Forest & Shade Tree Insect & Disease Conditions for Maine

Summary 2016

Maine Forest Service

MAINE DEPARTMENT OF AGRICULTURE CONSERVATION & FORESTRY

Augusta, Maine

Forest Health & Monitoring
Summary Report No. 27

September 2017

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Online version of this report available from:
http://www.maine.gov/dacf/mfs/publications/condition_reports.html

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Forest Insect & Disease—Advice and Technical Assistance

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Phone: (207) 287-2431
http://maine.gov/dacf/mfs/forest_health/index.htm

The Maine Forest Service/Forest Health and Monitoring (FH&M) program maintains a diagnostic laboratory staffed with forest entomologists and a forest pathologist. The staff can provide practical information on a wide variety of forest and shade tree problems for Maine residents. Our technical reference library and insect collection enables the staff to accurately identify most causal agents. Our website is a portal to information sheets and notices of current forest pest issues and other resources. Printed information sheets and brochures is available on many of the more common insect and disease problems. We can also provide you with a variety of other useful publications on topics related to forest insects and diseases.

Submitting Samples - Samples brought or sent in for diagnosis should be accompanied by as much information as possible including: host plant, type of damage (i.e., canker, defoliation, wilting, wood borer, etc.), date, location, and site description along with your name, mailing address and day-time telephone number or e-mail address. Forms are available on our website and in the Annual Summary Report for this purpose. Samples mailed to the laboratory should be accompanied by all necessary information and insects should be in crush-proof containers (such as mailing boxes or tubes). Live insects should be provided with adequate host material for food. Disease samples should be enclosed in paper bags. Mail containers for prompt shipment to ensure they will arrive at the Augusta laboratory or Old Town Office on a weekday.

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</table>

Forest & Shade Tree – Insect & Disease Conditions for Maine Reports
Sign Up Form

Sign up on-line at: www.maine.gov/dacf/mfs/publications/condition_reports.html (box at upper right)

The Maine Forest Service (MFS) Forest & Shade Tree Insect and Disease Conditions reports and Annual Summary Report provide information about what is impacting the health of Maine's forest and neighborhood trees. Updates are provided during the growing season and otherwise as conditions dictate. Additionally, our website is useful for special alerts and quarantine information. The MFS Insect and Disease Lab maintains hardcopy information sheets on a variety of pest problems that are also available on our website. Diagnostic services are provided as time and manpower permit. We are always interested in what you see affecting your trees – let us know!

E-Mail Address _____

You can cancel your subscription at using the unsubscribe link at the bottom of the mailings.

In an effort to conserve State resources, we are moving toward providing most material electronically. Although we will continue to offer the newsletter in hard copy if specifically requested, our default first option is now as an electronic publication.
**If you cannot or do not wish to receive the newsletter electronically please check here* ☐
**If you wish to receive electronic newsletter & paper Annual Summary check here* ☐

Name _____

Mailing Address_____

_____

Telephone_____ **Date (month/year)**_____/_____

Area of Interest (*only check one*):

- ☐ Academic Institution
- ☐ Christmas Tree Grower
- ☐ Government Agency
- ☐ Land Trust
- ☐ Logger
- ☐ Woodland Owner
- ☐ Other _____
- ☐ Arborist
- ☐ Forester
- ☐ Landscaper
- ☐ Library
- ☐ Nursery/Greenhouse
- ☐ Interested Individual

Comments:_____

Return your Completed Form To:

Insect & Disease Laboratory
168 Statehouse Station
Augusta, Maine 04333-0168

Phone (207) 287-2431
http://www.maine.gov/dacf/mfs/forest_health/index.htm

Scan to Sign up On-line

Or Contact Patti Roberts at: (207) 287-2431 or 168 SHS, Augusta, ME 04333-0168 for a paper subscription form.

MFS Forest Insect & Disease Diagnostic Request and Report Form

Sample provided - yes no Collection date _____

Please package disease samples in poly bags and insects in crush-proof containers.

Tree species affected _____

Township _____ County _____

Location in Township: (use area at right to construct map)

Property owner, address, and daytime phone number:

_____

_____

_____

_____

Location of affected plants:

- Forest or Woodlot ☐
- Yard or Landscape ☐
- Street or Driveway ☐
- Barnyard or Pasture ☐
- Tree Plantation ☐

Has the plant been recently transplanted? Yes No

Are there other plants of the same kind nearby? Yes No

Are they similarly affected? Yes No

Has the plant been recently fertilized? Yes No

Has the ground been disturbed? Yes No when/how?_____

Have weed killers been used in the vicinity? Yes No what?_____

Approximate size of trees: height _____ diameter _____ Number of trees checked _____

Damage Type: none _____ defoliation _____ wood borer _____ other _____

Damage Location: leaves _____ branches _____ trunk(s) _____ roots _____

Degree of damage: none ____ trace-light (<30%) _____ moderate (≥ 30-50%) _____ heavy-severe (>50%)

No. of trees affected: none _____ one _____ many _____ OR Number of acres _____

Describe problem and other additional information:_____

_____

_____

_____

Collector_____ Daytime Phone Number _____email:_____

P.O. Address _____

If we need further information to diagnose this sample who should we contact? _____

Daytime Phone Number _____ email:_____

Send sample to: Insect & Disease Laboratory, 168 State House Station, Augusta, ME 04333-0168
(or deliver in person to 50 Hospital Street) Tel. (207) 287-2431
e-mail: patti.roberts@maine.gov

Please send diseased herbaceous material to: Pest Management Office, Plant Disease Diagnostics Lab, 491 College Ave., Orono, ME 04473, http://extension.umaine.edu/ipm/

Acknowledgements

The information in this Annual Summary Report has been assembled and reviewed by Aaron Bergdahl, Charlene Donahue, Allison Kanoti, Dave Struble, and Colleen Teerling of the Maine Forest Service, Forest Health and Monitoring program. Many other individuals and organizations have contributed significantly to the information on forest health presented here, including the rest of the Forest Health and Monitoring Division.

The Forest Inventory and Analysis Unit of our Division provided invaluable assistance in a number of areas including: setting and retrieving traps for gypsy moth, spruce budworm, pine shoot beetle and exotic wood borers and bark beetles of spruce; surveying for browntail moth; peeling bolts at ash trap tree workshops, collecting data on hemlock impact plots among other duties.

We extend our thanks to Greg Miller, Greg Lord, and Ken Laustsen, Maine Forest Service, for their assistance with mapping, computer, and statistical tasks. Our survey work was greatly enhanced by the efforts of Amy Ouellette, Wayne Searles and Regina Smith. Patti Roberts has made a significant and much appreciated effort in assembling, formatting, and proof-reading this report.

We work closely with the DACF Division of Animal and Plant Health and appreciate the cooperation of Ann Gibbs, Division Director; Gary Fish, State Horticulturalist; and Karen Coluzzi, Pest Survey Coordinator in particular. Their work in quarantines, survey and outreach dovetails with and enhances our work.

A significant amount of work is completed through the assistance of volunteers. Our deepest thanks go to those who volunteer in survey and monitoring as well as other tasks. It would much more difficult to continue winter moth research and parasite control work without Sharon Whitney. Thank you to Nancy Sferra of The Nature Conservancy and Tim Bickford with Maine Army National Guard who ran the traps for the southern pine beetle survey this year. This survey would not have happened without them. We thank David Bourque and Dana Michaud for their taxonomic contributions and additions to the insect collection. And thanks to Gail Everett for her work on sorting and organizing the insect collection both at the lab and at the Maine State Museum Annex.

Sincere thanks are also extended to many other administrative and field staff of the Maine Department of Agriculture, Conservation, and Forestry, and to our many contacts in the USDA Forest Service Northeastern Area – Forest Health and Protection, the USDA-APHIS, and to our other cooperators in the Northeastern States of the U.S. and Eastern Provinces of Canada.

Introduction

This annual summary report describes the efforts towards understanding and managing the health issues of importance to Maine's forest resources. Emphasis is placed primarily on insect and disease relationships of forest, shade, and ornamental trees. The myriad of biotic and abiotic agents capable of damaging trees can result in losses to wood production and quality, water quality values, recreational opportunities and enjoyment and, in some cases, to human health. Conversely, the great majority of these agents are not simply beneficial, but critical to the productive functioning of forest ecosystems. Therefore, our understanding of the role insect and disease agents play in maintaining a healthy forest is as important as mitigating the damaging effects of the few native and invasive pest species capable of significant disruptions to forest sustainability.

The Forest Health and Monitoring Division has four primary mission responsibilities related to insect and disease conditions of our forest resources: 1) **monitoring and evaluating** the resource for overall health using both aerial and ground survey methods; monitoring is done for both specific agents of concern, and in cooperation with the statewide continuous forest inventory efforts of the Forest Inventory and Analysis group of the Division; 2) **providing advice and assistance** on forest health issues to private and public landowners, foresters, industrial and commercial entities, and to the general public; 3) **conducting applied research and demonstration projects** to further the understanding and improve management of specific pests of concern and other forest health issues, and 4) **supervising and managing the forest pest-related quarantines** established by state regulations.

As this report will show, there has been a high level of Division activities conducted on several existing pest problems, along with significant efforts towards anticipating forest pests not yet present in the state. And, considering the pest management challenges of the coming seasons, the efforts outlined in this report will serve to strengthen our response towards more effectively managing our forest resources.

This product was made possible in part by funding from the U.S. Department of Agriculture. Forest health programs in the Maine Forest Service, Department of Agriculture Conservation and Forestry are supported and conducted in partnership with the USDA, the University of Maine, cooperating landowners, resource managers, and citizen volunteers.

Personnel

In Memorium

We note the passing of **Maynard Atwood**, retired long-time Entomology Technician in western Maine, who died August 5th, 2016. Maynard originally came to work for the Maine Forest Service in spring of 1955, working seasonally for Fire Control. In the spring of 1961 he transferred to what was then known as the Division of Entomology, just in time to be involved in the 1961 spruce budworm treatment project in northern Aroostook County. He continued to work on survey and management of forest insects and diseases until he retired in Feb 29, 1984. Although his primary responsibility throughout his career was monitoring conditions in the Southern District in the Western Region, Maynard spent a large portion of the last 10 years of his career heavily focused on spruce budworm management, and back in the northern half of the state.

Even after he retired, he continued his involvement with our shop, often stopping at the lab when he was in Augusta and operating a light trap at his home in Kingfield into the 2016 season. His cheerful demeanor and ready assistance will be missed.

New Employees:

In July of 2016, **Joe Bither** of Stockholm, ME accepted the position of Senior Entomology Technician, which was vacated when Mike Skinner retired in December 2014. Joe brings a broad forestry background and experience in insect survey to this position. He has been a Maine Licensed Professional Forester since 2003 and completed his BS in Forest Management at the University of Maine in 1993. Joe has been with the Forest Inventory and Analysis (FIA) unit of Forest Health and Monitoring since 1999 and in recent years has helped with surveys for emerald ash borer, gypsy moth (trapping and egg mass scouting), spruce budworm (adult and overwintering larvae surveys) and pine shoot beetle. This year he has been busy tending to 40 beetle traps in Aroostook County as well as trap routes for spruce budworm and gypsy moth, all the while continuing his work with FIA. In January of 2017, Joe transitioned to working primarily for the Insect and Disease Management Unit, although he will continue to assist with inventory as needed.

Aaron Bergdahl joined the lab in late July of 2016 in the Forest Pathology position which had been vacant since the retirement of William Ostrofsky in 2015. A native of Vermont, Aaron came to Maine from North Dakota where he managed the state forest health program for seven years and was pursuing a doctoral degree in plant pathology. Aaron's office is at the entomology lab in Augusta.

Publications Authored by FH&M Staff

Bergdahl, Aaron D.; Hill, Alison, tech. coords. 2016. **Diseases of Trees in the Great Plains**. Gen. Tech. Rep. RMRS-GTR-335. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 229 p.

Insect Conditions

Insects: Softwood Pests

Balsam Woolly Adelgid
Adelges piceae
Host(s): Balsam Fir (*Abies balsamea*)

Balsam woolly adelgid (BWA) is established in all Maine counties. Forest Inventory and Analysis crews record BWA symptoms (and actual organism presence in the case of significant trunk-phase populations) on plots when encountered, but special measurements were not taken this year, nor were additional surveys conducted for this pest. Calls from the public and staff observations, particularly regarding trunk-phase populations, were up in 2016. This BWA population boom, combined with an abnormally dry growing season in 2016, could lead to future increases in fir decline and mortality in Maine's coastal and interior regions. Reports or observations of noticeable trunk phase and/or related fir decline came from many corners of the state including towns in Franklin, Kennebec, Penobscot, Piscataquis, Waldo and Washington counties. Several stands of declining fir with heavy trunk populations were reported by a landowner in central Piscataquis County; a follow-up visit to that area revealed pockets of large pole-sized/small saw-sized fir with widespread, heavy trunk populations of BWA, thinning crowns and scattered tree mortality.

Canadian Pine Scale
Matsucoccus macrocicatrices
Host(s): Eastern white pine (*Pinus strobus*)

Samples of eastern white pine collected in T4 R11 WELS and T5 R11 WELS (Piscataquis County) for examination of pine leaf adelgid damage were found to also have what appear to be the overwintering cysts of Canadian pine scale. Scales were found most commonly at branch nodes, but were also found on internodes. One emerged adult was found on the samples collected in mid-May. Eastern white pine samples examined from understory saplings in Old Town (Penobscot County) were also found to have considerable numbers of the cyst stage of this insect. In addition to sites already described, the insect was commonly found in areas with bark abnormalities due to cankers or wounding.

This insect is generally thought to be of little significance from a tree-health perspective; although work is currently being done to understand more about its role in white pine dieback in southern states (for a recent MS thesis on the topic see: https://getd.libs.uga.edu/pdfs/schulz_ashley_n_201508_ms.pdf).

Elongate Hemlock Scale
Fiorinia externa
Host(s): Primarily Fir and Eastern Hemlock (*Abie*s spp. and *Tsuga canadensis*)

Elongate hemlock scale (EHS) was detected in one new town (Frye Island, Cumberland County) in 2016. It was discovered on planted trees outside a fire station, and has spread to a few trees in forested land across the road. Because the infested trees brushed against emergency vehicles every time they left the station, EHS has very likely been transported to other areas on the island, although there have as yet been no further detections. This pest was surveyed for in forested areas in southern Maine; no other forest infestations were found. Elongate hemlock scale is known to be established in the forest in Kittery (York County) and has been found on planted trees in Cumberland County (Brunswick, Cape Elizabeth, Falmouth, Frye Island, Gorham, Portland, Scarborough, Yarmouth), Hancock County (Mount Desert, Sedgwick), Sagadahoc County (Topsham), and York County (Berwick, Kennebunk, Kennebunkport, Kittery, Ogunquit, Old Orchard Beach, Saco, Wells, York). Because it is cryptic and is widespread in other states, it appears establishment of this pest in our forests will be accelerated by importation and out-planting of infested trees.

Due to drought conditions, no chemical treatments were conducted in 2016.

See appendix B for more information.

Fir Coneworm
Dioryctria abietivorella
Hosts: Fir (*Abies* spp.), Spruces (*Picea* spp.) and Pines (*Pinus* spp.)

A Christmas tree grower in northern Aroostook County reported significant damage to balsam fir leaders in plantation trees. Larvae were found mining the terminal cluster of buds early in the season and later boring into the terminal shoots. A photo of a late-instar larvae provided for identification showed the typical dark color of fir coneworm caterpillars. The grower estimated that at least one-in-fifty trees in the plantation was damaged. Fir coneworm will infest the cones and shoots of a wide-range of conifer species. A bumper-crop of cones in surrounding forest trees in 2015 may have led to the problem in the Christmas tree plantation in 2016. The grower mitigated damage with corrective pruning when getting the trees ready for market. To aid in population reduction, pruning before the caterpillars leave the shoots and destruction of the infested material should accompany corrective pruning where possible.

Hemlock Woolly Adelgid
Adelges tsugae
Host(s): Eastern Hemlock (*Tsuga canadensis*)

Hemlock woolly adelgid (HWA) was detected in three new towns in 2016: Frye Island, Raymond, and Standish in Cumberland County. About 3.8 acres of mortality was mapped in Frye Island. It appears that this local infestation began in northern Frye Island and then spread downwind to the mainland. Hemlock decline, due at least in part to HWA damage, is also apparent from the ground in several coastal communities in York, Cumberland, Sagadahoc, and Lincoln counties.

Biological control establishment efforts continue in Maine. No *Sasajiscymnus tsugae* were released in 2016. On Frye Island a field insectary for *Laricobius osakensis* was established and about 450 beetles were released.

In 2016, nineteen sites were sampled for predators. Thirty-two adult *Sasajiscymnus tsugae* were recovered from five different sites in Kittery, Harpswell, Wiscasset and Freeport. No *Laricobius nigrinus* were recovered.

See Appendix B for more information.

Pine Leaf Adelgid
Pineus pinifoliae
Host(s): Eastern White Pine (*Pinus strobus*), Red Spruce (*Picea rubens*), Black Spruce (*P. mariana*)

Pine leaf adelgid is at epidemic levels in parts of Maine. In 2015, aerial surveys mapped damage to eastern white pine on more than 260,000 acres in Piscataquis County. Ground observations uncovered severe damage and pockets of mortality of sapling-sized white pine in the mapped area. A larger footprint of lighter damage was indicated from reports in other parts of Piscataquis County and parts of Penobscot County. Damage from this pest is most visible on the pines every other year. In 2016, the adelgid-caused galls were found in abundance on spruce hosts throughout the affected area. These deciduous galls were most visible in late June through July. By the end of July, many had fallen from their hosts. Thin-crowned pines and residual wilted shoots from previous years of damage were apparent on the pine. We expect to be able to map impacts to pine again in 2017 in an area equal or greater to that mapped in 2015. Increased education efforts may lead to detections of affected areas outside the currently known core area of damage, and there are no signs the epidemic has abated in previously mapped areas.

The Maine Forest Service fact sheet for pine leaf adelgid was changed in 2016. In the previous epidemic, the cone-like galls appeared in odd numbered years. In the current epidemic, they are most abundant in even-numbered years.

Pine Shoot Beetle
Tomicus piniperda
Host(s): Pines (*Pinus* spp.)

There is a State and Federal quarantine on pine shoot beetle and its host trees (pines) in all Maine counties except Aroostook and Washington. The Maine Forest Service and USDA-APHIS-PPQ trap to monitor for the spread of pine shoot beetle in unregulated counties. No pine shoot beetles were found in either Aroostook or Washington counties in 2016.

Red Pine Scale
Matsucoccus matsumurae

Host(s): Red Pine (*Pinus resinosa*)

Red pine scale was detected for the first time in Maine in 2014 in Mount Desert, Hancock County. No scale has been detected off of Mount Desert Island (MDI), however limited survey has been conducted by Maine Forest Service. USDA Forest Service conducts aerial survey in the area encompassing Acadia National Park, and mapped about 200 acres of mortality related to red pine scale on MDI.

Southern Pine Beetle
Dendroctonus frontalis
Host(s): Pines, especially Pitch Pine and Jack Pine (*Pinus* spp**.** especially *P. rigida* and *P. banksiana*), Red Spruce and Norway Spruce are occasional hosts (*Picea rubens, P. abies*)

In recent years, the Southern Pine Beetle (SPB) has been expanding its range north from southern states and hosts. It has now been found as far north as Massachusetts. Although currently in Massachusetts SPB has only been found in traps and not damaging trees yet, this aggressive bark beetle has been observed attacking pitch pine (*Pinus rigida*), eastern white pine (*P. strobus*) and Norway spruce (*Picea abies*) elsewhere in the Northeast, and is killing trees on Long Island, NY. For this reason, the Maine Forest Service is concerned about the SPB continuing its northern expansion into Maine. The MFS, with the cooperation of The Nature Conservancy and the Maine Army National Guard, used SPB lures supplied by the USDA Forest Service to survey for SPB in 2016. No SPB were found.

The SPB attacks weakened trees. Like other bark beetles, the first sign of their presence is pitch tubes on the trunk where the trees are trying to drown the beetles in sap. The beetles overwinter in all life stages and can have multiple generations in a year. Generally, infestations start in a small area and then spread out as the population increases with many beetles attacking the same tree to weaken its defenses.

The 2016 survey was conducted in three pitch pine stands in Hollis, Waterboro and Wells, all in York County. Two 12-funnel Lindgren traps were set up in each location (Table 1) on May 5, 2016 and trap catch collected every other week until June 16/17, 2016. This covers the primary long distance dispersal season for SPB; the rest of the summer they only move short distances.

Table 1. Locations of southern pine beetle traps in 2016

Township	County	Type	Host	Latitude	Longitude	Install Date	End Date
Wells	York	Natural	pitch pine	43.379286	-70.649937	5/5/2016	6/16/2016
Wells	York	Natural	pitch pine	43.377831	-70.645589	5/5/2016	6/16/2016
Waterboro	York	Natural	pitch pine	43.619324	-70.824679	5/5/2016	6/16/2016
Waterboro	York	Natural	pitch pine	43.604255	-70.810018	5/5/2016	6/16/2016
Hollis	York	Natural	pitch pine	43.666291	-70.664330	5/5/2016	6/17/2016
Hollis	York	Natural	pitch pine	43.676879	-70.657343	5/5/2016	6/17/2016

Spruce Beetle
Dendroctonus rufipennis
Host(s): White Spruce (*Picea glauca*), Red Spruce (*P. rubens*)

Decadent spruce trees along the coast continue to succumb to spruce beetle. Infestations are widely scattered and a reflection of tree age and poor sites. This is a continuation of an ongoing problem.

Spruce Budworm
Choristoneura fumiferana
Host(s): Balsam Fir (*Abies balsamea*), White Spruce (*Picea glauca*), Red Spruce (*P. rubens*), Black Spruce (*P. mariana*), Eastern Hemlock (*Tsuga canadensis*)

Spruce budworm is a periodic major pest of fir and spruce in Maine. The Maine Forest Service has been monitoring this insect since the early part of the last century. Since 1992, the Maine Forest Service has been monitoring populations using pheromone traps and catches in a subset of about 80 sites had averaged well below five moths per trap. In 2011, the average moth capture across those sites crept over five moths per trap for the first time in almost two decades. The average continued to climb, and in 2014 and 2015 it was more than 20 moths per trap. 2016 trap catches were down dramatically compared to the previous years and registered at only 7.5 moths per trap across those long-term sites. No defoliation was recorded from this insect in 2016.

The University of Maine's Cooperative Forest Research Unit, The Maine Forest Service, and Maine Forest Products Council formed The Maine Spruce Budworm Task Force in 2013 to intensify preparation for the next outbreak of spruce budworm in Maine. In 2016 the Task Force published a report outlining the risk from the coming spruce budworm epidemic as well as some recommendations for response. In addition, it launched a website, hosted by the University's Center for Research on Sustainable Forests, to provide information about spruce budworm to stakeholders. The report can be found on the task force website: www.sprucebudwormmaine.org.

Maine is poised at the beginning of another spruce budworm outbreak. Outbreaks occur on a roughly 40-year cycle in response to maturing forest stands and reduced pressure from parasites; the last time budworm was a problem in Maine was in the 1970's and 80's. This native defoliator of balsam fir and spruce has been defoliating trees in Quebec north of the Saint Lawrence Seaway for more than 10 years. Defoliation, which has spread to the south shore and into New Brunswick, currently covers more than 17 million acres. More information about spruce budworm in Maine can be found in Appendix C.

Insects: Hardwood Pests

Bare-patched Oak Leafroller
Pseudexentera spoliana (cressoniana)
Host(s): Red Oak (*Quercus rubra*)

Defoliation continues to occur in the area of Cherryfield (Washington County) and adjacent Hancock County. Aerial survey showed close to 3,000 acres of moderate to severe defoliation in this rural part of the state. This year scattered oak mortality was observed on the ground and reported by landowners and managers in the area. Defoliation from this pest has subsided in Augusta, Kennebec County.

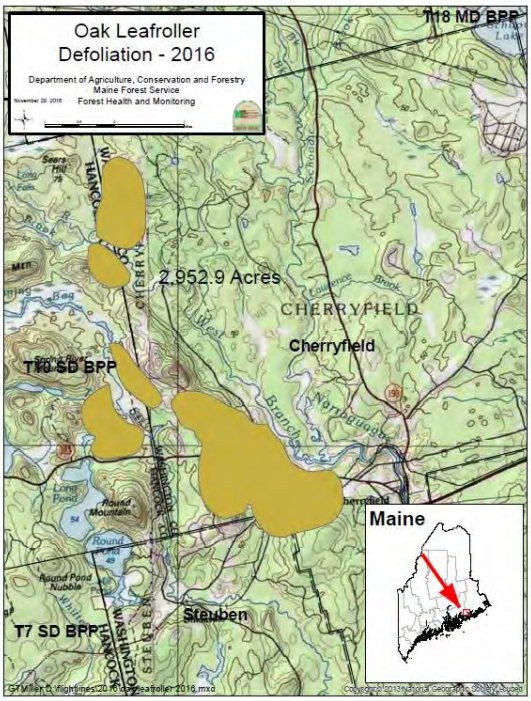


Figure 1. Bare-patched oak leaf roller defoliation 2016

Browntail Moth
Euproctis chrysorrhoea
Host(s): Red Oak (*Quercus rubra*), Apple (*Malus* spp.) and other species

Browntail moth is not only a tree pest but also, and more importantly, has health impacts on humans. Repeated exposure to browntail moth hairs, or single exposures in sensitive individuals, can cause a rash and/or breathing problems. This can be severe in some cases. Browntail is an invasive insect from Europe that has been in North America for over 100 years. It is found ONLY in Maine and Cape Cod, Massachusetts in North America. It is a difficult insect to work with because of the health effects and little work has been done to rigorously study this insect in decades, apart from control work in the 1990's in Maine.

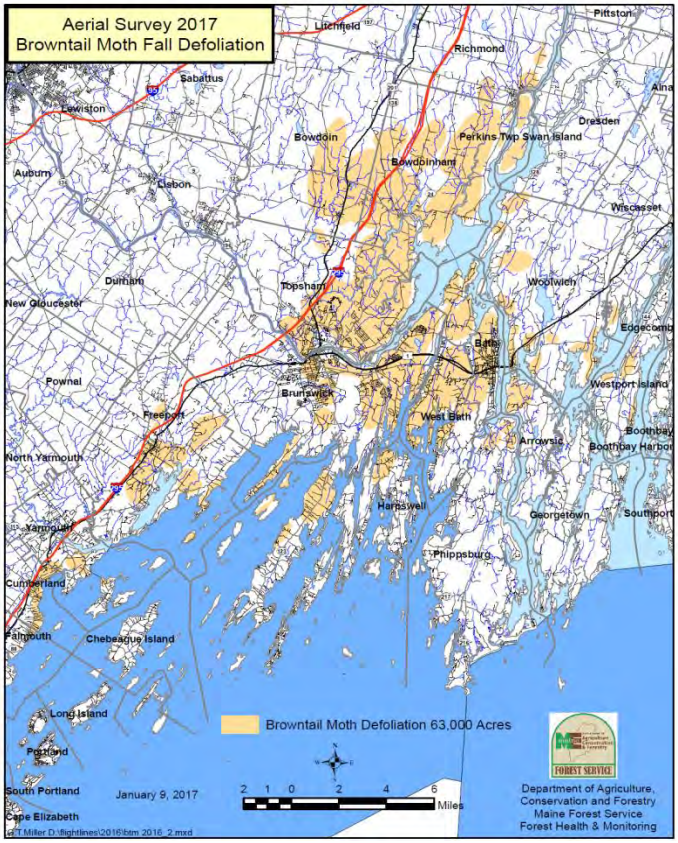


Figure 2. Browntail moth fall defoliation 2016

The population of browntail in Maine was very low for decades until the 1990's when it became a problem. Populations subsided again in 2005. It then slowly built up around Bowdoinham and Topsham in Sagadahoc County, and Brunswick in Cumberland County until 2015 when the population exploded. In the spring of 2016, the aerial survey showed 25,000 acres of defoliation from Falmouth (Cumberland County) through most of Sagadahoc County and into Lincoln and Kennebec Counties. Other areas affected but not severely enough to detect from the air ranged from Kennebunkport (York County), inland to Turner (Androscoggin County) and Waterville (Kennebec County) to Camden (Knox County).

Another aerial survey was conducted in late-August to map the leaf skeletonizing by the tiny (1/8th inch) larvae that overwinter. Over 63,000 acres were mapped (Figure 2), raising concerns about health effects in 2017. Winter web surveys have found the browntail has spread further Downeast to the Deer Isle area in Hancock

County. The number of webs is extremely high in the core area centered in Sagadahoc County and spreading out from there.

The expanding and intensifying infestation will catch many people off guard who have not dealt with browntail before. The known risk area for encountering browntail moth is shown on the map in Figure 3. There is also concern that expanding browntail moth populations combined with winter moth will have a severe impact on oak trees in the Midcoast region.

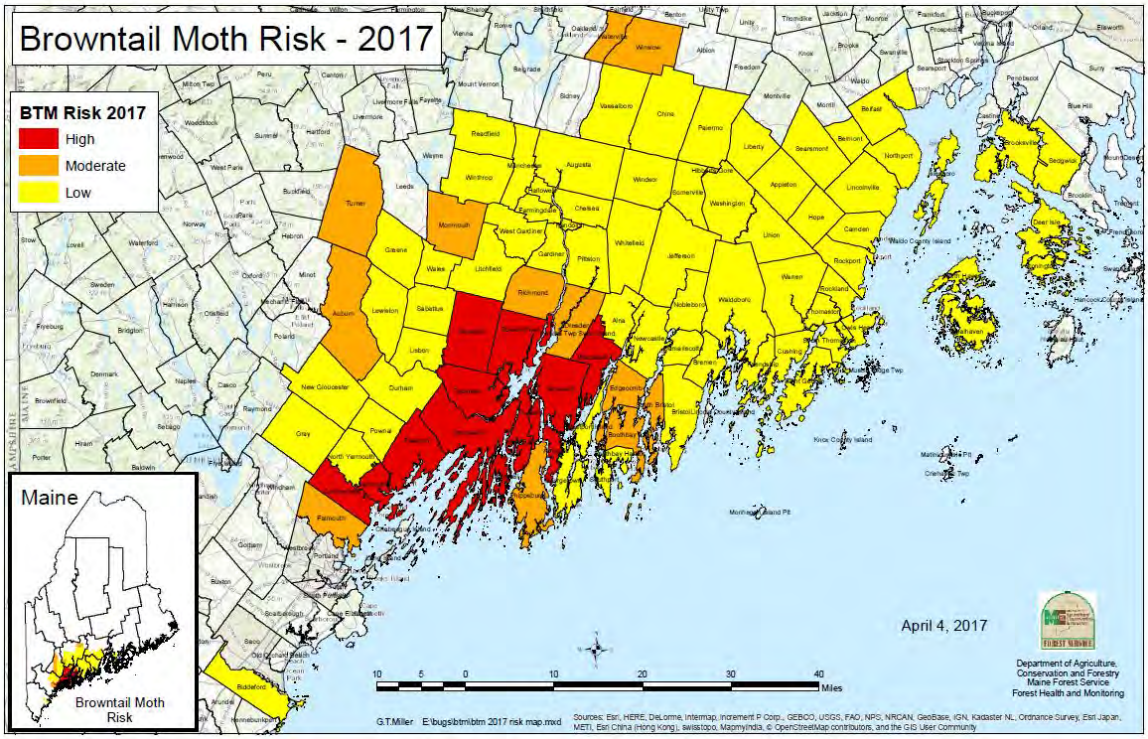


Figure 3. Browntail moth exposure risk predictions for 2017

Although browntail can affect the health of host trees – primarily oaks and apples, crabapples and other Rosaceae family trees and shrubs – the health effects of browntail are what more often cause people to look at controlling this insect. During the winter and early spring (before the leaves come out) the overwintering webs can be pruned from trees and destroyed. The Maine Forest Service assembled a list of arborists willing to prune webs out of trees that cannot be reached by home owners. Once the larvae emerge they can be controlled with a number of pesticides; the Maine Forest Service recommends using a Licensed Pesticide Applicator (LPA) if possible when controlling for browntail moth due to the caterpillars being high in trees and often near marine waters. The LPAs have the equipment and know the restrictions for protecting lobsters and other no-target organisms. The MFS has a list of LPAs willing to treat for browntail moth. If making a DIY pesticide application on your own property, select a pesticide product carefully: Always FOLLOW LABEL INSTRUCTIONS, ensure the intended site is listed on product label, and preferably, choose a product that lists browntail moth on the label. Treat before the end of May to prevent development of the toxic hairs. There are restrictions on the use of pesticides within 250' of marine waters; check with the Board of Pesticide control if you are within this zone.

With the rapid increase in the browntail population there was a concern that the public would not be aware of the problem. The MFS hosted a browntail roundtable in the fall bringing together different agencies and LPAs who have been dealing with the browntail problem in the past. This brainstorming session led to suggestions on how to approach this problem with the resources at hand. Some of the outcomes from this meeting have now been implemented. The Maine Forest Service enlisted the assistance of a number of other agencies. The Maine Center for Disease Control is working to alert the medical community to the browntail issue. The Maine Board of Pesticide Control (BPC) set up several outreach sessions over the winter in the affected area and Cooperative Extension

educators spoke at these meetings along with Maine Poison Control personnel. The MFS and BPC also developed a new browntail brochure. Community browntail groups have formed and been active in spreading the word, talking to town officials about appropriate courses of action, and mapping out where browntail is a problem in their towns.

Last summer, Dr. Groden from the University of Maine took samples of browntail moth caterpillars from several sites, ranging from relatively light inland populations to heavy coastal populations, and looked for diseases and parasitoids in the browntail cocoons. She is continuing this work in 2017. Dr. Groden, in cooperation with the MFS, also has funding to look at treating browntails in August with a number of different products.

Also, last spring and summer some of the LPAs tested treating for browntails using basal bark applications in sensitive areas where foliar sprays could not be used and treating in August with either foliar sprays or injections. These treatment options proved successful if the trees were healthy. Trees that are already stressed do not take up pesticides well enough to control the insects feeding on them, in which case a foliar spray is a better option if allowable.

- Trees close to the marine shore were treated using Safari (ai: dinotefuran). A backpack pump sprayer was used to treat the bottom 5-6 feet of the tree trunk in late April of 2016. Pretty good control was achieved, but products with dinotefuran as an active ingredient are expensive.
- Foliar treatments using Pyronyl (ai: pyrethrin) or Conserve (ai: spinosad) were applied August 10 – September 9, 2016 and achieved excellent results with what looked like 100% mortality. Injections using AceCaps (ai: acephate) were applied August 2, 2016, Tree Tech Vivid II (ai: abamectin) or Tree-age G4 (ai: emamectin benzoate) applied August 9 -24, 2016 and had excellent results on trees that had not been heavily stressed. The stressed trees had little control most likely due to reduced uptake by the tree.

There are pros and cons with fall treatments. Concerns include:

- The activity of pollinators coincides with treatment, so site selection for foliar applications needs to take surrounding blooming plants into careful consideration.
- It is difficult to know what trees have browntail on them before they start webbing up and are no longer exposed to pesticides.
- Injecting stressed trees may not provide effective control.

On the plus side:

- Fall treatments extend the window of opportunity for control,
- There is adequate leaf surface to apply the material,
- The larvae are treated before they cause health problems, and
- The larvae are small so it is easier to kill them.

Cherry Scallop Shell Moth
Hydria prunivorata
Host(s): Black Cherry (*Prunus serotina*)

This leaf-tying caterpillar is a very occasional pest of cherry trees – so occasional that our senior entomologist has not seen an outbreak in her 22 years with the Maine Forest Service. There was a 1,100 acre patch of defoliation spotted from the aerial survey and ground-truthed in the Turner area (Androscoggin County) where there are stands of cherry trees (Figure 4). These larvae carefully fold one or more cherry leaves over and stitch them together. They then feed inside this protected enclosure carefully skeletonizing the leaves but leaving the outer layer whole. The leaves are all brown but stay on the tree most of the summer.

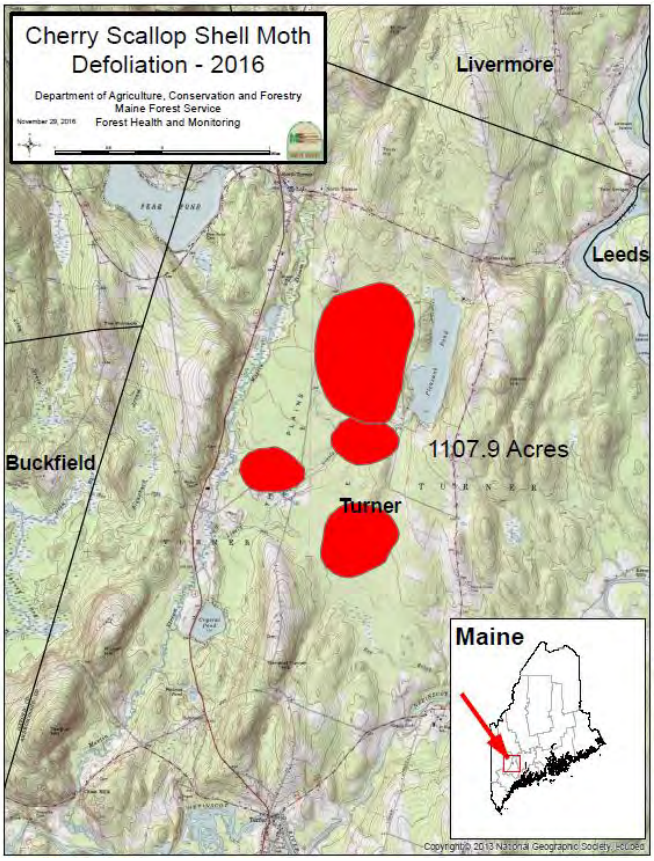


Figure 4. Cherry scallop shell moth defoliation 2016

Fall Webworm
Hyphantria cunea
Host(s): Ashes (*Fraxinus* spp.), Apples (*Malus* spp.), Cherries (*Prunus* spp.), Oaks (*Quercus* spp.), Birches (*Betula* spp.), and other hardwoods

Fall webworms create large webs in hardwood trees, especially ash and apple, starting in mid-summer. The larvae feed inside the webs so the webs expand as the larvae grow and need more leaves to eat. Fall webworm numbers were high Downeast and in central Maine around Clinton (Kennebec County) and Unity (Waldo County) and relatively low elsewhere in the state.

Forest Tent Caterpillar
Malacosoma disstria
Host(s): Aspens (*Populus* spp.) and other hardwoods

No defoliation from forest tent caterpillar was noted in 2016 although more caterpillars were seen massed on trees than in recent years. Light traps caught increased numbers of forest tent adults in southern Maine as far north as Androscoggin and Waldo Counties. Forest tent caterpillars feed on hardwood foliage in the spring especially on maple. Although they are called tent caterpillars, they do not form webs like their relatives.

Gypsy Moth
Lymantria dispar
Host(s): Apple (*Malus* spp.), Aspen (*Populus* spp.), Basswood (*Tilia americana*), Birch (*Betula* spp.), Larch (*Larix laricina*), Oak (*Quercus* spp.), and others (>300 trees and shrubs)

No gypsy moth defoliation was recorded in 2016. Egg mass counts in the population surveys for gypsy moth were generally low, with only a few plots in extreme southern Maine having more than five egg masses but fewer than ten detected in a five-minute walk. This insect is at epidemic levels in much of southern New England. Although surveys do not lead us to anticipate significant defoliation in Maine in 2017, continued dry conditions early in the growing season could open the door to an outbreak here.

Maine Forest Service and USDA APHIS Deployed 522 traps in 2016 in the transition zone (area where reproducing populations of gypsy moth have not been detected). Of those, 508 were retrieved (Table 2). Egg mass scouting was targeted to areas of southern Aroostook, central Piscataquis and central Somerset counties where trap catches were highest. To date, portions of each of those regions have been scouted and an egg mass was detected in each of two southern Aroostook towns, Dudley Township and Littleton (Table 3).

Table 2. Gypsy moth trap catches by county and number of moths

		Number of Traps by County					
		MFS-Aroostook	**MFS-Franklin**	**MFS-Oxford**	**MFS & APHIS-Piscataquis**	**MFS & APHIS-Somerset**	**State-wide**
Number of Moths	**0-9**	139	29	16	62	101	**347**
	10–19	11	5	3	18	11	**48**
	20–29	9	1		10	4	**24**
	30–39	8			9	1	**18**
	40–49	9			8		**17**
	50–100	9			26		**35**
	>100	14			5		**19**
	TOTAL	**199**	**35**	**19**	**138**	**117**	**508**

We anticipate revision of the state rule that governs the gypsy moth quarantine in 2017. Details of the additional areas proposed for inclusion in the quarantine are found in Table 3 and Table 4 and shown in Figure 5.

Table 3. Towns outside the current quarantine area with gypsy moth egg mass detections in 2012–2017.

Year	County	Town	Substrate/Area Description
2012	Penobscot	T3 R7 WELS	Striped maple, near road jct.
2012	Penobscot	T6 R7 WELS	Trap vicinity
2012	Penobscot	T7 R8 WELS	Roadside
2012	Piscataquis	T3 R11 WELS	Pullout
2012	Piscataquis	T7 R9 WELS	Trap vicinity
2012	Somerset	Flagstaff Twp	White birch
2013	Aroostook	Moro Plt	Red maple, Rte. 11
2013	Aroostook	T7 R5 WELS	Apple, Rte. 11
2013	Aroostook	T9 R5 WELS	Outhouse, rest area
2013	Penobscot	T6 R6 WELS	Black cherry
2013	Penobscot	T8 R6 WELS	Aspen, roadside
2013	Penobscot	T8 R8 WELS	Aspen by outhouse
2013	Piscataquis	Bowdoin College Grant East Twp	Picnic table, primitive campsite
2013	Somerset	Chase Stream Twp	Aspen, roadside
2013	Somerset	Indian Stream Twp	White birch, near boat launch
2013	Somerset	Johnson Mountain Twp	American beech, beside Rte. 201
2013	Somerset	Squaretown Twp	White birch, primitive campsite
2013	Somerset	T3 R5 BKP WKR	White birch, roadside
2016	Aroostook	Dudley Twp	Sugar maple
2017	Aroostook	Littleton	Eastern white pine

Table 4. List of towns without a second gypsy moth life stage detected proposed for inclusion in expanded quarantine area in 2013 and 2017.

County	Township	Comments
Aroostook	Hammond	Max counts >100 1 yr, >50 2 yr, high 122; egg masses in towns on both east and west.
Aroostook	Hersey	Trap catch trend ↑ (76, 125, 206, 260)
Aroostook	Ludlow	Trap catch trend ↑ (4, 15, 36, 120)
Aroostook	Masardis	Short history of elevated catches (2016, 2015)–112 highest catch.
Aroostook	Merrill	Trap catch trend ↑ (18, 60, 124, 228)
Aroostook	Oxbow Plt	High trap catch 2013 (1st year survey): 150
Aroostook	Saint Croix Twp	Max 29, 31, 159; note railyard for log movement in this town
Aroostook	Smyrna	Trap catch trend ↑ (15, 30, 103, 122)
Aroostook	T8 R3 WELS	2014–2016: 26, 25, 76 Max catch; none under 10 in 2016 (12 traps)
Aroostook	T8 R5 WELS	Bordered on 3 sides by towns proposed for inclusion
Aroostook	T9 R7 WELS	One year with high counts (Max 60); 2 following years lower-different route
Aroostook	Webbertown Twp	Max counts 111, 69, 49, 331
Franklin	Carrabassett Valley	Omitted in previous revisions due to use of old names
Franklin	Jim Pond Twp	Persistent higher counts at one site (52 max; last 3 years above 15)
Oxford	Otisfield	Omitted in previous revisions
Oxford	West Paris	Omitted in previous revisions
Penobscot	Indian Island	Revision to propose all of Penobscot County
Penobscot	T3 R8 WELS	Not trapped due to access difficulties, bordered on all sides by towns proposed for inclusion
Penobscot	T4 R7 WELS	Trap catch trend ↑ (137, 258, 320)

County	Township	Comments
Penobscot	T4 R8 WELS	Not trapped due to access difficulties, bordered on all sides by towns proposed for inclusion
Penobscot	T5 R7 WELS	Trap catch trend ↑ (134, 278, 700)
Penobscot	T7 R6 WELS	Bordered on 3 sides by towns proposed for inclusion
Penobscot	T7 R7 WELS	Trap catch trend ↑ (138, 294, 290, 300)
Penobscot	T8 R7 WELS	Not trapped due to access difficulties, bordered on 3 sides by towns proposed for inclusion
Piscataquis	Beaver Cove	5/6 2016 traps over 10/trap
Piscataquis	Big Moose Twp	Geography; 2016 counts, 2 >40, 7 of 9 over 10
Piscataquis	Bowdoin College Grant West Twp	Bordered on 3 sides by towns proposed for inclusion
Piscataquis	Cove Point Twp	Geography; close to Greenville, Moosehead Junction
Piscataquis	Frenchtown Twp	Geography; no significant recent trap history
Piscataquis	Harfords Point Twp	Geography; close to Greenville, Moosehead Junction
Piscataquis	Lily Bay Twp	Geography; firewood movement (park and camps); counts have climbed in last 2 years avail data compared to prev.
Piscataquis	Moosehead Junction Twp	Trap catch trend ↑, but low (Max: 15, 37, 34) and bordered on 3 sides by towns proposed for inclusion
Piscataquis	Rainbow Twp	Trap catch trend ↑, but low (Max: 5, 19, 26, 52); bordered on 3 sides by towns proposed for inclusion and difficult to access
Piscataquis	Shawtown Twp	Low history of trapping; 2015 1 trap at 40; geography
Piscataquis	T1 R12 WELS	Max count over 50 for at least 3 of last 7 years on record
Piscataquis	T1 R13 WELS	Max count of 60 and average of 37 moths/trap in 2016
Piscataquis	T2 R12 WELS	Counts high in 2016 (Max 80, Avg 44); geographically makes sense
Piscataquis	T2 R13 WELS	Max count 100, average of 28 in 2016
Piscataquis	T7 R10 WELS	Max of 73, has not been trapped recently, counts were climbing when trapped.
Piscataquis	T8 R9 WELS	High trap catch 2013 (1st year survey): 130
Somerset	Bradstreet Twp	Stood out as high counts in 2014; trapping limited in 2016 due to road washout
Somerset	Hobbstown Twp	Stood out as high counts in 2014; 2015 down, but still high in comparison to others, 2016 counts down.
Somerset	T5 R7 BKP WKR	Low trap history; max over 10 last 2 years, max 22.
Somerset	Upper Enchanted Twp	Geography; max count 23

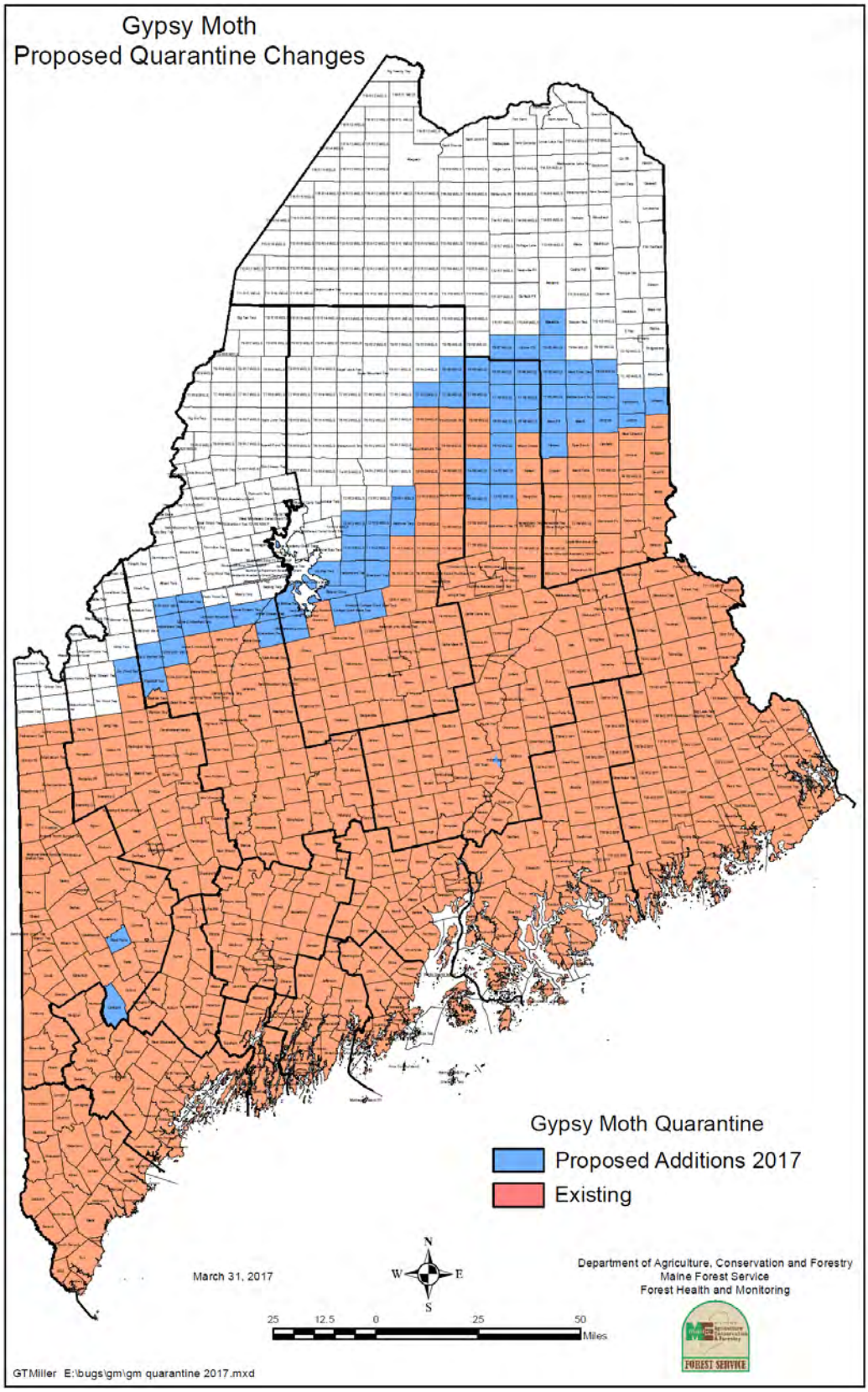


Figure 5. Gypsy moth quarantine area and proposed additions

Locust Leaf Miners
Odontota dorsalis and ***Parectopa robiniella***
Host(s): Black Locust (*Robinia pseudoacacia*)

The locust leaf miner (a beetle) and the digitate locust leafminer (a moth) both contributed to the scorched appearance of black locusts in Maine this year. Some locusts appeared untouched by damage and others had scant green leaves. Significant skeletonizing and mining was done by the leaf-mining beetle—*Odontota dorsalis.* However, some mines of a delicate moth species, the locust digitate leafminer (*Parectopa robiniella*), were also found on the foliage of affected trees. The previous outbreak of locust leaf mining beetles in Maine caused branch dieback and some locust mortality.

Oak Twig Pruner
Anelaphus parallelus
Host(s): Oak (*Quercus* spp.), Hickory (*Carya* spp.), Elm (*Ulmus* spp.), Walnut (*Juglans nigra*) and a number of fruit trees

As has been the case in recent even-number years, we had an uptick of reports of damage from oak twig pruner, primarily in red oak. Reports came in from Durham and Livermore (Androscoggin County), Edgecomb and Waldoboro (Lincoln County), Readfield (Kennebec County), Otisfield and Peru (Oxford County), Dixmont and Old Town (Penobscot County), Richmond (Sagadahoc County) and Kennebunk (York County). This species takes two years to mature, which helps to explain the biennial pattern of reports from the public. In their second season of feeding the larvae make pruning cuts beneath the bark. They cut around the branch except for the thin bark so that the branches break with the wind and fall to the ground. Sometimes the branches are noted when they are dangling in the crown—a spray of reddened, withered leaves. Others, people notice the fallen twigs and note the fine workmanship of the cut (and sometimes even note the frass or the larva itself). The larvae pupate within the twig in the fall. Many winters a warm blanket of snow insulates them. Oak twig pruner is not a significant threat to tree health.

Winter Moth
Operophtera brumata
Host(s): Oaks (*Quercus* spp.), Maples (*Acer* spp.), Apple (*Malus* spp.), Ashes (*Fraxinus* spp.), Birches (*Betula* spp.) and other trees and shrubs

Winter moth populations in some areas were not as high in 2016 as in 2015 due to early warm spring weather followed by cooling that allowed the winter moth to hatch but delayed bud break. The oak trees were then out of sync with larvae and many dead larvae were found when samples were taken in May. Cumberland County had 6,000 acres of defoliation in the annual aerial survey this year as opposed to over 10,000 acres last year. But for the first time, mortality from winter moth was mapped with 300 acres in Cape Elizabeth. Drought was possibly a contributing factor in the demise of these trees. After four years of defoliation and on poor, ledgy sites, they succumbed. In ground surveys defoliation ranged from light to heavy from Kittery to Rockland (Cumberland, Knox, Lincoln, Sagadahoc and York counties). Heaviest damage was in Cape Elizabeth, Peaks Island in Portland, Harpswell and Chebeague Island (Cumberland County).

The MFS ran a pheromone trap survey in December 2015 to determine where winter moth populations were heaviest and to delineate the outer reaches of the infestation. Traps were deployed at 75 locations in towns along the coast and along a transect inland from known infested areas. The survey covered coastal portions of York, Cumberland, Sagadahoc, Lincoln, Knox, Waldo and parts of Hancock, Androscoggin and Kennebec counties. Once again reports of moth observations were solicited from the public using a Survey Monkey form—2,400 reports were received through this method and calls/emails to the office. A map predicting intensity of defoliation was produced from these surveys to help green industry professionals and homeowners prepare for the growing season.

No parasitic flies, *Cyzenis albicans*, were released in the spring of 2016 but cocoons from Massachusetts were set out in Harpswell in November 2016 so that they can emerge naturally in the spring.

Flies were collected by the University of Massachusetts in the spring and cocoons checked for parasitism. Cocoons were carefully opened; if they were parasitized then the fly species was verified and *C. albicans* pupae returned to

the winter moth cocoon. The cocoons were then placed in peat moss in a cage and 2,000 cocoons were transported to Harpswell. The cage was buried in the ground and will be uncovered in April and the cage opened once flies begin to emerge. Our volunteer cooperator, Sharon Whitney has proved invaluable in assisting with this project and in monitoring adult winter moth populations. If this technique proves successful, then it will be used in future locations where winter moths become a problem.

Flies were recovered from Two Lights State Park, Cape Elizabeth and Fort McClary, Kittery in 2016. Recovering flies indicates that *C. albicans* has become established and over time should begin to help control the winter moth population.

Table 5. Release and Recovery of parasitic flies, *Cyzenis albicans*, in Maine

Town	County	Year Released	First Recovery of *C. albicans*
Harpswell	Cumberland	2013 & 2014, 2016	
Cape Elizabeth	Cumberland	2013 & 2015	2016
Kittery	York	2014	2016
Vinalhaven	Knox	2014	
Portland (Peaks Island)	Cumberland	2015	

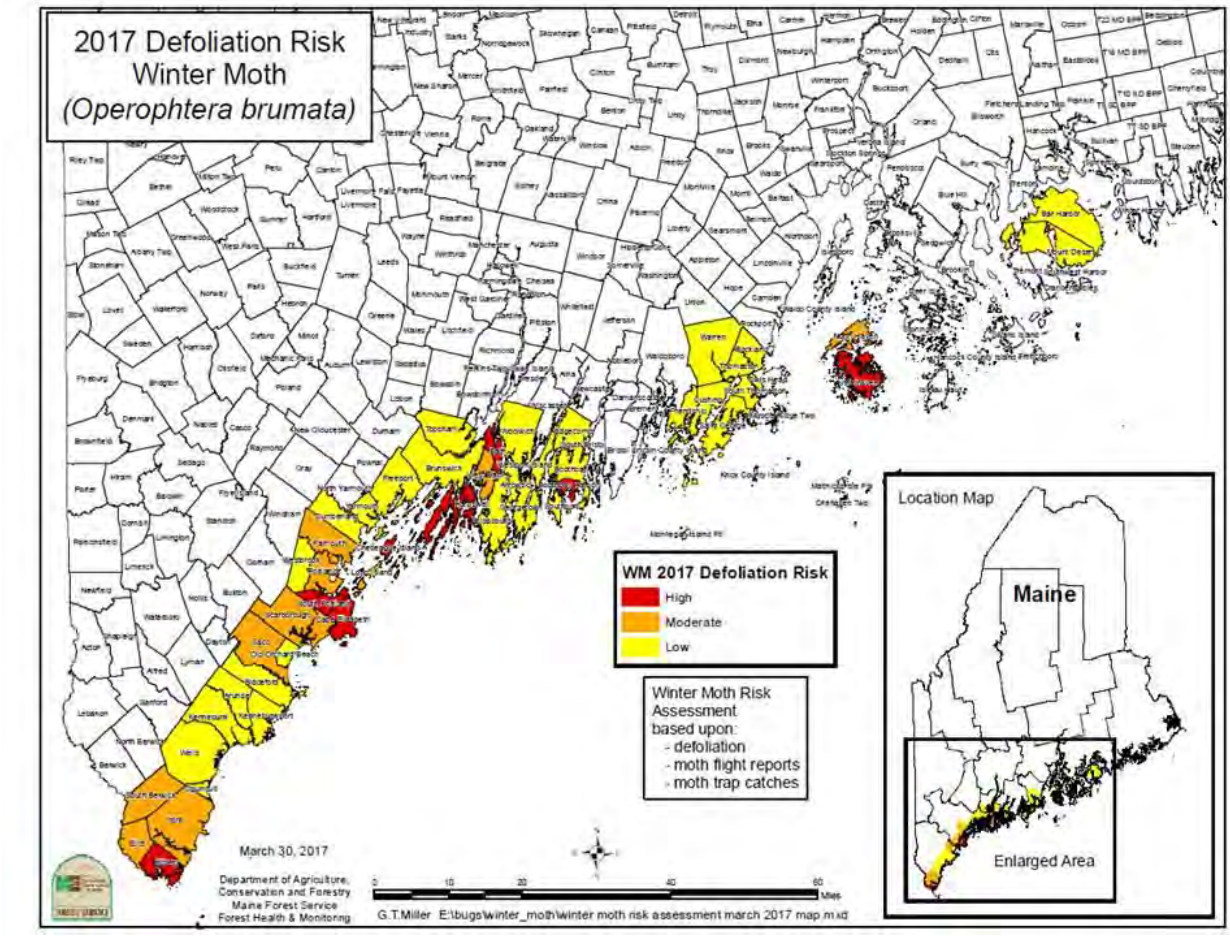


Figure 6. Winter moth defoliation risk predictions for 2017

Insects: Invasive Forest Insects Not Yet Detected in Maine

There have been no confirmed reports of the following insects in Maine: Asian longhorned beetle (ALB), brown spruce longhorned beetle (BSLB) and emerald ash borer (EAB). All three are woodboring beetles and are among dozens of species that can move in firewood and other untreated solid wood material. Because of this mode of transport and difficulty in detecting nascent populations of these insects, it is important to realize that we cannot say with certainty that these insects are not in Maine; only that they have not yet been found in Maine. Life histories make brown spruce longhorned beetle and emerald ash borer more easily moved than Asian longhorned beetle, but firewood movement has been tied to spread of all three of these insects. **They all are serious threats to Maine's forest and our forest-dependent economy.**

If you suspect you have found these insects or their damage please contact us as soon as possible: forestinfo@maine.gov; (207) 287-2431 or 1-800-367-0223 (in Maine). Carefully note the location and take pictures if possible. Pictures can be sent to forestinfo@maine.gov. Do not move the damaged material unless you can do so safely—two layers of contractor-grade garbage bag tightly sealed will contain these pests short-term.

If you suspect you have found any of the *insects*, please collect a sample in a secure container (pill bottles, or other sealed plastic or glass containers work well). Store the sample in a cool location such as a refrigerator or freezer until you can contact our office for identification of the specimen.

If you use social media, you can follow news about these insects on Twitter (@MaineBugWatch) or Facebook (Maine Bug Watch).

Asian Longhorned Beetle
Anoplophora glabripennis
Host(s): Maples (*Acer* spp.) and other hardwoods

No Asian longhorned beetle detected to date in Maine. The MFS did not conduct any formal surveys in 2016.

Outreach efforts in conjunction with Maine Department of Agriculture, Conservation & Forestry, Plant Health program continued as part of their Farm Bill funded initiative.

Images of the beetle, its look-alikes and the damage it causes can be found at: www.albmaine.org.

Brown Spruce Longhorned Beetle
Tetropium fuscum
Host(s): Primarily Spruce (*Picea* spp.), occasionally Fir (*Abies* spp.), Pine (*Pinus* spp.), and Larch (*Larix* spp.)

No brown spruce longhorned beetle has been detected to date in Maine. Traps for this pest were set in Aroostook County by MFS and other locations around the state by USDA APHIS. BSLB is established throughout much of Nova Scotia. In addition, a reproducing population has been detected in Memramcook, NB. The province is carrying out activities to slow the spread of BSLB from that location.

Emerald Ash Borer
Agrilus planipennis
Host(s): Ashes (*Fraxinus* spp.)

The MFS continues to work with cooperators to look for this destructive insect that has already become established as close as New Hampshire, northeastern Massachusetts and south of Montreal (See Appendix D). Emerald ash borer (EAB) is known to be within about 30 miles of our western border.

Emerald ash borer attacks all species of ash (*Fraxinus* spp.) and threatens the survival of ash on our continent. Infested trees often exhibit crown dieback from the top down, epicormic (excessive) shoots, and bark splits. Serpentine larval feeding tunnels can be found etched into the inner bark and sapwood. Pupation occurs either in the sapwood or inner bark. Emerging adults create 1/8th inch wide "D" shaped exit holes.

Woodpeckers often feed heavily on EAB larvae and pupae, especially during the fall, winter, and early spring. As they feed, they flick off the brown outer bark, exposing the blonde inner bark. This "blonding" is highly visible and is a good sign that EAB may be present. Recent new infestations in MA and NH were found because of woodpecker feeding.

See Appendix D for more information on the 2016 emerald ash borer survey efforts.

Exotic Wood Borers and Bark Beetles of Spruce
Various
Host(s): Spruces (*Picea* spp.) and others

Maine Forest Service conducted a Cooperative Agricultural Survey Program funded trapping effort focused on early detection of potentially destructive exotic pests of spruce in Aroostook County. Pathways of spread for these insects could include raw wood, camp firewood, and solid wood packing material. Three traps were hung at each of ten sites targeting the following beetle species not yet detected in Maine: *Ips sexdentatus, I. typographus, Pityogenes chalcographus, Tetropium castaneum, T. fuscum.* None of the target beetles were found.

Table 6. Exotic wood borers and bark beetles of spruce survey sites

Town	Site Description
Ashland	Wood receiver
Fort Fairfield	International border
Fort Kent	Wood receiver and international border
Madawaska	International border
Masardis	Wood Receiver
Nashville Plt	Wood Receiver
Presque Isle	Campground
Square Lake Twp	Boat landing and campground
Saint Croix Twp	Wood Receiver
Van Buren	Boat landing and international border

Insects: Other

Alder Flea Beetle
Altica ambiens
Host(s): Alder (*Alnus* spp.)

Alder flea beetles were abundant in 2016. Field technicians in our inventory unit noted that they needed to close truck windows to avoid larval intrusions to the passenger cab when travelling roads overarched by alders and several noticed and reported the stretches of alder with lacy brown leaves along roadsides in their travels through Maine. In his documentation of the biology of the alder flea beetle (MAES Bull. 265, 1917) William C. Woods describes the scene of an outbreak of this species well: "…By the middle of August practically all of the leaves of every alder bush…had been skeletonized by the larvae, and the trees looked brown and bare as though they had been swept by a fire." Although the current infestations did not uniformly reach that level, copses of alder could be found that fit that description. This is not an economic pest in Maine, as alder are of little economic significance.

Outbreaks are reported to last two to three years. Woods noted that the flea beetle prefers to oviposit within the leaf-rolls created by alder tubemaker moths (*Acrobasis rubrifasciella*), and noted that a drop in numbers of the moth coincided with the collapse of the 1912–1915 outbreak of alder flea beetle. A quick search of alder around the Old Town office in late August revealed some sign of the tubemaker (one frass tube) and ample evidence of alder flea beetle, including damage to foliage and feeding adults.

Boxelder Bug
Boisea trivitatta
Host(s): Maples (*Acer* spp.), primarily Boxelder (*A. negundo*)

The boxelder bug is a species of true bug that feeds primarily on the seeds of boxelder and other maple species. It is not considered a pest of trees, but in early autumn, huge congregations of the bugs may gather in sunny areas prior to seeking overwintering sites. The adults (mostly black with red wing margins) and nymphs (mostly red) mass together. They do not cause damage to either trees or structures, but in their quest for hibernation sites, they may enter houses and become a nuisance. Reports of boxelder bugs in Maine were up this year, with sightings centered around the Capitol Region including the towns of Augusta, Gardiner, Hallowell and Chelsea (Kennebec County) as well as in Lewiston (Androscoggin County), Gorham (Cumberland County), Farmington (Franklin County), Benton (Kennebec County), Levant (Penobscot County) and Skowhegan (Somerset County).

Leaf Miner on Holly
Probably ***Rhopobota dietziana***
Host(s): Hollies (*Ilex* spp.)

The mines of a leaf-miner and –tier on holly (*Ilex* spp.), possibly *Rhopobota dietziana*, were seen in abundance in Orono (Penobscot County) and Lincolnville (Waldo County). Hosts included the understory shrubs winterberry (*Ilex verticillata*) and mountain holly (*Ilex mucronata*). Although the mining itself was abundant enough to be eye-catching in places, the "hook" was a small tube of frass extending out of the mine on the undersurface of affected leaves. At first glance this resembled spindle-galls found on cherry, but close examination revealed that the hook was made of digested, not galled, plant tissue. By August, the moth had already departed all examined mines and tied leaves.

Springtails
Collembola
Springtails are small, soft-bodied primitive insects. In most situations, they are not pest species. Springtails thrive in moist places and generally feed on decaying plant matter, fungi, bacteria and other organic matter. They are abundant; one estimate is that a cubic meter of soil holds about 100,000 springtails. Most are seldom seen by casual observers; snowfleas are an exception. They frequently aggregate in impressive swarms during winter and spring thaws and other ideal (read "moist") conditions. Swarms are short lived and usually last less than a few days.

In 2016 we received many reports of masses of springtails—some in shovel-able quantities. Unfortunately, several reports came in a "shoot first, ask questions later" fashion—chemicals had already been applied to the "offending"

swarm before identification of the organism. A keystone of pest management is to identify the organism to be managed—what you're looking at might not be a pest at all!

As for springtails, management outside the immediate home environment really is not necessary. However, keeping areas around building foundations and entrances free of rotting debris including decaying mulch and leaves and reducing moisture around the building can limit swarming around the home and prevent infiltration into the home. If they do make it inside, snowfleas or springtails are not likely to survive long in a dry indoor environment. Persistent populations of springtails within homes should be addressed with moisture control, not chemical control.

Diseases and Injuries

Overview: The Forest Pathology program was re-started in July 2016, when the new forest pathologist started. For this reason, there is relatively limited information on specific locations and occurrences of diseases. However, since July 20, the program has completed numerous field visits and has travelled the state of Maine to better understand the state's current forest health conditions. The program has written one multi-state Evaluation and Monitoring grant application to the US Forest Service requesting funding for an enhanced monitoring of white pine needle disease and overall white pine health. Co-authorship was completed on a publication started in the current pathologist's previous position, GTR-335 Diseases of Trees in the Great Plains. Four presentations were given on various forest and shade tree pathology and forest health topics. Since July 20, approximately 52 tree disease clinic diagnoses were provided to landowners, homeowners, foresters, and others. An additional twenty on-site visits were documented involving tree and forest disease diagnostic assistance. Contributions were made to four issues of the *Forest and Shade Tree Insect and Disease Conditions for Maine* newsletter. Other significant monitoring and evaluation work included a survey of spruce needle diseases (*Rhizosphaera kalkhofii and Stigmina lautii)*, assistance to the USFS collecting Dutch elm disease isolates around Maine, and a significant amount of time was needed to adjust to and learn about the new environments of Maine and the unique disease conditions in the State.

Diseases and Injuries: Native

Anthracnose Diseases of Hardwoods
Various species, depending on the host species
Host(s): Ashes (*Fraxinus* spp.), Birches (*Betula* spp.), Maples (*Acer* spp.), Oaks (*Quercus* spp.)

Anthracnose diseases were considerably less prevalent in 2016 than in previous years. This was due to the lack of moisture early in the summer needed for the disease to cyclically re-infect foliage and build inoculum. General observations and reports of the major leaf diseases follow.

Ash anthracnose infections by *Gnomoniella fraxini* was light throughout the central and southern regions of the state. Birch anthracnose, caused by *Discula betulina,* was reported in a handful of coastal areas in 2016, but occurrence of damage was not reported elsewhere in the state. Maple anthracnose, potentially caused by a number of diseases in Maine (*Aureobasidium apocryptum (*syn. *Gloeosporium apocryptum* and *Kabatiella apocrypta), Discula campestris (*syn. *Gloeosporium campestre), D. umbrinella (*syn. *Gloeosporium umbrinellum) and Colletotrichum spp. (*syn. *Glomerella spp.)*), on native maple species was very minor and rarely seen. Oak anthracnose infection by *Apiognomonia quercina* was light and sporadic in areas where oaks grow in Maine.

***Armillaria* Root Rot**
***Armillaria* spp.**
Host(s): Trees, shrubs and several other plant species.

The *Armillaria* root rot fungus is present throughout the environment and several species are thought to occur in Maine. *Armillaria* is typically only able to parasitize stressed trees, except for certain species of *Armillaria* that are sufficiently virulent to alone cause rapid decline and mortality. *Armillaria* root rot was seen in several areas in Maine in 2016 parasitizing stressed trees. Samples were received from logging operations in Kittery and Waterford where foresters noticed the characteristic white mycelial fans just under the bark of trees in serious decline. In these two areas, the fungus appeared to be an important factor causing tree mortality, however significant predisposing stressors were identified at both areas. The *Armillaria* root rot disease complex is of concern due to the current widespread stress to pines, especially white pine that have suffered several years of heavy defoliation due to white pine needle diseases described later in this report.

***Caliciopsis* Canker of White Pine**
Caliciopsis pinea
Host(s): Eastern White Pine (*Pinus strobus*)

Caliciopsis canker is an ongoing problem in regions of Maine where white pine is abundant. Several sites where *Caliciopsis* canker was prevalent were observed in the west and southwest of the state. Presence of the disease is often indicated by numerous white streaks of pine pitch on the main stems of trees, however this is not always a clear indication of the disease since other agents (e.g., bark beetles) can cause similar symptoms. *Caliciopsis* canker is thought to be associated with overstocked stands and poor soils, but quantitative data are not available.

***Cytospora* Canker**
***Cytospora* spp.**
Host(s): Balsam Fir (*Abies balsamea*); Concolor Fir (*A. concolor*); Spruces (*Picea* spp.)

Several species of *Cytospora* can cause cankers of branches and stems of both conifers and hardwoods. The disease is primarily a problem on ornamental trees, and most commonly found in Maine on concolor firs and on white and Colorado blue spruces. In the forest setting, the disease is almost exclusively associated with highly stressed trees, and is commonly encountered on stressed trees in the genus *Populus*.

Fire blight
Erwinia amylovora
Host(s): Trees and shrubs in the Rosaceae family (apple, pear, mountain ash and others are most commonly seen infected by fire blight in Maine).

Fire blight was observed in an apple orchard in Androscoggin County in 2016. Incidence at the orchard was severe, causing cankering and dieback of many branches. The disease has the potential to be highly destructive to many species in the Rose Family. This is of particular significance to residential and commercial fruit growers and to horticultural and landscape plantings.

Fir Needle Casts
Lirula nervata*, *Lirula mirabilis*, *Isthmiella faullii*, *Rhizosphaera pini
Host(s): Balsam Fir (*Abies balsamea*); Fraser Fir (*A. fraseri*)

Many Christmas tree plantations have been moderately to heavily affected by needle cast diseases in the past several years. In 2016, disease incidence appeared to be quite light with few reports of the disease and one sample processed at the lab between July 20, when the new pathologist started, and the end of the field season.

Hemlock Shoot Blight
Sirococcus tsugae
Host: Eastern Hemlock (*Tsuga canadensis)*

Hemlock shoot blight is found throughout the state, wherever hemlocks are found, but is most prevalent in southern and southwestern areas of Maine. It has affected trees in ornamental settings, but is of more significance to hemlock regeneration in forest habitats.

Herbicide Injury
Damage and mortality to a variety of hardwood and softwood tree and shrub species resulting from the mis-application of various herbicides has continued to result in several homeowner requests for information. Verified and suspected cases of damage were reported from a number of locations around Maine in 2016.

***Phomopsis* spp. Galls**:
***Phomopsis* spp.**
Host(s): Oaks (*Quercus* spp.); occasionally other hardwoods

Several reports of *Phomopsis* galls on oaks are received annually, largely due to the unusual appearance and often the large numbers of the galls which develop on the branches and main stem of individual trees. The galls may be pea-sized up to softball-sized or sometimes larger. Some heavily infected tree crowns may have hundreds of galls, with subsequent branch dieback which can occasionally result in tree mortality. The galls are thought to be initiated by infection from a *Phomopsis* spp. fungus, but the subsequent growth of the gall continues for a number of years as woody host tissue. The disease is native, and is usually considered to be inconsequential in forest settings.

Pine Tip Blight
***Diplodia pinea* (*Sphaeropsis sapinea*)**
Host(s): Red, Scots, and Austrian Pine (*Pinus resinosa*, *P. sylvestris*, *P. nigra*)

Diplodia tip blight is widespread and moderately damaging to exotic hard pines (Scots, Austrian, and Mugo pines) throughout the state. Red pines showing symptoms of tip blight and shoot blight are commonly infected with both *Diplodia pinea* and *Sirococcus conigenus* (described below). This was confirmed at several of the red pine plantations visited in 2016. General observations from Maine indicate that the relative rate of development of *Diplodia* infections in red pines is considerably slower than that of *Sirococcus* infections. However, taken together, these shoot and tip blights continue to pose a significant threat to red pine in native and plantation stands. Infection levels have remained high for the past several years due, in large part, to favorable wet weather conditions during springs and summers.

Red Rot of White Pine
***Phellinus pini* (including other related *Phellinus* species)**
Host(s): Eastern White Pine (*Pinus strobus*), also other Pines (*Pinus* spp.), Spruces (*Picea* spp.), Larches (*Larix* spp.), and several other conifers

Internal decay of pines and other conifers from *Phellinus pini* is often associated with over-mature trees, and with trees growing poorly in understory conditions or on poor sites. Red rot is often considered the most economically significant disease of mature white pine because it causes the highest wood volume losses. The pathogen is classed as a canker-rot. Some concern has been expressed recently that increased stresses on white pine health (see the ***Caliciopsis* Canker of White Pine** and **White Pine Needle Cast and Needle Blight** sections of this report) may result in an increase in losses over time from *Phellinus pini*, as well, although this relationship has not yet been examined in any detail. In 2016, the disease was reported as causing losses to white pine in a stand in Penobscot County, but this was not able to be confirmed. In previous years, this disorder was reported in several counties in Maine.

***Sirococcus* Shoot Blight**
Sirococcus conigenus
Host(s): Red Pine (*Pinus resinosa*), other hard pines (*Pinus* spp.)

Sirococcus shoot blight remains a significant threat to red pine in native and plantation stands throughout the state. In 2016, heavy infection levels were observed in red pine plantings in Lincoln, Aroostook, Penobscot, Hancock, Androscoggin and Oxford counties. This damage has been attributed to *Sirococcus conigenus*. *Diplodia* tip blight is widespread and moderately damaging to red pine in these same areas.

Eastern Dwarf Mistletoe
Arceuthobium pusillum
Host(s): White Spruce (*Picea glauca*), Black Spruce (*P. mariana*), Red Spruce (*P. rubens*), Balsam Fir (*Abies balsamea*)

In 2016, damage to black spruce, red spruce and balsam fir by eastern dwarf mistletoe was frequently seen along coastal areas of Maine. The parasite was also seen in several inland areas, but only minor severity was observed.

Spruce Needle Casts
Rhizosphaera kalkhoffii; Stigmina lautii
Host(s): White Spruce (*Picea glauca*) and Colorado Blue Spruce (*P. pungens*)

Spruce needle cast diseases continued at moderate to high levels across the state, wherever the hosts occur. It has been especially damaging to ornamental plantings in suburban settings, in public parks, and along community streets. Severe damage to trees from the needle casts has resulted in some mortality, but more often the aesthetics of trees has been so affected as to warrant a considerable number of tree removals. In 2016, a spruce needle cast disease survey was initiated. Results from the first year indicate that *Stigmina* needle cast disease is far more common than *Rhizosphaera* needle cast.

Tar Leaf Spot
Rhytisma acerinum
Host(s): Norway Maple (*Acer platanoides*); occasionally other *Acer* spp.

Incidence of tar leaf spot diseases was low in 2016 due to lower than average spring precipitation. The disease is common wherever Norway maples are planted as ornamentals, especially in urban and suburban communities. A few reports of minor premature defoliation were received from Kennebec County in 2016.

***Verticillium* Wilt**
***Verticillium* spp..**
Host(s): Maples (*Acer* spp.) and many other hardwoods

In 2016, one possible *Verticillium* wilt sample was handled at the lab. Visual symptoms and wilt/dieback patterns consistent with *Verticillium* wilt were observed during statewide travels, however these were casual observations and samples were not taken.

White Pine Needle Cast and Needle Blight
Mycosphaerella dearnessii (= Lecanosticta acicola), Lophophacidium dooksii* (=*Canavirgella banfieldii*), and *Bifusella linearis
Host(s): Eastern White Pine (*Pinus strobus*)

In 2016, the needle disease complex that has been impacting white pine trees, for what is believed to be 10 consecutive years, has continued to result in extensive pre-mature needle shedding wherever white pines grow across the state. Losses of one-year-old needles during late May and through June resulted in numerous disease clinic requests for assistance. The disease remains widespread, but most severe throughout central, western, and southern Maine. A July aerial survey revealed nearly 125,000 acres of severely impacted white pine in Oxford and Androscoggin counties. Due to the mostly consistent disease level over the past years, the implications of this chronic stress and mortality are a growing concern. An aerial survey in areas of Baxter State Park in August indicated disease presence and high severity in certain areas. The extent to which pine leaf adelgid has contributed to the overall decline in pine health in the Baxter area remains unclear. Pine leaf adelgid does not appear to be associated in other areas of Maine where white pine are severely affected by needle casts/blights. Continued

monitoring of this situation will be prioritized for early detection of any emerging insect or disease agents that could serve as further factors leading to white pine decline and mortality.

Diseases: Non-Native

Dutch Elm Disease
Ophiostoma ulmi* and *Ophiostoma novo-ulmi
Host(s): American Elm (*Ulmus americana*)

Dutch elm disease (DED) is a perennial issue and was evident throughout central and southern Maine as symptoms developed in mid-summer 2016. The disease is judged to be at moderate levels in younger elms in mixed forest and roadside stands. Several disease specimens were collected from around Maine in 2016 and sent to a USFS lab in Wisconsin for a national DED resistance trial.

Oak Dieback
***Diplodia corticola* (=*Botyrosphaeria corticola*)**
Host(s): Oak (*Quercus* spp.), Grape (*Vitis* spp.)

Symptoms of oak tip dieback were observed in Standish and Augusta in 2016 (Cumberland and Kennebec counties). Symptoms include the drying and death of leaves and branch tips, often with a clearly delimited canker separating the dead portion from the live portion of the branch. Leaves on affected branches become brown and persist on the tree, at least for several weeks. It is very likely that the causal agent for this dieback is *Diplodia corticola* (=*Botyrosphaeria corticola*). A specific site in North Limington where symptoms were observed in past years was re-visited with USFS pathologist and former Maine Forest Service Pathologist. Symptoms in this area had progressed and, according to area residents, several oak trees had died and had been removed. This disease is generally considered to be a secondary agent, affecting trees initially weakened or damaged by some other cause. No on-site underlying stressors were apparent.

White Pine Blister Rust
Cronartium ribicola
Host(s): Eastern White Pine (*Pinus strobus*)

White pine blister rust remains a significant threat, especially to white pine regeneration and sapling-sized trees and stands throughout Maine. The new strain of the fungus, which has been shown to infect previously resistant and immune cultivars of *Ribes*, poses an additional risk, especially in neighboring states that had eased quarantine regulations on these cultivars. Establishment and cultivation of any *Ribes* within the quarantine zone, and any *Ribes* of European black currant lineage in the entire state, has been and still is prohibited.

Division Activities

Northeast Forest Fire Protection Compact - Forest Health Working Team

State forest pest managers in the Northeast have been looking for a way to maximize shrinking resources across the region. In 2011 Maine and the ten partner jurisdictions contained within the Northeast Forest Fire Protection Compact (NEFPC) established a Forest Health Working Team to provide resource sharing and mutual assistance for forest health related situations. Initial seed money was provided by member jurisdictions for survey and response to pest problems requiring resources beyond what each entity could do on its own. A USDA grant in 2014 then funded a pilot/demonstration of a resource-sharing project linked to increased survey capacity for the Worcester Massachusetts Asian longhorned beetle infestation. Personnel from Maine, the other New England states and New York were activated for duty in Worcester.

There were six mobilizations associated with the NFFPC Forest Health Working Team in 2014 and 2015, none in 2016 (Table 7). These mobilization efforts were a definite success from Maine's "sending jurisdiction" perspective: response was expedited and finance and logistical matters were facilitated through the Compact's oversight. More importantly, we were able to provide survey and response training to MFS staff so that we are better prepared to address emerging threats before they arrive in Maine. We also now have a way to call for assistance when Maine has a pest problem requiring additional resources. In these times of shrinking resources, this initiative is proving to be extremely beneficial.

The Maine Forest Service has promoted a suggestion that the USFS release some of the funds currently targeted for other projects and reallocate them to maintain a standing pool of funding to underwrite survey mobilizations under the NFFP Compact's forest health working team. We also believe that, where all states in the Northeast Area are members of analogous mutual aid Compacts, this approach would be beneficial for the entirety of the region. This effort remains a work in progress.

Table 7. Compact forest health mobilizations 2013 – 2015

Date	Issue	Location	Host Agency	Task	Number Mobilized	Home Agencies	Source of Travel Funds	Salaries Paid by
Spring 2013	EAB	NH	NH	Survey	6	**ME**, MA	NH	Home Agency
Fall 2014	ALB	MA	MA	Survey	20	**ME**, CT, NS, NH, VT, USFS, USDA-PPQ	USFS Grant	Home Agency
Mar/Apr 2015	SPB	NY	US-FWS*	Tree Felling	20	QC, NB	US-FWS	US-FWS
April 2015	SPB	NY	NY	Survey	6	**ME,** NS, NH	USFS Grant	Home Agency
June 2015	SPB	NY	NY	Information & Education	5	**ME**, NS, NY, VA, NJ	USFS Grants	Home Agency
Nov 2015	SPB	NY	NY	Survey	8	**ME,** MA, RI, VT	USFS Grant	Home Agency
Nov 2015	SPB	NY	NY	Tree Felling	10	QC	NY	NY

EAB - Emerald Ash Borer

ALB - Asian Longhorned Beetle

SPB - Southern Pine Beetle

*United State Fish & Wildlife Service

Aerial Survey

Aerial survey flights were flown from June into September in 2016 for both delineating forest pest problems and overflights detecting potential damage and stress situations. Damage by the following pests was mapped: bare-patched oak leafroller (*Pseudexentera spoliana*), browntail moth (*Euproctis chrysorrhoea*), cherry scallop shell Moth (*Hydria prunivorata*), winter moth (*Operophtera brumata*) and white pine needle damage. Trees along the margins of ponds, beaver flowages, heaths, etc. are in poor health across the entire state due to fluctuating water levels in recent years. Birch at high elevations is in poor condition overall. Beech in northwestern parts of the state where beech bark disease is killing trees on the hardwood ridges is also noticeable.

We continue to balance the need to survey the forest with the cost of flights. The survey flights were made from four different MFS aircraft: a Cessna 185, a Cessna 305 (a Korean War observation plane known as an L19) on floats, a Laker that can land on the ground or water, or a Bell Jet Ranger helicopter. In addition, trained, unaccompanied MFS pilots conduct initial aerial reconnaissance in sections of the state where no new detectable stress events are anticipated. This effort is incorporated into fire detection and other MFS routine flight activities. If they see anything unusual in the forest they give a call to the Entomology Lab. We also solicit ancillary ad hoc reports from outside cooperators. These efforts augment our internal capacity and provide a cost effective initial detection tool for triggering targeted survey and evaluation.

We have been using digital aerial sketch mapping (DASM) since 2007 and find it an improvement over using paper maps and a pencil. However, like any other electronic device, it is always wise to bring a mechanical backup. The computers and software are supplied through a grant with the USDA Forest Service who also help troubleshoot problems both in the air and in interpreting the data. Greg Miller, MFS GIS Coordinator, handles the data and produces maps from the surveys.

Bioblitzes at Acadia National Park

The year 2016 marked the last of a series of bioblitzes at Acadia National Park (ANP). The Maine Forest Service has been co-sponsoring bioblitzes in the park since 2004 along with the ANP, the Maine Entomological Society and the University of Maine. A bioblitz is a 24-hour period when as many different species are collected as possible within a certain area. The ANP blitzes have focused on one insect (or spider) taxon each year; for example, beetles, or moths & butterflies. Eight of these blitzes have been focused on the little studied Schoodic Point section of ANP. The last five blitzes have taken place primarily on Mount Desert Island with additional collecting on Schoodic Point.

The 2016 blitz focused on Lepidoptera (moths & butterflies). This year the bioblitz tallied ca 400 species; 48 species were noted only from sites on Mt. Desert Island; 171 species were new records for the bioblitz; 59 species were records not previously reported for the Mt. Desert Island area and 13 species were not reported for Maine in the Brower lists. All these were from the third time that Lepidoptera had been a focus of a blitz!

Participation and support of these events has several benefits for the MFS. We have an opportunity to survey the insects in an area rarely studied or heavily used; learn of invasive species that may be found there; develop and maintain interagency connections; build new relationships with participating taxonomists; enhance in-house taxonomic expertise and spark an interest in participants for forest insects. Additionally, excess specimens are deposited in the MFS collection. The MFS provides lab and field equipment, personnel to assist in running the blitz, and participants for collecting, processing and identifying specimens.

For more information on the blitzes go to: http://www.nps.gov/acad/naturescience/bioblitz.htm

Firewood and Invasive Insects Awareness Campaign

Maine Forest Service continues to partner with the DACF Division of Animal and Plant Health on invasive insect outreach – in particular, hemlock woolly adelgid, winter moth, and browntail moth, and emerald ash borer. In 2016 the Maine Association of Conservation Districts contracted with DACF Division of Plant and Animal Health to do outreach on invasive insects. This was funded by a Farm Bill cooperative agreement with USDA-APHIS.

The "*Leave Your Firewood at Home*" and/or "*Be on the Lookout for Invasive Insects*" message were promoted at fairs, festivals, camper shows, outdoor shows, various industry shows, and other gatherings. We ran multiple training sessions for right-of-way arborists as these are some of the folks "on the frontline" when it comes to looking at trees.

Several ads in various camping magazines and newspaper supplements were printed. The goal of these ads was to reach out-of-state campers before they left home with their firewood. Notices about the out-of-state firewood ban were given to campground owners to help them inform their out-of-state campers of the new legislation **before** they came to Maine. Groups with an outdoor connection have been asked to put a message on their website promoting leaving firewood at home. Maine State Parks, Maine Campground Owners Association (MECOA) and a race track that has camping all have notices about firewood as do some individual campgrounds.

The effort to educate the public about firewood is a broad program across the Northeast with funding from both USDA Forest Service and USDA-APHIS. These agencies have also put their time and effort into the outreach effort along with states and private groups. The Nature Conservancy's "*Don't Move Firewood*" campaign has also been instrumental in spreading the word through their internet presence, videos and PSA's.

Insect Collection

The Maine Forest Service Insect Collection has over 70,000 specimens in the reference portion of the collection. Additionally, there are now more than 5,000 ant specimens stored in alcohol, more than 60,000 spider records, and in excess of 10,000 bark beetle and woodborer specimens. Besides having most of the specimens themselves here we also have computerized records of all this material. Some of the material in the collection is now stored at the Maine State Museum (MSM) Annex along with the University of Maine collection. We have had donations of personal collection of Maine insects over the past few years and those are being incorporated into the Maine State holdings at either 50 Hospital Street or the MSM Annex.

We are continually adding to the collection and upgrading it as time – *and volunteers* – allow. Without the assistance provided by Maine Entomological Society and other volunteers we would not be able to maintain and manage this valuable reference collection. More help is always needed!

Light Trap Survey

The Maine Forest Service has been monitoring forest insect pest populations with an array of light traps across the State for over 70 years. Twenty-two traps were run in 2016 in locations from South Berwick to Allagash to Topsfield (

Table 8). Rothamstead light traps are used in most locations with blacklight traps at the remaining sites. The Rothamstead trap has a 150W light bulb inside a protective casing with an entry for moths. The moths fall down a funnel into a can where they die. Blacklight traps have metal fins that the moths hit as they fly toward the light and then fall into a collecting can. One light trap runs on batteries as there is no power at Frost Pond. Trap operators collect the catch daily and send the catch in weekly to be processed. The timeframe for trap operation is either 30 or 45 days depending on the location and flight season of the moths of interest. The results are used in predicting forest pest outbreaks. A heartfelt thank you goes out to the trap operators each year. Although it is not difficult to operate a trap and they are minimally compensated for it, attention to detail and daily attendance is required and very much appreciated.

A checklist of significant insect defoliators is used in sorting the moth catch material. Trap catch records for some of these insects are available for over 30 years' worth of trapping. Other insects that are trapped and occur in unusual numbers or have not been seen before are noted in the light trap records. A portion of the moth catch is saved for use in outreach programs during the remainder of the year. Pest populations of significance are reported in the appropriate section of this report. These traps are also used to monitor for invasive species coming into the State.

Table 8. 2016 light trap locations

Trap Location	County	Start date	End date	Number of nights
Allagash	AROOSTOOK	7/3	7/31	30
Ashland	AROOSTOOK	7/3	7/31	30
Bar Harbor	HANCOCK	6/17	7/31	45
Big Six Twp - Ste. Aurelie	SOMERSET	7/3	7/31	30
Bowerbank	PISCATAQUIS	6/17	7/31	45
Calais	WASHINGTON	6/17	7/31	45
Crystal	AROOSTOOK	7/3	7/31	30
Durham	ANDROSCOGGIN	6/17	7/31	45
Exeter	PENOBSCOT	6/17	7/31	45
Hope	KNOX	6/17	7/31	45
Jackman	SOMERSET	7/3	7/31	30
Kingfield	FRANKLIN	7/3	7/31	30
Millinocket	PENOBSCOT	6/17	7/31	45
Monson	PISCATAQUIS	6/17	7/31	45
New Sweden	AROOSTOOK	7/3	7/31	30
Rangeley	FRANKLIN	6/17	7/31	45
South Berwick	YORK	6/17	7/31	45
T15 R15 WELS – Ste. Phamphile	AROOSTOOK	7/3	7/31	30
T3 R11 WELS - Frost Pond	PISCATAQUIS	6/17	7/31	45
Topsfield	WASHINGTON	6/17	7/31	45
Turner	ANDROSCOGGIN	6/17	7/31	45

Public Assistance

Public assistance from the Forest Insect and Disease Program takes many forms. We speak at workshops and field days to a broad range of audiences, write articles for our own and other publications, speak with television, newspaper and radio journalists, answer questions at trade shows and other venues, and answer the many questions that come in by phone calls, e-mails and walk-in visitors. We documented presenting in person to over 3,000 people, answering well over 1,000 calls and spoke with the press 23 times over the year.

We continued to publish the Conditions Reports during the 2016 growing season. Our use of web-based vehicles continued to increase our readership with now over 1,800 people choosing to use the electronic format (an increase of ~400 over 2015 subscriptions). We also continue to offer these products in the traditional paper format (approx. 55 subscribers for the paper format). Both these formats continue to be extremely popular with clientele.

Quarantine Administration

The unit administers state quarantines on European larch canker, gypsy moth, hemlock woolly adelgid, pine shoot beetle and white pine blister rust. Parallel federal quarantines exist for European larch canker, gypsy moth and pine shoot beetle. Each quarantine lists regulated articles and areas. Compliance agreements, usually held by receivers, allow controlled movement of regulated articles out of the regulated area for the European larch canker, gypsy moth, hemlock woolly adelgid and pine shoot beetle quarantines. **Questions about forestry related quarantines and moving regulated material and requests for compliance agreements can be directed to Allison Kanoti, e-mail: allison.m.kanoti@maine.gov; phone: (207)-827-1813; Maine Forest Service, PO Box 415, Old Town, ME 04468-0415.** More information on the quarantines is contained in **Appendix A: Forestry Related Quarantines in Maine – 2016.**

Maine Forest Service
DEPARTMENT OF AGRICULTURE, CONSERVATION & FORESTRY
INSECT & DISEASE MANAGEMENT PUBLICATIONS
Technical Report Series

No. **Title**

1. LaBonte, G.A. The Saddled Prominent Outbreak of 1970-1971 and Its Damages. March, 1978. 20 pp.
2. Dearborn, R.G., H. Trial, Jr., D. Struble and M. Devine. The Saddled Prominent Complex in Maine with Special Consideration of Eastern Maine Conditions. March, 1978. 20 pp.
3. Maine Forest Service, Entomology Division. Spruce Budworm in Maine: 1977. March, 1978. 80 pp.
4. Devine, M.E., H. Trial, Jr. and N.M. Kotchian. Assessment of Spruce Budworm Damage in the Moosehorn National Wildlife Refuge. August, 1978. 32 pp.
5. Struble, D., H. Trial, Jr. and R. Ford. Comparison of Two Rates of Sevin-4-Oil for Spruce Budworm Control in Maine: 1976. August, 1978. 28 pp.
6. Morrison, T.A. and J.B. Dimond. Field Trials for Control of Spruce Budworm in Maine: A History and Bibliography. September, 1978. 13 pp.
7. Bradbury, R. Spruce Budworm Parasitic Survey in Maine with Special Reference to the 1978 Season. December, 1978. **Unpublished**.
8. Trial, Jr., H. and A. Thurston. Spruce Budworm in Maine: 1978. December, 1978. 109 pp.
9. Trial, Jr., H., W. Kemp and D. Struble. Evaluation of Split Application and Reduced Dosages of Sevin-4-Oil for Spruce Budworm Control in Maine: 1978. November, 1979. 30 pp.
10. Struble, D., W. Kemp and H. Trial, Jr. Evaluation of a Reduced Dosage of Orthene for Spruce Budworm Control in Maine: 1977 and 1978. December, 1979. **Unpublished**.
11. Dimond, J.B., M. Kittredge, D. Schaufler and D. Pratt. *Bacillus thuringiensis*: Operational Project - Spruce Budworm Control in Maine 1978. 1978. 36 pp.
12. Kemp, W.P., H. Trial, Jr. and D. Struble. Sampling and Analysis Design for Departmental Insecticide Monitoring. February, 1979. 32 pp.
13. Connor, J.Y. and H. Trial, Jr. *Bacillus thuringiensis*: Operational Project - Spruce Budworm Control in Maine 1979. November, 1979. 20 pp.
14. Trial, Jr., H. and A. Thurston. Spruce Budworm in Maine: 1979. March, 1980. 111 pp.
15. Bradbury, R.L. and G.A. LaBonte. Winter Mortality of Gypsy Moth Egg Masses in Maine. November, 1980. 4 pp.
16. Devine, M.E. and J.Y. Connor. Resurvey of Spruce Budworm Damage in the Moosehorn National Wildlife Refuge. February, 1981. 21 pp.
17. Trial, Jr., H. and M.E. Devine. Spruce Budworm in Maine: Biological Conditions in 1980 and Expected Infestation Conditions for 1981. February, 1981. 64 pp.
18. Trial, Jr., H. and M.E. Devine. Spruce Budworm in Maine: Results of the 1981 Project, Biological Conditions in 1981, and Expected Infestation Conditions for 1982. April, 1982. 83 pp.
19. Trial, Jr., H. and M.E. Devine. Spruce Budworm in Maine: Results of the 1982 Project, Biological Conditions in 1982, and Expected Infestation Conditions for 1983. March, 1983. 76 pp.
20. Trial, Jr., H. and M.E. Devine. Spruce Budworm in Maine: Results of the 1983 Project, Biological Conditions in 1983, and Expected Infestation Conditions for 1984. May, 1984. 75 pp.
21. LaBonte, G.A. Control of the Red Oak Leaf-Mining Sawfly. August, 1984. 7 pp.
22. Dearborn, R.G., R. Bradbury and G. Russell. The Forest Insect Survey of Maine -Order Hymenoptera. May, 1983. 101 pp.

23. Trial, Jr., H. and M.E. Devine. Spruce Budworm in Maine: Results of the 1984 Project, Biological Conditions in 1984, and Expected Infestation Conditions for 1985. April, 1985. 75 pp.

24. Trial, Jr., H. and M.E. Devine. Spruce Budworm in Maine, Results of the 1985 Project, Biological Conditions in 1985 and Expected Infestation Conditions for 1986. August, 1986. 71 pp.

25. Bradbury, R.L. Efficacy of Selected Insecticides Against the White Pine Weevil (Coleoptera: Curculionidae). November, 1986. 8 pp.

26. Trial, Jr., H. and J.B. Dimond. An Aerial Field Trial Evaluating Split Applications and New Formulations of *Bacillus thuriengiensis* Against the Spruce Budworm, *Choristoneura fumiferana* in Maine. March, 1988. 20 pp.

27. Bradbury, R.L. An Economic Assessment of the White Pine Blister Rust Control Program in Maine. January, 1989. 17 pp.

28. Trial, Jr., H. Spruce Budworm in Maine: The End of the Outbreak, Biological Conditions in 1986, 1987, and 1988, and a Look at the Future. October, 1989. 50 pp.

29. Granger, C.A. Forest Health Research and Monitoring Activity in Maine 1989-90. April, 1990. 30 pp.

30. Trial, Jr., H. and J.G. Trial. The Distribution of Eastern Hemlock Looper {*Lambdina fiscellaria* (Gn.)} Eggs on Eastern Hemlock {*Tsuga canadensis* (L.) Carr} and Development of an Egg Sampling Method on Hemlock. February, 1991. 12 pp.

31. Trial, Jr., 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. September, 1992. 12 pp.

32. Dearborn, R.G. and C.P. Donahue. The Forest Insect Survey of Maine - Order Coleoptera (Beetles). December, 1993. 101 pp.

33. Trial, Jr., H. and M.E. Devine. Forest Health Monitoring Evaluation: Brown Ash (*Fraxinus nigra*) in Maine - A Survey of Occurrence and Health. May 1994. 37 pp.

34. Trial, Jr., H. and M.E. Devine. The Impact of the Current Hemlock Looper, *Lambdina fiscellaria* (Guen.), Outbreak in Selected Severely Damaged Stands of Eastern Hemlock. December 1994. 16 pp.

35. Bradbury, R.L. Efficacy Trials of Foray 48B Against Early Larval Instars of the Browntail Moth, *Euproctis chrysorrhoea* (L.). May, 1995. 7 pp.

36. Trial, Jr., H. and M.E. Devine. The Impact of the Hemlock Loopers, *Lambdina fiscellaria* (Guenée), and *L. athasaria* (Walker) on Eastern Hemlock and Balsam Fir in New England. November, 1995. 24 pp.

37. Trial, Jr., H. and M.E. Devine. Forest Health Monitoring Evaluation: Brown Ash (*Fraxinus nigra*) in Maine - A 1995 Resurvey of Brown Ash Decline Plots Established in 1993. August 1996. 12 pp.

38. Bradbury, R.L. The Browntail Moth, *Euproctis chrysorrhoea*, Summary of Maine Forest Service Activities For 1995. March 1998. 12 pp.

39. Donahue, C. and K. Murray. Maine's Forest Insect and Disease Historical Database: Database Development and Analyses of 16 Years (1980-1995) of General Survey Data. February 1999. 17 pp.

40. Bradbury, R.L. The Browntail Moth, *Euproctis chrysorrhoea*, Summary of Maine Forest Service Activities for 1996. October 1999. 13 pp.

41. Foss, K.A. Variations in Ground Beetle (Coleoptera: Carabidae) Populations Across Ecological Habitats for the Stetson Brook Watershed in Lewiston, Maine. October 2001. 2- pp. + i-ii.

42. Foss, K.A and R.G. Dearborn. Preliminary Faunistic Survey of Mosquito Species (Diptera: Culicidae) with a Focus on Population Densities and Potential Breeding sites in Greater Portland, Maine. November 2001. 35 pp.
Revised May 2002 including 3 additional pages of larval data.

43. Maine Mosquito Surveillance Program – Report of the 2001 Working Group (MeDOC/FH&M, MMCRI, Coop. Extension serv. PMO, DHS-HETL). November 2001. Revised 2004. 134 pp.

44. Foss, K.A. and R.G. Dearborn. Preliminary Survey of Mosquito Species (Diptera: Culicidae) with a Focus on Larval Habitats in Androscoggin County, and Additional Larval Data for Portland, Maine during 2002. December, 2002. 51 pp.

45. Jennings, D.T., C.D. Dondale, J.H. Redner. An Annotated Checklist of the Spiders (Arachnida: Araneae) of Mount Katahdin, Baxter State Park, Maine, USA. October 2012. 30pp.

Appendices

Appendix A
Forestry Related Quarantines in Maine – 2016

The five forestry related state quarantines currently in effect in Maine are: White Pine Blister Rust, Gypsy Moth, European Larch Canker, Hemlock Woolly Adelgid and Pine Shoot Beetle. Except for the White Pine Blister Rust Quarantine, the regulated material designated in the rules and regulations may be moved freely within the quarantine area. Movement from the quarantine area to unregulated areas is restricted.

The Maine Forest Service maintains compliance agreements with facilities outside the quarantine areas which allow some movement of regulated materials outside the quarantine zones. Questions about forestry related quarantines and moving regulated material and requests for compliance agreements can be directed to Allison Kanoti, e-mail: allison.m.kanoti@maine.gov; phone: (207) 827-1813; Maine Forest Service Insect, PO Box 415, Old Town, ME 04468. More details are available on our website: http://maine.gov/dacf/mfs/forest_health/quarantine_information.html.

The following is only a partial summary of the rules. Refer to the cited statutory authority and related rules for complete quarantine regulations. Information about regulated areas can be found at the end of this section.

I. White Pine Blister Rust

a. Rules and Regulation

i. Title 12 MRSA 1988, Subchapter III, §803:8305 Shipment Prohibited.
ii. Department of Conservation, Bureau of Forestry Rules Chapter One.

b. Summary: *Ribes* spp. (currants and gooseberries) are alternate hosts for the non-native white pine blister rust fungus (*Cronartium ribicola*). This disease causes mortality and severely reduces the commercial value of eastern white pine (*Pinus strobus*). 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. The sale, transportation, further planting or possession of plants of other species in the genus *Ribes* (commonly known as currants and gooseberries) including cultivated wild, or ornamental sorts) is prohibited in all or part of the following counties: York, Cumberland, Androscoggin, Kennebec, Sagadahoc, Lincoln, Knox, Waldo, Hancock, and parts of Oxford, Franklin, Somerset, Piscataquis, Penobscot, Aroostook, and Washington (see map and list of towns at the end of this section).

This quarantine is administered by the Forest Health & Monitoring Division of the Maine Forest Service, phone: (207) 287-2431 or (207) 287-2791.

Gypsy Moth

c. Rules and Regulation:

i. 7 CFR Part 301.45, United States Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection and Quarantine as printed in the Federal Register.
ii. Title 12 MRSA, §8305 of the Laws of the State of Maine.

d. Summary: The infested area in Maine is quarantined for the movement of regulated articles, which includes wood of any species such as logs, pulpwood, trees, shrubs, firewood, Christmas trees, and chips, and requires the inspection and certification of such material if movement is *from the infested area* of the state *to non-infested states and foreign countries*. This is administered by the USDA-APHIS, PPQ in Hermon, Maine, phone: (207) 848-0000.

Since **Maine is not completely infested and quarantined**, wood or regulated articles moving *from the infested area* of the state *to the non-infested area* of the state must be accompanied by a certificate or go to a facility 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 non-infested parts of Canada* 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 Forest Health & Monitoring Division of the Maine Forest Service, phone (207) 827-1813 or (207)287-2791.

e. **Note:** The regulated area for the gypsy moth quarantine is due for expansion. See *gypsy moth* in the Annual Summary Report.

II. European Larch Canker

a. Rules and Regulation:

i. 7 CFR Part 301.91 of the United States Department of Agriculture, Animal & Plant Health Inspection Service, as published in the Federal Register

ii. Title 12 MRSA, §8305 of the Laws of the State of Maine.

b. **Summary:** All parts of larch (*Larix* spp.) including but not limited to logs, pulpwood, branches, twigs, etc., are regulated. Parts of Hancock, Knox, Lincoln, Waldo, and Washington counties are designated as the quarantined area from which their movement is restricted. This is managed by the USDA-APHIS, PPQ in Hermon, Maine, phone: (207) 848-0000; and the Forest Health & Monitoring Division of the Maine Forest Service, phone (207) 827-1813 or (207) 287-2791.

III. Hemlock Woolly Adelgid

a. Rules and Regulations:

i. 7 MRSA, Chapter 409, §2301-2303 of the Laws of the State of Maine.

ii. Department of Agriculture, Food & Rural Resources, Division of Plant Industry Rules Chapter 266.

b. Summary: Hemlock Woolly Adelgid is quarantined to prevent its artificial spread in the State, in order to protect Maine's forest, timber and wildlife resources from this destructive pest. Rooted hemlock plants, hemlock branches and/or needles, hemlock chips with top material (branches and/or needles) and uncomposted bark with top material (branches and/or needles) are regulated. The area currently under quarantine includes all of York, Lincoln and Sagadahoc Counties and parts of Androscoggin, Cumberland, and Kennebec Counties in Maine; portions of the northeastern United States to our south and west; the States of Alaska, California, Oregon and Washington in the western United States; and the Province of British Columbia in Canada.

Questions about importing hemlock seedlings and nursery stock should be directed to Animal and Plant Health, 28 State House Station, Augusta, ME 04333; Tel. (207) 287-3891. Questions about movement of chips, bark and top material should be directed to the Insect and Disease Laboratory, 168 state House Station, Augusta, ME 04333; phone: (207) 827-1813.

c. Note: The regulated area for the hemlock woolly adelgid quarantine in Maine is due for expansion at a minimum eastward through Knox County.

IV. Pine Shoot Beetle

a. Rules and Regulations:

i. 7 CFR Part 301.5, United States Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection and Quarantine as printed in the Federal Register

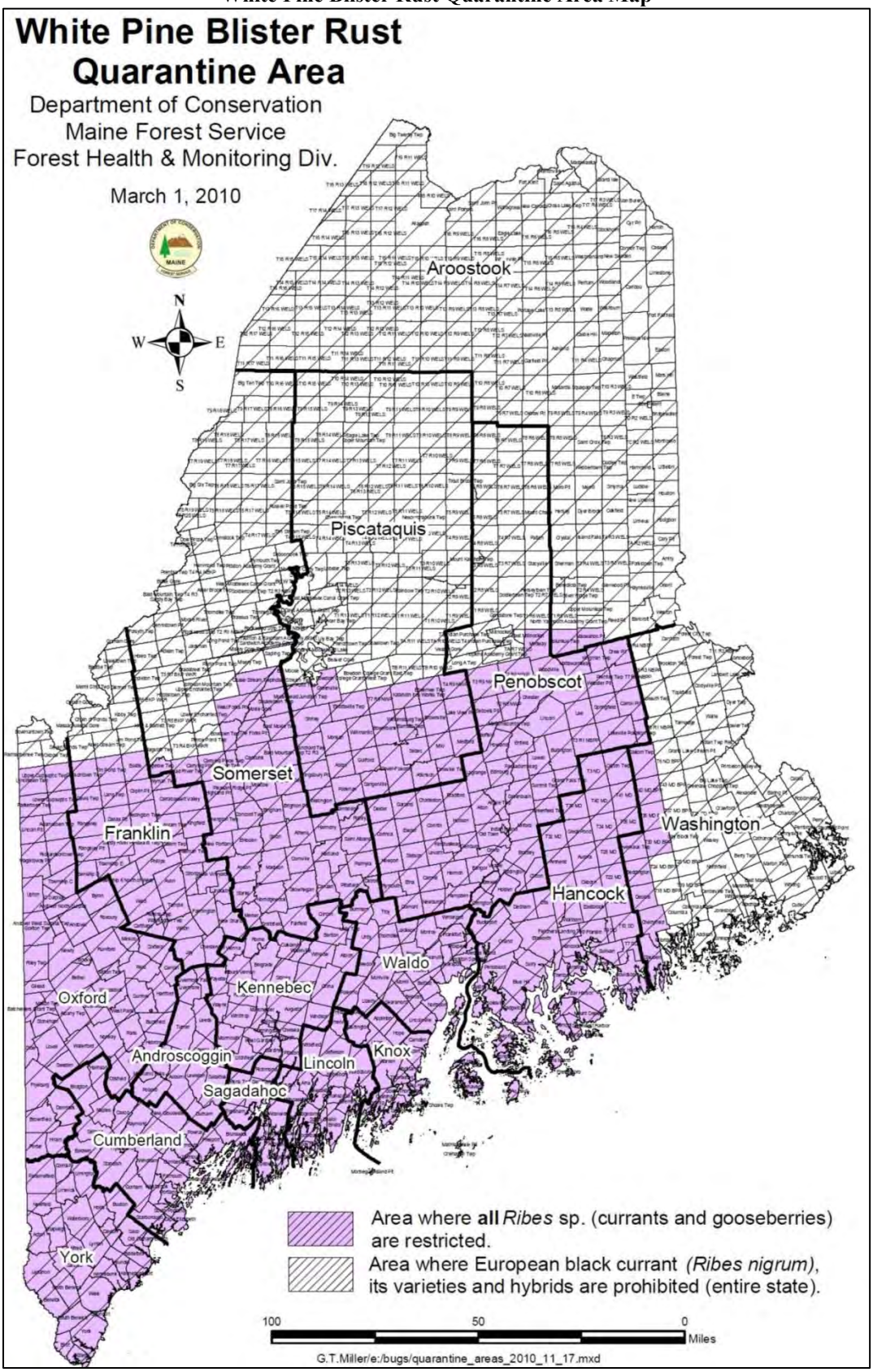
ii. 7 MRSA, Chapter 409, Section 2301 of the Laws of the State of Maine.

iii. Department of Agriculture, Food & Rural Resources, Division of Plant Industry Rules Chapter 268.

b. Summary: This quarantine designates regulated areas in the United States of America including the following areas in Maine: all counties except Aroostook and Washington Counties. Regulated articles are pine products with bark including entire plants, or plant parts such as Christmas trees, nursery stock, branches, boughs and stumps, pine logs and lumber with bark attached and bark mulch, nuggets or wood chips with bark attached. This is managed by the USDA-APHIS, PPQ in Hermon, Maine, phone: (207) 848-0000; and the Forest Health & Monitoring Division of the Maine Forest Service, phone (207) 827-1813 or (207) 287-2791.

NOTE: A summary of forestry related quarantines and links to maps and Federal and State laws and rules can be found on our web-site: http://maine.gov/dacf/mfs/forest_health/quarantine_information.html**.**

White Pine Blister Rust Quarantine Area Map



Towns Regulated by Maine's White Pine Blister Rust Quarantine*

***Note: *Ribes nigrum,* European black currant and its varieties or hybrids are prohibited statewide.**

Androscoggin County: The entire County.

Aroostook County: Macwahoc Plt, Molunkus Twp

Cumberland County: The entire County.

Franklin County: Avon, Carrabassett Valley, Carthage, Chesterville, Coplin Plt, Dallas Plt, Davis Twp, Eustis, Farmington, Freeman Twp, Industry, Jay, Kingfield, Lang Twp, Madrid Twp, Mount Abram Twp, New Sharon, New Vineyard, Perkins Twp, Phillips, Rangeley, Rangeley Plt, Redington Twp, Salem Twp, Sandy River Plt, Stetsontown Twp, Strong, Temple, Tim Pond Twp, Township 6 North of Weld, Township D, Township E, Washington Twp, Weld, Wilton, Wyman Twp

Hancock County: The entire County.

Kennebec County: The entire County.

Knox County: The entire County.

Lincoln County: The entire County.

Oxford County: Adamstown Twp, Albany Twp, Andover, Andover North Surplus, Andover West Surplus Twp, Batchelders Grant Twp, Bethel, Brownfield, Buckfield, Byron, C Surplus, Canton, Denmark, Dixfield, Fryeburg, Gilead, Grafton Twp, Greenwood, Hanover, Hartford, Hebron, Hiram, Lincoln Plt, Lovell, Lower Cupsuptic Twp, Lynchtown Twp, Magalloway Plt, Mason Twp, Mexico, Milton Twp, Newry, Norway, Otisfield, Oxford, Paris, Parkertown Twp, Peru, Porter, Richardsontown Twp, Riley Twp, Roxbury, Rumford, Stoneham, Stow, Sumner, Sweden, Township C, Upper Cupsuptic Twp, Upton, Waterford, West Paris, Woodstock

Penobscot County: Alton, Argyle Twp, Bangor, Bradford, Bradley, Brewer, Burlington, Carmel, Carroll Plt, Charleston, Chester, Clifton, Corinna, Corinth, Dexter, Dixmont, Drew Plt, Eddington, Edinburg, Enfield, Etna, Exeter, Garland, Glenburn, Grand Falls Twp, Greenbush, Greenfield Twp, Hampden, Hermon, Holden, Howland, Hudson, Indian Island, Kenduskeag, Kingman Twp, Lagrange, Lakeville, Lee, Levant, Lincoln, Lowell, Mattamiscontis Twp, Mattawamkeag, Maxfield, Medway, Milford, Newburgh, Newport, Old Town, Orono, Orrington, Passadumkeag, Plymouth, Prentiss Twp T7 R3 NBPP, Pukakon Twp, Seboeis Plt, Springfield, Stetson, Summit Twp, T2 R8 NWP, T2 R9 NWP, T3 R1 NBPP, T3 R9 NWP, Veazie, Webster Plt, Winn, Woodville,

Piscataquis County: Abbot, Atkinson, Barnard Twp, Blanchard Twp, Bowerbank, Brownville, Dover-Foxcroft, , Ebeemee Twp, Elliottsville Twp, Greenville, Guilford, Katahdin Iron Works Twp, Kingsbury Plt, Lake View Plt, Medford, Milo, Monson, Moosehead Junction Twp, Orneville Twp, Parkman, Sangerville, Sebec, Shirley, T4 R9 NWP, T7 R9 NWP, Wellington, Williamsburg Twp, Willimantic

Sagadahoc County: The entire County.

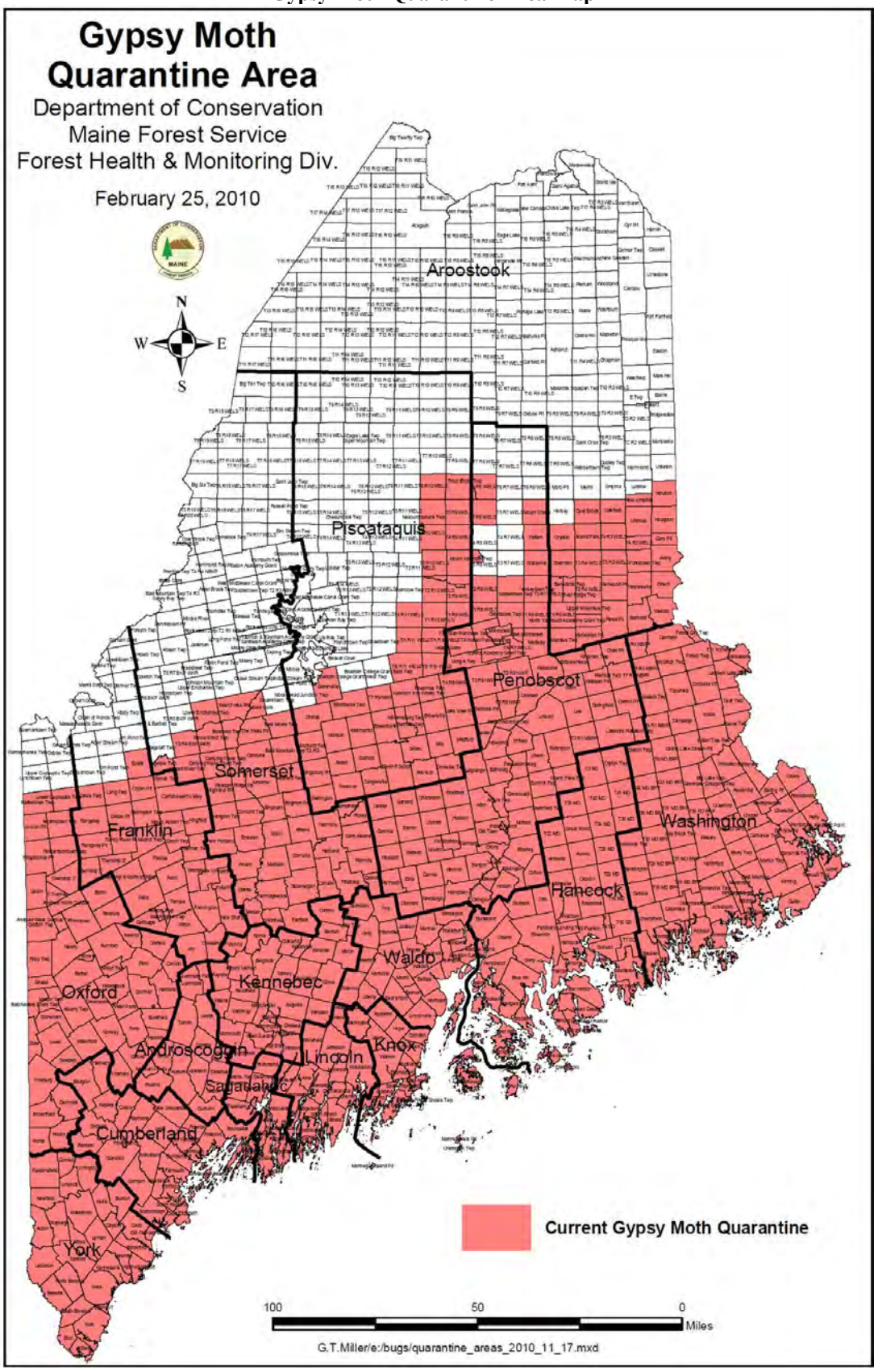
Somerset County: Anson, Athens, Bald Mountain Twp T2 R3, Bigelow Twp, Bingham, Bowtown Twp, Brighton Plt, Cambridge, Canaan, Caratunk, Carrying Place Town Twp, Carrying Place Twp, Chase Stream Twp, Concord Twp, Cornville, Dead River Twp, Detroit, East Moxie Twp, Embden, Fairfield, Harmony, Hartland, Highland Plt, Indian Stream Twp, Lexington Twp, Madison, Mayfield Twp, Mercer, Moscow, Moxie Gore, New Portland, Norridgewock, Palmyra, Pittsfield, Pleasant Ridge Plt, Ripley, Saint Albans, Skowhegan, Smithfield, Solon, Squaretown Twp, Starks, The Forks Plt, West Forks Plt

Waldo County: The entire County.

Washington County: Beddington, Cherryfield, Deblois, Devereaux Twp, Sakom Twp, Steuben, T30 MD BPP, T36 MD BPP, T42 MD BPP

York County: The entire County.

Gypsy Moth Quarantine Area Map



Areas Regulated by Maine's Gypsy Moth Quarantine

The entire counties of: Androscoggin, Cumberland, Hancock, Kennebec, Knox, Lincoln, Sagadahoc, Waldo, Washington and York and Portions of Counties as described below.

Baxter State Park –The entire park (entire townships of: Mount Katahdin Twp, Nesourdnahunk Twp, T3 R10 WELS, T4 R9 WELS, T5 R9 WELS, T6 R10 WELS, Trout Brook Twp and portions of: T2 R10 WELS, T2 R9 WELS, T3 R8 WELS, T4 R10 WELS, T6 R8 WELS)

Aroostook County- Amity, Bancroft, Benedicta Twp, Cary Plt, Crystal, Dyer Brook, Forkstown Twp, Glenwood Plt, Haynesville, Hodgdon, Houlton, Island Falls, Linneus, Macwahoc Plt, Molunkus Twp, North Yarmouth Academy Grant Twp, New Limerick, Oakfield, Orient, Reed Plt, Sherman, Silver Ridge Twp, T1 R5 WELS, T2 R4 WELS, T3 R3 WELS, T3 R4 WELS, T4 R3 WELS, TA R2 WELS, Upper Molunkus Twp, Weston

Franklin County- Avon, Carrabassett Valley, Carthage, Chesterville, Coplin Plt, Dallas Plt, Davis Twp, Eustis, Farmington, Freeman Twp, Industry, Jay, Kingfield, Lang Twp, Madrid Twp, Mount Abram Twp, New Sharon, New Vineyard, Perkins Twp, Phillips, Rangeley, Rangeley Plt, Redington Twp, Salem Twp, Sandy River Plt, Strong, Temple, Township 6 North of Weld, Township D, Township E, Washington, Weld, Wilton, Wyman Twp

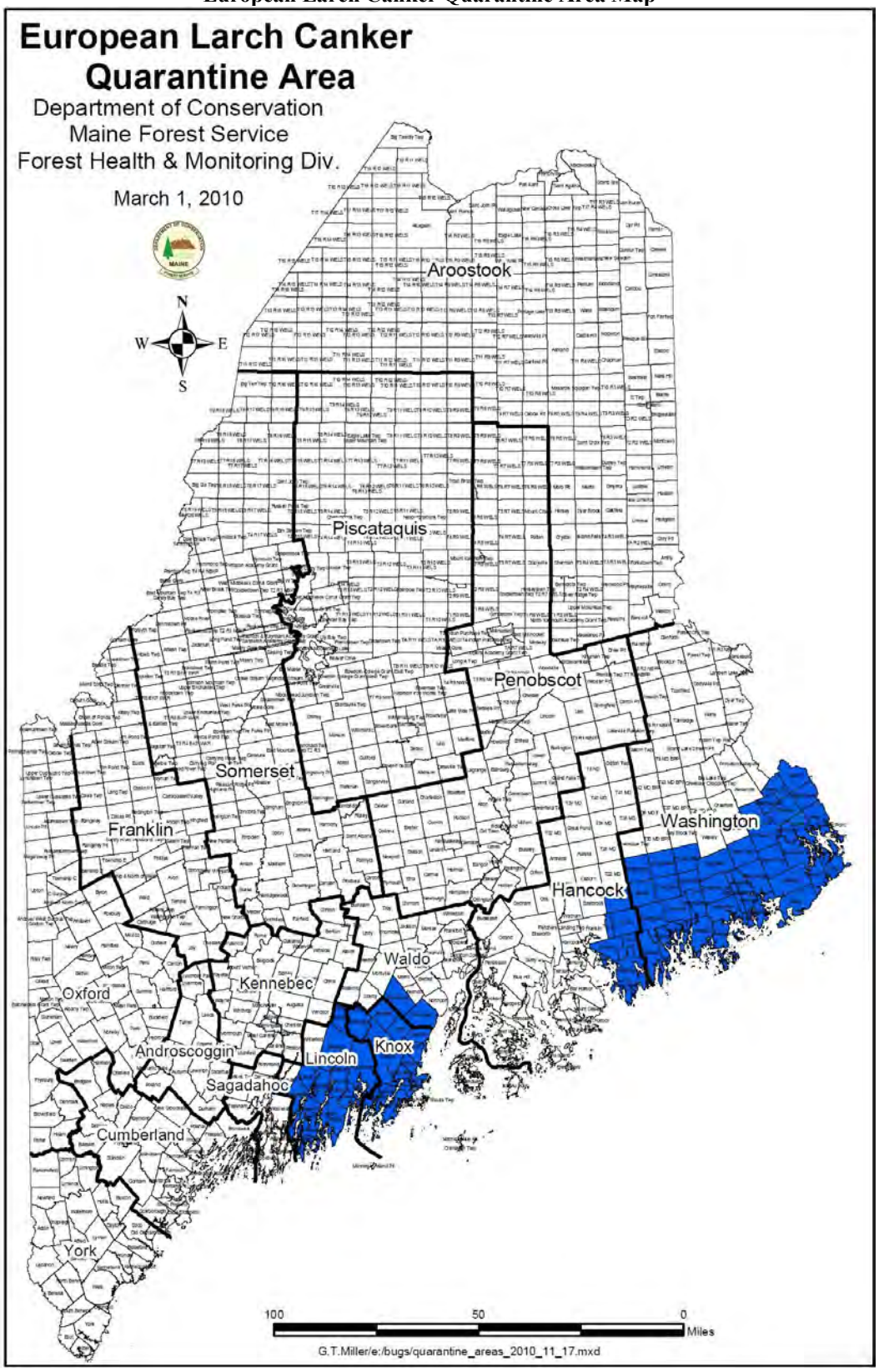
Oxford County- Adamston Twp, Albany Twp, Andover, Andover North Surplus, Andover West Surplus Twp, Batchelders Grant Twp, Bethel, Brownfield, Buckfield, Byron, C Surplus, Canton, Denmark, Dixfield, Fryeburg, Gilead, Grafton Twp, Greenwood, Hanover, Hartford, Hebron, Hiram, Lincoln Plt, Lovell, Lower Cupsuptic Twp, Magalloway Plt, Mason Twp, Mexico, Milton Twp, Newry, Norway, Otisfield, Oxford, Paris, Parkertown Twp, Peru, Porter, Richardsontown Twp, Riley Twp, Roxbury, Rumford, Stoneham, Stow, Sumner, Sweden, Township C, Upton, Waterford, West Paris, Woodstock

Penobscot County- Alton, Argyle, Bangor, Bradford, Bradley, Brewer, Burlington, Carmel, Carroll Plt, Cedar Lake Twp, Charleston, Chester, Clifton, Corinna, Corinth, Dexter, Dixmont, Drew Plt, East Millinocket, Eddington, Edinburg, Enfield, Etna, Exeter, Garland, Glenburn, Grand Falls Twp, Greenbush, Greenfield Twp, Grindstone Twp, Hampden, Hermon, Herseytown Twp, Holden, Hopkins Academy Grant Twp, Howland, Hudson, Kenduskeag, Kingman Twp, Lagrange, Lakeville, Lee, Levant, Lincoln, Long A Twp, Lowell, Mattamiscontis Twp, Mattawamkeag, Maxfield, Medway, Milford, Millinocket, Mount Chase, Newburgh, Newport, Old Town, Orono, Orrington, Passadumkeag, Patten, Plymouth, Prentiss Twp T7 R3 NBPP, Pukakon Twp, Seboeis Plt, Soldiertown Twp T2 R7 WELS, Springfield, Stacyville, Stetson, Summit Twp, T1 R6 WELS, T1 R8 WELS, T2 R8 NWP, T2 R8 WELS, T2 R9 NWP, T3 R1 NBPP, T3 Indian Purchase Twp, T4 Indian Purchase Twp, T5 R8 WELS, T6 R8 WELS, TA R7, Veazie, Veazie Gore, Webster Plt, Winn, Woodville and portions of T3 R8 WELS within the boundaries of Baxter State Park.

Piscataquis County- Abbot, Atkinson, Barnard Twp, Blanchard Plt, Bowerbank, Brownville, Dover-Foxcroft, Ebemee Twp, Elliotsville Twp, Greenville, Guilford, Katahdin Iron Works Twp., Kingsbury Plt, Lake View Plt, Medford, Milo, Monson, Mount Katahdin Twp, Nesourdnahunk Twp, Orneville Twp, Parkman, Sangerville, Sebec, Shirley, T1 R10 WELS, T1 R11 WELS, T1 R9 WELS, T2 R10 WELS, T2 R9 WELS, T3 R10 WELS,T4 R9 NWP, T4 R9 WELS, T5 R9 NWP, T5 R9 WELS, T6 R10 WELS, T7 R9 NWP, TA R10 WELS, TA R11 WELS, TB R10 WELS, TB R11 WELS, Trout Brook Twp, Wellington, Williamsburg Twp, Willimantic and portions of T4 R10 WELS within the boundaries of Baxter State Park.

Somerset County- Anson, Athens, Bald Mountain Twp T2 R3, Bigelow Twp, Bingham, Bowtown Twp, Brighton Plt, Cambridge, Canaan, Caratunk, Carrying Place Twp, Carrying Place Town Twp, Concord Twp, Cornville, Dead River Twp, Detroit, East Moxie Twp, Embden, Fairfield, Harmony, Hartland, Highland Plt, Lexington Twp, Lower Enchanted Twp, Madison, Mayfield Twp, Mercer, Moscow, Moxie Gore, New Portland, Norridgewock, Palmyra, Pittsfield, Pierce Pond Twp, Pleasant Ridge Plt, Ripley, Skowhegan, Smithfield, Solon, Saint Albans, Starks, T3 R4 BKP WKR, The Forks Plt, West Forks Plt

European Larch Canker Quarantine Area Map



Towns Regulated by Maine's European Larch Canker Quarantine

Hancock County - Gouldsboro, Sorrento, Sullivan, T7 SD, T9 SD, T10 SD, and T16 MD, and Winter Harbor

Knox County - Appleton, Camden, Cushing, Friendship, Hope, Owls Head, Rockland, Rockport, Saint George, South Thomaston, Thomaston, Union, Warren, and Washington

Lincoln County - Alna, Boothbay, Boothbay Harbor, Bremen, Bristol, Damariscotta, Edgecomb, Jefferson, Newcastle, Nobleboro, Somerville, South Bristol, Southport, Waldoboro, Westport Island, and Wiscasset

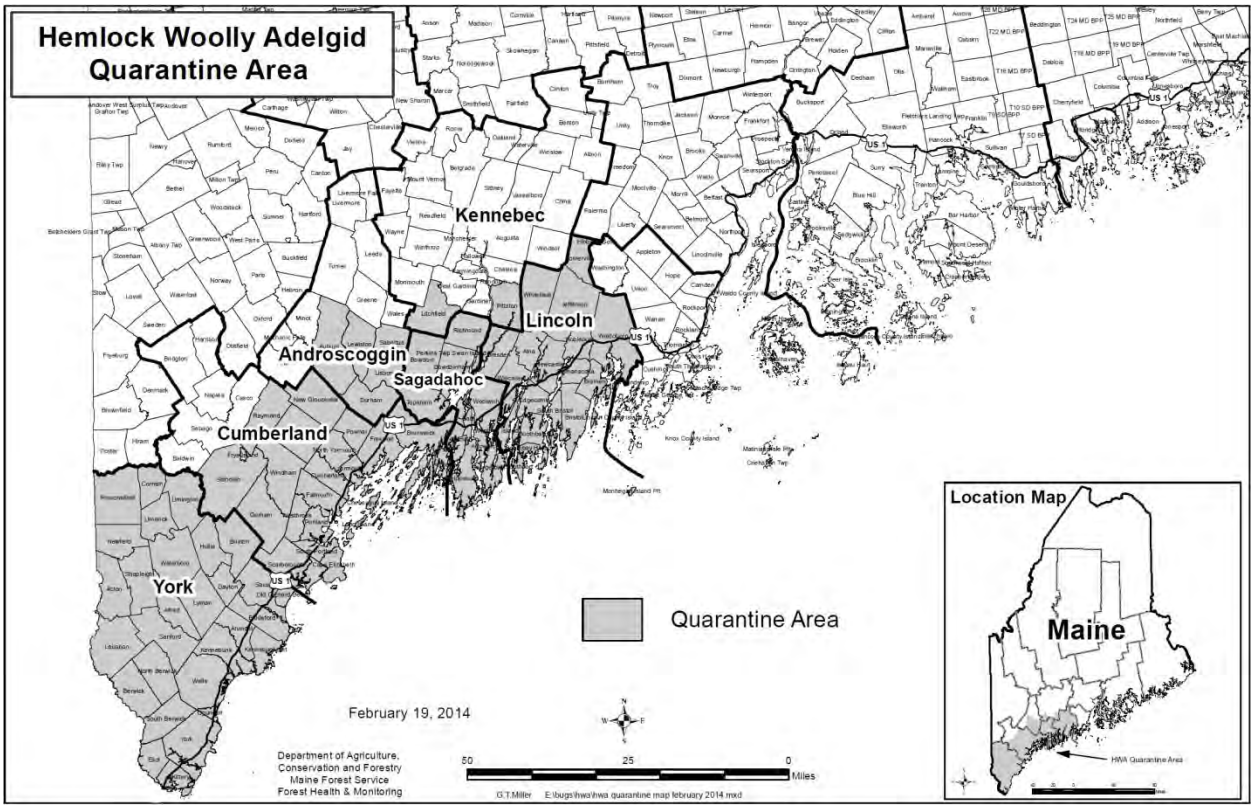
Waldo County - Lincolnville and Searsmont

Washington County - Addison, Baring Plantation, Beals, Beddington, Berry Township, Calais, Cathance Township, Centerville Township, Charlotte, Cherryfield, Columbia, Columbia Falls, Cooper, Cutler, Deblois, Dennysville, East Machias, Eastport, Edmunds Township, Harrington, Jonesboro, Jonesport, Lubec, Machias, Machiasport, Marion Township, Marshfield, Meddybemps, Milbridge, Northfield, Pembroke, Perry, Robbinston, Roque Bluffs, Steuben, T18 MD BPP, T19 MD BPP, T24 MD BPP, T25 MD BPP, Trescott Township, Whiting, and Whitneyville

Areas in the United States Regulated by Maine's Hemlock Woolly Adelgid Quarantine

Quarantined Areas in Maine:

Androscoggin County: the towns of Auburn, Durham, Lewiston, Lisbon and Sabattus
Cumberland County: the towns of Brunswick, Cape Elizabeth, Chebeague Island Cumberland, Falmouth, Freeport, Frye Island, Gray, Gorham, Harpswell, Long Island, New Gloucester, North Yarmouth, Portland, Pownal, Raymond, Scarborough, South Portland, Standish, Westbrook, Windham and Yarmouth
Kennebec County: the towns of Litchfield and Pittston
Lincoln County
Sagadahoc County
York County



Quarantined Counties in New Hampshire:

Belknap, Carroll, Cheshire, Hillsborough, Merrimack, Rockingham, Strafford, Sullivan

Quarantined Counties in Vermont: Bennington, Windham, Windsor

Other Quarantined Areas:

Eastern United States: (see www.maine.gov/dacf/php/horticulture/HWAInfestedCounties.shtml)

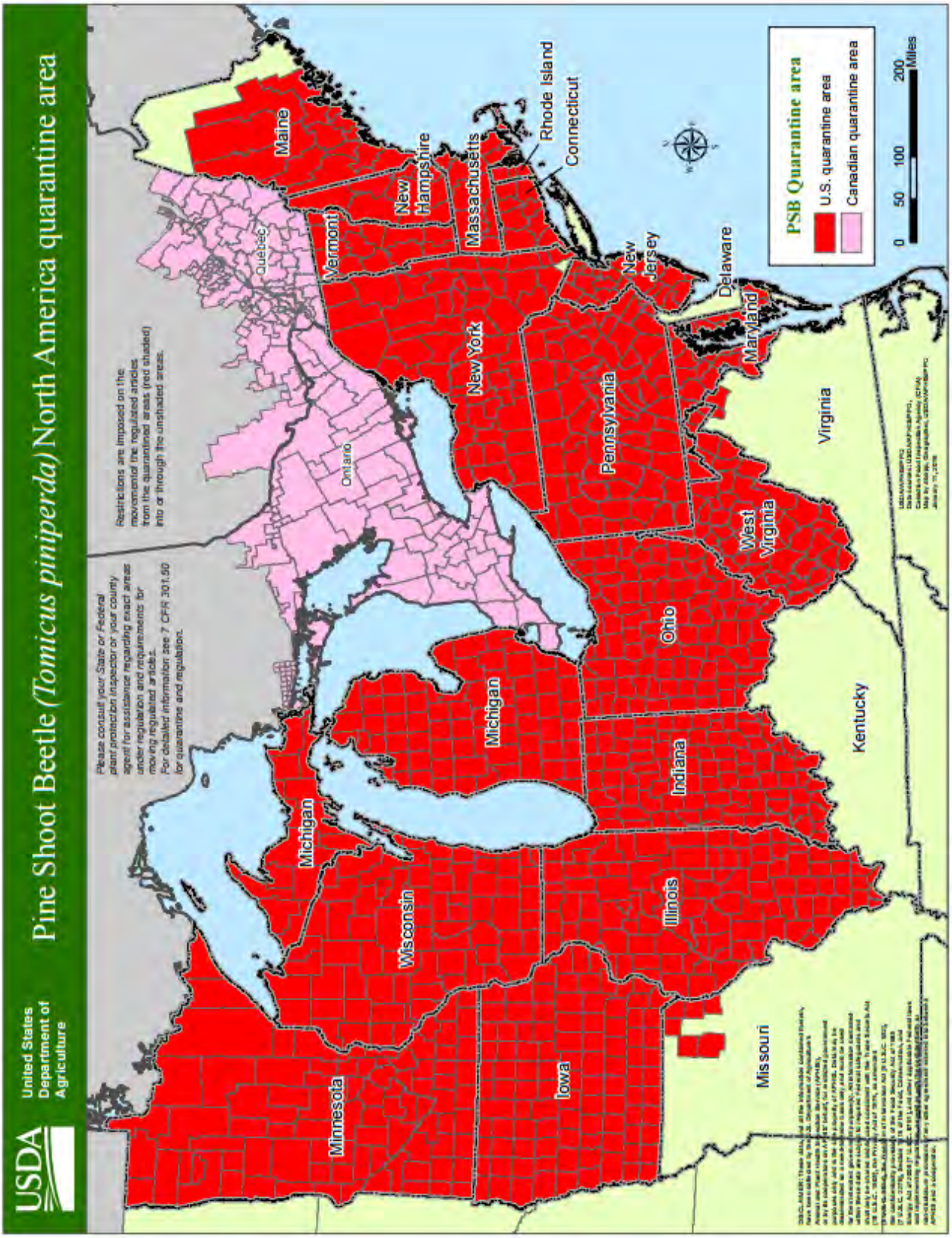
All or Parts of:
Connecticut (All)
Delaware (All)
Georgia (Parts)
Kentucky (Parts)
Massachusetts (All)
Maryland (Parts)
New Hampshire (Parts)
New Jersey (All)
New York (Parts)
North Carolina (All)
Ohio (Parts)
Pennsylvania (Parts)
Rhode Island (All)
South Carolina (Parts)
Tennessee (Parts)
Vermont (Parts)
Virginia (Parts)
West Virginia (Parts)

Western United States:

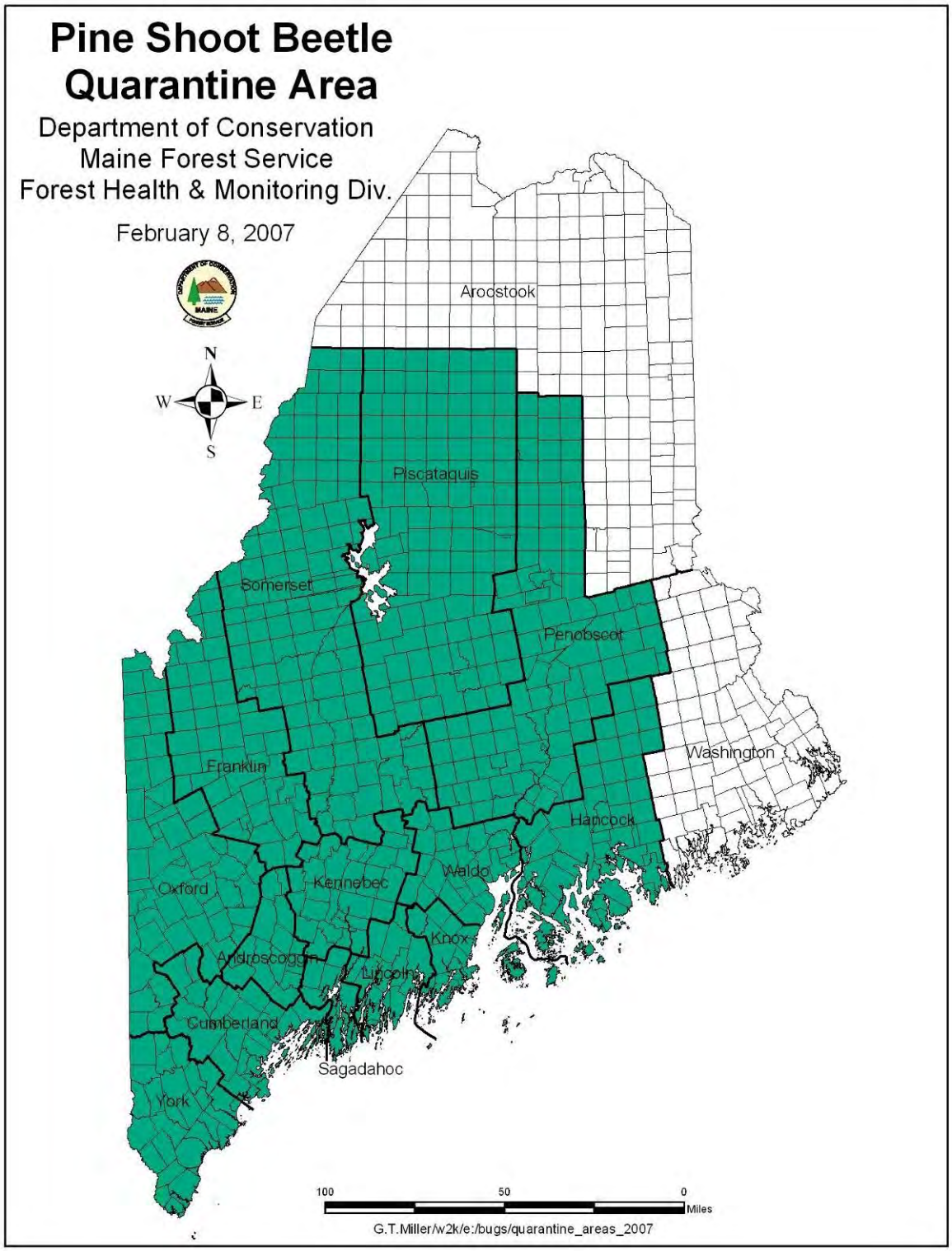
The Entire States of:
Alaska
California
Oregon
Washington

Western Canada
British Columbia

United States and Canadian Pine Shoot Beetle Quarantine Areas
www.aphis.usda.gov/plant_health/plant_pest_info/psb/downloads/psbquarantine.pdf



Maine Pine Shoot Beetle Quarantine Area Map



Maine Counties Regulated by the Pine Shoot Beetle Quarantine

Androscoggin, Cumberland, Franklin, Hancock, Kennebec, Knox, Lincoln, Oxford, Penobscot, Piscataquis, Sagadahoc, Somerset, Waldo and York Counties (All *except* Aroostook and Washington)

Appendix B
2016 Hemlock Woolly Adelgid and Elongate Hemlock Scale Report

Colleen Teerling, Forest Entomologist
Maine Forest Service, DACF
SHS 168, Augusta, ME 04333

Hemlock woolly adelgid (HWA) (*Adelges tsugae*) was first detected in Maine forests in August 2003. Currently, the pest is found in the forest in towns from Kittery to Camden with an additional cluster of HWA in the area of Sebago Lake (Figure B1). Most known infestations are close to the coast or other significant water. Hemlock decline, due at least in part to HWA damage, is apparent in several coastal communities.

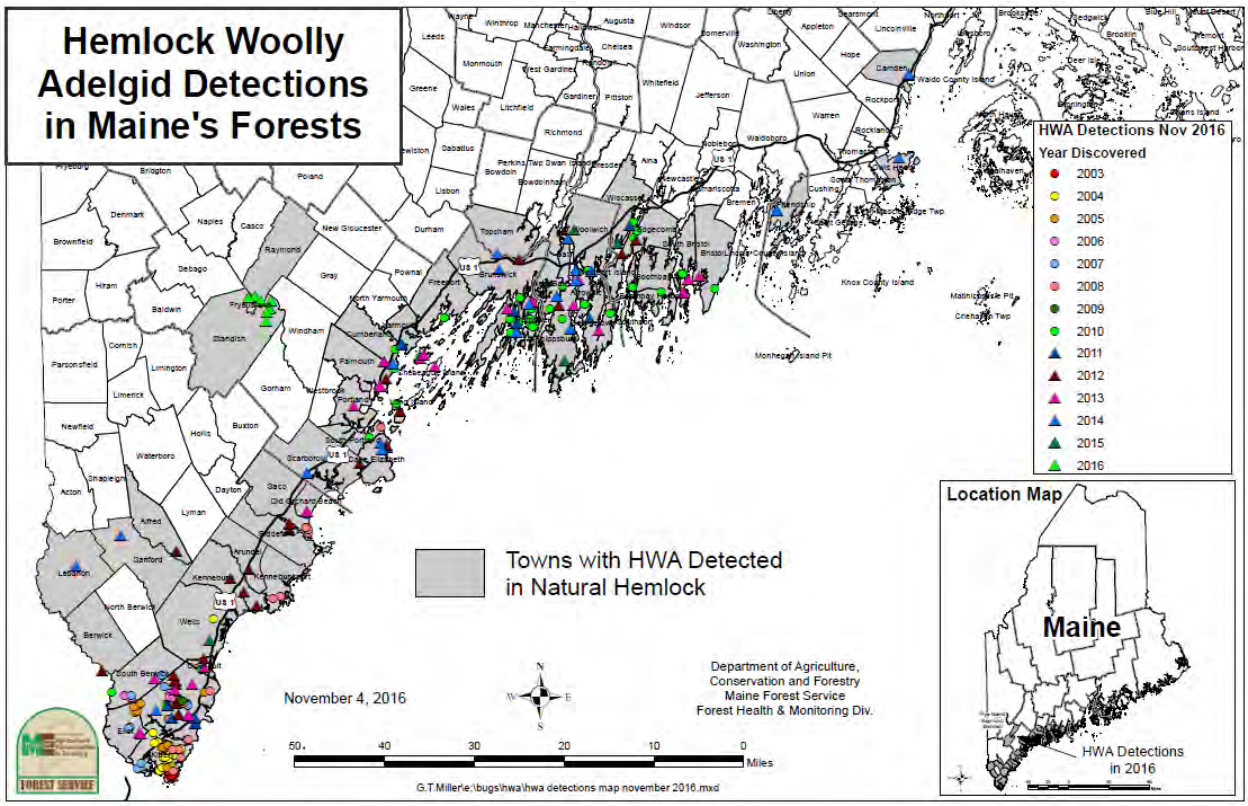


Figure B1. Hemlock woolly adelgid detections in Maine's forests

Elongate hemlock scale (EHS) (*Fiorinia externa*) is an emerging invasive forest insect problem in the state of Maine. It was first recognized in the state in 2009, and MFS has had spray programs to contain individual sites of infestation on planted trees since then. EHS was detected in the forest for the first time on Gerrish Island (Kittery) York County) during sampling for *Laricobius nigrinus* in fall of 2010. Until 2016, all subsequent forest detections were in forests of one town (Kittery, York County). However, in 2016, EHS was discovered on planted trees outside a fire station in Frye Island, and has spread to a few trees in forested land across the road. Because the infested trees brushed against emergency vehicles every time they left the station, EHS has very likely been transported to other areas on the island, although there have as yet been no further detections. Several detections on ornamental trees are usually reported each year, so far scattered from Kittery to Mount Desert (Figure B2).

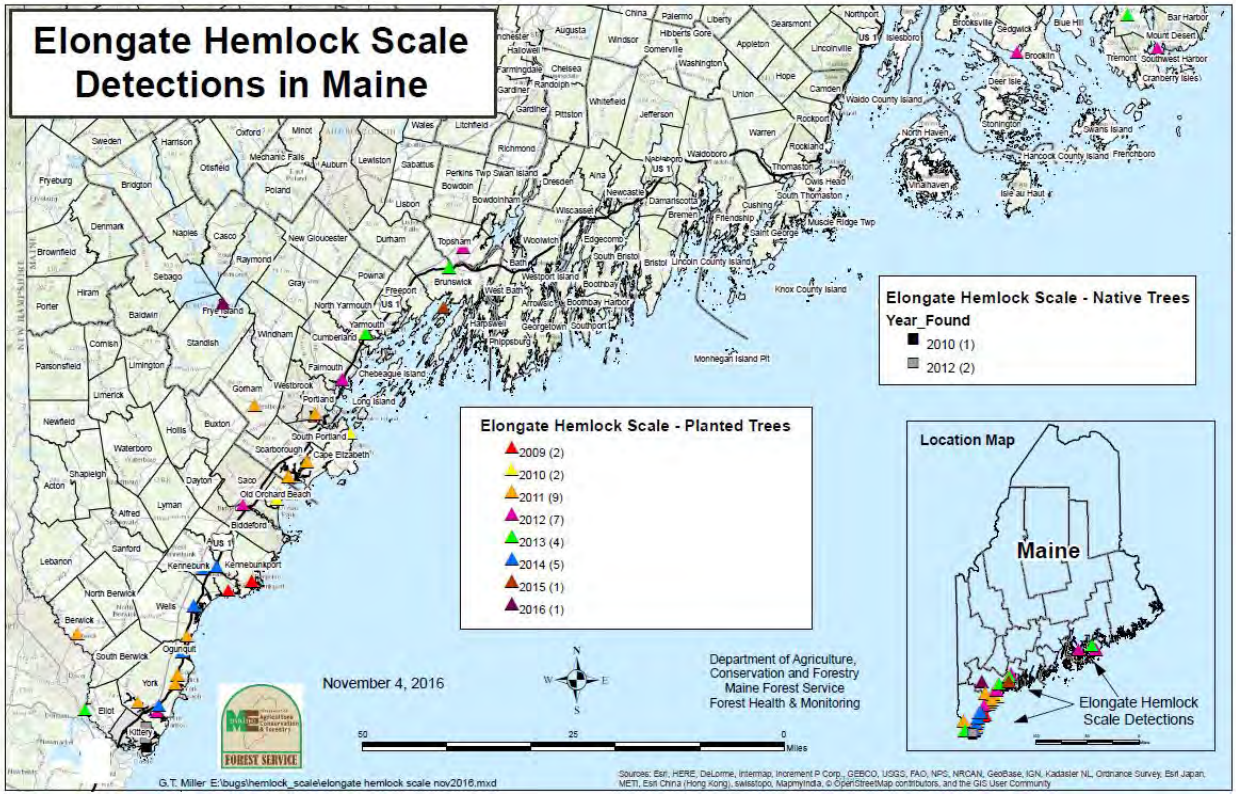


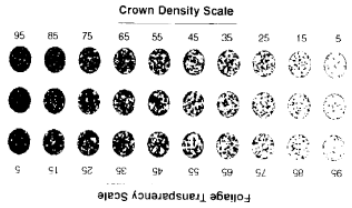
Figure B2. Locations of forest and planted tree detections of elongate hemlock scale in Maine

The bulk of the field work for these projects was conducted by Wayne Searles and Regina Smith. We had additional assistance from Greg Bjork (MFS-FIA), Amy Ouellette, Melanie Duffy (MFS-FIA), and others. A summary of 2016 activities related to these two pests follows.

Hemlock monitoring plots were established at five sites in Maine in 2011 to assess hemlock crown health and presence of three stressors (HWA, EHS and hemlock tip blight (*Sirococcus tsugae*)). Crown indicators and damage agent information was collected on each of the plots during December 2016 revisits, these variables in addition to diameter at breast height were collected in 2015. Field assistance was provided by the MFS forest inventory unit. Data from these sites and similar locations in Vermont and New Hampshire will be analyzed by David Orwig of Harvard Forest. Crown classification measures follow those established for USDA Forest Service, Forest Inventory and Analysis Phase 3 plots. Infestation status (infested or not) of individual trees is based on what observers can see from the ground. 2014 values are reported for uncompacted live crown ratio (uLCR) and retained foliage: variables that were not collected in 2011. Values for retained foliage (Orwig) and training aid for crown density and foliage transparency are as follows:

Retained Foliage:

1:1–25% foliar loss (75–99% retained)
2: 26–50% foliar loss (50–74% retained)
3: 51–75% foliar loss (25–49% retained)
4: 76–99% foliar loss (1–24% retained)
5: dead



A non-statistical comparison of average values on the impact plots is presented below (Table B1). A new plot site was established in December 2015 in Hallowell (Kennebec County) outside the current known distribution of HWA and EHS.

It is interesting to note that the crown densities decreased in all sites; even the one without detected adelgid or scale (this site does have tip blight). The smallest decrease in crown density was in Kittery—this plot was experiencing

significant decline when the plots were first established. This site is also the only one where there was decrease in foliage transparency (less light coming through the foliated portions of the branches). This matches well with the "gut feeling" from observers at this site—that the trees were in a period of recovery due to a collapse in adelgid populations. Note that decreases in crown density and increases in foliage transparency indicate declining crown condition.

Table B1. Comparison of values for selected variables on hemlock impact plots

Location (Year Established)	**Infestation Status**	**No. Infested Hemlock/ No. Live Hemlock**		**Average Crown Density**		**Average Foliage Transparency**		**Avg. uLCR**		**Average Retained Foliage**	
		2011	**2016**	**2011**	**2016**	**2011**	**2016**	**2014**	**2016**	**2014**	**2016**
Hallowell (2015)	No HWA detected		0/52		44%		20%		44%		1.1
Pownal (2011)	No HWA detected	0/59	0/58	56%	40% ↓16	20%	20% ↑0	63%	61%	1.2	1.1
Wiscasset (2011, partial harvest 2014)	Light HWA infestation, detected 2011	0/50 0/31*	15/24	60% 62%*	39% ↓21*	18% 18%*	25% ↑7*	68%	65%	1.2	1.5
Freeport (2011)	Moderate HWA infestation, detected 2010	2/63	54/58	48%	33% ↓15	21%	32% ↑11	52%	50%	1.3	1.6
York (2011)	Light HWA, detected 2006	6/63	14/62	45%	27% ↓18	25%	38% ↑13	65%	65%	2.0	2.2
Kittery (2011)	Heavy HWA and EHS, detected 2003 (HWA) and 2010 (EHS)	58/58 (HWA) 40/58 (EHS)	45/50 (HWA) 34/50 (EHS)	34%	32% ↓2	37%	30% ↓7	63%	63%	2.4	2.5

* Values with * for trees present at 2011 and 2016 measurements.

Detection Surveys

Maine Forest Service conducts an annual detection survey for HWA in towns along the border of the quarantine area for the pest. Limited detection surveys are also conducted within the quarantine area in towns without adelgid detections. In 2016, detection surveys were conducted on 113 sites across 25 towns and 5 counties (Table B2). The target of at least 200 branches surveyed was achieved at 92 of these sites. In this survey, EHS was watched for, but was not detected. Given size and location of EHS, adelgid focused surveys are not necessarily going to be efficient in detecting trace amounts of scale.

Table B2. 2016 Maine Forest Service hemlock woolly adelgid detection survey by county and town

County	Town	# Sites	Sites with >200 Branches	Town HWA Detection Status	Town in HWA quarantine?
Cumberland	Frye Island	1	1	detected	Y
Cumberland	Raymond	4	4	detected	Y
Cumberland	Standish	5	5	detected	Y
Hancock	Blue Hill	1	1	not detected	N
Hancock	Ellsworth	7	3	not detected	N
Hancock	Trenton	2	0	not detected	N
Knox	Appleton	4	4	not detected	N
Knox	Hope	5	5	not detected	N
Knox	Rockland	5	2	not detected	N
Knox	Rockport	7	6	not detected	N
Knox	So.Thomaston	6	1	not detected	N
Knox	St. George	2	0	not detected	N
Knox	Thomaston	5	1	not detected	N
Waldo	Belfast	6	6	not detected	N
Waldo	Lincolnville	7	7	not detected	N
Waldo	Montville	6	6	not detected	N
Waldo	Northport	6	4	not detected	N
Waldo	Searsport	6	3	not detected	N
Waldo	Stockton Springs	6	4	not detected	N
York	Acton	4	4	not detected	Y
York	Berwick	3	3	not detected	Y
York	Lebanon	5	5	not detected	Y
York	Newfield	3	3	not detected	Y
York	Parsonsfield	2	2	not detected	Y
York	Sanford	2	2	not detected	Y
York	Shapleigh	3	3	not detected	Y

An EHS detection survey was initiated within York County in 2015 to help make decisions regarding allocating limited containment resources for planted trees found to have elongate hemlock scale. The goal of the survey is to cover the area under quarantine for HWA with forest surveys for elongate hemlock scale. With surveyors focused on detection of scale, additional detection of adelgid is likely. Sites did not overlap between the two detection surveys. Surveyors looked for sites of at least 5 acres with more than 100 hemlocks. The survey did not result in detection of scale or adelgid in the forest in any new towns.

Table B3. 2016 Survey sites for elongate hemlock scale and hemlock woolly adelgid

County	Town	# sites surveyed	EHS found?
York	Kennebunk	3	no
York	Kennebunkport	1	no
York	Ogunquit	10	no
York	S. Berwick	1	no
York	Wells	2	no
York	York	1	no

Winter Mortality Survey

Winter mortality data has been collected for several years for a project in cooperation with Virginia Tech's Tom McAvoy (Figure B3). Adelgid infested branches are collected from five sites for observation under a dissecting scope in early March. Sistens and progrediens density counts were conducted at three sites and results were submitted to our cooperator. Mortality ranged from 91-99% across the five sites, and averaged 98% (Table B4). In comparison, mortality over the mild winter of 2011–2012 was less than 18% across five sites.

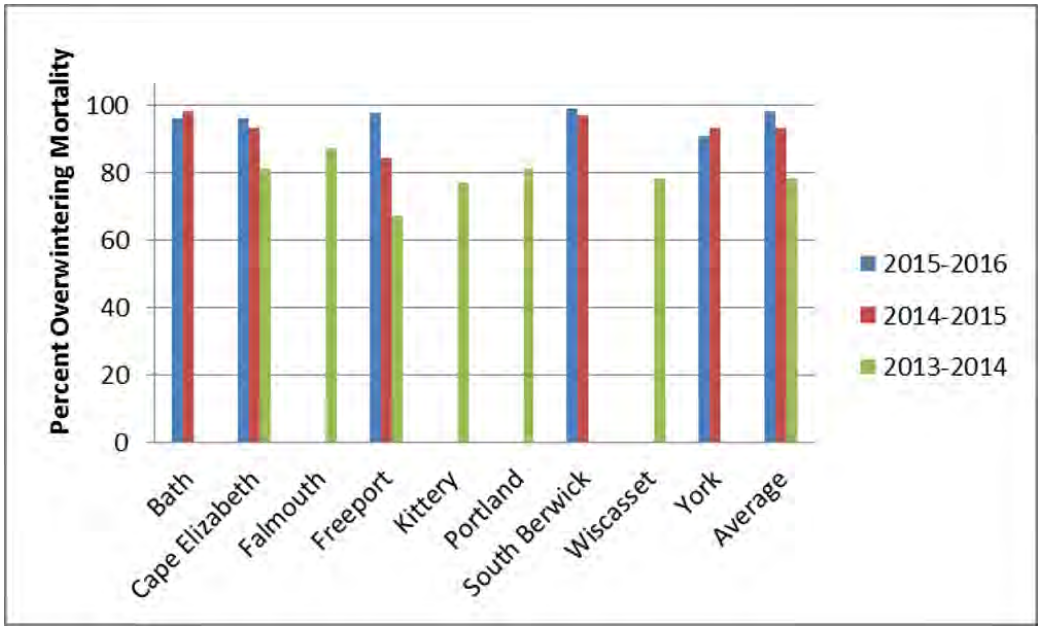


Figure B3. Overwintering mortality of hemlock woolly adelgid in Maine 2014–2016

Table B4. Hemlock woolly adelgid overwintering mortality (Winter 2016)

County	Town	Date Collected	Date Counted	# HWA dead	# HWA alive	% mortality
Sagadahoc	Bath	3/2/2016	3/3/2016	483	18	96.4
York	South Berwick	3/2/2016	3/3/2016	489	5	99.0
York	York	3/2/2016	3/3/2016	453	47	90.6
Cumberland	Cape Elizabeth	3/2/2016	3/3/2016	482	21	95.8
Cumberland	Freeport	3/2/2016	3/3/2016	396	9	97.8
			summary	**2303**	**100**	**97.8**

Biological Control

No *Sasajiscymnus tsugae* beetles were released this year in Maine. A new predator of HWA, *Laricobius osakensis,* was released on Frye Island. Beetles were obtained in November from Virginia Tech. A field insectary was developed on Frye Island where future releases of this predator will occur, with the hope of eventually being able to collect predators from this site for use in other areas. Approximately 450 beetles were released at this site. This is the first time *L. osakensis* has been released in Maine.

In past years, since the initial detection of HWA in Maine's forests, the MFS has facilitated the release of over 98,800 *S. tsugae* beetles and more than 5000 *Laricobius nigrinus* beetles (Table B5). These sites range along the known distribution of HWA (Figure B3). In addition, MFS conducted experimental pre-inoculative releases on other adelgid species in three sites in Maine prior to HWA detection (Table B6).

Table B5. Hemlock woolly adelgid biological control releases 2004–2016

County/Town	***Laricobius nigrinus*** **Released**	***Laricobius osakensis*** **Released**	***Sasajiscymnus tsugae*** **Released**
Cumberland		**450**	**24,303**
Cape Elizabeth			5,000
Freeport			10,500
Harpswell			7,500
Portland			1,303
Frye Island		450	
Lincoln			**6,500**
Wiscasset			6,500
Sagadahoc			**15,469**
West Bath			4,000
Bath			4,500
Woolwich			6,969
York	**5,272**		**52,568**
Kittery	900		17,734
Saco	500		4,500
Sanford			5,000
South Berwick			14,037
York	3,872		11,297
Grand Total	**5,272**	**450**	**98,840**

Table B6. 2002 Pre-inoculative release of *Sasajiscymnus tsugae* in Maine

Town	County	Number Released	Host
Owls Head	Knox	1500	Balsam woolly adelgid
Rockport	Knox	1500	Balsam woolly adelgid
Sanford	York	2000	Pine bark adelgid

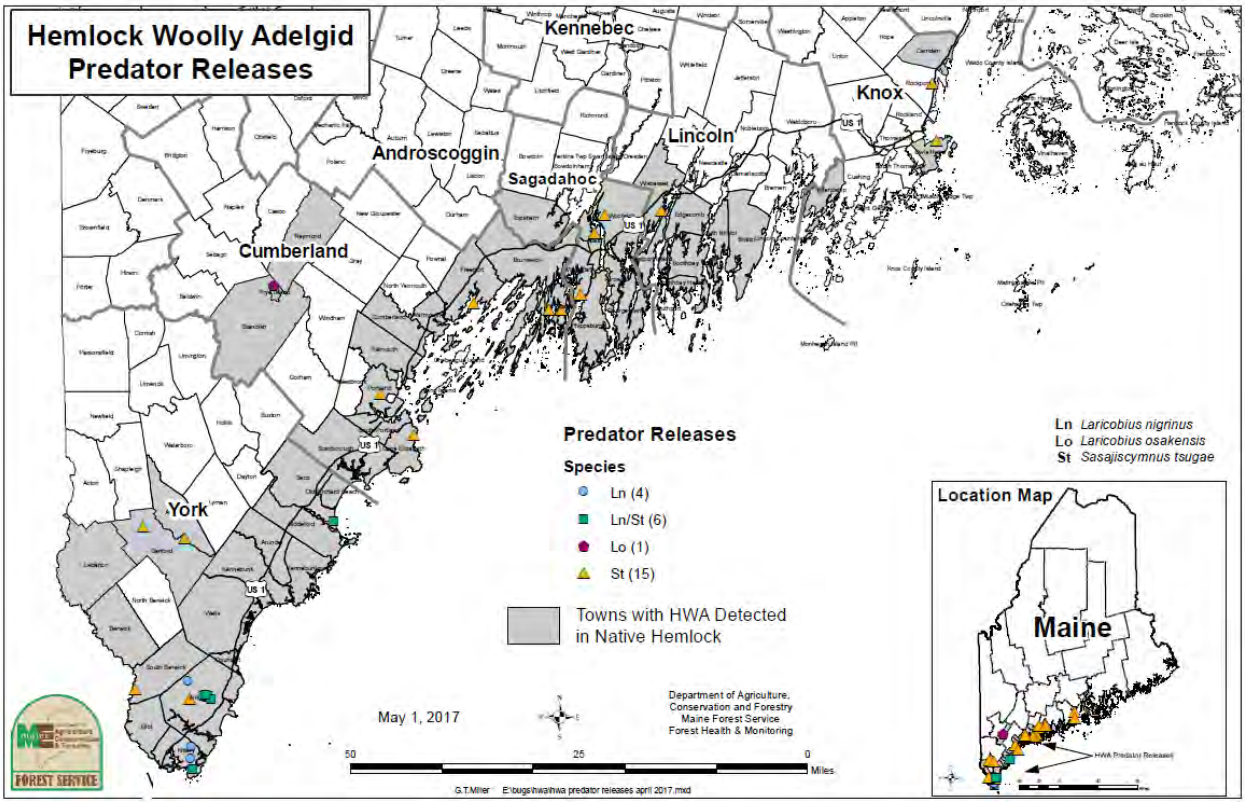


Figure B4. *Sasajiscymnus tsugae* (St), *Laricobius osakensis*(Lo) and *L. nigrinus* (Ln) release sites in Maine 2002–2016

Each fall, release sites are sampled to determine whether predator beetles have become established. In 2016, no *Laricobius nigrinus* were recovered. *Sasajiscymnus tsugae* beetles were recovered from five release sites in Harpswell and Freeport (Cumberland County), Wiscasset (Lincoln County), and Kittery (York County). (Table B7 and Table B8).

Table B7. *Laricobius nigrinus* recoveries in Maine (2007–2016)

Year	Number per General Location (areas with recoveries only)		
	Kittery	**York**	**Saco**
2006	Release Year		
2007	0	Release Year	
2008	0	0	Release Year
2009	0	**1**	0
2010	**2**	**7**	**1**
2011	**2**	0	0
2012	0	0	0
2013	0	0	0
2014	0	**12**	0
2015	0	0	0
2016	0	0	0

Table B8. *Sasajiscymnus tsugae* recoveries in Maine (2005–2016)

Year	Number per General Location (areas with recoveries only)						
	Kittery	**York**	**Harpswell**	**Saco**	**West Bath**	**Freeport**	**Wiscasset**
2004	Released						
2005	0						
2006	**17**						
2007	**13**	Released					
2008	**18**	**1**					
2009	**28**	0					
2010	**55**	**1**	Released	Released - **1**			
2011	**37**	0	**3**	0	Released - **1**	Released	
2012	0	0	**2**	0	0	0	
2013	0	0	0	0	0	0	Released
2014	**6**	0	**1**	0	0	**1**	**0**
2015	0	0	0	0	0	0	0
2016	**26**	0	**5**	0	0	**1**	**5**

An earlier summary of the Maine Forest Service' HWA biological control program is available in Appendix B of the 2008 Annual Summary Report: *Forest & Shade Tree Insect & Disease Conditions for Maine: A Summary of the 2008 Situation* available online at http://www.maine.gov/tools/whatsnew/attach.php?id=637596&an=1.

Chemical Control

In 2016, although we had considered treating EHS and HWA infested trees in Frye Island in areas of high risk of transfer, no treatments were carried out due to drought conditions.

Appendix C

Spruce Budworm in Maine 2016

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April 14, 2017

The Maine Forest Service (MFS) and its cooperators are closely watching spruce budworm in Maine to monitor and prepare for another epidemic of this native defoliator. Over the last several years, many indicators have pointed to the imminence of the next epidemic: pheromone and light trap surveys had shown a steady rise since 2011, defoliation in Quebec has increased year after year, anecdotal and confirmed accounts of defoliation in New Brunswick have cropped up over the past two years. This is an insect whose epidemics cover vast regions and flights of moths from heavily infested areas can migrate to new areas. That there will be another outbreak in Maine, soon, is undeniable. When, where, how severe, and what the specific impacts and reactions may be remain to be seen.

The Maine Forest Service, cooperators within and outside the state, and Canadian provinces are working together to monitor and predict the growth of the spruce budworm population and its potential impact on the region's forests. Monitoring takes place using pheromone traps, light traps, overwintering larval samples, ground and aerial surveys.

The most sensitive method of monitoring budworm is pheromone traps. Permanent pheromone trap locations were established in the early 1990's across the northern half of the State and have been run yearly for the past twenty years. In recent years, that network has run about 80 sites set up by the Maine Forest Service, J.D. Irving Ltd, Penobscot Nation Department of Natural Resources and the USDA Forest Service. In 2014, the pheromone trap monitoring program was significantly expanded, with 21 land owners and managers participating in setting and retrieving traps at more than 400 sites. A similar group of organizations has participated in 2015 and 2016.

Spruce budworm pheromone survey cooperators 2016

American Forest Management	Maine Forest Service
Appalachian Mountain Club	Orion Timberlands, LLC
Baskahegan Company	Maine Bureau of Parks and Lands
Baxter State Park	Penobscot Experimental Forest
Forest Society of Maine	Penobscot Nation Department of Natural Resources
Hilton Timberlands, LLC	Prentiss & Carlisle
J.M. Huber Corporation	Rangeley Lakes Heritage Trust
J. D. Irving Ltd.	Seven Islands Land Company
Katahdin Forest Management, LLC	Wagner Forest Management, Ltd.
LandVest	Weyerhaeuser

Cooperators were asked to place traps approximately one per township or every six miles in stands that were 25 acres or larger and at least 50% pole-sized or larger spruce/fir. These could be mature or pole sized stands, uncut or lightly cut spruce-fir dominated and could be pre-commercially thinned or shelterwood stands. Cooperators chose the sites based on where they had monitored in the past, with new sites established due to previous or planned management, change in access or other reasons.

The trapping method follows standardized protocol used by both Canadians and Americans since 1986. http://phero.net/iobc/montpellier/sanders.html.

Each site had a three-trap cluster with traps arranged in a triangle with approximately 130 feet between traps. Instructions were to place traps away from the road and at an average elevation for the area. Cooperators were asked to deploy traps during the first three weeks of June and retrieve them after mid-August. The catch was sent to the Maine Forest Service entomologist in Old Town for processing.

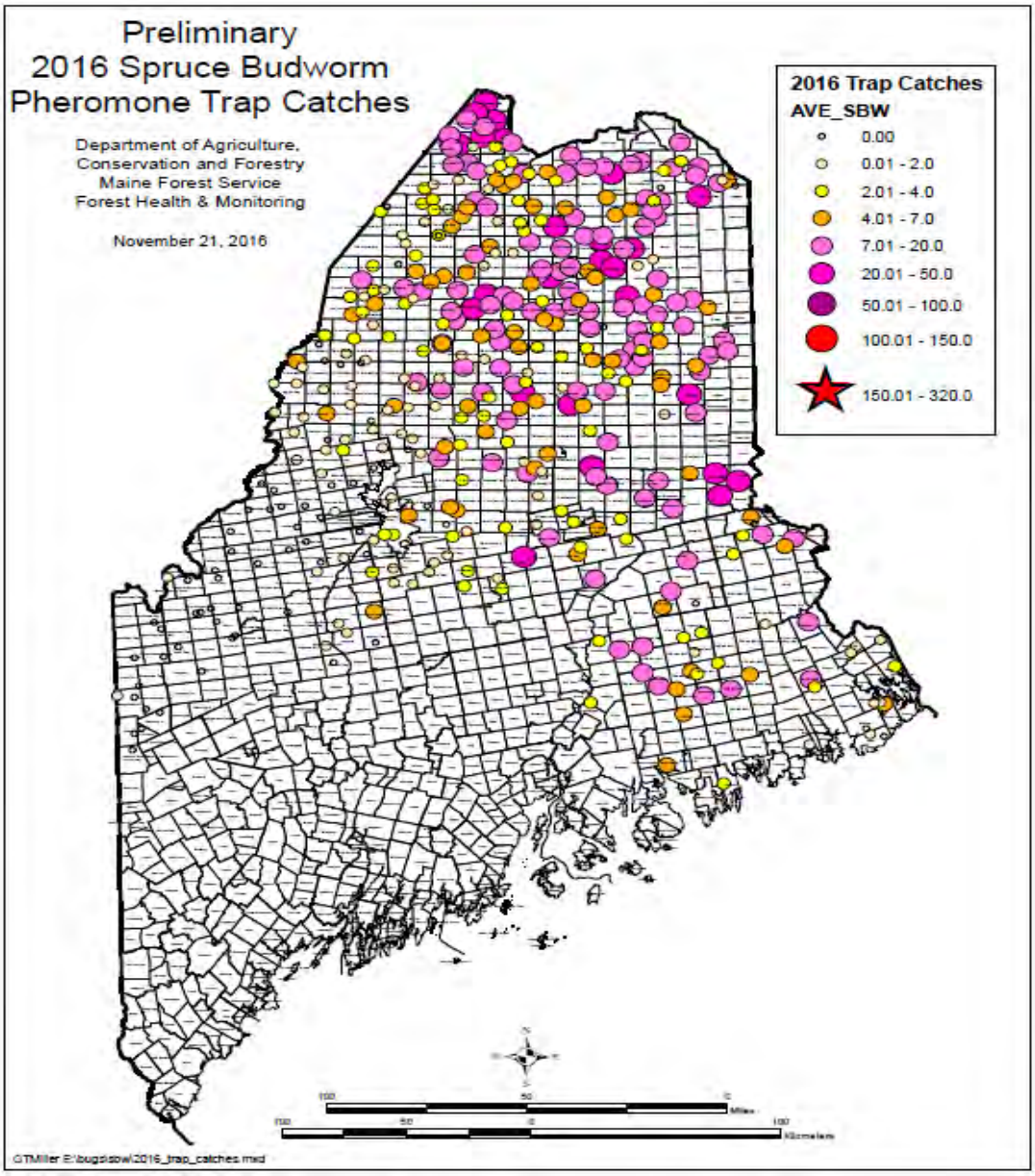


Figure C1. 2016 Distribution of spruce budworm pheromone traps and trap catches across Maine.

The traps used were high capacity re-usable Multipher traps capable of monitoring spruce budworm moth populations over a wide range of densities. Using the lure provided, catches will range from 0–20 at low population densities to over l000 at high densities. The SBW lure was made by Synergy Semiochemicals Corp. http://www.semiochemical.com. This lure was first used in Maine in 2014, in previous years, a Contech brand lure was used. The insecticide used in the traps is a 1" x 4" strip (10% DDVP) brand Vaportape II.

The expanded spruce budworm pheromone survey shows spruce budworm is widespread but still at low numbers across the trapping range (Figure C1 and Figure C2). Trapping effort was heaviest in the northern third of the state, light across the middle of the state, with no trapping in the south where budworm is not expected to have a direct impact (Figure C1). In the state as a whole and across each county, the average number of moths per trap dropped in 2016 compared to the previous several years (Figure C2). As in previous years, the majority of traps (91 percent) captured trace to 50 moths/trap (Figure C3).

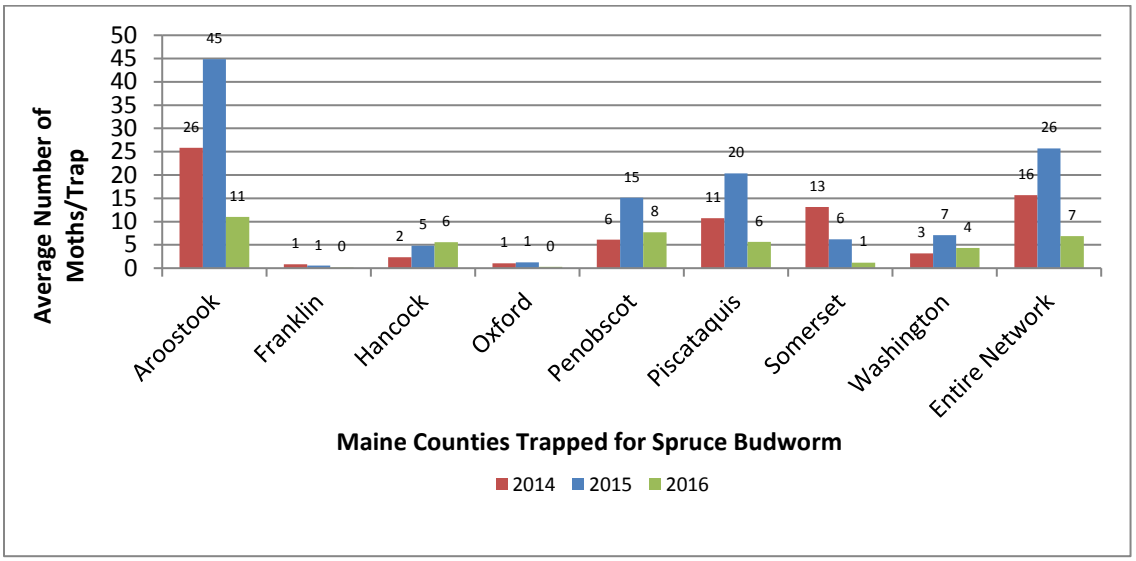


Figure C2. Average number of spruce budworm moths in pheromone traps by county in Maine 2014–2016.

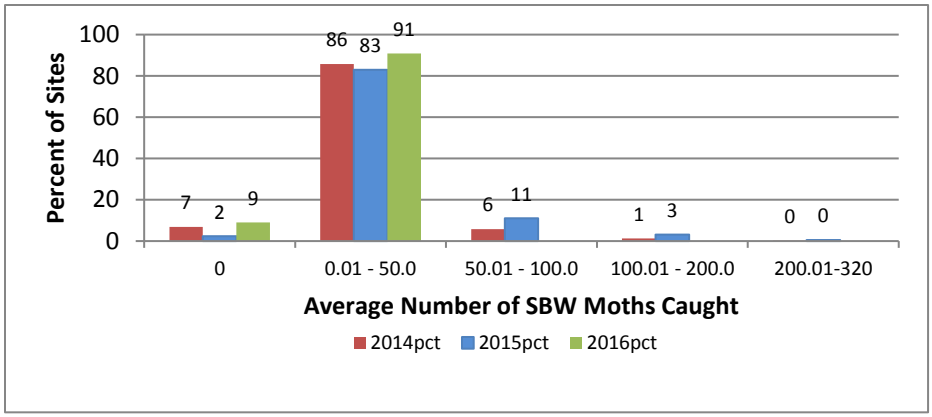


Figure C3. Percent of sites with spruce budworm in pheromone traps by catch 2014–2016.

As noted earlier, the Maine Forest Service has monitored collections at a set of longer term pheromone trap sites for the past 24 years. During that time, the average number of moths/trap stayed well below 10 until 2013 when the number jumped to 18 (Figure C4). In 2014 and 2015 it was above 20 moths/trap. This year, average catches declined to seven moths/trap.

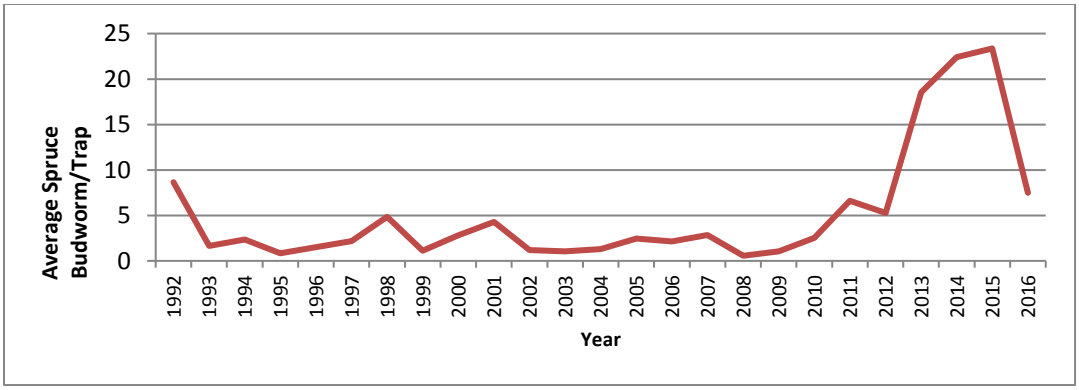


Figure C4. Spruce budworm pheromone trap average catch <u>long term sites only</u> (Maine Forest Service, J.D. Irving Ltd., Penobscot Nation DNR, USDA Forest Service).

Light traps have been used in Maine for decades to monitor spruce budworm populations and other forest defoliators and continue to be used today. This year 22 traps were run by Maine residents in their backyards. They are paid a small stipend for checking the traps daily. Budworm moth counts from light traps were up from previous years (Figure C5). Eight sites in the network caught a total of 146 moths (Table C). Perhaps more than 90% of this catch can be attributed to the widely-publicized moth flights from Quebec in late July, and not to moths hatched and fed in Maine (Figure C6 and Figure C7). In the 10 years before 2013 there were less than 10 spruce budworm moths caught in all the light traps combined. Therefore, the past years are a significant increase but not enough to see defoliation yet. At such low numbers, apparently wide fluctuations are not surprising as there are only a few locations where the moths may happen to be caught.

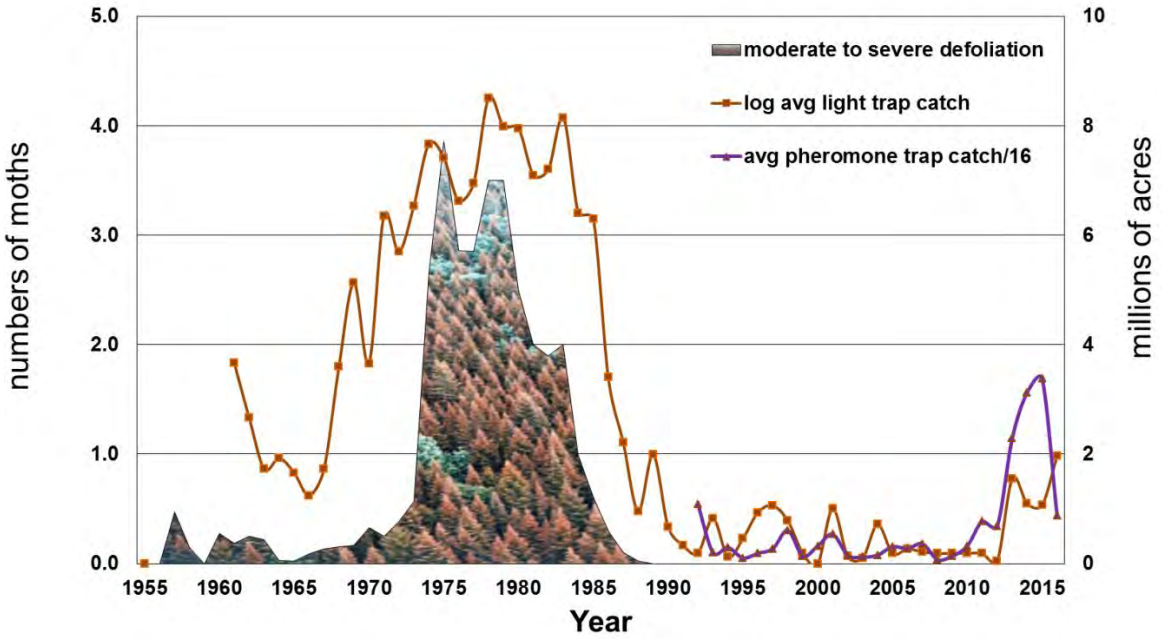
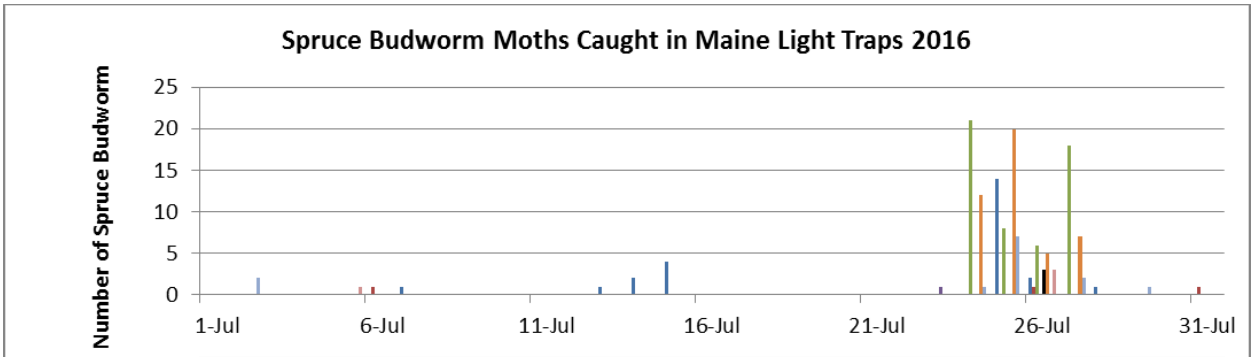


Figure C5. Composite graph of spruce budworm population indicators: defoliation, light trap and pheromone trap data 1955–2016 (2016 light trap data as of 1/4/2017).

Table C1. Spruce budworm caught in light traps in 2015 and 2016.

Town	County	SBW 2015	SBW 2016
Allagash	Aroostook	3	25
Ashland	Aroostook	0	3
Bowerbank	Piscataquis	1	0
Calais	Washington	2	0
Crystal	Aroostook	5	53
Millinocket	Penobscot	1	1
Mount Desert	Hancock	n/a	4
New Sweden	Aroostook	2	3
Rangeley	Franklin	1	0
Topsfield	Washington	0	44
T3 R11 Wells	Aroostook	17	13
T15 R15 WELS	Aroostook	2	0
Total number of moths		**34**	**146**



	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	31-Jul
Allagash	0	0	0	0	0	0	1	0	0	0	0	0	1	2	4	0	0	0	0	0	0	0	0	0	14	2	0	1	0	0	0
Ashland	0	0	0	0	0	1	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0	1	0	0	0	0	1
Crystal	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0	0	0	21	8	6	18	0	0	0	0
Millinocket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
New Sweden	0	0	0	0	0	0		0	0	0			0	0	0	0	0			0	0	0	0	0	0	3	0	0	0	0	0
Topsfield	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	20	5	7		0	0	0
T3 R11 WELS	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	1	7	0	2	0	1	0	0
Mount Desert	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0

Figure C6. Number of spruce budworm moths caught in spruce budworm positive light traps by date in Maine in 2016. Note: Some traps ran before July 1, those data not are shown. No spruce budworm were caught in that period.

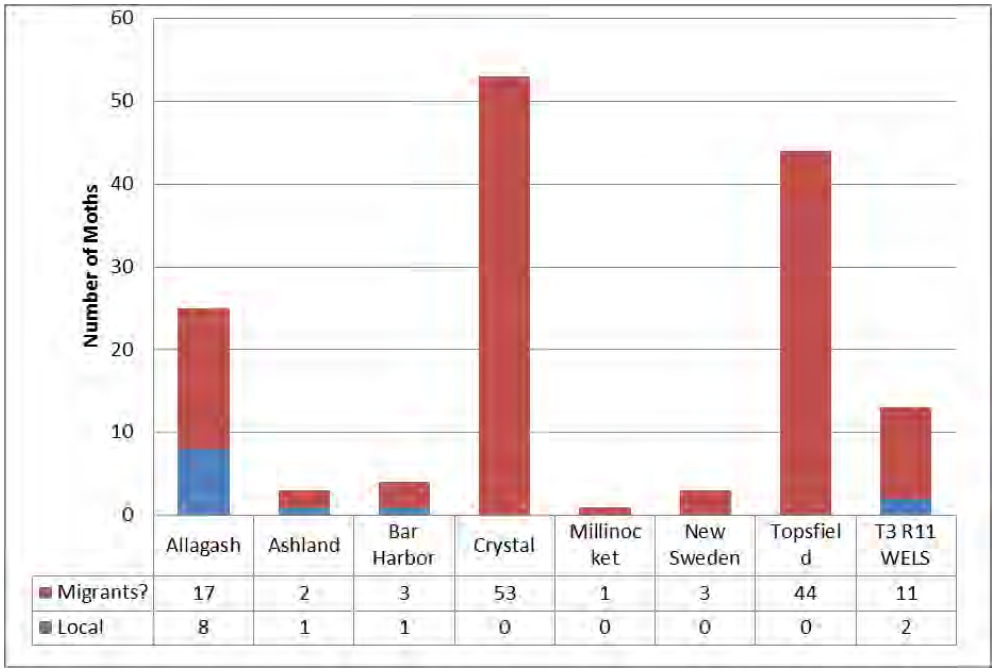


Figure C7. Number of spruce budworm moths in light traps likely to be migrants vs. local based on collection date.

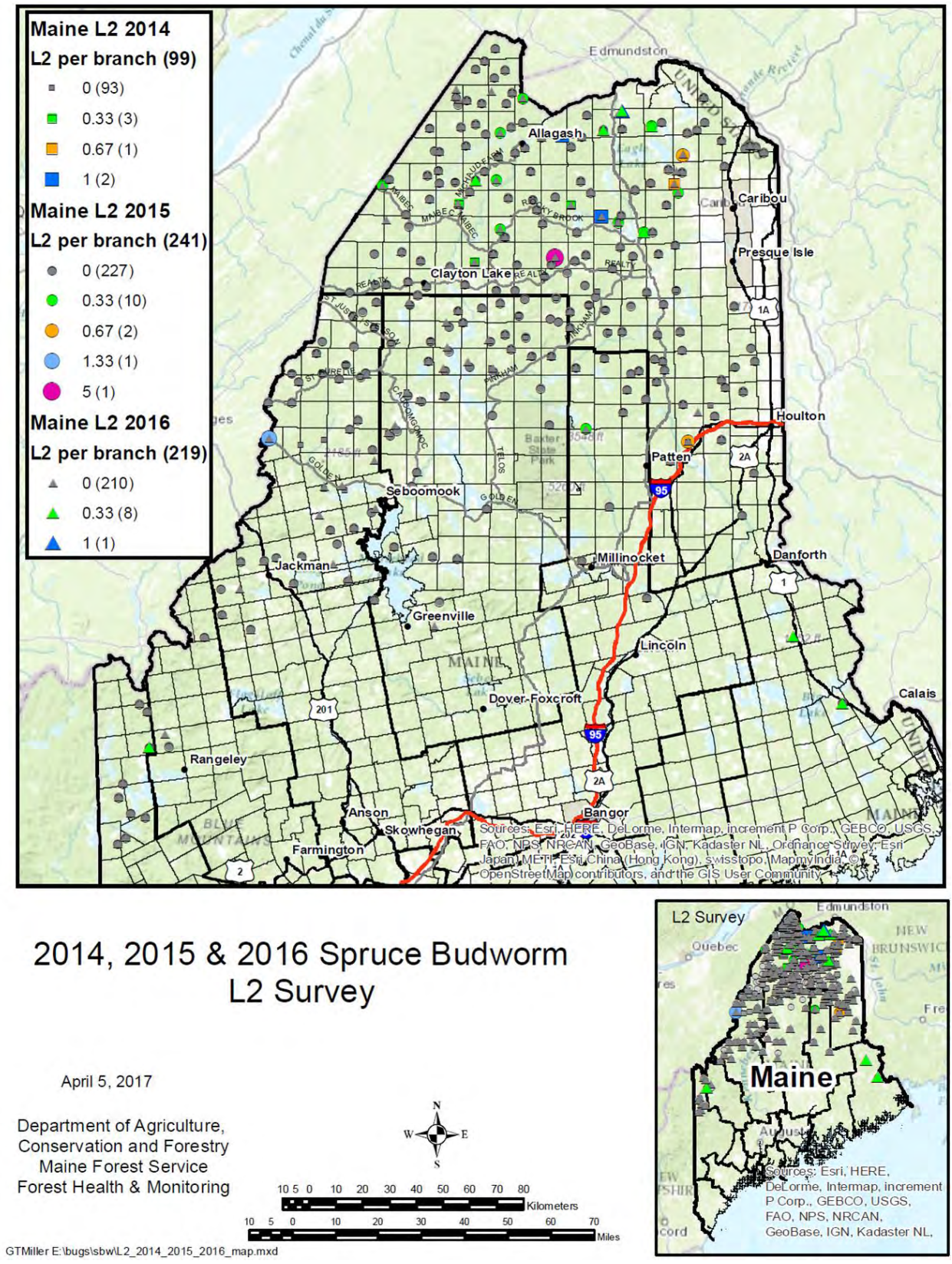
More than 30 volunteers committed to collecting moths on a weekly or better basis at Maine sites. These sample locations were included in the Healthy Forest Partnership's Budworm Tracker Program. This project is managed by the Healthy Forest Partnership. Results will be reported at www.budwormtracker.ca.

The University of Maine Cooperative Forestry Research Unit (CFRU) continues to head up an "L2" sample program in conjunction with the Canadian Forest Service as part of the Healthy Forest Partnership. The L2 project goals are to assemble a broadly distributed long-term time series of budworm population monitoring data to: (1) enhance opportunities for management planning by identifying incipient local populations as early as possible and (2) add to a database that can be linked with vegetation data and information about natural enemies in the future to fill important knowledge gaps about how landscape conditions influence local outbreak dynamics. CFRU members have approved funding for support of an additional three years of this survey (2017–2019).

Branch samples were taken during the fall and winter of 2015–16 in areas where pheromone trap catches had been high or modeling predicted at-risk stands. Three branches were cut from the mid-crown at 241 sites in 2015–16. Samples were sent to Canada for processing and were processed at the New Brunswick Province lab in Fredericton. In 2015, a total of 33 larvae were found in samples across 14 sites (Table C2). 227 sites had no larvae recovered. A similar survey was conducted in 2016–17. The Canadian Forest Service processed samples at their lab in Fredericton. A total of 11 larvae were found in samples across nine sites. 210 sites had no larvae recovered. A map of three years of L2 samples is shown below (Figure C8). These data can also be viewed on the healthy forest partnership research map at: http://www.healthyforestpartnership.ca/en/research/what-where-and-when/.

Table C2. Number of overwintering spruce budworm larvae (L2) recovered (2015 and 2016 data).

Year	Town	County	L2/Branch
2015–2016	Allagash	Aroostook	0.3
	Dyer Brook	Aroostook	0.7
	Perham	Aroostook	0.3
	Portage Lake	Aroostook	0.3
	T12 R9 WELS	Aroostook	5
	T13 R11 WELS	Aroostook	0.3
	T13 R7 WELS	Aroostook	0.3
	T15 R11 WELS	Aroostook	0.3
	T15 R15 WELS	Aroostook	0.3
	T16 R4 WELS	Aroostook	0.7
	T17 R5 WELS	Aroostook	0.3
	T18 R10 WELS	Aroostook	0.3
	T6 R8 WELS	Penobscot	0.3
	T5 R20 WELS	Somerset	1.3
2016–2017	New Canada	Aroostook	1
	New Canada	Aroostook	0.3
	Portage Lake	Aroostook	0.3
	T15 R12 WELS	Aroostook	0.3
	T17 R5 WELS	Aroostook	0.3
	Wallagrass	Aroostook	0.3
	Lower Cupsuptic Twp	Oxford	0.3
	Princeton	Washington	0.3
	Topsfield	Washington	0.3



2014, 2015 & 2016 Spruce Budworm L2 Survey

April 5, 2017

Department of Agriculture,
Conservation and Forestry
Maine Forest Service
Forest Health & Monitoring

GTMiller E:\bugs\sbw\L2_2014_2015_2016_map.mxd

Figure C8. Winter 2014–2015; 2015–2016 and 2016–2017 spruce budworm L2 survey in Maine. Data courtesy of the Cooperative Forestry Research Unit, University of Maine.

Both ground and aerial surveys were conducted in 2016, looking specifically for spruce budworm in northern Maine where damage would first appear. Field staff from the department including staff from Maine Forest Service (Forest Health & Monitoring, Forest Policy and Management and Forest Protection) and Public Lands as well as cooperators from Inland Fisheries and Wildlife, USDA Forest Service and New Hampshire Forest Health participated in a tour to become familiar with the visual signatures of spruce budworm defoliation. The tour, hosted by the Province of Quebec's Forest Pest Management Service, included several field sites with varying levels of defoliation and stand compositions/harvest history and a lesson on quantifying levels of defoliation. It took place in early July to increase the chances for recognition of spruce budworm defoliation within Maine during ensuing fieldwork.

No feeding damage from spruce budworm was apparent in either ground or aerial surveys in Maine. Feeding needs to be approaching a moderate level of damage before it is visible from the air and moth counts are not high enough anywhere in Maine to expect that level of feeding yet. Ground surveys were very limited in their extent and not expected to pick up damage yet. It will take more time on the ground looking at more trees to begin to find defoliation at this level of budworm feeding. A focused observer is needed to see trace to light damage in the forest so casual visitors to the forest usually do not notice damage until it starts to get moderate to heavy.

Populations of spruce budworm in Maine remain low, but detectable. Maine is poised at the beginning of another spruce budworm outbreak. Outbreaks occur on a roughly 40-year cycle in response to maturing forest stands and reduced pressure from parasites; the last time budworm was a problem in Maine was in the 1970's and 80's. This native defoliator of balsam fir and spruce has been defoliating trees in Quebec north of the Saint Lawrence Seaway for more than 10 years. Defoliation, which has spread to the south shore and into New Brunswick, currently covers more than 17 million acres. Current population levels in the state will allow more time to prepare before trees begin to experience growth-loss from budworm feeding.

Updates to this report will be posted to www.sprucebudwormmaine.org as well as www.maineforestservice.gov.

Acknowledgements:
A big thank you goes out to all the folks who paid attention to details of the trap protocol and strove to get the traps out and samples back in for processing. From people in the woods to those who managed data from multiple surveyors in the office, a lot of effort went into the trap network. We appreciate their efforts and the support of the Spruce Budworm Task Force members.

Special recognition and appreciation to Pierre Therrien with the Quebec Ministry of Forests, Wildlife and Parks, who coordinated with local ministry staff to organize and present a remarkable field tour with many learning opportunities in the Matapédia River valley.

Amy Ouellette, Regina Smith, Jeff Harriman, Bryan Way and Elicia Dionne of the Maine Forest Service helped sort through and count budworm samples that came into Old Town office and the Augusta lab. Charlene Donahue runs the light trap program. She grew the cooperator network from its base in 2013 to the current level of participation—her work has provided the foundation for this report and the current spruce budworm project.

Appendix D
Monitoring for Emerald Ash Borer

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The Maine Forest Service (MFS) continues to work with cooperators to monitor for this destructive insect that has already become established as close as New Hampshire, northeastern Massachusetts and south of Montreal (Figure D1 and Figure D2). Emerald ash borer (EAB) is known to be within about 30 miles of our western border.

Emerald ash borer attacks all species of ash (*Fraxinus* spp.) and threatens the survival of ash on our continent. Infested trees often exhibit crown dieback from the top down, epicormic (excessive) shoots, and bark splits. Serpentine larval feeding tunnels can be found etched into the inner bark and sapwood. Pupation occurs either in the sapwood or inner bark. Emerging adults create 1/8th inch wide "D" shaped exit holes.

Woodpeckers often feed heavily on EAB larvae and pupae, especially during the fall, winter, and early spring. As they feed, they flick off the brown outer bark, exposing the blonde inner bark. This blonding is highly visible and is a good sign that EAB may be present. Recent new infestations in MA and NH were found because of woodpecker feeding.

The Maine Forest Service and its partners have continued to educate the public about EAB and other invasive insects in workshops and exhibits at various venues. These and active public involvement with biosurveillance and trap tree programs, continue to heighten public awareness and reporting of EAB symptoms – particularly "blonding", the signs of woodpecker feeding. In 2016, MFS and its partners within the State Horticulturists office received approximately 100 reports of EAB symptoms/sightings. We responded to all such reports, many involving on-site visits. To date all have proven to be something other than EAB.

In addition to visually surveying trees for EAB damage and woodpecker feeding, and educating and recruiting the public to watch for signs of EAB, three other methods were used to monitor for EAB in 2016: a purple trap survey (Figure D3) which was carried out by a private company and overseen by USDA-APHIS, and the girdled trap tree survey and biosurveillance (Figure D4), programs which were conducted by MFS.

Purple Trap Survey: In 2016, the US Department of Agriculture contracted with a private company to hang purple traps throughout the country. Maine Forest Service was only minimally involved in this project. The contractor placed 969 traps throughout the state. Approximately 25 additional traps were placed at high-risk sites by MFS, USDA-APHIS and the Maliseet and Penobscot tribes

Girdled Trap Tree Survey: In 2016, the MFS coordinated with private landowners, municipal governments, and multiple state and federal agencies (including the University of Maine and Acadia National Park) to create, harvest and peel girdled ash trap trees for EAB. In the spring of 2015, 23 girdled trap trees were created throughout the state. In the early winter of 2016, two log-peeling workshops were held and 144 three-foot bolts from these trees were peeled and examined for signs of EAB. No EAB were found. In the spring of 2016, 22 trap trees were girdled and will be peeled early in 2017.

Biosurveillance: Biosurveillance with the hunting wasp, *Cerceris fumipennis* was also employed to monitor for EAB. Biosurveillance efforts were concentrated in southern and western Maine, as *C. fumipennis* does not appear to live in the eastern and northern part of the state. In 2016, two new small wasp colonies were found. In total, biosurveillance was carried out at 42 sites and buprestids were collected at 26 of these sites. This effort generated 221 beetles; none were EAB.

The following maps show the known distribution of EAB outside of Maine, the federal purple trap survey, and the locations of girdled trap trees and *Cerceris fumipennis* biosurveillance sites in Maine for 2016.

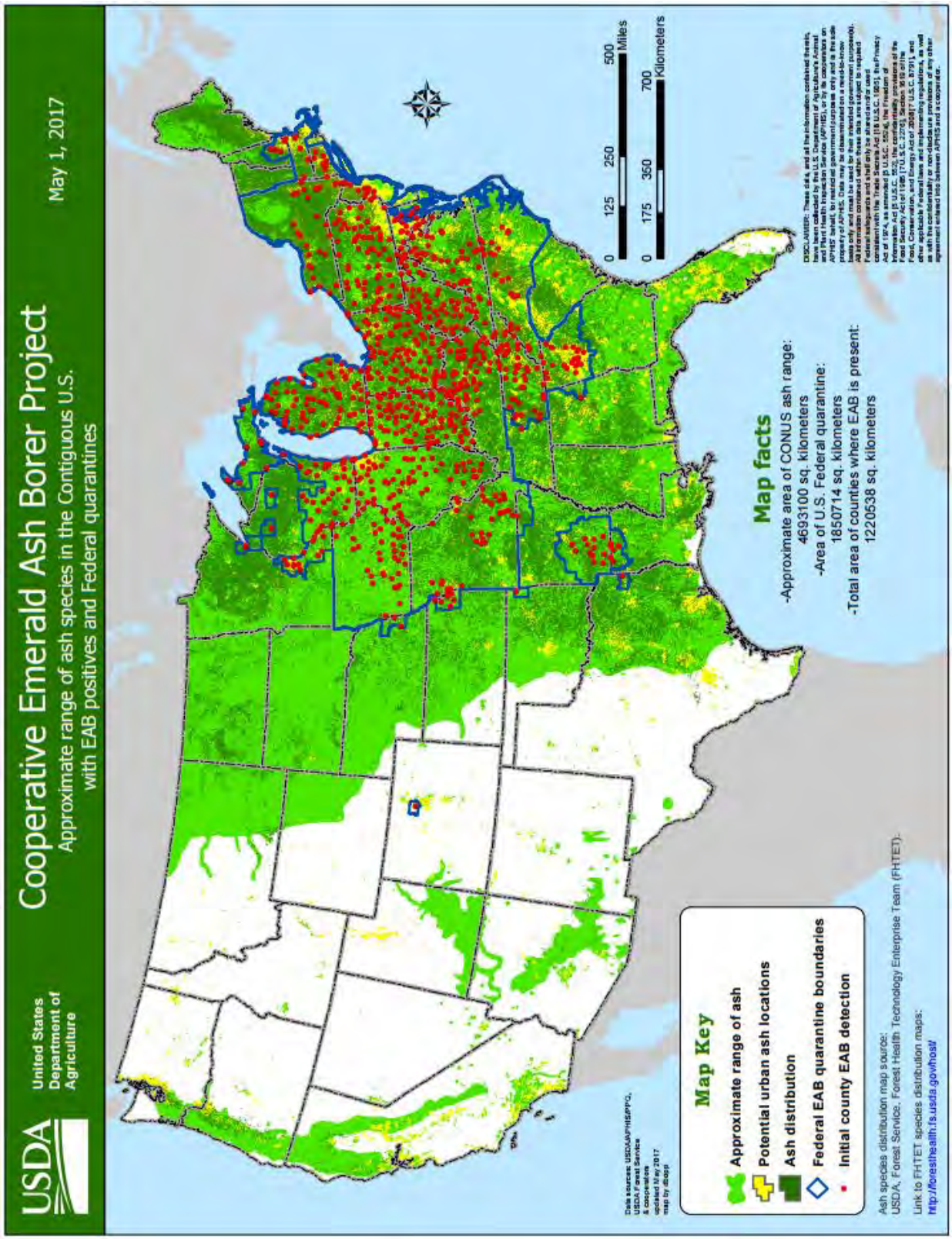

Figure D1. Range of ash and initial county detection of emerald ash borer in the USA (USDA APHIS, May 2017).

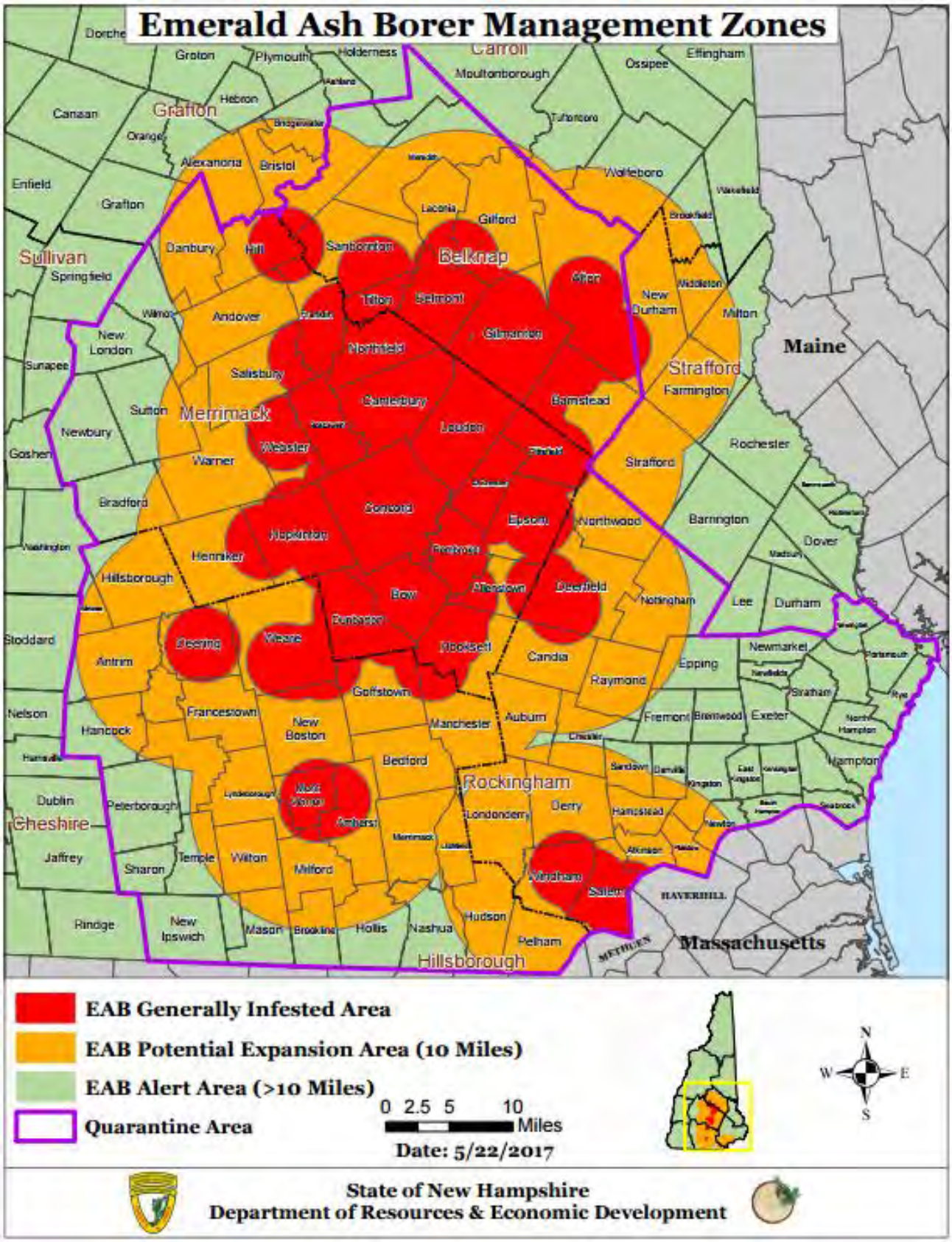

Figure D2. Emerald ash borer infested areas and quarantine in New Hampshire (NH DRED, DFL).

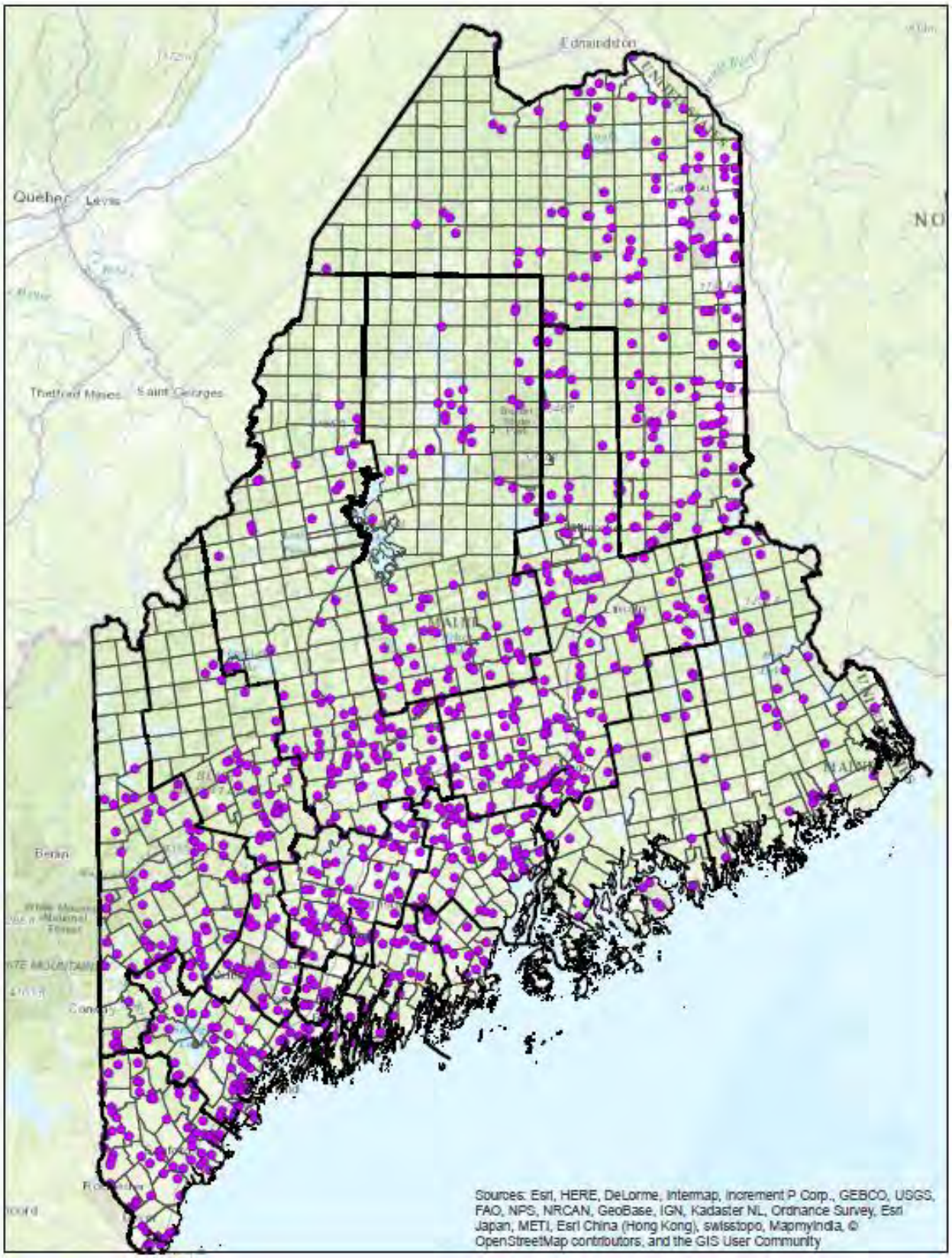

Figure D3. Maine survey grids for national purple trap survey overseen by USDA-APHIS 2016.

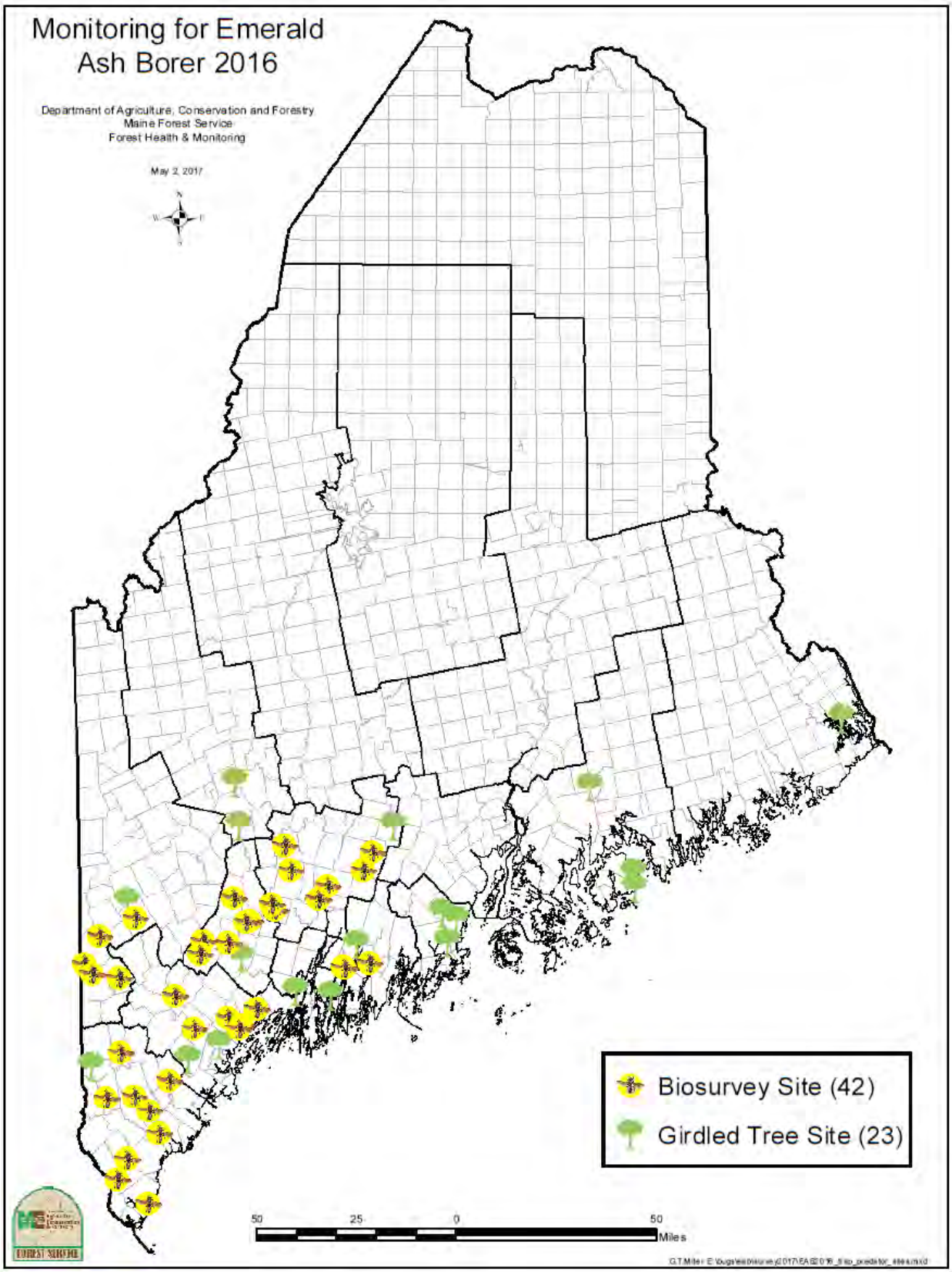

Figure D4. Emerald ash borer monitoring locations with biosurveillance and trap trees, 2016.

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