damage resulting from Hurricane Bob in 1991.

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

92-9 Insect and Disease Management Division Augusta, Maine

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 287-2431 or 287-2791 .

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 287-2431 or 287-2791 .

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 287-2431 or 287-2791

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 287-3891 and the Insect and Disease Management Division of the Maine Forest Service, phone 287-2431 or 287-2791.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 7 - Feb. 1993

Gypsy Moth in Maine - 1992
Prepared by Richard Bradbury

Although gypsy moth populations remained at epidemic levels in 1992, there was a significant decline in the total acreage defoliated. Aerial surveys conducted in July delineated 278,485 acres of forested type which received some degree of defoliation this year, predominately in York and Cumberland counties (Figure 1). This was the first drop in acreage since the current outbreak began in 1988 (Table 1). Table 2 exhibits the defoliation acreages by county and by level of intensity. A reduction in defoliation was seen in all counties except York where 81% of the total damage occurred in 1992 (Figure 1).

Table 1
Total Acres Defoliated by Gypsy Moth in Maine
During the Current Outbreak (1988-1992)

Year	Acres Defoliated
1988	100
1989	34,280
1990	270,432
1991	620,933
1992	278,485

Table 2
Acres of Forested Lands Defoliated by Gypsy Moth
in Maine in 1992 by County

County	Low	Moderate to High	Total
Androscoggin	7,202	2,384	9,586
Cumberland	15,878	23,963	39,841
Franklin	0	87	87
Oxford	110	43	153
Sagadahoc	2,394	0	2,394
York	33,432	192,992	226,424
Totals	59,016	219,469	278,485

Overwintering mortality was minimal during the winter of 1991-92 with nearly 100% of the egg masses collected in March and April of 1992 exhibiting some degree of hatch. Egg hatch exceeded 75% in all samples taken from below the snow line. Egg parasitism by Anastatus disparis and Ooencyrtus kuvanae was commonly observed at egg mass collection sites, but not at levels sufficient to limit defoliation.

First hatch was reported May 1 in Arundel. The hatching period was extended in 1992 and complete egg hatch was not recorded until May 21, approximately seven days later than in 1991. The peak of the second instar occurred around June 6. Development sampling was done biweekly until June 22 when the mean larval index was 4.68. Pupation had begun in many locations in York County by July 1.

Larval mortality was very high within many heavily infested forest stands resulting in the complete collapse of gypsy moth populations in those areas. The principal pathogen in these epizootics appeared to be nucleopolyhedrosis virus (NPV), which causes a malady commonly referred to as "wilt disease." The larval fungal disease caused by Entomophaga maimaiga was observed in many locations, but did not appear to cause any widespread plunges in the population levels.

Parasitism of larval and pupal stages was examined in three locations - Wayne, Acton and Windham. Data resulting from this survey in 1992 are unreliable because all sample locations sustained heavy mortality caused by NPV. The high mortality within the larval samples caused by NPV reduced the sample size to such low levels that accurate assessment of the impact of parasitism was impractical.

The Maine Forest Service did not participate in the USDA-FS 1992 Cooperative Gypsy Moth Suppression Program. The lack of participation in the 1991 project led to a decision not to invest the time and money required to make this program available in 1992. A number of small privately funded control operations were conducted, primarily to reduce the nuisance associated with high populations and to improve tree appearance.

Pheromone trapping for male moths in townships lying along the quarantine line was again performed in 1992 utilizing 231 "milk-carton" traps baited with "plus" Disparlure. Trap catches increased from 1991 levels along eastern portions of the quarantine line, but were much lower than catches from the previous year along the western portion of the line. These results reflect the decline of the gypsy moth in south central Maine which would correspond to the western part of the quarantine line and the low to moderate numbers of gypsy moth in the east. Areas around the pheromone traps which had high catches of male moths were examined in October to determine if other life stages of the gypsy moth were present. None of the areas included in this survey revealed any additional gypsy moth life forms indicating that moths possibly flew or were carried in from infested locations or that the local populations were too low to be found.

Egg mass population levels were sampled in September and October, 1992 at 70 sites using fixed (one/two hundredth acre) and variable (10 BAF prism) plots at each site. The data collected show significant reductions in current overwintering egg mass (em) levels from those of last year, with only ten plots having over 500 em/acre. As would be expected from defoliation data, all but one (southern Oxford County) of the high overwintering sites were in York County (Figure 2).

In November 1992, towns were contacted to inform them of the intensity and location of defoliation in their respective towns. So far, requests for additional information have been light but in the past interest has increased in March.

In summary, the gypsy moth populations and corresponding defoliated acreage fell substantially in Maine in 1992. Given the high incidence of NPV-caused epizootics which occurred in 1992, current populations are not healthy in many locations. In spite of the general decline and poor health of the population, the high number of overwintering eggs in York County indicate some degree of damage will occur in southern portions of the state in 1993.

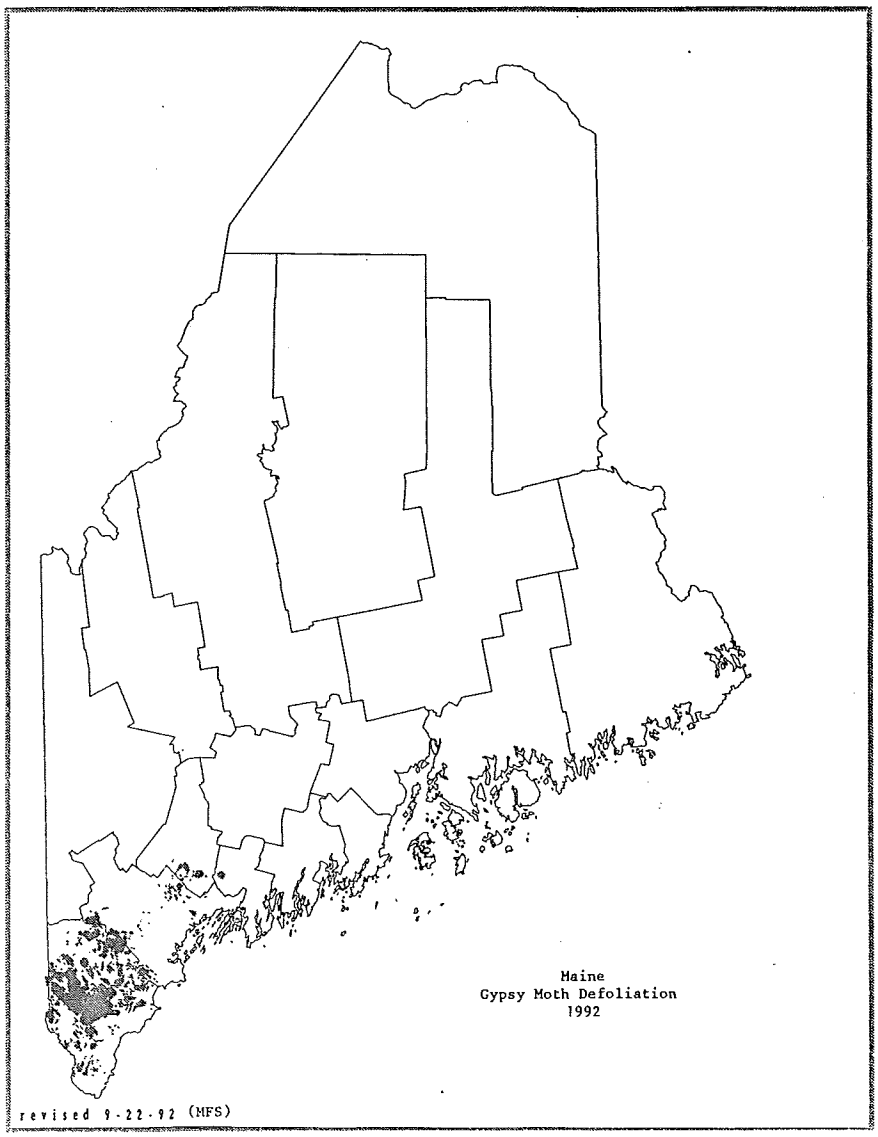
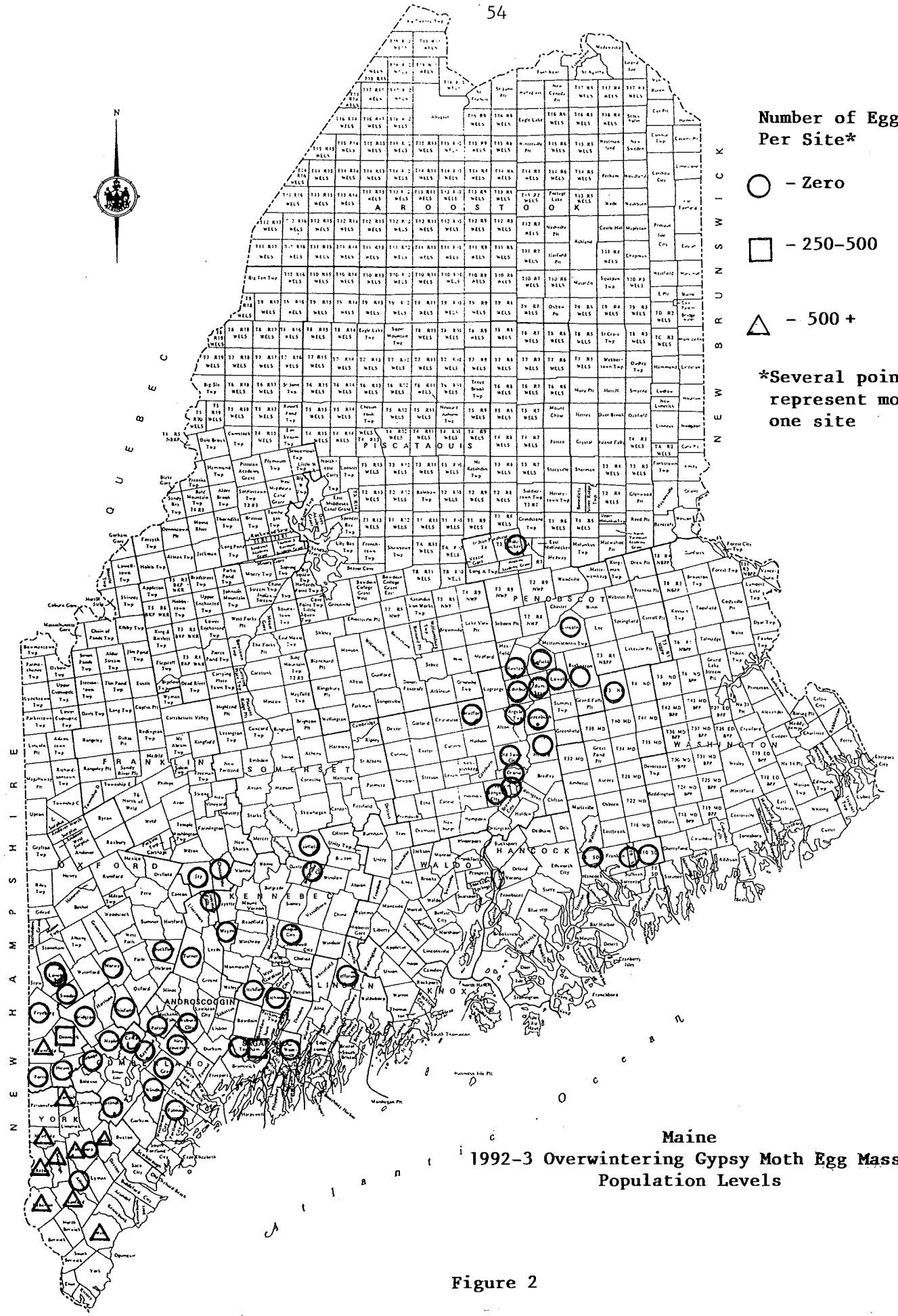


Figure 1

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 7 - Feb. 1993



Maine
1992-3 Overwintering Gypsy Moth Egg Mass Population Levels

Figure 2

White Pine Blister Rust Control Program - 1992
Clark Granger

The Maine Forest Service has annually conducted a white pine blister rust control program since 1917, the year after this disease was first detected in Maine. While there have been many program refinements, the basic approach has remained the same. That has been to eliminate (eradicate) the alternate host plants of this disease (currants and gooseberries) wherever they occur within infective range of commercial quality white pine trees, and to maintain a quarantine against the importation and cultivation of susceptible alternate host plants. (See Forestry Related Quarantines in Maine pg. 49).

For reasons of economy and efficiency, the MFS does not attempt to directly protect white pine in all sections of the state and instead concentrates its limited funds in areas where most commercial white pine occurs (generally the southern half of the state). Within this area certain sections are targeted for control efforts each year based upon the quality of pine to be protected, proximity of the pine areas to blister rust scouts hired for that season, and availability of recent aerial black and white and infrared photo coverage. During 1991 currants and gooseberries (ribes) were scouted and eradicated in the following municipalities:

Biddeford	Otisfield
Falmouth	Oxford
Harrison	Saco
Naples	Sebago
Norway	South Berwick

The towns of Falmouth, Harrison, and South Berwick were only partially scouted in 1992, and will be the towns where 1993 scouting will commence. The other towns have been completed for this cycle.

Eradication (destruction) of ribes plants was accomplished through application of Tordon RTU, a herbicide applied at the rate of 8 oz. per gallon of water using non-powered spray equipment. The total amount of undiluted Tordon used in 1992 was 144 oz. (9 pounds). This was adequate to eradicate 3,200 individual ribes plants on 8,977 acres. Actual pine acres protected totalled 4,272, an effort which required 820 person hours of labor.

This control program is expected to continue in 1993, and areas to be scouted have already been delineated on aerial photographs for use by the scouts.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report 7 - Feb. 1993

THE HEMLOCK LOOPER IN MAINE - 1992 and a FORECAST FOR 1993

Prepared by
Henry Trial Jr.

Introduction

Heavy to severe defoliation by hemlock looper, [Lambdina fiscellaria (Guen)], increased in Maine every year since defoliation was first mapped in 1989 (450 acres) until 1991. In 1992 acreage finally declined from the 1991 peak. In 1991, high egg densities and excellent survival of larvae throughout the feeding period resulted in 225,000 acres of heavy to severe defoliation. Egg density measured in the fall and winter of 1991 indicated reductions in outbreak severity in some areas but overall for 1992 a defoliated area only slightly (10 to 20%) smaller than the 1991 area was expected.

Although expected larval numbers were found during early season surveys, weather conditions in 1992 resulted in larval survival that was much lower than in 1991. Weather conditions that were good for infested trees and poor for larval survival resulted in a significant decrease in the predicted severity and extent of defoliation. Many areas, where heavy defoliation was predicted, received only moderate damage. A significant area, mostly in eastern Maine, did have heavy to severe defoliation but even in this area defoliation on 1992 needles was less than expected. Another closely related species of hemlock looper, L. athasaria, that is causing damage elsewhere in New England has been a problem in southwestern Maine but is currently at very low population levels.

Surveys of the hemlock looper infestation and technical assistance to industrial and private owners of looper damaged forest land required a considerable time commitment by the Maine Forest Service (MFS), Insect and Disease Management (I&DM) Division in 1992. Activities included expanded egg sampling in areas where spraying or accelerated harvest was considered, a survey of early larval densities to confirm egg predictions, assessment of larval development over time to help calibrate spray timing for numerous small control projects, and evaluation of the Bureau of Public Lands spray area. Looper moth activity was monitored using pheromone and light traps, aerial and ground surveys of defoliation were conducted, and an egg survey to predict 1993 damage was completed.

In addition, the MFS participated in three cooperative projects involving looper that were partially funded by focus funding grants provided by the U.S. Forest Service, Forest Health Protection. These projects were improvement of hemlock looper egg processing laboratory facilities at Old Town, assessment of the impacts of the current looper outbreak on affected host trees, and morphological comparison of larvae of the two looper species (L. fiscellaria and L. athasaria) currently causing defoliation in New England.

Larval Development

Seasonal development of hemlock looper larvae was tracked throughout the summer of 1992 to provide information to those interested in surveying or controlling looper populations. These data will also add to the historical record of this outbreak.

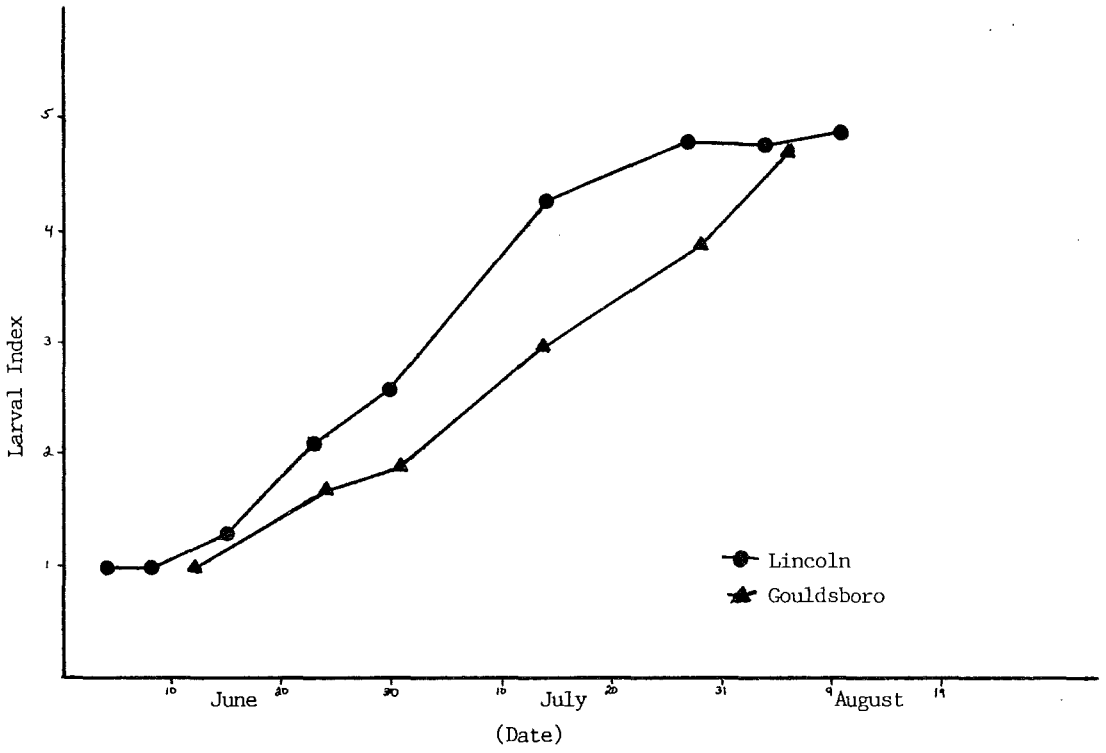
Development samples were collected periodically, from egg hatch through moth emergence, from two locations; in central Maine at Lincoln and on the coast at Gouldsboro. Additional development collections were made from several sites near planned spray areas. When larval development near these spray sites approached the spray threshold, the frequency of development samples was increased; following treatment sampling in these areas was discontinued. Larvae for each development sample were collected from branches of 3 to 5 overstory and 3 to 5 regeneration host trees (hemlock everwhere except Gouldsboro, where fir and white spruce were used). Larvae were placed in a vial of alcohol and taken to Old Town for instar determination. At the Lincoln site populations were high and only a small portion of each branch was needed to obtain 50 to 100 larvae. Although larval populations in Gouldsboro started fairly high, by the end of July populations had declined to the point that it was difficult to collect 50 larvae; by mid August larvae were very scarce everywhere in the stand. Ten samples were taken at the Lincoln site and eight from Gouldsboro during 1992.

A larval index was calculated for each site and date by multiplying the number of larvae per instar by the number of the instar and then dividing by the total number of larvae. For example, 25 1st instar plus 25 2nd instars would give an index of 1.5 (25x1 +25x2 = 75 /50 = 1.5). The ten development samples collected from Lincoln and eight samples from Gouldsboro in 1992 were graphed to show the progression of development over time (Figure 1).

The first egg hatch observed in 1992 was in Lincoln, Lakeville, and T4 ND on May 28. Very few larvae were seen, indicating that hatching had just begun. Larvae were very small and dark, indicating that they had hatched within a day of the observation. Hatch in the Lincoln area was approximately a week later than in 1991 and occurred about

the same time as the Lincoln egg hatch in 1989 and 1990. Development patterns for the 1992 season in central Maine areas were very similar to those seen during 1989 and 1990 and about a week slower than the 1991 development.

Figure 1. Hemlock Looper Larval Development Index for Lincoln and Gouldsboro Maine - 1992



The beginning of egg hatch was much later in coastal areas than that observed in Lincoln. Samples collected from Gouldsboro and other coastal areas between June 3 and June 5 had no evidence of egg hatch. A few scattered newly hatched larvae were found in coastal areas on June 9, and 63 first instar larvae were found in a Gouldsboro development sample on June 12. Development in coastal areas lagged behind the Lincoln area by 10 to 14 days throughout the entire 1992 development period.

Cool and wet weather in June and July resulted in slower than normal larval development for looper in 1992. Adverse weather conditions had the greatest effect along the coast and may have even delayed moth emergence to a point where mating and egg deposition were affected. Moths began to emerge in late August and early September and peaked in mid September in central Maine. Few moths were seen along the coast, however, until late September and moth activity there persisted well into October. Adverse coastal weather also seemed to lower larval survival.

Larval Observations

Population predictions generated from overwintering egg densities were checked in the spring of 1992 using a larval beating survey. Resources were not available to check all areas covered by the general egg survey, but many areas where landowners had expressed an interest in the looper infestation were checked. The method for this survey was similar to procedures used in Newfoundland. A meter square beating frame (a wood frame with white cloth stretched over the frame) was held under a single meter long branch on the sample tree. The branch was then beaten with a stick to dislodge larvae, which would fall to the cloth. The larvae were then counted to assess population density. This was done on three trees in each area sampled. While this method has limited precision, results seemed to reflect egg counts. Samples taken in areas where egg counts predicted low defoliation rarely produced larval counts exceeding 10 larvae per branch, whereas counts in high egg density areas usually exceeded 50 larvae per branch. Several areas with egg counts in the severe category had larval counts greater than 100 and some counts exceeded 200 larvae. In areas of moderate egg density, larval count ranging from 14 to 120 larvae per branch. Moderate egg densities produced the most variable larval counts.

Larval survival is difficult to assess for hemlock looper because larvae are very mobile and are easily dislodged from branches by wind and rain or during the sampling process. Larval counts from tree mid crowns are much lower immediately after a heavy rain than after a day without wind or rain. When large numbers of larvae are dislodged from the tree, the time necessary to climb back up the tree is highly variable. Also, many larvae are lost during this type of event. These sampling problems favor observations about survival over a predetermined and scheduled series of samples.

Larval survival was considerably higher in 1991 than it had been in 1989 and 1990 largely due to excellent weather during the 1991 development period. However, in 1992 weather conditions affecting looper development and survival were very adverse. For 1992 larval survival from the first to the fifth instar was estimated at from four to ten percent (versus 14 - 23 % in 1991), and represents the poorest survival seen during the current outbreak.

The primary reason for this decreased survival was probably the very cool, wet, and windy weather in 1992. Several wind and rain events occurred in 1992 that knocked larvae to the ground. Each time this occurred, many larvae were unable to regain a suitable feeding site and were lost.

Another factor known to significantly affect looper survival is disease. Larvae were not cultured for disease organisms in 1992 but populations were checked for obviously sick larvae or dead larvae. Very few sick or dead larvae were observed in central Maine but numerous dead larvae were reported from the area of the Gouldsboro development site.

Defoliation

An aerial and ground survey of 1992 hemlock looper defoliation was completed in late December and a generalized map of the area showing moderate (detectable, but <50% total defoliation) and heavy to severe (>50% total defoliation) damage was prepared (Figure 2). Heavy to severe defoliation was mapped on 68,074 acres and 150,000 acres received moderate defoliation. Most of the area were defoliation was noted in 1992 had been mapped as heavy to severe defoliation in 1991. Only about 5,000 acres of heavy to severe defoliation was mapped in new areas, mostly near Millinocket and Grand Falls. As in 1991, areas mapped in inland regions and coastal areas west of the Penobscot River contained predominantly hemlock. Areas mapped on the coast, east of the Penobscot and along the St. Croix River were predominantly fir. Figure 2 is only intended to show the general location of the 1992 looper damage. The MFS also prepared more detailed site specific maps that were sent to each municipality in the affected areas.

The 1992 defoliation survey was extremely difficult to conduct, requiring extensive ground observations to confirm aerial observations and complete. Looper larvae start feeding on new needles but soon change to older foliage and remain there until nearly all the old needles have been consumed. Early depletion of larvae due to poor survival in 1992 meant that in most areas surviving larvae were able to complete development on old needles and very little new growth was damaged. Damage on new needles was not sufficient to show from the air, and damage to old needles, even when severe, was hidden by new needles.

Many areas that lost more than 80 percent of their old needles and about 20 percent of their new needles (greater than 50 percent of their total foliage) could not be reliably identified from the air as having current damage. These trees appeared thin and off color in many cases but aerial observers could not determine whether the damage was caused in 1991 or 1992. Ground checks were needed in these areas to determine the time of defoliation. The need for ground checks, and some reevaluation from the air, extended the defoliation survey effort well into December.

Most of the acreage classified as heavy to severe defoliation was hemlock type found in east central Penobscot, northern Hancock, and central Washington Counties. Much of

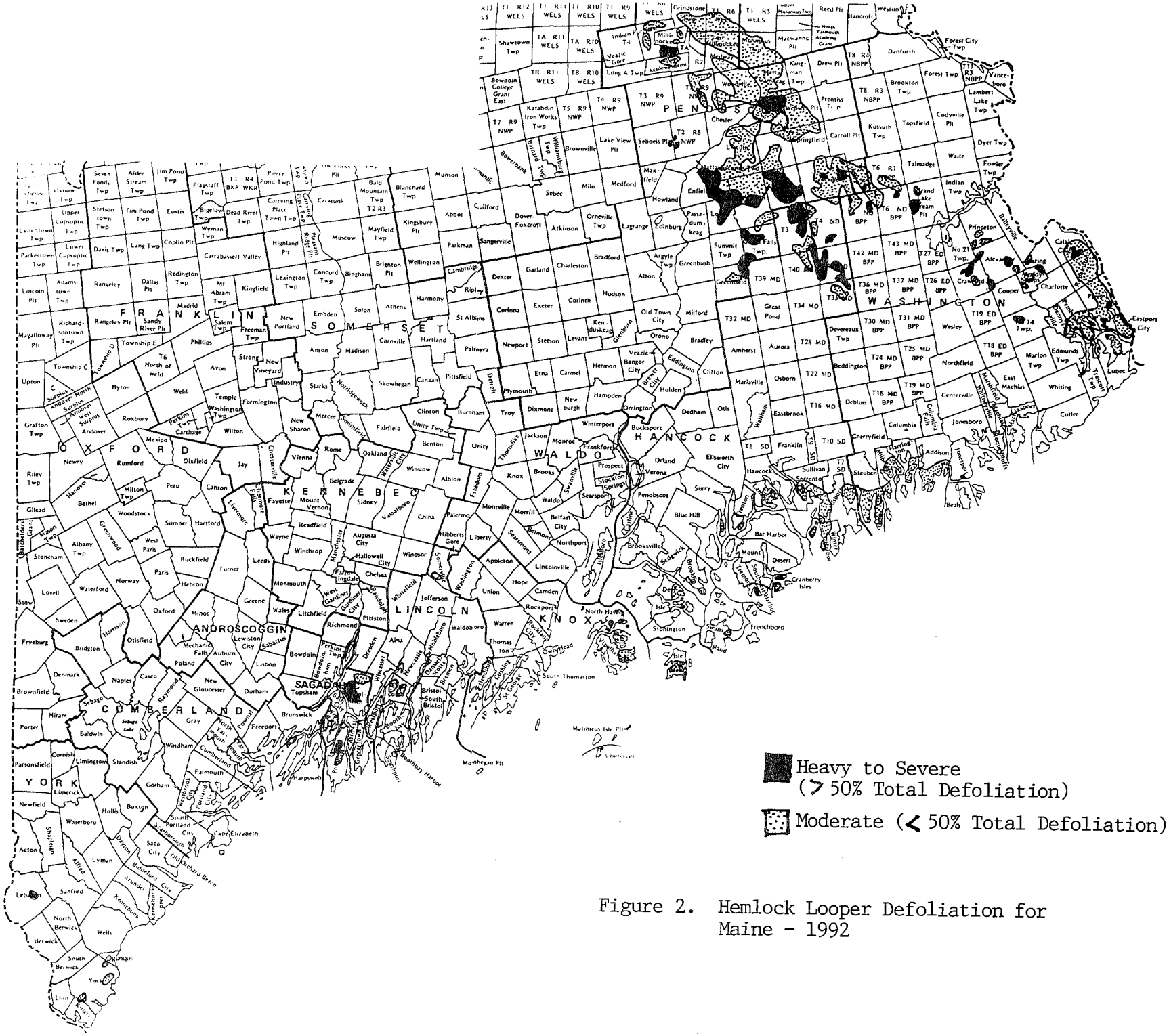


Figure 2. Hemlock Looper Defoliation for Maine - 1992

the area had received heavy damage in 1991 but new areas and expansions of some old areas were found. Part of this heavy to severe area was easily detectable from the air but other areas were added after ground checks revealed heavy 1992 defoliation to old needles.

Scattered small areas of heavy to severe defoliation were mapped near the coast and on islands from York to Washington Counties. Damage in stands west of Penobscot Bay was on hemlock whereas fir and white spruce were the affected hosts east of Penobscot Bay. The most heavily damaged coastal areas were near Bath in Sagadahoc County, and on points and islands in Hancock and Washington Counties.

Light Trap Survey

In 1992, the light trap operating period for 11 of the light traps in the MFS, I&DM Division's network (Figure 3) was extended into the fall to include the hemlock looper moth flight period. In 1991 nine of these traps had been operated during the month of September but some moth activity was noted in late August so in 1992 the operating period was moved up to August 17. It was hoped that this earlier date would capture any early moths and more fully evaluate the flight period. The choice of light trap locations to be extended was based on actual and potential looper defoliation in Maine and surrounding jurisdictions.

Hemlock looper moths were caught in all 11 light traps operated in 1992 (Table 1). Only two of the traps had a high moth catch (>300 moths in the season). The highest catch was at the Calais trap on the eastern border that caught 1,416 moths. This trap had caught over 5,000 moths in 1991. The other high catch (403 moths) was at the newly established South Berwick location in southwestern Maine. Moderate moth catches (70 to 299 moths) were seen at three sites; North Bridgton, Topsfield, and Washington. All other locations had low catches (<70 moths).

The majority of the moths trapped in 1992 were caught in mid September. Only three traps caught moths in August and of these only South Berwick caught a significant number of moths in August. The two southernmost traps, South Berwick and North Bridgton, had prolonged moth activity periods that lasted nearly the entire month of September and, in South Berwick, part of August. At one trap on the eastern coast, Steuben, nearly all the moths captured were caught at the end of September. Development was very slow in this area and moth activity was noted well into October. Late development in 1992 resulted in late moth emergence statewide but emergence on the eastern coastal area was especially late and may have affected mating and egg laying success.

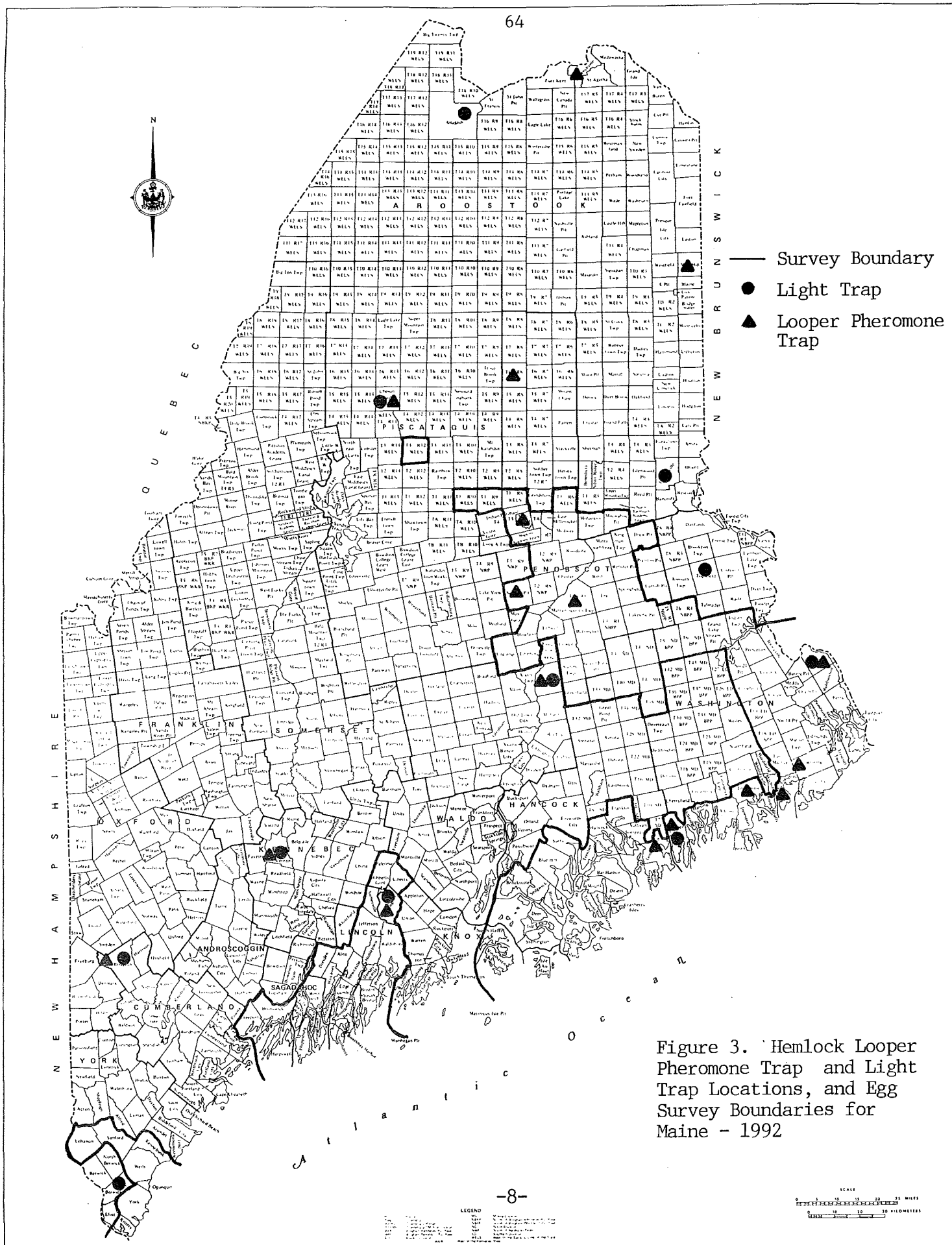


Figure 3. Hemlock Looper Pheromone Trap and Light Trap Locations, and Egg Survey Boundaries for Maine - 1992

Moth catches from all traps were examined to determine the sex ratio of the catch. In 1992 all eastern Maine traps caught many more females than males; southern Maine traps, caught many more males than females. These ratios match the 1991 pattern. Reasons for this apparent regional variation are unknown.

Table 1. Hemlock Looper (Lambdina fiscellaria) Light Trap Moth Catch Totals - Maine 1992*

Trap Location	# Males Moth Caught	# Female Moths Caught	Total # Moths Caught
Allagash	5	4	9
Calais	78	1,338	1,416
Chesuncook	11	5	16
Greenbush	2	4	6
Haynesville	3	2	5
Mount Vernon	9	25	34
No. Bridgton	93	15	108
So. Berwick	244	159	403
Steuben	8	21	29
Topsfield	35	50	85
Washington	63	10	73

*Light trap data provided by Dan Pratt - MFS, I&DM, Augusta

Moth Trapping With Pheromones

In 1992 the MFS used, for the first time, traps baited with hemlock looper pheromone to test their usefulness for evaluating moth abundance. Three looper pheromone baited traps were placed in a triangular pattern at each of 18 locations (Figure 3). Locations were selected to evaluate a wide range of looper infestation conditions ranging from no known population conditions in the trapping area to very high levels of infestation. No attempt was made to cover the known infested area with traps.

The mean moth catch per trap in areas assessed in 1992 (Table 2) ranged from 239 near Gardner Lake (Whiting) in southeastern Maine to two moths per trap at Frenchville in the northeastern part of the State. Four locations near known areas of heavy looper defoliation had counts over 170 moths per trap. Two locations that had no known heavy defoliation nearby also had high moth counts. These two areas were, however, downwind of known heavy areas. Two areas that had experienced heavy defoliation in 1991 (Lincoln and Gouldsboro) but showed population declines in 1992, had relatively low moth catches. All traps placed in central and southern Maine caught at least 20 moths per trap. Moth catch

was lowest in northern Maine but the location closest to a known infestation, Estcourt, did catch an average of 15 moths per trap.

Table 2. Hemlock Looper (Lambdina fiscellaria) Pheromone Trap Moth Catch Totals - Maine 1992

Location	# Hemlock Looper Moths/Trap
Bucks Harbor	226
*Calais	263
*Chesuncook	58
Estcourt	15
Frenchville	2
Gouldsboro	54
*Greenbush	173
Jonesboro	74
Lincoln	53
Mars Hill	8
Millinocket	236
*Mt. Vernon	20
*No. Bridgton	37
Seboeis Plt.	59
*Steuben	195
T6 R8	61
Whiting	239

*Indicates proximity to light trap

The MFS does not have enough data to relate pheromone trap catches to other life stages such as the 1992 egg densities or 1993 larval populations. The MFS is likely to use a low level of pheromone trapping again in 1993 to study the value of this survey as a predictor of population levels.

1992 Predictive Egg Survey

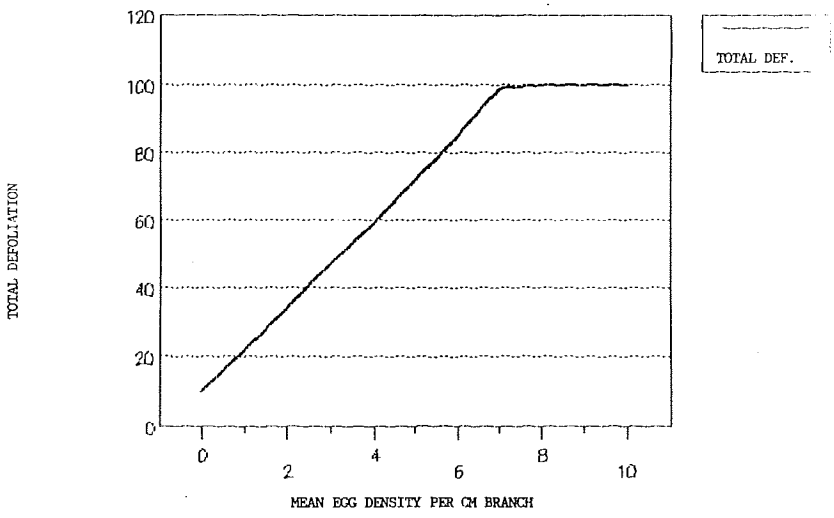
The MFS conducted a survey of hemlock looper egg density in 1992 in and near areas of defoliation to provide a generalized defoliation prediction for the infested area and to determine population trends throughout the state. To accomplish these general goals, a relatively low density sampling format of one or two sample points per infested town was considered adequate. Sample density was increased in many areas where landowners requested or were expected to request more information in order to make looper management decisions.

The 1992 survey began in early November and was not completed until January 30, 1993. The extended survey period was due to a shortage of Division resources.

The egg sampling method was the same as that used in 1990 and 1991 except that sampling branches from regeneration trees was discontinued. Data from an MFS study of egg density versus defoliation, (Trial and Trial, 1992)* showed that this change could be made without decreasing sample accuracy. Branches from overstory trees (three) were collected at each sample site from either hemlock, balsam fir, or in a few locations white spruce. Branches were taken to the MFS laboratory facility at Old Town and eggs were counted using an egg washing method developed in Newfoundland and modified for use in Maine. The average number of eggs per branch from the three branches was used to predict 1993 defoliation.

The new set of egg density and defoliation data collected during the 1991 study was used to develop a new predictive egg density to defoliation relationship (Figure 4) that was used for this predictive survey. This new relationship was similar to the relationship developed in 1990 but it does show that somewhat fewer eggs are needed to produce the various levels of defoliation. The new relationship was based entirely on overstory branches which allows for the elimination of regeneration branches from the sample. Because it was developed from data that covered a full range of egg densities and a large geographical area, it is thought to be more accurate than the previous relationship.

Figure 4. Predicted Total Defoliation on Hemlock based on Average Mid-crown Egg Density per 100 cm Branch



*Trial, H. and J. G. Trial. A Method to Predict Defoliation of Eastern Hemlock [Tsuga canadensis (L.) Carr] by Eastern Hemlock Looper [Lambdina fiscellaria (Gn.)] using Egg Sampling. Me. Dept. of Conserv., For. Serv., I&DM Div.. Tech. Rep. No. 31. 12pp.

The efforts to develop a predictive survey method have shown that many factors other than egg density can have profound impacts on the amount of defoliation ultimately realized in an area. Factors such as the amount of foliage available, number of years looper has been in an area, stand site quality, weather conditions the next season, and whether the population in an area is healthy can greatly affect defoliation.

Boundaries of the 1992 egg survey are shown in Figure 3. A total of 288 samples have been collected and processed to date, making the 1992 survey approximately 32 percent smaller than the 1991 survey and approximately the same size as the 1990 survey. The decrease in the size of the general survey was due to a significant decrease in the extent of heavy to severe defoliation in 1992 and by the decision to reduce general sample density to one collection per town in many areas.

Egg density measured during the 1992 survey is summarized on a map (Figure 5) to show population trends and the location of the higher egg density levels throughout the state. This egg density map was used in combination with the aerial defoliation map to predict the potential level of damage expected in 1993. Past defoliation was considered because experience with the present hemlock looper infestation has shown that the ultimate level of 1993 defoliation will depend significantly on the level of 1992 defoliation.

The actual level of defoliation experienced in 1993 will be highly dependent on larval survival, weather conditions, and natural population collapses due to disease. Obviously, good weather for larvae and high survival will increase defoliation as will drought conditions, which stress host trees. A rapid buildup of disease organisms that control looper population could cause rapid population collapse and low defoliation even in areas of high egg density.

During the current hemlock looper outbreak the MFS has observed extreme variability in egg density within individual towns and at times even within the same stand. Because looper population densities are so extremely variable, it is very likely that areas on the general map that are shown as heavy will have light areas and areas depicted as light may have patches of heavy defoliation in 1993. The best description of the map categories is probably, "areas where the majority of susceptible stands are expected to receive the defoliation specified". To attain a reliable prediction of expected defoliation for a potential spray block or to influence management of a parcel of commercial forest land, a much higher sample density would be required.

The largest area of high and extreme egg density evident from the 1992 egg survey is a band of forest, five to 15

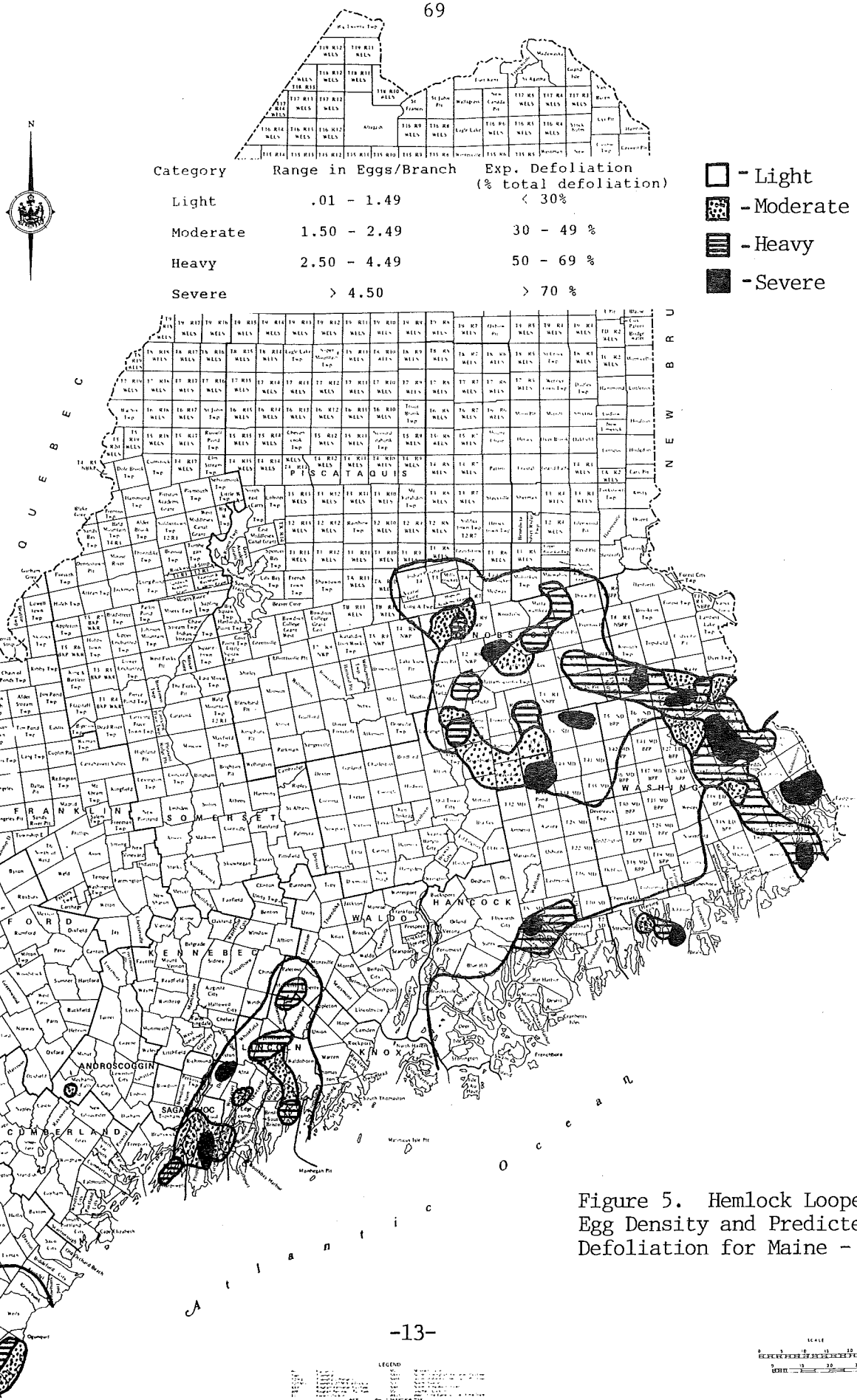


Figure 5. Hemlock Looper Egg Density and Predicted Defoliation for Maine - 1992

miles wide, stretching south east from east central Penobscot County to the eastern Washington County coast. The affected host on the western end of this band is hemlock and fir is the most common host in the east. Some stands near Calais contain both fir and hemlock.

Large areas of mixed moderate, heavy, and severe egg density found in central Penobscot County in 1991-92 decreased in size considerably in 1992-93. Smaller areas of heavy and severe egg density were found in the general vicinity of Lincoln. Significant new areas of moderate and heavy egg density were found south of Lincoln along the Penobscot River and in the Greenfield area. These areas had low egg densities in 1991-92 and did not receive serious defoliation last season.

A significant reduction in egg density was noted in coastal sections of Hancock and Washington Counties in the 1992-93 survey. Looper caused serious defoliation and significant mortality to fir and spruce in this region in 1990 and 1991. However, damage decreased in many areas in 1992 and the forecast for most of the region is for low populations for 1993. Small areas of heavy to severe populations remain scattered through the region. A larger area of heavy population was found a short distance from the coast near Franklin.

Populations in the Bath area are predicted to be moderate to severe in 1993 and looper may cause significant damage in stands that were hard hit in 1991 and 1992. An unexpected development seen in this year's egg survey was the reoccurrence of heavy populations in parts of Lincoln County. Populations in this area were thought to have collapsed after severe defoliation in 1989 and 1990. Egg density in Lincoln County was very low in 1991.

Areas of moderate to heavy egg density in York County seem to have expanded even though the area did not receive much heavy defoliation in 1992. Many areas like York County, where poor weather conditions in 1992 protected stands temporarily continue to have damage potential from looper.

Impacts

Two studies of the impact of the current hemlock looper infestations on host trees are underway. The larger study began in 1990 and has 36 assessment locations in Maine, New Hampshire, Massachusetts, and Vermont. Maine has 26 of the survey areas and is evaluating impacts of L. fiscellaria on hemlock (21 sites) and on spruce fir type (5 sites). The other New England states have a total of 10 sites, all hemlock, and all were attacked by L. athasaria.

The other impact study in progress is designed to evaluate damage by looper in "worst case" sites in Maine. The most severely impacted sites in Maine were not well represented in the initial impact study due to the spotty nature of the heavily damaged areas and because two of the plots in the original study that were heavily damaged were salvaged. In this "worst case" study, several of the most severely damaged areas were mapped from the air and were subsequently surveyed on the ground to determine the extent of looper impacts. When losses in this type of area are determined, total impacts can be calculated by expanding losses over similar areas mapped aerially. Most areas salvaged because of looper damage had similar damage as that seen in this study and could be added to the total impact figure.

Neither impact study has progressed enough to provide quantitative results. Data from the "worst case" study should be available by the spring of 1993. Complete results from the larger study will take longer to process. However, some general observations can be made based on an interim data assessment prepared in 1992.

In general, the most severe impact of the current looper infestation will be very spotty and unlike spruce budworm, heavy losses are not likely to occur over large areas. Looper caused mortality to hemlock seems to be extremely localized, and poorly understood factors like water stress, stress from partial harvesting, and sites near water (islands, points, and shoreline) that might concentrate looper populations seem to determine the extent of mortality in an area. Most forest stands that do not have one or more of these stress factors seem to have survived the present outbreak with minor top dieback and intermediate tree mortality.

If in 1992, as in 1991, weather had been favorable to looper larval survival the impact picture might have been very different. The impact of a specified population level on host trees varies considerably depending on weather and other factors prevalent during the feeding season. The warm and very dry conditions seen in 1991 resulted in much higher levels of damage in high population areas than during any other period of the current looper outbreak. Considering the high larval numbers early in 1992 and the reduced foliage compliment resulting from 1991 defoliation weather conditions favorable to looper larvae in 1992 would have resulted in the death of many stands that are now surviving.

Despite an apparent reprieve in looper damage due largely to cold wet 1992 weather, impacts in many areas were still significant. In central Penobscot County many hemlock stands were damaged so badly by the fall of 1991 that landowners rescheduled harvest plans and in many areas began

immediate salvage. Nearby stands that were not harvested show significant hemlock mortality.

In central Penobscot County and southern Washington County several residential and recreational property owners experienced heavy losses of hemlock and young fir trees near their homes and camps. Some owners were able to spray their land with Bt. (Bacillus thuringiensis) and thus avoid heavy losses but these owners were in the minority. Many owners will be faced with expensive or time consuming cleanup efforts.

Landowners in coastal areas of Washington, Hancock, and Sagadahoc Counties also lost many trees to looper around their homes and camps. Most hard hit areas were on the shore, on points, or on islands. Losses in these areas were focused on young fir and white spruce trees although large mature white spruce killed in some areas. In Sagadahoc County mature and young hemlocks were killed.

In eastern Washington County several stands of young balsam fir were killed or heavily damaged by looper. Many of these stands were used to produce balsam fir tips for wreath making but looper damage in 1991 and 1992 will prevent tipping on survivors for several seasons. Some Christmas tree growers in Washington and Hancock Counties had to treat their plantations to prevent significant damage by looper.

Hemlock Looper Management Activities

Both industrial and small private landowners, affected by the current looper outbreak, have been very active in management of this pest's impacts to reduce losses. Most industrial landowners have attempted to reduce losses by salvage cutting and adjusting cutting plans. Large landowners have first selected the worst of their infested land by examining MFS or their own aerial defoliation maps and the MFS general egg density survey. Based on these data and company cutting plans, landowners have selected stands where specific population and damage samples are necessary to refine their looper management strategy. Industry staff have collected looper egg and damage samples which are examined and evaluated by the MFS. Landowners have used these evaluations to shift normal harvesting or salvage cuts to areas where looper represented a significant threat to the forest.

Control of looper damage by spraying was again employed successfully in 1992 by several owners of residential or recreational property. Generally these private owners are primarily concerned by the effect of looper mortality on property values and aesthetics. Several property owners in coastal Maine and others with lots on inland lakes are planning spray operations in 1993. Because most affected

residential properties are near people and water, the biological agent Bt. is recommended for these treatments. Properly timed and executed Bt spray treatments proved successful in 1991 and 1992. Individuals considering spray control are generally dependent on the MFS for survey information, data evaluation, and spray timing.

Another important aspect of looper management on residential land is the removal of trees killed by looper. On many properties, especially on coastal islands, these dead trees represent a significant fire hazard. Removal of looper killed trees can be expensive to some owners.

Some owners of looper infested forest land will decide to do nothing to lessen impacts. Considering the unpredictable and spotty nature of looper mortality, some of those who choose not to attempt to manage impacts will be successful.

Future Plans

Several areas of heavy to severe egg density remain scattered throughout the southern half of Maine and good weather in 1993 could result in a looper resurgence in many areas next summer. In general, however, the looper outbreak in many parts of Maine shows signs of collapse in the near future. Overall, the area of heavy to severe defoliation in 1993 is likely to be smaller than the 1992 area and major new areas are not expected.

MFS surveys and evaluations of the looper populations, damage, and impacts will continue until the outbreak subsides. Technical assistance will be provided to affected industrial and private landowners. Processing and evaluations of site specific egg and damage samples should be completed by March and recommendation on management options will be forwarded to the various individuals and companies. The MFS will assist individuals and groups in planning, timing, and implementing spray projects for June of 1993.

Impact studies on established plots and other selected damaged areas will continue. A report on two years measurements of 26 permanent impact plots will be available in the fall of 1993. This study is partially supported by a U.S. Forest Service grant.

Finally, the MFS will continue to observe and evaluate all aspects of the current hemlock looper outbreak. This includes evaluation of biological observations made in Maine and other affected jurisdictions to better understand the outbreak.

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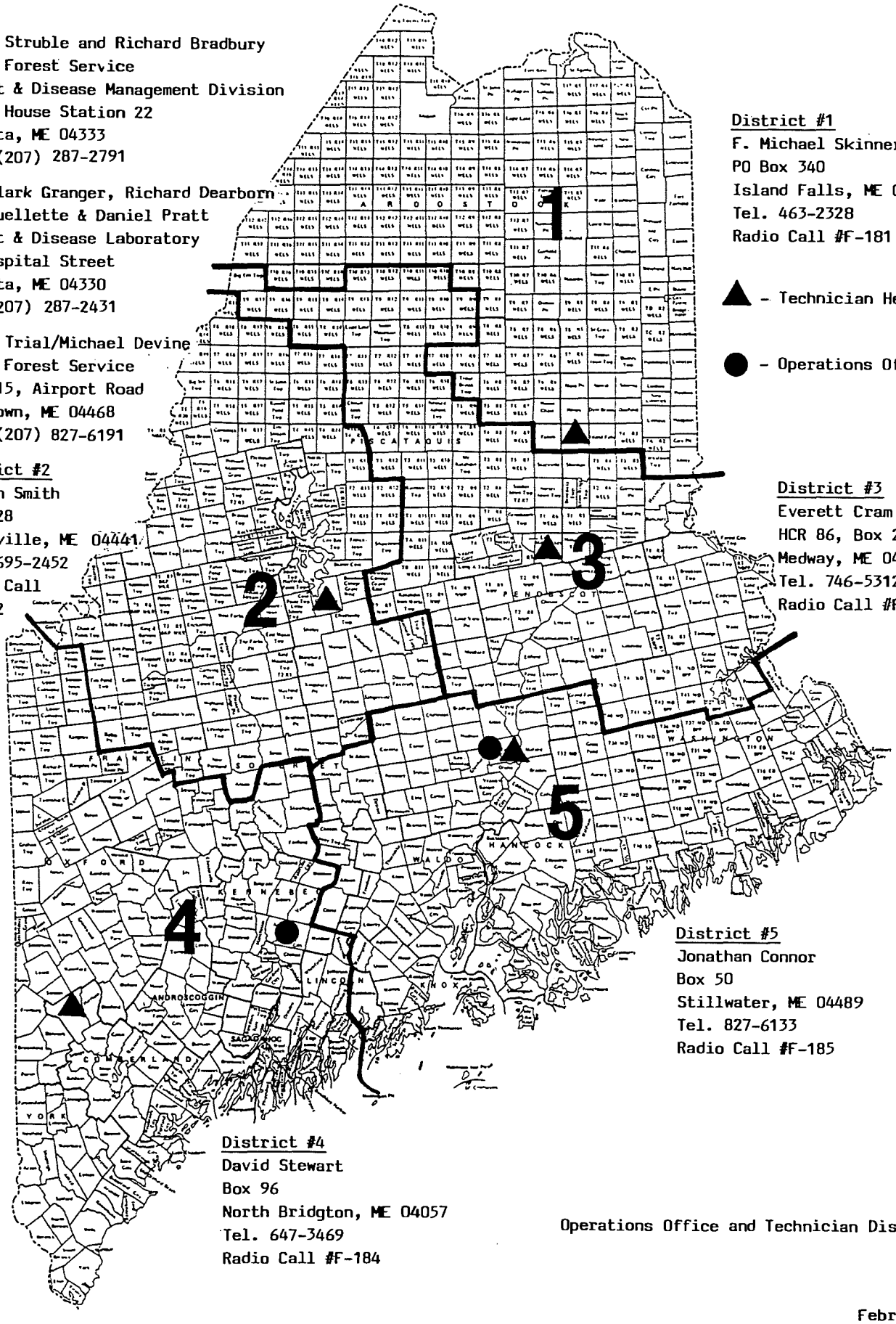

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