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Forest & Shade Tree & Insect Disease Conditions for Maine: A Summary of the 2014-2015 Situation

Maine Forest Servce, Maine Department of Agriculture, Conservation & Forestry

Forest & Shade Tree Insect & Disease Conditions for Maine

A Summary of the 2014 & 2015 Situation

Forest Health & Monitoring
Summary Report No. 26

July 2016

Maine Forest Service
MAINE DEPARTMENT OF AGRICULTURE
CONSERVATION & FORESTRY
Augusta, Maine

Forest Insect & Disease—Advice and Technical Assistance

Maine Department of Agriculture, Conservation and Forestry, Maine Forest Service
Insect and Disease Laboratory
168 State House Station, 50 Hospital Street, Augusta, Maine 04333-0168
Phone: (207) 287-2431 Fax: (207) 287-2432
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 not only our material and notices of current forest pest issues but also provides links to other resources. A stock of 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 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 on the last page of 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 plastic bags. Mail containers for prompt shipment to ensure they will arrive at the Augusta laboratory on a weekday.

Insect & Disease Laboratory	State Entomologist
168 State House Station Augusta, Maine 04333-0168 Location: 50 Hospital Street Phone: (207) 287-2431 Fax: (207) 287-2432 Hours: Mon.-Fri. 7:30 a.m. - 4:00 p.m. (call ahead as we are often in the field) Charlene Donahue, Forest Entomologist (207) 287-3244 charlene.donahue@maine.gov Colleen Teerling, Forest Entomologist (207) 287-3096 colleen.teerling@maine.gov Regina Smith, Entomology Technician Wayne Searles, Entomology Technician Amy Ouellette, Conservation Aide Allison Kanoti, Forest Entomologist P.O. Box 415 Old Town, Maine 04468 Location: 87 Airport Road (207) 827-1813 allison.m.kanoti@maine.gov	David Struble 22 State House Station Augusta, Maine 04333-0022 Phone: (207) 287-2791 Fax: (207) 287-8422 dave.struble@maine.gov **State Supervisor of FH & M** Mike Devine 22 State House Station Augusta, Maine 04333-0022 Phone: (207) 287-3920 mike.devine@maine.gov

Forest & Shade Tree – Insect & Disease Conditions for Maine Reports

Sign Up Form

For on-line form: http://www.maine.gov/dacf/mfs/forest_health/condition_rpt_signup.html

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 especially 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!

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Name _____

Mailing Address _____

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

Area of Interest (*only check one*):

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

Comments: _____

Return your Completed Form To:

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

Phone (207) 287-2431 Fax (207) 287-2432
http://www.maine.gov/dacf/mfs/forest_health/index.htm

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 Fax (207) 287-2432
e-mail: patti.roberts@maine.gov

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

Acknowledgements

The information in this Annual Summary Report has been assembled and reviewed by 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 winter moth, conducting sampling for hemlock woolly adelgid predators, and collecting data on hemlock impact plots. Maine Forest Service Forest Protection and Policy and Management divisions assisted with emerald ash borer surveys.

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 Mike Skinner Wayne Searles, Regina Smith, Amy Ouellette, Jocelyn Lahey and Julie Churchill. 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, State Horticulturalist; Karen Coluzzi, Pest Survey Coordinator and Lorraine Taft, Outreach Coordinator in particular. Their work in quarantines, survey and outreach nicely dovetails with 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. In particular we thank David Bourque and Dana Michaud for their taxonomic contributions and additions to the insect collection. And thanks to Gail Everett, Lucy Guarnieri for their 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 Maritime Provinces of Canada.

Personnel

Former Employees:

William Ostrofsky retired On November 1, 2015 after a career that spanned 43 years with the final nine working for the Maine Forest Service. Bill had a passion for pathology and a gift for service. He was always available to help us learn more about the world of forest pathology. We heard from clients that his availability to them either one-on-one or in providing group training was also greatly appreciated. Not only did Bill provide technical support to the people of the state but he also was involved in research projects across the region to better understand forest pathology issues. Bill served in various official capacities in a broad range of professional societies over the years. He was author or co-author to more than 80 journal article and miscellaneous scientific publications. He was a champion of our *Forest and Shade Tree Insect and Disease Condition Reports* bulletin and helped to make sure it got out to you on a regular basis.

Bill's involvement in forest pathology can be traced back to 1972 and his undergraduate degrees at UNH and work as a forest technician for Alex Shigo at the US Forest Service in Durham NH. Those auspicious initial experiences led to a PhD in forest pathology and a professional career that stretched from the University of Oregon to the University of Maine and spanned 33 years – before his 9 years working as the Maine Forest Service's forest pathologist. Although he is very much missed, we wish him the best in retirement.

Mike Skinner of Crystal retired from the Maine Forest Service In December of 2014 after four decades with the state. Mike came on when spruce budworm was a problem back in the seventies and did everything from pole pruning branch samples to running a helicopter spray base. He then continued on in entomology, surveying the northern part of the state for insect and disease problems. Mike worked on the North American Maple Project, Forest Inventory, Forest Health Monitoring, Brown Ash Evaluation, Larch Canker Study and many more. He ran survey trapping projects in northern Maine for gypsy moth, spruce budworm, pine shoot beetle and other invasive insects. We could depend on Mike to do whatever task was sent his way with a joke and a grumble but always a smile and a laugh as well. We will miss his sharp evaluation of forest pest problems as *well as his cooking.*

Julie Davenport (Churchill) worked in a project position for the division in the summers of 2013 and 2014 and from January through May 2015. Julie graduated from the University of Maine Orono, School of Forest Resources while working with us in 2015. She left in May 2015 to pursue work which provided significantly more compensation and was more relevant to earning her Forester's License. She worked on emerald ash borer, longhorned beetle, browntail moth and elongate hemlock scale surveys and also spent some time assisting the forest inventory program.

Jocelyn Lahey worked in a project position for the division from January 2014 through August 2014. She left the lab to pursue work closer to home in Portland. Josie finished up her bachelor's degree at the University of Southern Maine while working for the lab. While there she took several entomology-themed courses, as well as worked on a sawfly project under Dr. Joseph Staples and volunteered at the Maine Medical Center Research Institute Vector Borne Disease Lab working with everyone's favorite disease vectors (ticks and mosquitoes). For the MFS, Josie worked on browntail moth and emerald ash borer surveys as well as web projects and the insect collection.

In Memorium

Douglas A. Stark (1927-2014) worked for the Maine Forest Service for 32 years, from 1956 to 1988. He was the first Forest Pathologist for the State of Maine. Doug's initial work here was focused on monitoring the spread of Dutch elm disease and on publicizing disease management protocols. Dutch elm disease was just starting to decimate the native elm populations in Maine's cities, towns, and forests during the late 1950's and early 1960's, and Doug's expertise was greatly appreciated by many town tree boards, municipalities, and private citizens. Doug was also a very passionate and well-respected authority on white pine blister rust. He was instrumental in advocating for the continuance of quarantine procedures for exclusion and removal of *Ribes* plants (currants and gooseberries), the primary hosts of the disease. These efforts have protected the valuable white pine resource in an economically efficient manner for the past several decades. The value of this work is especially appreciated now, as a new strain of the blister rust pathogen can now infect commercial cultivars of *Ribes* previously immune to the disease. A great deal of his time was also spent on spruce budworm management and control operations during the large epidemic of the 1970's. Doug was heavily involved in chestnut restoration efforts in Maine,

locating residual survivors on the landscape and working with others on the restoration efforts which are now coming to fruition. Doug is remembered as a wonderful teacher and mentor, an expert tree disease diagnostician, and a meticulous recorder of field observations of tree and forest health and general forest conditions. He always presented a courteous and professional manner to clientele and co-worker alike, and was a friend we shall all miss.

Everett "Skip" Cram (1944-2015) Skip originally came to work for the Division in the spruce budworm lab during the winter of 1979-80; transferring from his position as an Allagash Wilderness Waterway ranger. He became a fulltime Insect Ranger working on budworm in 1983. When the Division reorganized in 1987 he was assigned as entomology technician responsible for the Medway District. He held this position until his retirement in 2001. Skip was a "Jack of All Trades" and was happiest when he was working with his hands building or repairing something. He is remembered not only for his stories but also the many contributions he made as an employee with this division. Part of his entomology legacy is the design of the bole cages used in a study of the development of the hemlock woolly adelgid predator *Sasajiscymnus tsugae* on balsam woolly adelgid. His cage design has been shared with others doing research in entomology— and those cages constructed for the predator study remain functional.

Rex McBreairty (1922-2015) came to work for the division in 1963 as an Insect Ranger (now Entomology Technician), covering the old Ranger District 3 (west of the Allagash). Although he encountered and worked on a number of pest problems, the principal focus across his 20 year career was spruce budworm. When he retired in 1983 he had been involved with the whole gamut - from the early stages of build-up in the northwestern part of the state through to the beginning of the general collapse. After he retired he continued to be involved, operating a light trap in Allagash until recently.

New Employees:

Regina Smith Joined the lab in late September of 2014 in the Entomology Technician position which had been filled earlier in the year by Jocelyn Lahey. Regina's capstone project and employment at the University allowed her to uncover her passion for the study of insects with a special interest in both the introduced honeybee and native bumblebees. She has broadened that experience since she started at the lab—sorting samples from beetle and light traps; participating in week-long details in Worcester Massachusetts to aid in the Asian longhorned beetle effort and in Long Island to NY to assist the southern pine beetle; setting and collecting winter moth traps and then dissecting their catch; conducting survey for browntail moth, elongate hemlock scale and emerald ash borer traps, and assisting in curating the collection among other tasks. Regina is field-assigned in Portland.

Amy Ouellette joined us in September 2015 as a Conservation Aide out of the lab in Augusta. Among other projects, she has helped out in counting samples from the spruce budworm survey; surveying for winter moths and browntail webs, conducting equipment inventories and working on maintenance of the insect collection. Amy has insect survey experience from previous contract work with the Department of Agriculture Conservation & Forestry and diverse fieldwork experiences from previous employment. We're happy to have her assistance in the division.

Patti Roberts began working for the Forest Service at the main office before transitioning to work at the lab in the spring of 2014. Patti fills the position left vacant when Jean Maheux retired in December 2011. Jean had left her desk at 50 Hospital Street years before retirement and had been working out of the Maine Forest Service office in Harlow. By the summer of 2014, Patti had moved into the lab full time.

Patti has been an incredible asset to our work group. She is the friendly voice and face that greets customers on the phone and as they come in the front door. Patti is uncomplaining in completing the mundane and unusual tasks an office associate at an entomology lab faces. She does not hesitate to jump in where she sees need for help in duties others may flinch at: from properly stowing browntail moth webs and pole pruners, to organizing and inventorying entomology equipment, to providing support at trainings and information to the public at trades shows and other events. We continue to be impressed by her enthusiasm, caring and adaptability.

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http://www.maine.gov/dacf/mfs/publications/condition_reports.html

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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.

Publications authored by FH&M Entomologists

Managing Hemlock in Northern New England Forests Threatened by Hemlock Woolly Adelgid and Elongate Hemlock Scale by **Allison Kanoti**, Kyle Lombard, Jen Weimer, Barbara Schultz, Jim Esden, Ryan Hanavan, Michael Bohne. USDA, Forest Service, State and Private Forestry, Northeastern Area, 11 Campus Blvd., Ste 200 Newtown Square, PA 19073. 28 pages. 2015. Online Access: http://na.fs.fed.us/pubs/2015/FH_ManagingHemlockNortherNEForests21050916.pdf

Abstract
Hemlocks in northern New England are threatened by invasions of two exotic pests: hemlock woolly adelgid (HWA) and elongate hemlock scale (EHS). HWA is a forest pest that causes major damage throughout the native range of eastern hemlock. It has been spreading into northern New England since before 2000. EHS is a more recent invader. This document provides guidelines for managing threatened hemlock forests in the Northeast based on forest health specialists' current understanding of the interplay between HWA and EHS, our climate, and our forests.

Degree-Day Model for Emergence of Cerceris fumipennis (Hymenoptera: Crabronidae) in Northeastern America Based on Field Observations. by Claire. E. Rutledge, M. K. Fierke, Phillip D. Careless, and **Colleen Teerling** *in* Annals of the Entomological Society of America 108(6):971-977. 2015.

Abstract
Cerceris fumipennis (Say, 1837) (Hymenoptera: Crabronidae) is a solitary ground-nesting wasp that uses adult buprestid beetles to provision nests. It is being used as a detection tool for the invasive buprestid, *Agrilus planipennis* F., the emerald ash borer. Modeling the degree days necessary for emergence of the wasp will aid in that effort. During 2010 and 2011, 27 and 23 soil temperature probes, respectively, were deployed at *C. fumipennis* colonies in three US states and Ontario, Canada. Sites were monitored daily for wasp emergence. Degree-day models were constructed using the soil temperature data from the probes and air temperature data available on the internet from nearby weather stations. Our base temperature for degree-day accumulation for *C. fumipennis* was 10°C. The average soil degree days needed for emergence was 696.2 ± 16.8. The average air degree days needed for emergence was 463.73 ± 14.01. To measure the performance of the air degree-day model, we tested the model against a set of 24 distinct sites for which emergence dates were known from 2010–2012. The average difference in date at which the predicted degree days were accumulated, and that at which wasps emerged at a site was—0.15 d, with a median value of 1 d. This provides a narrow window to monitor for emergence using readily available data, air temperature, which is more efficient and cost effective than driving to colonies weekly or daily to ascertain wasp activity.

The Ground Beetle (Coleoptera: Carabidae) Fauna of Maine, USA, by **Richard G. Dearborn**, Robert E. Nelson, **Charlene Donahue**, Ross T. Bell and Reginald P. Webster *in* The Coleopterists Bulletin 68(3):441-599. 2014. Online Access: http://www.colby.edu/MES/Dearborn_et_al_2014_Maine_Carabids.pdf

This paper was selected as the Outstanding Paper in the 2014 Coleopterists Bulletin.

Abstract
A survey of the modern carabid fauna of Maine has shown that the fauna consists of 425 documented species, 14 more than previously documented for the Maine fauna in the latest catalog for the family in North America or in the most recent checklist on the state beetle fauna. **New state records** are *Agonum cupreum* Dejean, *Amara anthobia* Villa and Villa, *Anisodactylus laetus* Dejean, *Bembidion intermedium* Kirby, *Bembidion sejunctum sejunctum* Casey, *Brachinus vulcanoides* Erwin, *Diplocheila impressicollis* Dejean, *Elaphropus dolosus* LeConte, *Lebia grandis* Hentz, *Myas coracinus* Say, *Olisthopus micans* LeConte, *Panagaeus fasciatus* Say, *Pentagonica picticornis* Bates, and *Tachyta parvicornis* Notman. The record for *B. sejunctum sejunctum* is the first for the species in the eastern United States. A recent record for *Omophron labiatum* (F.) in the state could not be substantiated by any specimen. Notes on biology are presented for species for which that knowledge exists. Distributions are presented for all taxa based on standard biophysical regions for the state and the knowledge of those distributions; distribution maps are presented for all species for which township records are known and for which we have specimen records in our database. Work on better defining the current distributional limits is ongoing. Several adventive European taxa have already exhibited very rapid dispersal across the state.

Insect Conditions

Insects: Softwood Pests

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

Balsam woolly adelgid symptoms (and actual organism presence in the case of significant trunk phase populations) are recorded from forest inventory and analysis plots when encountered, but no special measurements were taken this year nor were additional surveys conducted for this pest. Balsam woolly adelgid is established in all Maine counties.

Elongate Hemlock Scale
Fiorinia externa
Hosts: Primarily Fir and Eastern Hemlock (*Abies* spp. and *Tsuga canadensis*)

Elongate hemlock scale was detected in ornamental trees in one new town (Ogunquit) in 2014. No new towns or counties detected in 2015. This pest was surveyed for in forested areas in southern Maine, no additional 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, 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.

One site was treated for containment in 2014. Due to difficulties with the contracting process, no chemical treatments were conducted in 2015.

See appendix B for more information.

Hemlock Woolly Adelgid
Adelges tsugae
Host(s): Hemlock (*Tsuga* spp.)

Hemlock woolly adelgid (HWA) was detected in a new county in 2014. Knox County was determined to be infested, with detections in the towns of Friendship, Owls Head and Camden. In addition, HWA was detected in two new towns in York County: Lebanon and Sanford. No new town or county detections occurred in 2015.

Most known infestations are close to the coast or other significant water. Hemlock decline, due at least in part to HWA damage, is apparent from the ground in several coastal communities in York, Cumberland, Sagadahoc, Lincoln counties. In 2014, about 9 acres of mortality were mapped on Great Diamond Island (Cumberland County). That was the first time damage associated with this adelgid had reached the threshold where it was readily detectable during aerial surveys. No additional hemlock mortality was mapped in 2015.

Biological control establishment efforts continue in Maine. In 2014, 13,750 *Sasajiscymnus tsugae* lady beetles were released in Maine. Some of the beetles were received from North Carolina Department of Agriculture through a cooperative agreement with USDA APHIS PPQ. Others were purchased from a commercial supplier through a grant with USDA Forest Service. Release sites were in Bath (Sagadahoc County), Portland (Cumberland County), Sanford and South Berwick (York County) and Wiscasset (Lincoln County). In 2015, 7,272 *S. tsugae* lady beetles were released in Maine. Maine Forest Service purchased 6,969 beetles were from a commercial supplier through a grant with USDA Forest Service. Those beetles were released in Woolwich (Sagadahoc County) at a site with a conservation easement held by Kennebec Estuary Land Trust. The City of Portland (Cumberland County) acquired

303 beetles and released them at Mayor Baxter Woods as part of their integrated approach to hemlock woolly adelgid management in that city park.

Fall sampling for predator beetles in 2014 yielded adult predator beetles at 4 sites. Laricobius nigrinus were recovered from two sites in York (York County). S. tsugae adults were recovered in Harpswell and Freeport (Cumberland County). Sampling in 2015 did not result in recoveries.

One site on the leading edge of the known distribution of hemlock woolly adelgid was treated to manage spread of hemlock woolly adelgid. This was in a high-traffic area of Camden. Treatments used imidacloprid in combination with dinotefuran on large-diameter trees, and imidacloprid alone on smaller diameter trees.

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 outbreak levels in parts of Maine. In 2015, aerial surveys mapped severe damage to white pine on 262,303 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.

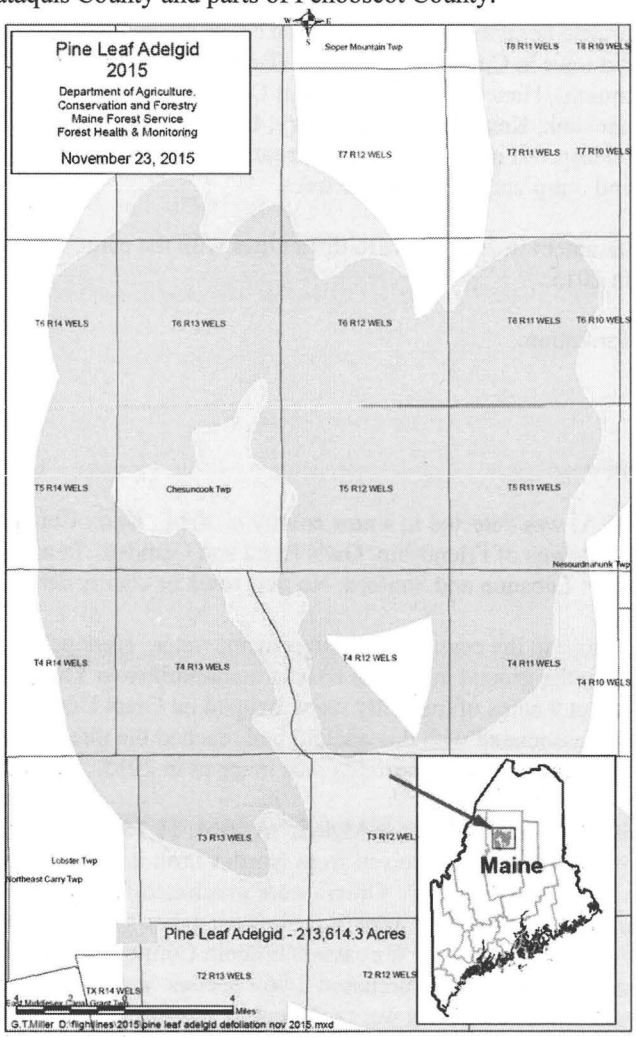


Figure 1. Pine leaf adelgid damage 2015

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 beetle were found in either Aroostook or Washington counties in 2014 or 2015.

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. Acadia National Park volunteers and staff carried out significant survey efforts in the fall and winter of 2014-2015 on MDI. Their efforts uncovered red pine scale in Bar Harbor (Hancock County) from trees that were not yet symptomatic. In addition they found unhealthy infested and dead red pine on both sides of Somes Sound in the town of Mount Desert. Initial aerial survey in 2014 had uncovered tree mortality and decline concentrated on the east side of the sound.

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 we have been using pheromone traps and catches have averaged well below 5 moths/trap across the northern part of the State. In 2011 that average crept up to over 5 moths/trap and in 2015 the average was 27 moths/ traps; up slightly from 25 moths/trap in 2014. All of the sites had some spruce budworm moths.

2015 was the second year the Maine Forest Service asked large land owners and managers in northern Maine to help survey for spruce budworm by setting out pheromone traps on their lands. We requested one 3-trap sample per 6 mile-square township set in at least a 25 acre spruce/fir stand that was composed of > 50% spruce/fir pole-sized or larger trees. In 2015 nineteen entities participated in setting out over 1300 traps at 452 sites. An additional 129 traps used in a research project were included in the tally as well.

The overall average moths/trap was 25.7 moths/ trap with 98% of the traps positive for spruce budworm. The townships with the most moths are in Aroostook and Piscataquis Counties. The number of traps with over 100 moths has gone from six in 2014 to 17 in 2015 and the number of traps with over 50 moths doubled.

Table 1. Average number of spruce budworm moths in pheromone traps by county

	Average Number of SBW Moths/Trap	
County	**2014**	**2015**
Aroostook	25.8	44.9
Franklin	0.8	0.5
Hancock	2.4	4.9
Oxford	1.1	1.3
Penobscot	6.1	15.1
Piscataquis	10.7	20.4
Somerset	13.2	6.2
Washington	3.2	7.1
Grand Total	**15.7**	**25.7**

No spruce budworm damage was detected either in ground or aerial surveys. The University of Maine spearheaded an overwintering larval survey (called L2 for the larval instar collected). Land managers had crews take three mid-crown branch samples from 100 of the most at risk sites. Branch samples were sent Canada for processing. Eleven larvae were found, all in townships in Aroostook County.

Table 2. Number of spruce budworm larvae found in 100 branch samples in winter of 2014/15

Township	**Number of Larvae**
Saint Francis	3
T12 R12 WELS	1
T14 R13 WELS	1
T14 R7 WELS	3
T14 R8 WELS	1
Westmanland	2
Total	**11**

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 than10 years. Defoliation, which has spread to the south shore, currently covers more than 15 million acres. New Brunswick is seeing increased numbers of budworm moths in their pheromone traps and saw light amounts of defoliation in the northern part of the province in 2015.

Insects: Hardwood Pests

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

This is a tiny moth that flies early in the spring and lays its eggs on the buds of red oaks. The larvae hatch, initially feed on the buds, then roll the leaves from the tip down and feed inside the leafroll. They finish up feeding in June and drop to the ground to pupate and stay there until the following spring.

It has only rarely been reported as a problem. Defoliation likely attributable to this pest was observed during ground surveys in July 2015 in the Tunk Lake area (Hancock County)

Birch Leafminer
Messa nana* or *Fenusa pusilla
Host(s): Birch (*Betula* spp.)

Birch trees in northern parts of Aroostook, Franklin, Penobscot, Piscataquis and Somerset Counties as well as Hancock and Washington Counties are showing light to occasionally moderate damage from birch leafminers as well as anthracnose. Birch is mostly scattered in small stands other than at higher elevations.

Browntail Moth
Euproctis chrysorrhoea
Host(s): Red Oak (*Quercus rubra*)

Browntail moth winter web counts were moderate to high in small areas of Bath, Bowdoinham Topsham and West Bath (Sagadahoc County) and Brunswick and Freeport (Cumberland County) again in the winter of 2014-15. In 2014 defoliation mapped using aerial surveys was 430 acres and this dropped to just 90 acres in Freeport (Cumberland County) in the spring of 2015. Aerial survey to detect defoliation was late and trees may have re-foliated making it difficult to see the damage.

But in September 2015 over 10,000 acres of defoliation by first instar larvae was mapped in Sagadahoc and Cumberland Counties (Figure 2). This level of fall defoliation has not been seen since the early 2000's. Winter web ground surveys have verified the aerial survey results. Browntail moth winter webs were found from Warren (Knox County) to Kittery (York County) and inland to Turner (Androscoggin County) and Waterville (Kennebec County). The intensity of the core infestation in coastal Sagadahoc and Cumberland Counties is worrisome for the human health risk even more than the risk to tree health. The expanding and intensifying infestation will catch many people off guard who have not dealt with browntail before. The 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.

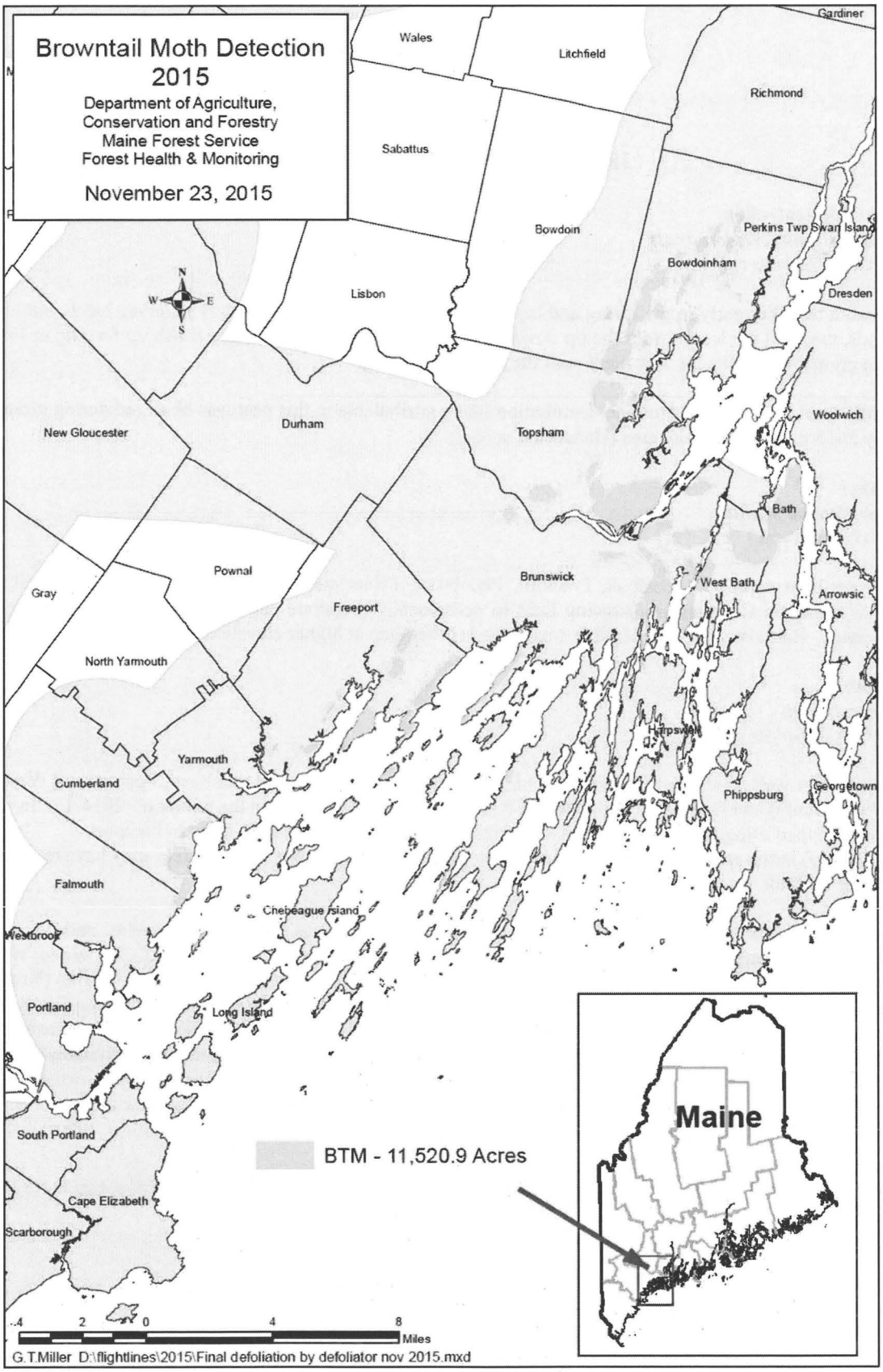


Figure 2. Browntail moth fall defoliation 2015

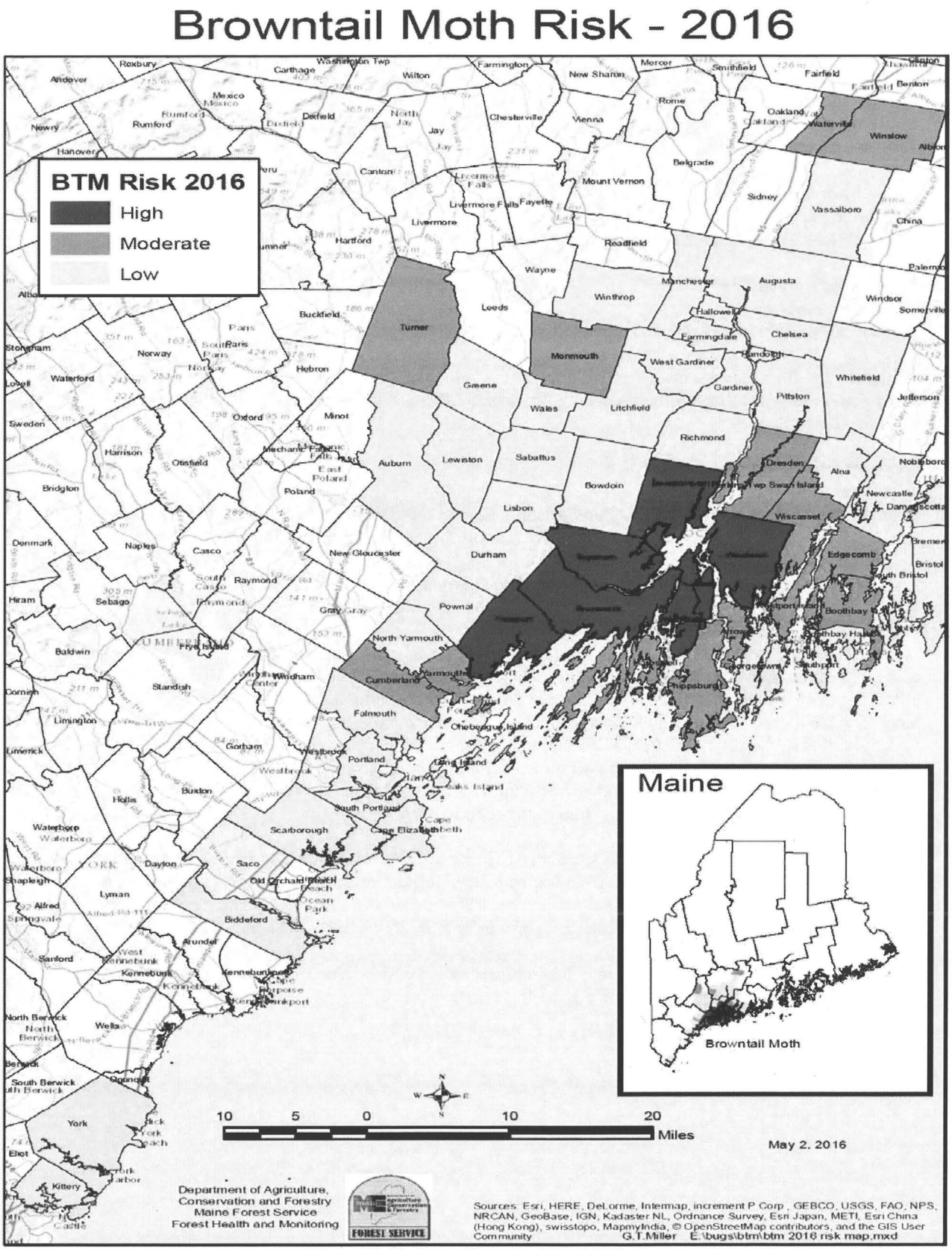


Figure 3. Browntail moth risk - 2016

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, moderate in York 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; populations remained low in 2014 and 2015. 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)

Eight (8) acres of defoliation resulting from gypsy moth larval feeding were recorded in 2014 in Orient (Aroostook County) on the same island where it was found in 2013. No defoliation was recorded in 2015.

In 2014, The MFS deployed 398 pheromone-baited, milk carton traps in towns adjacent to the gypsy moth quarantine zone (transition zone). The 382 recovered traps captured approximately 1,930 male moths. Only 17 percent of the traps had more than 10 moths per trap, and no trap captured more than 70 moths. This is down from more than 8,000 moths caught in 98 traps in 2013—likely due in most part to shifting the trapping area north in the eastern portion of the zone. In 2015, The MFS and USDA APHIS deployed a total of 509 pheromone-baited, milk carton traps in towns adjacent to the gypsy moth quarantine zone (transition zone). The 498 recovered traps captured approximately 2,075 male moths. Less than 10 percent of the traps had more than 10 moths per trap; only 12 traps had more than 25 moths; and no trap captured more than 90 moths.

In 2014 and 2015, egg mass scouting to locate newly infested areas was conducted in townships with higher trap catches. There were no new detections of towns with reproducing populations of gypsy moth.

Egg mass counts in the population surveys for gypsy moth were low in both 2014 and 2015.

The state rule that governs the gypsy moth quarantine is overdue for revision. Additional towns proposed for addition to the quarantine are detailed in Figure 4.

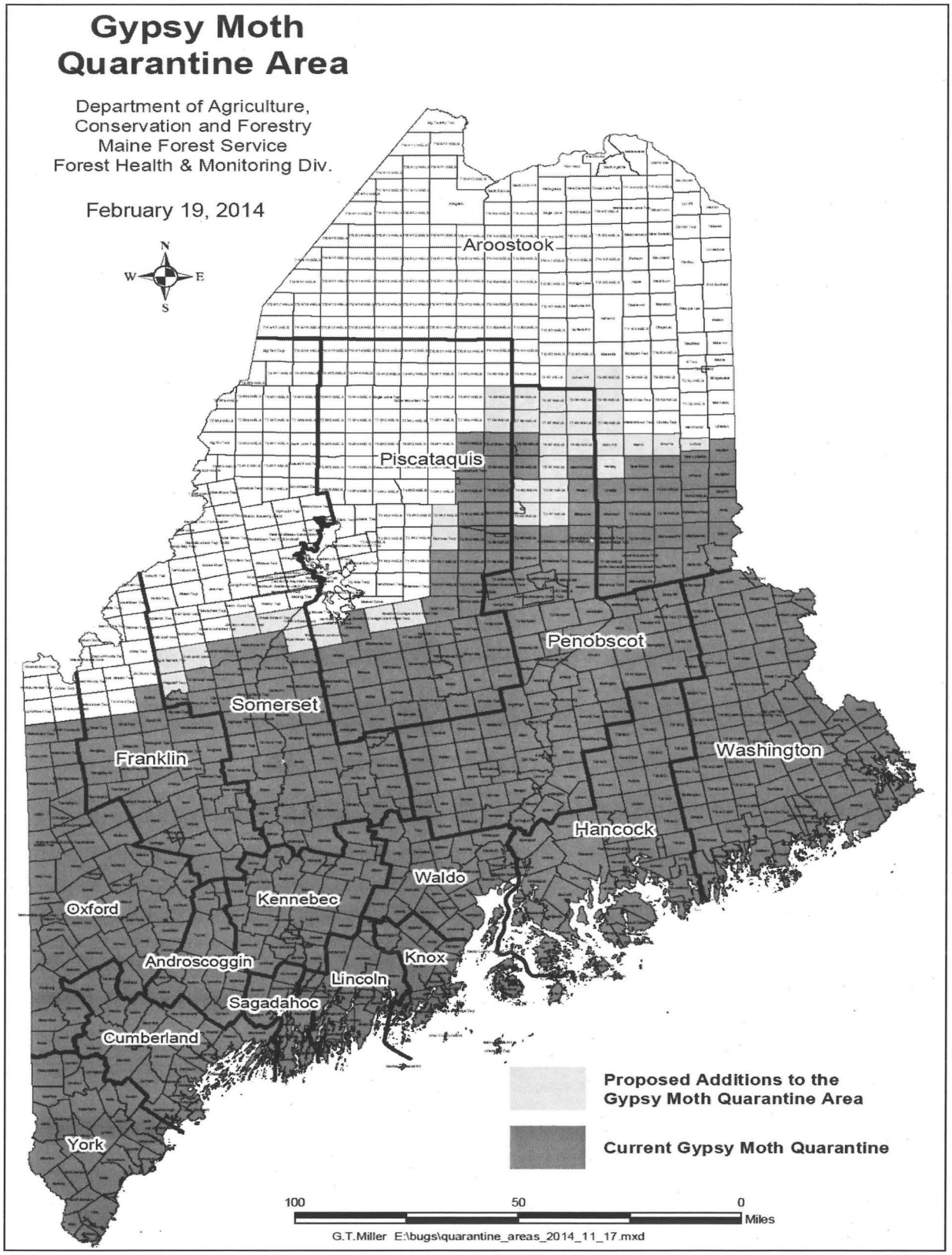


Figure 4. Gypsy moth quarantine area and proposed additions

Oak Stem Phylloxerid tentatively *Moritziella corticalis*
Host: White Oak (*Quercus alba*)

In September of 2008 a landowner in Waldoboro (Lincoln County) contacted the Maine Forest Service concerned that his planted white oak saplings were dying. The trunks of the trees were coated with tiny insects that were obvious only on the white oaks and on the majority of that species in the planting.

Insect samples were taken on September 8, 2008 and sent to the Systemic Entomology Laboratory (SEL). They were identified as *Phylloxera* but the species was unknown and they wanted more samples. No *Phylloxera* were found in 2009-2011 but in 2012 they appeared again and a second samples was sent to the SEL lab. We have not had an update from SEL.

In July 2014, retired USFS entomologist Mike Montgomery visited the site to observe the insects and damage. Unfortunately the insects were not readily visible in July. However, Dr. Montgomery's visit yielded a plausible tentative identification of the pest as the oak stem Phylloxerid, *Moritziella corticalis* (Kaltenbach, 1867). This insect is known to feed on the bark and twigs of white oak and is reported as a pest of English Oak (*Q. robur*) in Europe. Records from overseas indicate this insect is thought to be North American in origin. More work will be conducted on confirming an identification as time allows.

It appears that cultural practices and Cynipid gall wasp damage (tentatively identified as the oak potato gall caused by *Neuroterus quercusbatatus* (Fitch) by Dr. Montgomery) are significant contributors to the oak sapling mortality in Waldoboro.

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 is firmly established along the southern coast of Maine from Kittery (York County) to Bar Harbor (Hancock County) and on many offshore islands. The aerial survey showed 1,996 acres defoliated in 2014 and 10 times that in 2015 with 10,264 acres. Although more acres of defoliation were mapped in 2015 than in 2014, the intensity was not as severe. i.e. Many trees were not as heavily defoliated but there was a much broader footprint across the landscape. 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). Total area mapped in aerial survey in 2015 was 10,264 acres, all in Cumberland County.

The MFS ran a pheromone trap survey in December 2014 and 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. At the same time, reports of moth observations were solicited from the public using a Survey Monkey form—over 700 reports were received through this method in each year. A map predicting intensity of defoliation was produced from these surveys to help green industry professionals and homeowners prepare for the growing season (Figure 5).

Parasitic flies, *Cyzenis albicans*, were released in 2014 and 2015 in cooperation with Dr. Joseph Elkinton, University of Massachusetts and funded by the USDA. Three towns received flies in 2014: Kittery (York County), Harpswell (Cumberland County) and Vinalhaven (Knox County). Two thousand flies were released in Vinalhaven 1200 in Kittery and Harpswell. In 2015releases were made in two towns in Cumberland County: Peaks Island - Portland - 2,000 flies and Two Lights State Park, Cape Elizabeth – 1,000 flies (Table 3). Locations where flies had been released in previous years were sampled for parasitoid flies. No flies recovered to date which is not unexpected as it takes a few years for the fly population to be large enough to start finding them.

Table 3. Releases of parasitic flies, *Cyzenis albicans*, in Maine

Town	County	Dates	Number of *Cyzenis albicans*
Harpswell	Cumberland	May 1, 2013	2000
Cape Elizabeth	Cumberland	May 1, 2013	2000
Kittery	York	May 16 & 23, 2014	1200
Harpswell	Cumberland	May 16 & 22, 2014	1200
Vinalhaven	Knox	May 21, 2014	2000
Portland	Cumberland	May 15, 2015	2000
Cape Elizabeth	Cumberland	May 15, 2015	1000

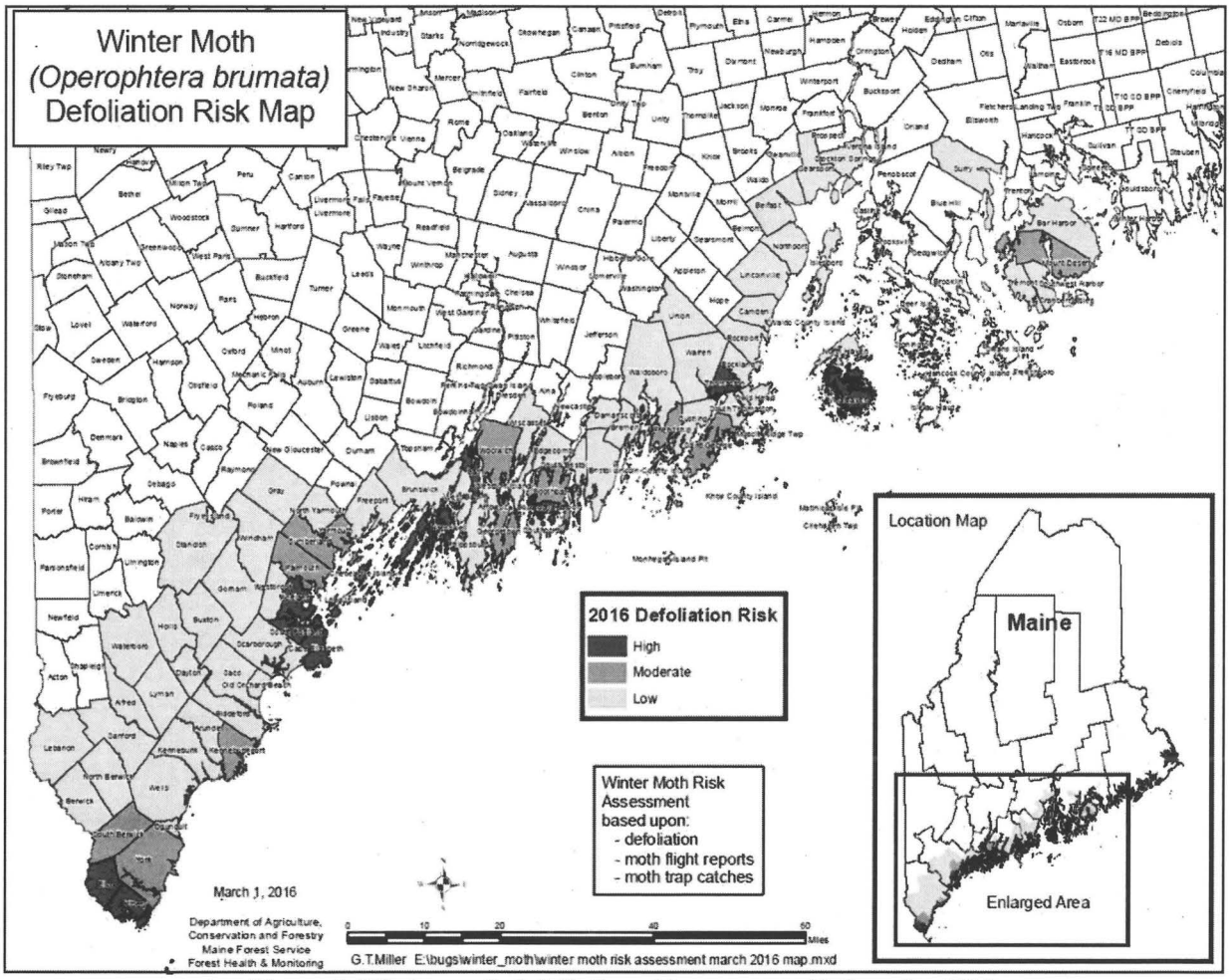


Figure 5. Winter moth defoliation risk map – predictions for 2016

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 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. **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).

If you have found damage you suspect was made by any of these insects, please 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 these 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): Hosts: Maples (*Acer* spp.) and other hardwoods

No Asian longhorned beetle detected to date. In 2014, visual surveys of Asian longhorned beetle hosts were conducted in six high-risk towns. This works was supported by a grant from the

County	Town	Date of Survey	Number of Trees
Androscoggin	Auburn	11/24/2014	100
Cumberland	Westbrook	7/30/2014	50
Oxford	Bethel	11/25/2014	100
Sagadahoc	Bath	8/19/2014	51
Somerset	Fairfield	12/4/2014	55
York	Saco	12/19/2014	100

No formal surveys in 2015.

Outreach efforts in conjunction with Maine Department of Agriculture, Conservation & Forestry, and 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 detected to date. Trapping in 2014-2015 was conducted by USDA APHIS, PPQ.

Emerald Ash Borer
Agrilus planipennis
Host(s): Ash (*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 feeding 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.

In addition to visually surveying trees for EAB damage and woodpecker feeding, and educating and recruiting the public to watch for signs of EAB, the MFS employed three means of monitoring for EAB in 2014 and 2015.

Purple Trap Survey: In both 2014 and 2015, the Maine Forest Service (MFS) coordinated the state's participation in the national EAB survey with purple panel traps. In 2014, 587 purple prism traps were hung throughout the state. In 2015, 710 purple sticky traps and 20 green funnel traps were hung throughout the state. All traps were examined and were negative for EAB.

Girdled Trap Tree Survey: In both years, 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 2013, 33 girdled trap trees were created throughout the state. In January and February of 2014, three log-peeling workshops were held (in northern, central and southern locations) and 250 3-foot bolts from these trees were peeled and examined for signs of EAB. None were found.

In 2014 twenty-four trap trees were created throughout the state in. Between January and March 2015, 174 3-foot bolts from these trees were peeled with no sign of EAB found. In the spring of 2015, approximately 20 trap trees were girdled and will be peeled early in 2016.

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 2014, four new wasp colonies were found, ranging in size from 2-90 nests. In total, biosurveillance was carried out at 35 sites and buprestids were collected at 25 of these sites. This effort generated 370 beetles; none were EAB.

Fourteen new colonies of Cerceris fumipennis were found in 2015, ranging in size from 3 to over 150 nests. Biosurveillance was conducted at 55 sites and beetles were collected at 25 of these sites. A total of 445 beetles was collected. No EAB were found.

See Appendix D for more information on 2014 & 2015 survey locations.

Diseases and Injuries

Overview: During 2014, general activities of the Forest Pathology program included co-authorship on two published abstracts, three newspaper interviews, and ten formal seminar presentations on various forest and shade tree pathology and forest health topics. Approximately 193 tree disease clinic diagnoses were provided to landowners, homeowners, foresters, and others. An additional twenty-six 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, and for two additional issues of *Forest Conditions Updates*. W. Ostrofsky, Forest Pathologist, was grant co-author, and is a co-principal investigator for the USDA Forest Service grant *Extent and severity of Caliciopsis canker of white pine: Risk assessment, evaluation of silvicultural management tools, and diagnostic assay development*. Other significant monitoring and evaluation work included support for surveys of white pine needle diseases (*Lecanosticta acicola* and others), hard pine shoot blight (*Sirococcus conigenus)*, and white pine canker disease (*Caliciopsis pinea*). Significant time was also spent on final field measurements, data analysis, and preparation of a draft report of the 15-year study of larch canker (*Lachnellula willkommii*).

Dr. Ostrofsky retired in November, 2015 before the writing of this report. Observations for 2015 are summarized from Conditions Reports and from clinic call notes.

Diseases and Injuries: Native

Anthracnoses of Hardwoods
Host(s): Ashes (*Fraxinus* spp.), Birches (*Betula* spp.), Maples (*Acer* spp.), Oaks (*Quercus* spp.)

Anthracnose diseases were considerably less prevalent in 2014 than in 2013. The majority of oaks that had been severely damaged by frost and anthracnose last year appeared to have substantially recovered, with some minor localized exceptions. Specific observations and reports of the major leaf diseases follow.

Ash Anthracnose: Leaf infections by *Gnomoniella fraxini* were judged to be trace to light through the central and southern regions of the state. Moderate infections were noted in Phippsburg (Sagadahoc County) and Troy (Waldo County).

Birch Anthracnose: Birch anthracnose (*Discula betulina*) was common on paper and grey birches throughout the state, but caused little damage and only very scattered pre-mature defoliation. This was evidenced by the above-average fall foliage conditions experienced during the late-summer and autumn season.

Maple Anthracnose: Damage from anthracnose diseases on native maple species was very minor. The disease was identified on sugar maple from Biddeford (York County), and on red maple from Hartland (Somerset County).

Oak Anthracnose: The primary pathogen identified was *Apiognomonia quercina*. Specific reports of oak damage were recorded from the following towns: Brunswick and New Gloucester (Cumberland County), Sedgwick (Hancock County), Farmington (Franklin County), and from Newfield and York (York County). Oaks in a natural stand in the Newfield area were severely damaged by the anthracnose, and displayed evidence of moderately heavy branch dieback. Reports from the landowner indicated heavy defoliation from the disease the previous year, but whether the anthracnose was the initial cause of the decline, or coincidental with a decline caused by other factors is unknown.

Arborvitae Root Rot
***Armillaria* spp.**
Host(s): Arborvitae (*Thuja occidentalis*)

Armillaria root rot has been occasionally associated with Arborvitae, especially nursery-grown Arborvitae planted in ornamental settings. Typical symptoms appear as "sectoring", with one or two main stems dying from a single, multi-stemmed plant. In 2014, the condition was again diagnosed from Newcastle (Lincoln County) and Kenduskeag (Penobscot County).

Ash Leaf and Twig Rust
Puccinia sparganioides
Host(s): White Ash (*Fraxinus americana*); Green Ash (*F. pennsylvanica*)

Ash leaf rust was identified from Orland and Otis (Hancock County), and from Kittery and York (York County). The disease resulted in only light infection levels during 2014.

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

Caliciopsis canker is an emerging problem in pine growing regions of eastern North America. In North America, *Caliciopsis pinea* infects eastern white pine (*Pinus strobus*), *P. echinata*, and *P. virginiana*. In Europe, the pathogen infects *P. pinaster* and *P. radiata*. Although reports of damage caused by *C. pinea* were common in the 1930s, since then there has been very little progress towards understanding the epidemiology of this disease elevating the need for disease management guidelines. For example, *Caliciopsis* canker is associated with overstocked stands and poor soils, but quantitative data are not available.

A multi-state USDA Forest Service survey of the extent and severity of *Caliciopsis* canker on white pine was initiated during the 2014 field season. The objective of this study was to identify areas at greatest risk of *C. pinea* damage. In 2014, twenty randomly selected stands were surveyed in Maine, with *Caliciopsis pinea* identified on white pine regeneration from 16 stands surveyed. *Caliciopsis* symptoms in overstory trees were also identified in 16 stands, but not always from those with infected white pine regeneration. Relationships between tree stress resulting from the white pine needle disease complex, and the incidence and severity of *Caliciopsis* canker have not been established, but may become apparent as studies continue.

In 2015, the study was expanded to assess *Caliciopsis* canker incidence and severity as it may be related to soil type characteristics. An additional sixteen white pine stands were surveyed for the canker disease in Maine and the data will be combined with similar data collected in New Hampshire by USDA Forest Service and New Hampshire DRED personnel. Of the sixteen plots surveyed in Maine this year, fruiting of the pathogen was found on sapling–sized white pines in ten of the stands. Symptoms of pitching (pitch streaks along the main bole) were observed in all sixteen stands. Percentage of white pines exhibiting pitching ranged from a low of 10% in a stand in Lyman, to73% in a stand in Shapleigh. Although pitching is one criterion for assessing infection by *Caliciopsis*, not all pitching is likely the result of infection by this pathogen. Detailed canker analyses are being conducted by University of Maine, other State, and USDA Forest Service cooperators to determine the reliability of using pitching as a survey tool for this disease.

In addition, four sapling white pines were collected from five plots (Fryeburg, Limington, Sanford, Sebago, and Steep Falls) in 2014 and sent to project cooperators at the Univ. Georgia. The material was examined for both *Caliciopsis* infections and for the presence of any associated scale insects, thought to be associated with *Caliciopsis*-caused white pine damage now occurring in Georgia and other southern states. Presence of the scale *Matsuccoccus macrocicatrices* was confirmed on all four saplings. Of the 24 saplings submitted from the Northeast for the study, none were free from the scale insect. Research on this complex continues in Georgia.

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

Several species of *Cytospora* can cause cankers of branches and stems of conifers. 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 2014, *Cytospora* canker was diagnosed affecting white spruce in Limerick (York County), on Norway spruce in Stockholm (Aroostook County), and Concolor fir in Westbrook (Cumberland County).

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

Many Christmas tree plantations have been moderately to heavily affected by needle cast diseases in the past several years. In 2014, disease incidence appeared to be quite light, with only a few plantations reporting the problem. Balsam fir plantations in Belgrade (Kennebec County) and Waldoboro (Lincoln County) were affected by primarily *Lirula nervata*. *R. pini* was also common throughout southern Maine, but appeared at only trace to light infection levels. However, *R. pini* was reported causing some moderate to heavy damage on balsam fir in Mapleton (Aroostook County).

Fir Tip Blight
Delphinella balsameae
Host(s): Balsam Fir (*Abies balsamea*); Concolor Fir (*Abies concolor*)

Fir tip blight was diagnosed from mature Concolor fir in Belfast (Waldo County). Incidence of this disease in 2014 appeared to be less frequent than in recent past years.

Fir Branch Dieback
Cause Unknown
Host(s) Balsam Fir (*Abies balsamea*)

Symptoms of fir branch dieback usually appear in late winter or early spring, when needles on the distal six inches or more of apparently healthy branches turn a bright red, with subsequent needle loss, and often with the entire branch eventually dying. The relatively scattered pattern of branches that are affected do not fit well with typical winter injury symptoms and, in a few cases, other factors appear to be the cause. Often, the needles are colonized by *Rhizosphaera pini*. *R. pini* is not believed to be the initiating or only agent responsible, again because the pattern of symptom development is not consistent with typical needle cast pathogens. While these symptoms have been observed for many years, a consistent, single initiating cause remains unknown. It is expected that most trees will recover from the branch dieback. In 2014, symptoms were observed occasionally throughout central and southern Maine; samples were examined from Richmond (Sagadahoc County), Augusta, and Oakland (Kennebec County). In 2015, reports came from Leeds, Lewiston (Androscoggin County); Freeport, Gorham, Portland, Yarmouth (Cumberland County); Phillips (Franklin County); The Forks (Somerset County); West Paris (Oxford County) and elsewhere.

Hemlock Rust
Pucciniastrum vaccinii
Hosts: Eastern hemlock (*Tsuga canadensis*); blueberry (*Vaccinium* spp.)

Hemlock rust, a native disease considered of relatively minor importance, was reported from Camden (Knox County) on ornamental trees in 2014.

Hemlock Shoot Blight
Sirococcus tsugae
Host: Eastern hemlock (*Tsuga canadensis)*
Hemlock shoot blight is prevalent throughout the state, wherever hemlocks are found. It has affected trees in ornamental settings, but is of more significance to hemlock regeneration in forest habitats. A recent survey of the damage to hemlock regeneration has indicated the disease is most severe in southern and southwest regions of Maine. In 2014, the disease was identified from Camden (Knox County) on ornamental trees, and in natural forest regeneration in Limington (York County).

Herbicide Injury

Damage and mortality to white pines resulting from the application of Imprelis herbicide has continued to result in several homeowner requests for information. Even though the material was removed from the market within months of its release a few years ago, the long-term effects of tree damage continue to be a concern. Damage cases were reported from Naples (Cumberland County) and Lincoln (Penobscot County) in 2014.

***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. In 2014, *Phomopsis* galls were reported from oaks in Orono (Penobscot County), Kennebunk (York County), and Augusta (Kennebec County). In 2015 reports were received from Skowhegan (Franklin County), Sidney (Kennebec County), and Sanford (York County). The disease is native, is considered to be generally of inconsequential importance 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 Mugho pines) throughout the state. Red pines which may show some symptoms of tip blight and shoot blight are commonly infected with both *Diplodia pinea* and *Sirococcus conigenus* (described below). 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 native red pine resources. Infections 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): 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 2014, the disease was reported as causing losses to white pine in a stand in Oxford (Oxford County). The disease was also noted as prevalent in two locations during the *Caliciopsis pinea* survey work: Albany (Oxford County), and Sebago (Cumberland County).

***Sirococcus* Shoot Blight**
Sirococcus conigenus*; *Sirococcus piceicola
Host(s): Red Pine (*Pinus resinosa);* other hard pine spp.; Spruces (*Picea* spp.)

Sirococcus shoot blight remains a significant threat to red pine in native and plantation stands throughout the state. In 2014, heavy infection levels and mortality has been diagnosed from Chase Stream, Upper Enchanted, and Mayfield Twps. (Somerset County). Additional reports have included Harrington (Washington County), Presque Isle (Aroostook County), and Northeast Harbor (Hancock County). This damage has been attributed to *Sirococcus*, and tentatively to *S. conigenus*. A sample of what was believed to be *Sirococcus piceicola* was received from Mars Hill (Aroostook County) on ornamental white spruce. *S. piceicola* has apparently been found recently in New Brunswick and elsewhere infecting red pine as a host, as well as spruce (G. Stanoz, personal communication). Pathogen samples from Maine have not yet been subjected to the molecular methods required to distinguish between these two species.

Spruce Mistletoe
Arceuthobium pusillum
Host(s): White Spruce (*Picea glauca*), Black Spruce (*P. mariana*), Red Spruce (*Picea rubens*)

In 2014, the town of Bristol (Lincoln County) reported a coastal stand of (primarily) black spruce and red spruce damaged by eastern dwarf mistletoe. The pathogen is well-known along coastal and island spruce forests of Maine, and has contributed to stand attrition at some sites.

Spruce Needle Cast
Rhizosphaera kalkhoffii
Host(s): White Spruce and Colorado Blue Spruce (*Picea glauca*; *Picea pungens*)

Spruce needle cast continues 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 cast has resulted in some mortality, but more often the aesthetics of individuals has been so affected as to warrant a considerable number of tree removals. In 2014, the disease was reported from Mapleton (Aroostook County), Portland (Cumberland County), Augusta (Kennebec County), Farmington (Franklin County), Southport (Lincoln County), Georgetown (Sagadahoc County), and Kennebunk (York County).

Spruce Needle Rust
Chrysomyxa weirii
Host(s): Spruce spp. (*Picea* spp.)

Weir's cushion rust was found on ornamental Colorado blue spruce from Farmington (Franklin County) and Mapleton (Aroostook County). Severity of the disease was light to moderate in both cases, with no lasting damage expected.

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

Incidence of tar leaf spot diseases was comparatively low in 2014. The disease is common wherever Norway maples are planted as ornamentals, especially in urban and suburban communities. No reports of widespread leaf browning and premature defoliation were received in 2014, but samples were submitted for diagnosis from Westbrook (Cumberland County), and from York and Biddeford (York County).

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

In 2014, two instances of *Verticillium* wilt were reported on landscape trees from Gardiner (Kennebec County), and Turner (Androscoggin County). Each occurrence involved sugar maple but appeared to be resulting in minor damage, with dieback of a single branch in each case.

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

The needle disease complex that has resulted in extensive pre-mature needle shedding in white pines over the past several years continued at a similar level of intensity in 2014 and 2015. Losses of one-year-old needles during late May and through June resulted in numerous disease clinic requests for assistance. This complex has been active at notable levels since at least 2006. As part of a region-wide study coordinated by USDA Forest Service personnel, two permanent plots in Maine were again assessed for white pine needle disease symptoms. The disease complex was also noted when conducting the survey for *Caliciopsis pinea* (described above in this report). The disease remains widespread but most severe throughout central, western, and southern Maine. An extensive survey in Downeast and northern regions of Maine indicated disease presence wherever white pine was found (samples are currently being analyzed at Univ. New Hampshire), but disease intensity in these regions was judged to be considerably less than in southern and western areas.

In 2014, occurrence of the white pine needle disease complex was identified from Leeds (Androscoggin County), Ashland (Aroostook County), Bridgton, Cumberland, Freeport, Gray, Naples, Sebago, and Windham (Cumberland County), Orland and Otis (Hancock County), Augusta, China and Winthrop (Kennebec County), Rockport (Knox County), Dresden and Newcastle (Lincoln County), Bethel, Brownfield, and Oxford (Oxford County), Old Town (Penobscot County), Bowdoinham, Richmond, and Woolwich (Sagadahoc County), Acton, Limington, Newfield, and Sanford (York County).

In addition to the locations listed above, samples of infected needles were collected and sent to cooperators at the Univ. New Hampshire for further identification and confirmation of pathogen species. Sites sampled in 2014 included: Leeds (Androscoggin County), Caribou, Littleton, Orient, Portage Lake, Presque isle, T8R6 W.E.L.S.,

T16R4 W.E.L.S., and Wallagrass (Aroostook County), Brunswick and North Yarmouth (Cumberland County), T22 M.D. (Hancock County), Augusta, Pittston, and Waterville (Kennebec County), Waldoboro (Lincoln County), Norway (Oxford County), Bangor and Lincoln (Penobscot County), Guilford (Piscataquis County), Woolwich (Sagadahoc County), Prospect (Waldo County), Baring Plantation, Cherryfield, East Machias, Kossuth, and No. 14 Twp. (Washington County), and Acton (York County).

Winter Injury to Red Spruce

In 2015 observations of red spruce at higher elevations in Johnson Mountain Township (Somerset County) revealed symptoms typical of freezing injury to foliage from this past winter. The phenomenon was intensively studied and documented during the 1980's and 1990's, when causes of spruce decline became the focus of climate change investigations. The damage, which includes the death and (usual) reddening of foliage, is the result of either a rapid freezing, or an especially deep freezing of the tissues. This is not the same damage that results from the more common wind-burn, or winter desiccation, and accounts for the significant difference in the pattern of damage on individual trees. The examined trees were of sapling size developing in even-aged stands with no overstory. Damage was considered moderate to light on most individual trees that had been affected, and is not considered to be a serious threat to tree survival.

Diseases: Non-Native

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

A perennial problem, Dutch elm disease was evident throughout central and southern Maine, with symptoms in full display during mid-summer 2014. The disease is judged to be at moderate levels in younger elms in mixed forest and roadside stands. Specific reports or observations of the disease were recorded from Lewiston (Androscoggin County), Gray (Cumberland County), and Bar Harbor (Hancock County) in 2014.

European Larch Canker
Lachnellula willkommii
Host(s): Eastern Larch, European Larch, Japanese Larch (*Larix laricina; L. decidua; L. leptolepis*)

Survey continued for European larch canker in the quarantine buffer towns, and in towns located between the two principal quarantine zones along the mid-coast. No new locations of European larch canker were identified in the 2014 survey. Four infected European larch found at the Brunswick site, currently outside the quarantine boundary but under eradication efforts since 2008, were removed or pruned.

A final re-measurement of a long-term study plot of disease intensification in Deblois (Washington County), was completed, and a final report is being prepared. Results of the 14-year study were presented at the Northeastern Forest Pest Council meeting in March, 2015.

In 2014, assistance with a European larch canker research effort was provided to cooperators at the Laurentian Forestry Centre, Quebec, Canada. Samples of *Lachnellula willkommii* were collected from within the quarantine areas in Maine for the studies. The material was subjected to procedures which allows for the identification of the pathogen in wood samples, in the absence of pathogen fruiting. The methods are being used to develop a possible early-detection survey technique for the disease. Samples of fruiting structures and cankers were collected from Cushing, Friendship, South Thomaston and Warren (Knox County), and from Cathance, Cutler, Deblois, Jonesboro, and Milbridge (Washington County) for analysis.

Oak Dieback
***Diplodia corticola* (=*Botyrosphaeria corticola*)**
Hosts: Oak (*Quercus* spp.), Grape (*Vitis* spp.)
Symptoms of oak dieback were observed in Standish (Cumberland County) and a few surrounding towns in 2015. 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 first report of the pathogen in Maine from nearby hosts exhibiting identical symptoms was published in *Plant Disease* this year. This disease is generally considered to be a secondary agent, affecting trees initially weakened or damaged by some other cause.

White Pine Blister Rust
Cronartium ribicola
Host(s): 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. One instance of the illegal cultivation of gooseberries and currants was discovered in Readfield (Kennebec County) in 2014, with the subsequent confiscation, removal, and destruction of the plants, as dictated by Maine law.

In 2014, assistance for the identification and management options for white pine blister rust was provided to landowners in the towns of Rumford (Oxford County), and Norridgewock (Somerset County). In addition, white pine blister rust was noted in several locations during the course of the *Caliciopsis pinea* survey work. Infected trees were reported in stands from Leeds (Androscoggin County), Gray (Cumberland County), and Richmond (Sagadahoc County).

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 Worchester.

There were six mobilizations associated with the NFFPC Forest Health Working Team in 2014 and 2015 (Table 4). 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.

Recipient partners report a similar level of benefit that would not have been otherwise available. The USDA-funded demonstration pilot project was a key component to these successes, and the related mobilizations that were funded by other sources clearly demonstrate the synergistic benefit of this program. 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 to 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 4. 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 both 2014 and 2015 for both delineating forest pest problems and overflights detecting potential damage and stress situations. Damage by the following pests was mapped: browntail moth (*Euproctis chrysorrhoea*), gypsy moth (*Lymantria dispar*), pine leaf adelgid (*Pineus pinifoliae*), red pine scale (*Matsucoccus matsumurae*) and winter moth (*Operophtera brumata*). 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 in either a Cessna 185 or 305 (a Korean War observation plane) float plane. 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. Although like any other electronic devise 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 trouble shoot 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 Maine Forest Service has been co-sponsoring bioblitzes in Acadia National Park (ANP) since 2004 along with the ANP, the Maine Entomological Society and the University of Maine. A bioblitz is a 24-hour period of time 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 and four have taken place primarily on Mount Desert Island with additional collecting on Schoodic Point. The 2014 blitz focused on beetles (Coleoptera) for a second year at a different time of the season. In 2015 wasps (Hymenoptera) and millipedes and centipedes (Myriapoda) were the focus. Participation and support of these events has a number of paybacks 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

Once again, a major focus this year was training and outreach on the issue of how firewood movement spreads invasive pests. Maine Forest Service continues to partner with the DACF Division of Animal and Plant Health on invasive insect outreach - in particular the Asian longhorned beetle (ALB) and emerald ash borer (EAB). This project included training volunteers to take the invasive insect issue to the public and putting the message out in as many venues as possible. Similar activities occurred in other states across the northeast.

Wallet cards, bookmarks, posters, flyers and factsheets were put up or distributed in town offices, convenience stores, libraries, at trail heads and other venues. 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. There were also informational outreach events at the Kittery rest area for tourists coming into the state. 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. In cooperation with the Maine DOT, training sessions were held for municipal and Public Works personnel on how to recognize invasive insects if encountered during their work on park and roadside 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 new out-of-state firewood ban were printed and 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 were contacted and 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.

The DACF Division of Animal and Plant Health heads up the Forest Pest Outreach Volunteers program. This program trains volunteers to be able to identify potential forest pests and to provide them with support to go into their communities and train more people.

Insect Collection

The Maine Forest Service Insect Collection is closing in on having 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 traps were run in 2014 and 2015 in locations from South Berwick to Allagash to Topsfield (Table 5). 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 down into a collecting can. One light trap runs on batteries as there is no power at Frost Pond. Trap operators collect the catch on a daily basis 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 5. 2014 and 2015 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
Bowerbank	PISCATAQUIS	6/17	7/31	45
Calais	WASHINGTON	6/17	7/31	45
Crystal	AROOSTOOK	7/3	7/31	30
Exeter 2014	PENOBSCOT	6/17	7/31	45
Frost Pond – T3 R11 WELS	PISCATAQUIS	6/17	7/31	45
Haynesville	AROOSTOOK	6/17	7/31	45
Hope	KNOX	6/17	7/31	45
Kingfield	FRANKLIN	7/3	7/31	30
Millinocket	PENOBSCOT	6/17	7/31	45
Mount Vernon	KENNEBEC	6/17	7/31	45
New Sweden	AROOSTOOK	7/3	7/31	30
Rangeley	FRANKLIN	6/17	7/31	45
Sedgwick	HANCOCK	6/17	7/31	45
Shirley/Monson	PISCATAQUIS	6/17	7/31	45
South Berwick	YORK	6/17	7/31	45
Ste. Aurelie - Big Six Twp	SOMERSET	7/3	7/31	30
Topsfield	WASHINGTON	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 continued to publish the Conditions Reports during the 2014 and 2015 growing season. Our use of list-serves and web-based vehicles have increased our readership to over 1,500 people choosing to use the electronic format (up 25% from 2014). 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 – 2015.**

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 – 2015

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. With the exception of 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.

c. **New in 2015:** Eradication efforts continue in Brunswick (Cumberland County).

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.

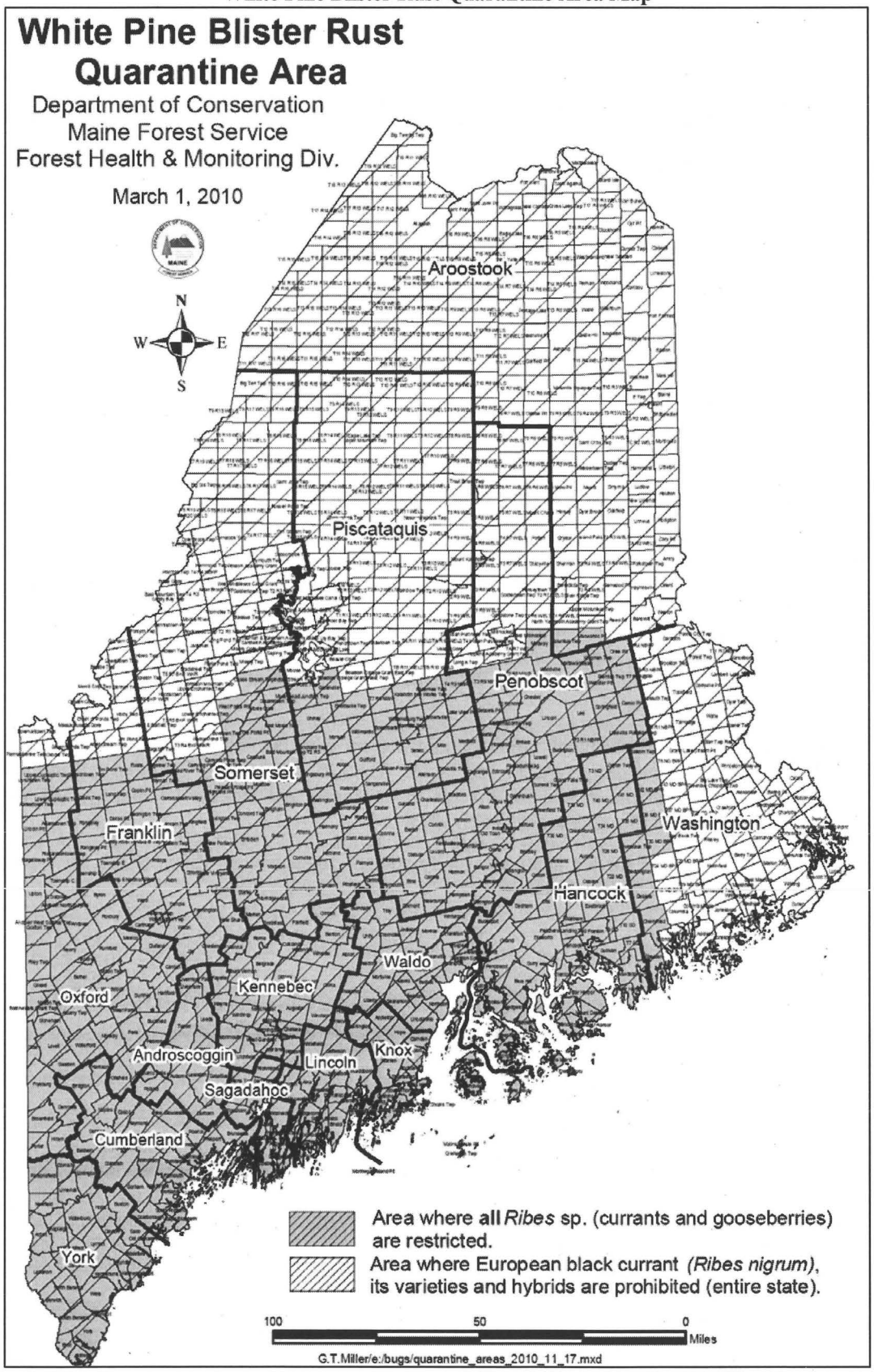
IV. Pine Shoot Beetle

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.

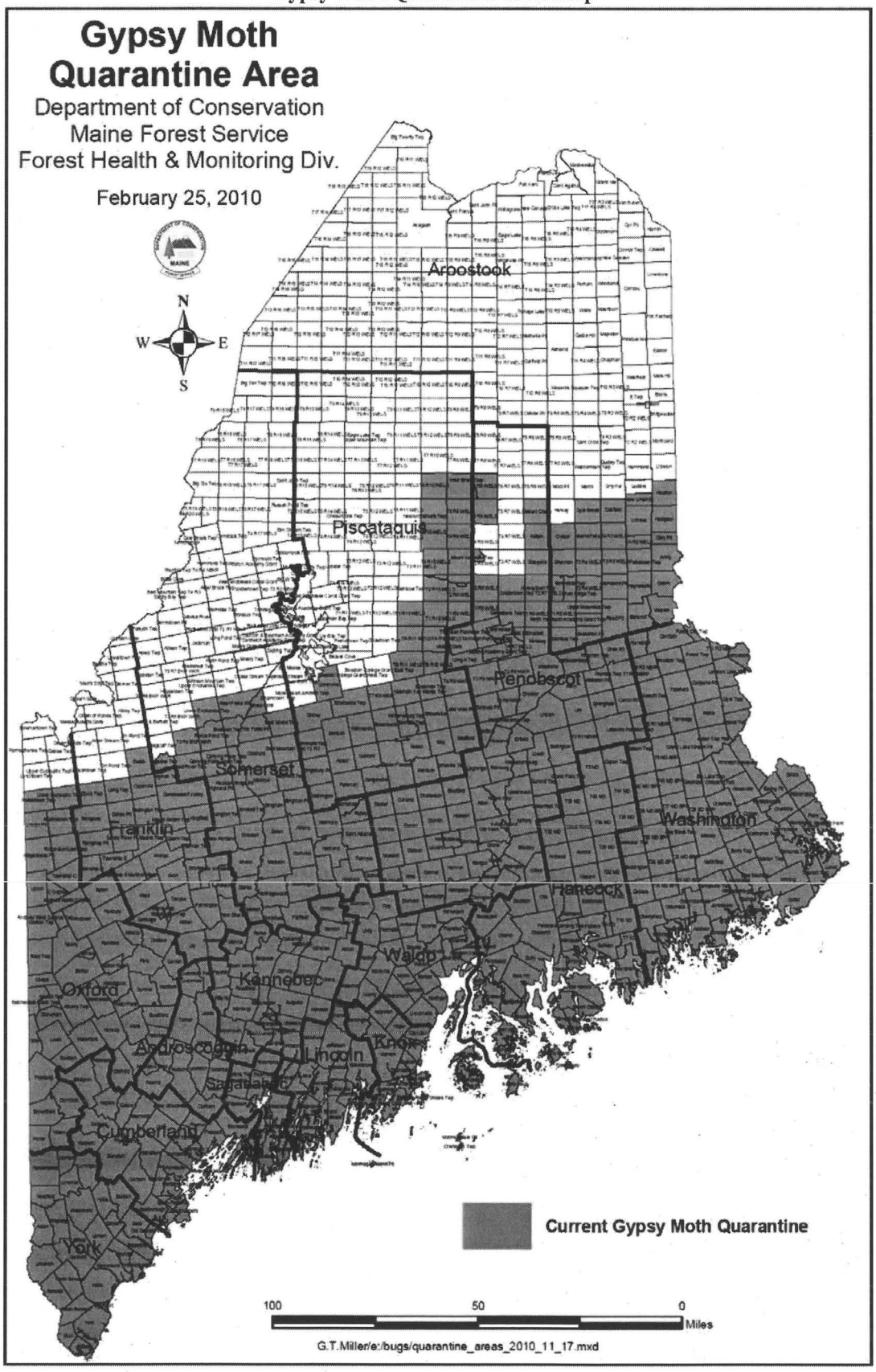
Somerset County: Anson, Athens, Bald Mountain Twp T2 R3, Bigelow Twp, Bingham, Bowtown Twp, Brighton Plt, Cambridge, Canaan, Caratunk, Carrying Place Town Twp, Carrying Place Twp, Chase Stream Twp, Concord Twp, Cornville, Dead River Twp, Detroit, East Moxie Twp, Embden, Fairfield, Harmony, Hartland, 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

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)

Androscoggin County- The entire County.

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

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, Strong, Temple, Township 6 North of Weld, Township D, Townthip E, Washington, 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- 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.

Sagadahoc County- The entire County.

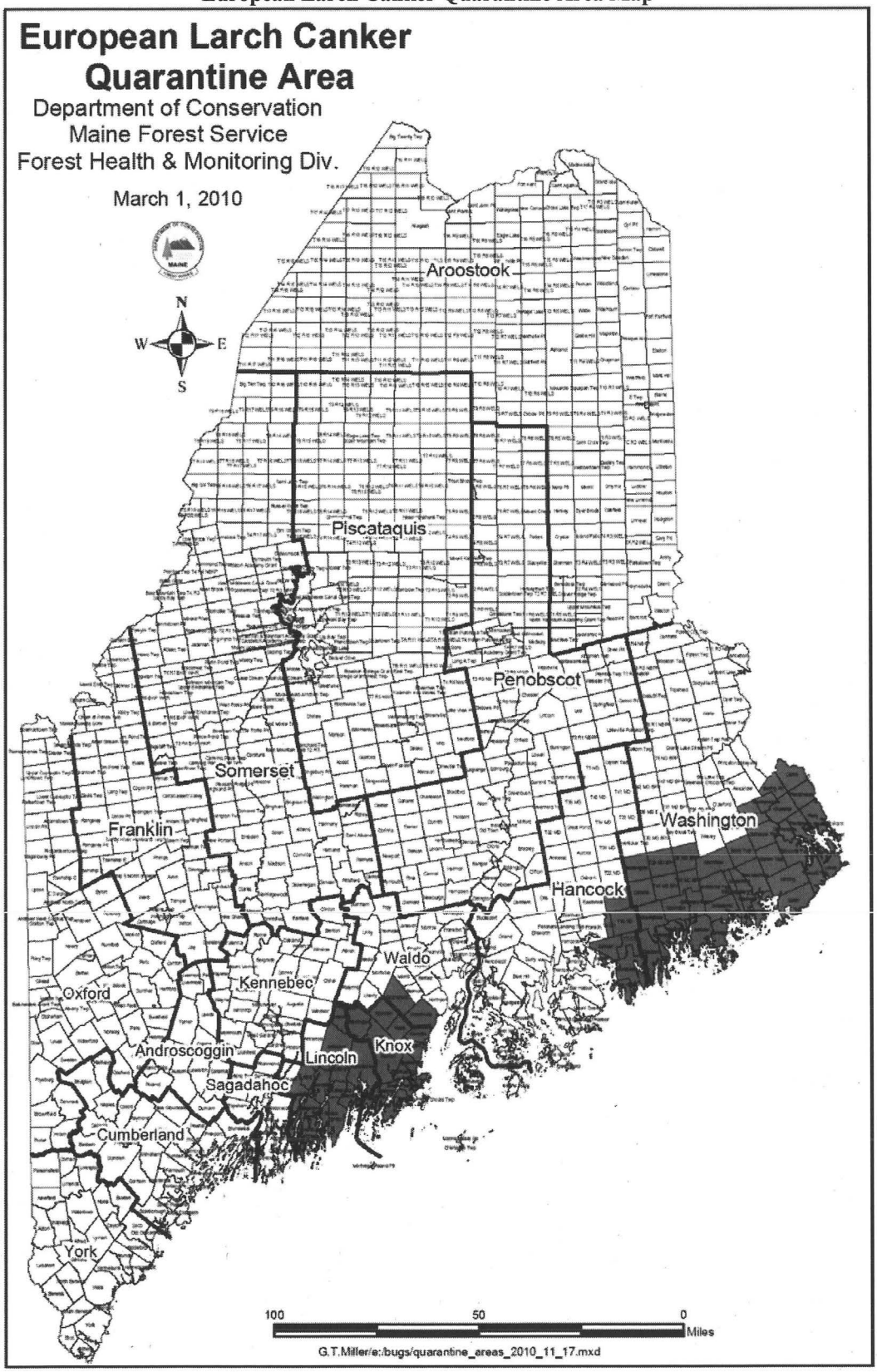
Somerset County- Anson, Athens, Bald Mountain Twp T2 R3, Bigelow Twp, Bingham, Bowtown Twp, Brighton Plt, Cambridge, Canaan, Caratunk, Carrying Place Twp, Carrying Place Town Twp, Concord Twp, Cornville, Dead River Twp, Detroit, East Moxie Twp, Embden, Fairfield, Harmony, Hartland, Highland Plt, Lexington 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

Waldo County- The entire County.

Washington County- The entire County.

York County- The entire County.

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

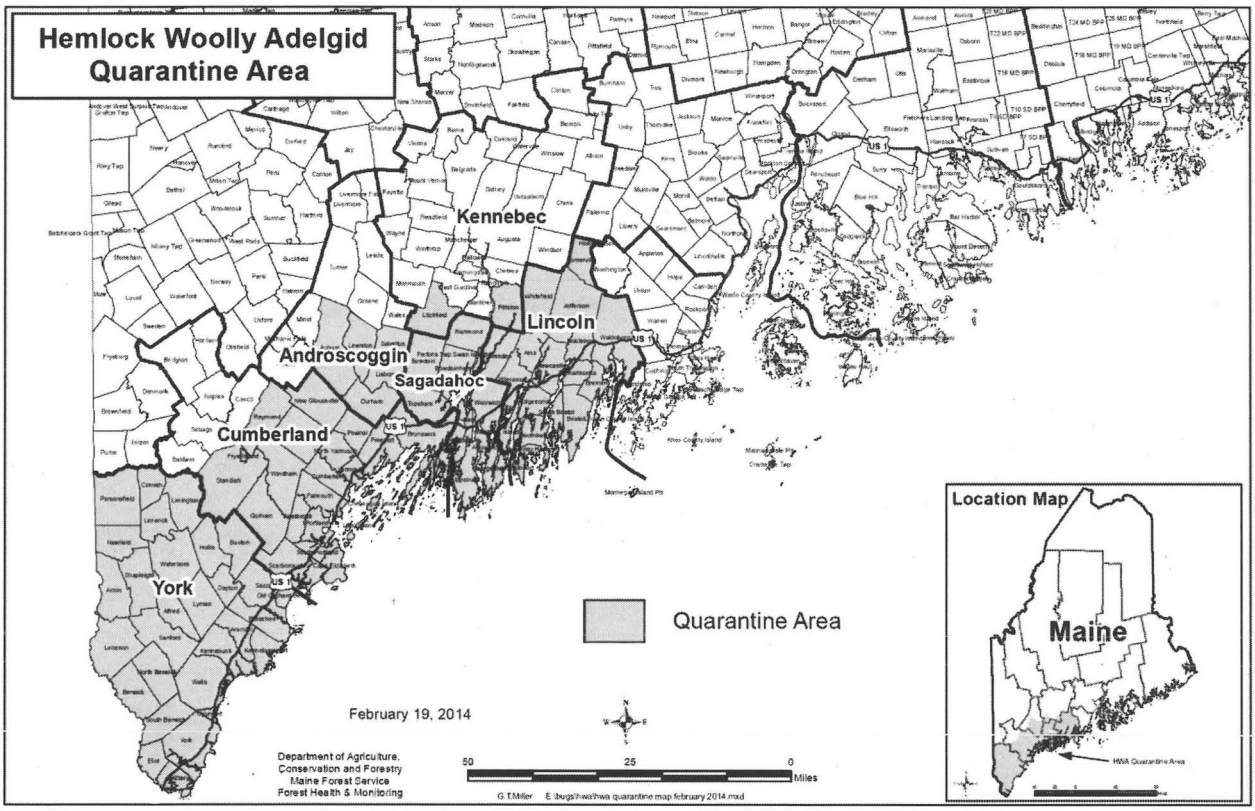
Cumberland County: the towns of Brunswick, Cape Elizabeth, Chebeague Island Cumberland, Falmouth, Freeport, Frye Island, Gray, Gorham, Harpswell, Long Island, New Gloucester, North Yarmouth, Portland, Pownal, Raymond, Scarborough, South Portland, Standish, Westbrook, Windham and Yarmouth

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

Quarantined Counties in Vermont: Bennington, Windham

Other Quarantined Areas:

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

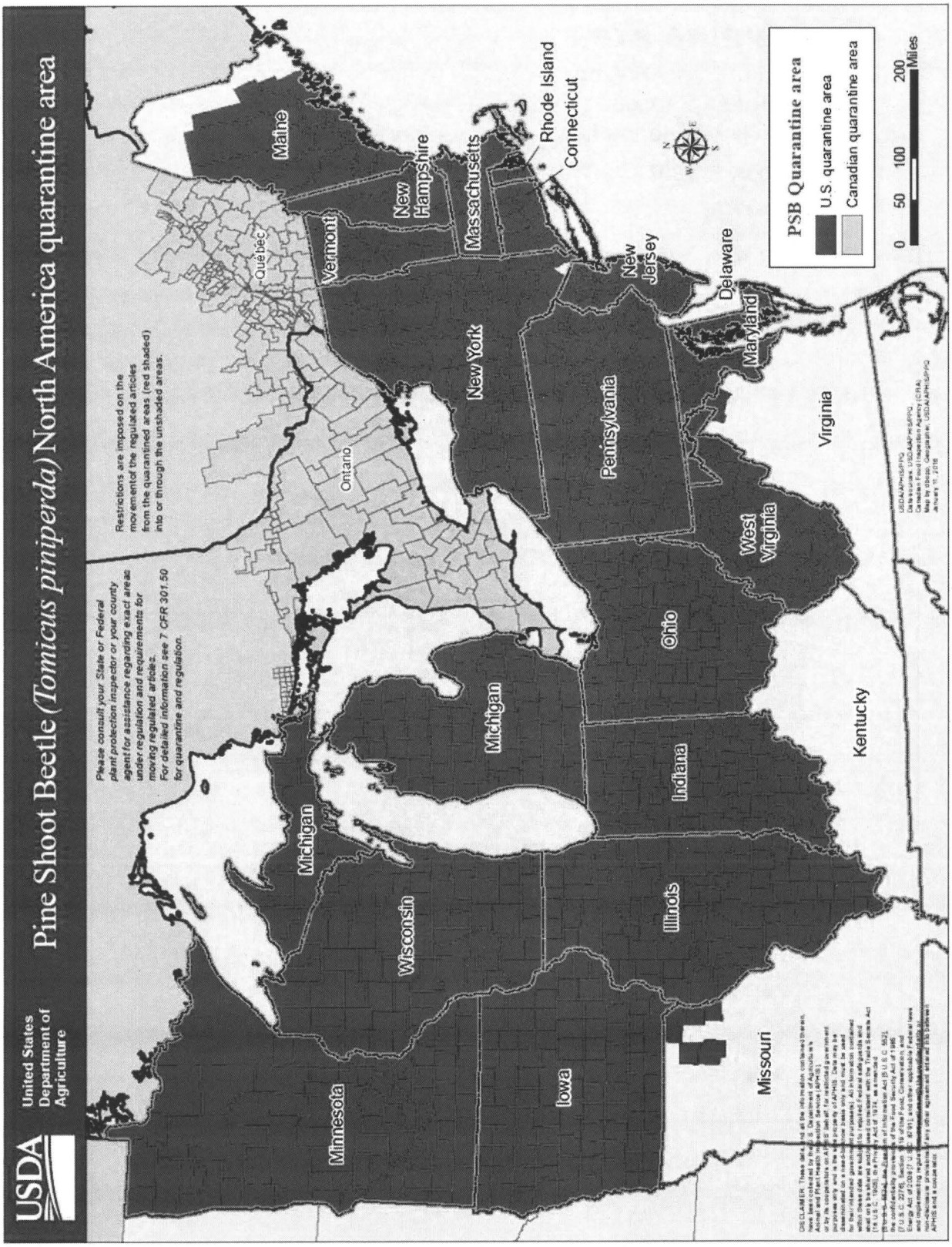
All or Parts of:
Connecticut (All)
Delaware (All)
Georgia (Parts)
Kentucky (Parts)
Massachusetts (All)
Maryland (Parts)
North Carolina (All)
New Jersey (All)
New York (Parts)
Pennsylvania (Parts)
Rhode Island (All)
South Carolina (Parts)
Tennessee (Parts)
Virginia (Parts)
West Virginia (Parts)

Western United States:

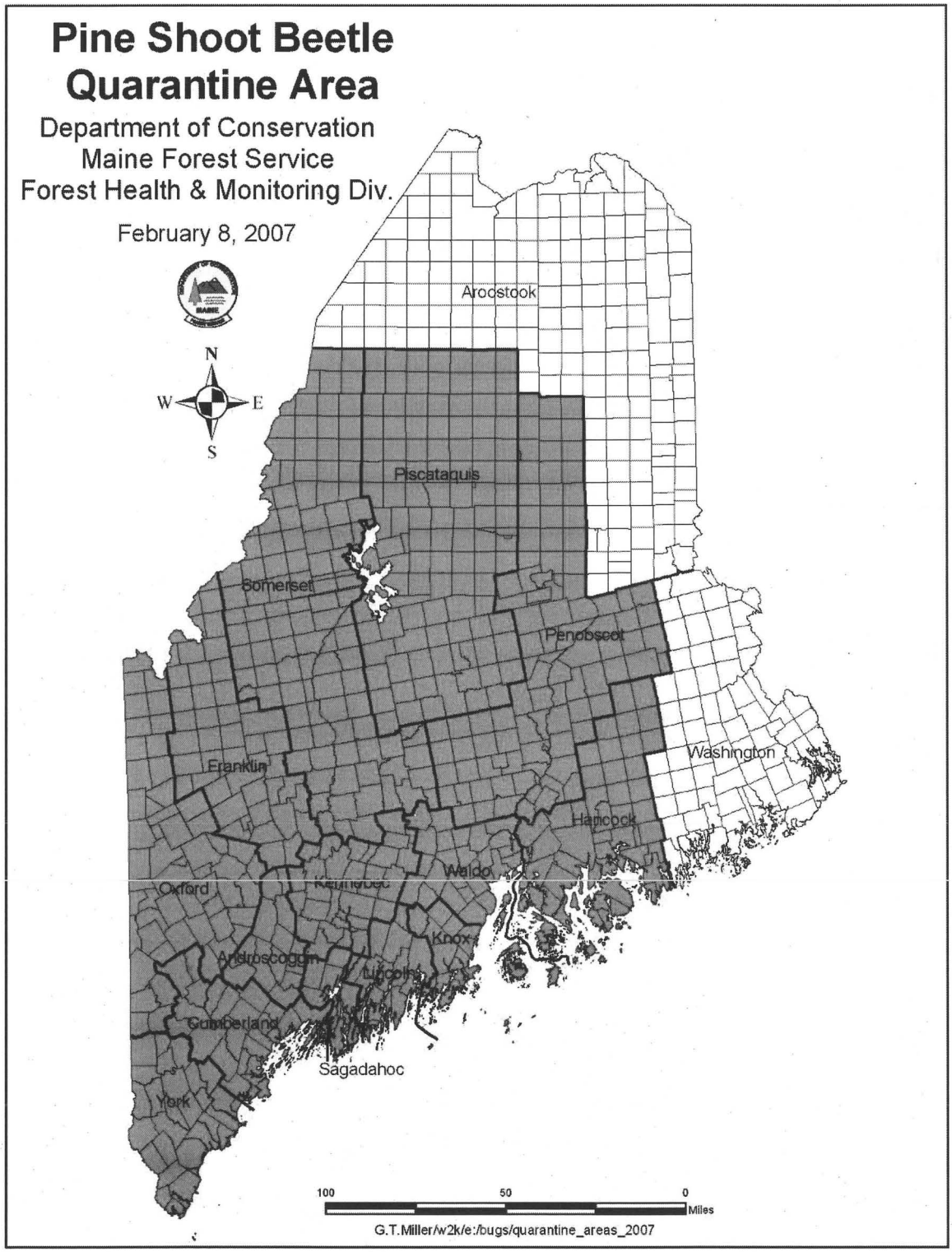
The Entire States of:
Alaska
California
Oregon
Washington

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

2014-2015 Hemlock Woolly Adelgid and Elongate Hemlock Scale Report

Allison Kanoti, Forest Entomologist
Maine Forest Service, ACF
PO Box 415 Old Town, ME 04468

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 at least from Kittery to Camden (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. Hemlock mortality was picked up in aerial survey for the first time in 2014, on Great Diamond Island (Portland) Cumberland County, with just under nine acres mapped.

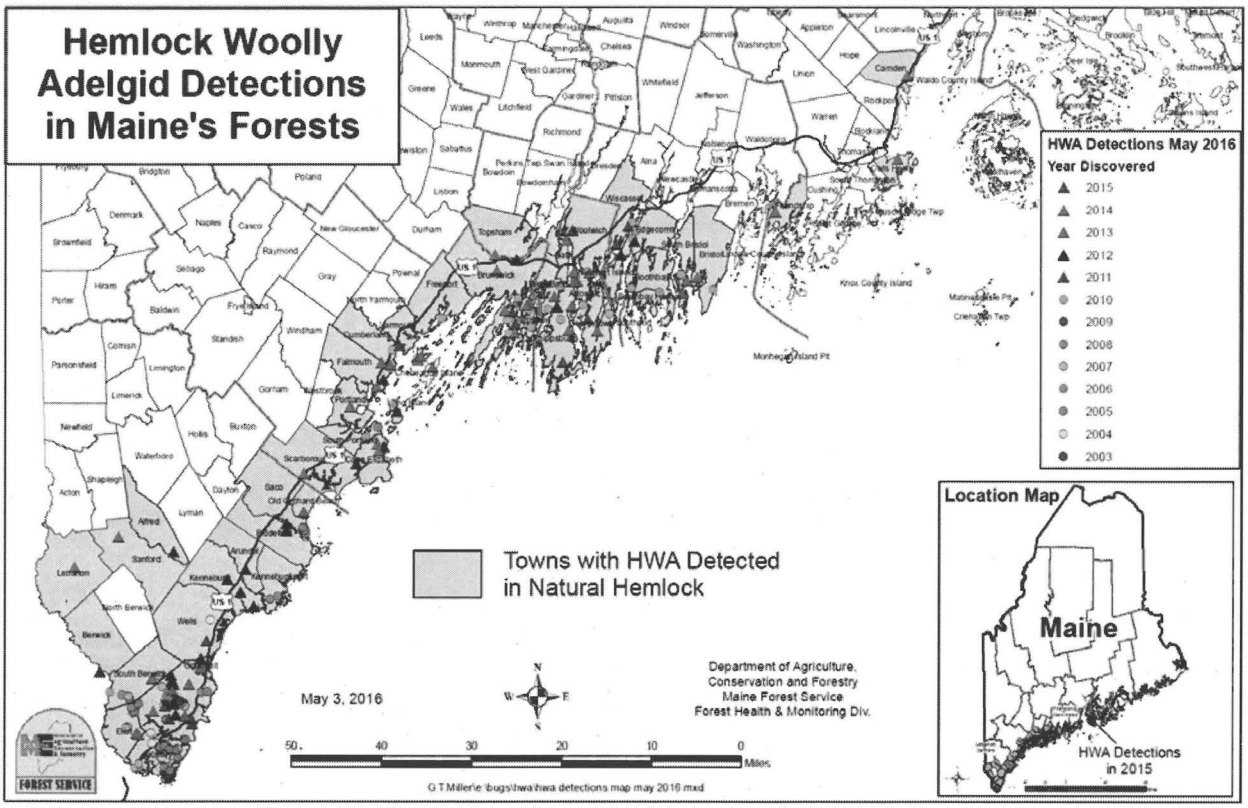


Figure B1. Hemlock woolly adelgid detections in Maine's forests

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. All subsequent forest detections have been in forests of one town (Kittery, York County). Several detections on ornamental trees are reported each year, so far scattered from Kittery to Mount Desert (Figure B2).

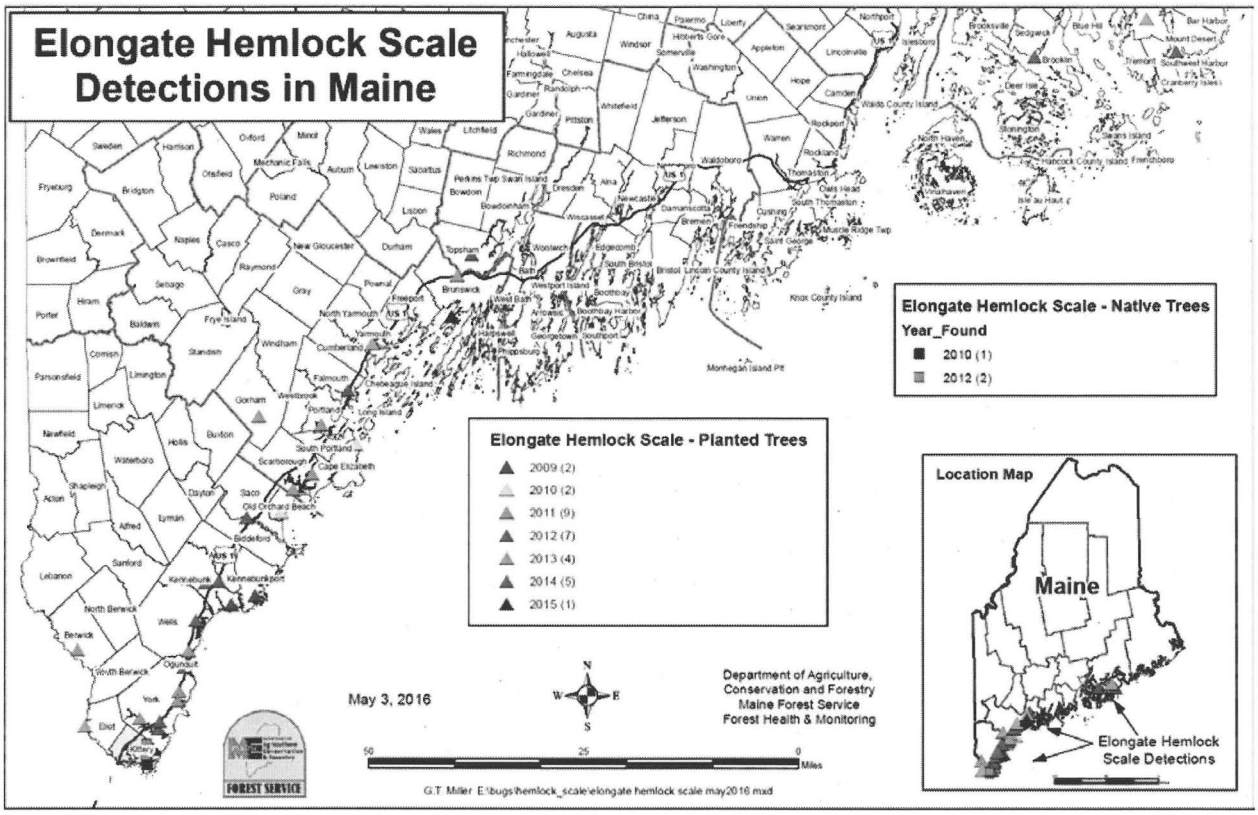


Figure B2. Locations of forest and planted tree detections of elongate hemlock scale in Maine

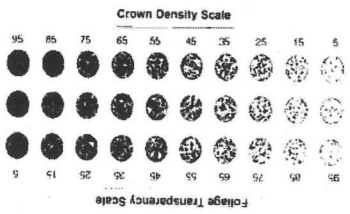
The bulk of the field work for these projects was conducted by Wayne Searles and Regina Smith. We had additional assistance from Greg Bjork (MFS-FIA), Julie Churchill, Melanie Duffy (MFS-FIA), Jocelyn Lahey and others. A summary of 2014-2015 activities related to these two pests follows.

Hemlock Impact Assessment Plots

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 2014 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 collected in 2011 and those collected in 2014 is presented below (Table B1). Data are not yet compiled from 2015 re-measurements.

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 2011 and 2014 values for selected variables on hemlock impact plots

Location	Infestation Status	No. Infested Hemlock/ No. LiveHemlock		Average Crown Density		Average Foliage Transparency		Avg. uLCR	Average Retained Foliage
		2011	2014	2011	2014	2011	2014	2014	2014
Pownal	No HWA detected	0/59	0/58	56%	40% ↓16	20%	21% ↑1	63%	1.2
Wiscasset	Light HWA infestation, detected 2011	0/50 0/31*	18/31	60% 62%*	41% ↓21*	18% 18%*	25% ↑7*	68%	1.2
Freeport	Moderate HWA infestation, detected 2010	2/63	60/63	48%	35% ↓13	21%	31% ↑10	52%	1.3
York	Light HWA, detected 2006	6/63	13/63	45%	30% ↓15	25%	37% ↑12	65%	2.0
Kittery	Heavy HWA and EHS, detected 2003 (HWA) and 2010 (EHS)	58/58 (HWA) 40/58 (EHS)	19/56 (HWA) 39/56 (EHS)	34%	31% ↓3	37%	32% ↓5	63%	2.4

*Harvest conducted in 2014. Values with * for trees present at 2011 and 2014 measurements.

There was a marked increase in readily detected infested trees at the Freeport and Wiscasset sites. As the crowns recede due to adelgid damage, this number may also decrease.

A new plot site was established in December 2015 in Hallowell (Kennebec County) outside the current known distribution of HWA and EHS.

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. Two new towns and a county were added to the list of those known to have infestations of adelgid in forest-hemlocks in 2014 as a result of this survey: Friendship and Owls Head (Knox County). In addition, Justin Williams found infestations in two new towns during his master's degree thesis work at the University of New Hampshire: Lebanon and Sanford (York County). As well, an arborist reported the first find of hemlock woolly adelgid in Camden (Knox County). In 2014, detection surveys were conducted on 221 sites across 50 towns and eight counties (Table B2) and in 2015, 150 sites, 38 towns and eight counties. In total, 276 unique sites were visited. The target of at least 200 branches surveyed was not achieved at all sites—over the two year period it was achieved at 233 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. 2014-2015 Maine Forest Service hemlock woolly adelgid detection survey by county and town
(ND = not detected in the forest; NQ = Not within the state quarantine boundary)

County	Town	Sites			Sites With >200 branches			Town HWA Detection Status	Town HWA Quarantine Status
		2014	2015	Total Sites	2014	2015	Total Sites		
Androscoggin	Auburn	2	2	2	2	2	2	ND	Quarantined
	Greene	7	7	10	7	7	10	ND	NQ
	Lisbon	2	0	2	2	0	2	ND	Quarantined
	Minot	4	4	5	4	4	5	ND	NQ
	Poland	5	5	5	5	5	5	ND	NQ
	Turner	7	5	9	7	5	9	ND	NQ
	Wales	6	5	6	6	5	6	ND	NQ
Cumberland	Baldwin	0	6	6	0	6	6	ND	NQ
	Casco	5	5	6	5	5	6	ND	NQ
	Naples	0	5	5	0	5	5	ND	NQ
	North Yarmouth	2	0	2	2	0	2	ND	Quarantined
	Scarborough	1	0	1	0	0	0	Detected	Quarantined
	Sebago	6	5	8	6	5	8	ND	NQ
	Standish	2	0	2	2	0	2	ND	Quarantined
Hancock	Ellsworth	8	0	8	3	0	3	ND	NQ
	Trenton	2	0	2	0	0	0	ND	NQ
Kennebec	Augusta	6	7	7	6	7	7	ND	NQ
	Chelsea	6	5	7	6	5	7	ND	NQ
	China	5	5	5	5	5	5	ND	NQ
	Gardiner	5	6	6	5	6	6	ND	NQ
	Hallowell	1	1	1	1	1	1	ND	NQ
	Litchfield	0	1	1	0	1	1	ND	Quarantined
	Manchester	2	2	2	2	2	2	ND	NQ
	Monmouth	6	4	8	6	4	8	ND	NQ
	Randolph	2	2	2	2	2	2	ND	NQ
	West Gardiner	5	5	5	5	5	5	ND	NQ
	Windsor	5	5	5	5	5	5	ND	NQ
Knox	Camden	5	0	5	5	0	5	Detected	NQ
	Cushing	5	5	5	0	0	0	ND	NQ
	Friendship	1	0	1	0	0	0	Detected	NQ
	Owls Head	2	0	2	1	0	1	Detected	NQ
	Rockland	4	0	4	1	0	1	ND	NQ
	Rockport	6	0	6	4	0	4	ND	NQ
	Saint George	9	4	9	0	0	0	ND	NQ
	South Thomaston	5	0	5	0	0	0	ND	NQ

County	Town	Sites			Sites With >200 branches			Town HWA Detection Status	Town HWA Quarantine Status
		2014	2015	Total Sites	2014	2015	Total Sites		
	Thomaston	6	0	6	2	0	2	ND	NQ
	Union	5	5	5	5	5	5	ND	NQ
	Warren	6	5	6	6	5	6	ND	NQ
	Washington	6	5	6	6	5	6	ND	NQ
Oxford	Hiram	0	5	5	0	5	5	ND	NQ
	Porter	0	5	5	0	5	5	ND	NQ
Saga-dahoc	Bowdoinham	0	2	2	0	2	2	ND	Quarantined
	Topsham	2	0	2	2	0	2	Detected	Quarantined
Waldo	Belfast	6	0	6	6	0	6	ND	NQ
	Lincolnville	6	0	6	6	0	6	ND	NQ
	Montville	7	0	7	7	0	7	ND	NQ
	Northport	4	0	4	3	0	3	ND	NQ
	Palermo	5	5	5	5	5	5	ND	NQ
	Searsport	6	0	6	4	0	4	ND	NQ
	Stockton Springs	6	0	6	4	0	4	ND	NQ
York	Acton	3	0	3	3	0	3	ND	Quarantined
	Buxton	2	0	2	2	0	2	ND	Quarantined
	Cornish	0	2	2	0	2	2	ND	Quarantined
	Dayton	0	2	2	0	2	2	ND	Quarantined
	Hollis	0	2	2	0	2	2	ND	Quarantined
	Limerick	0	2	2	0	2	2	ND	Quarantined
	Limington	0	2	2	0	2	2	ND	Quarantined
	Lyman	4	0	4	4	0	4	ND	Quarantined
	Newfield	0	2	2	0	2	2	ND	Quarantined
	North Berwick	3	0	3	3	0	3	ND	Quarantined
	Parsonsfield	0	3	3	0	3	3	ND	Quarantined
	Sanford	1	0	1	1	0	1	Detected	Quarantined
	Shapleigh	4	0	4	4	0	4	ND	Quarantined
	Waterboro	0	2	2	0	2	2	ND	Quarantined
		221	**150**	**276**	**178**	**141**	**233**	**6**	**22**

An EHS detection survey was conducted within York County in 2015. This survey was initiated 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. Variables collected included hemlock health, adelgid density, and scale density comments (surveys likely not enough to fully evaluate overall density of scale in the site). Surveyors looked for sites of at least 5 acres with more than 100 hemlocks. In 2015, many of the towns in York County were surveyed

(Table B3). The survey did not result in detection of scale or adelgid in the forest in any new towns. Plans are to continue the survey in 2016.

Hemlock Health

Good: foliage has normal color and density (transparency), overall appearance is good.

Fair: foliage somewhat off-color and/or some trees have thinning crowns, overall appearance is fair. Some branch recession

Poor: most trees stressed, foliage chlorotic and/or thinning crowns common, overall appearance poor. Crowns severely receded. Live crown ratios very low.

Dead: Most trees dead

HWA/EHS Density

Absent: None detected

Trace: Infestation detectable on a few branches within the sample area (site) or tree (point).

Low: Most trees uninfested (site) and/or have <10% infested branches (site/point)

Medium: ≥ 50% trees infested (site), most infested trees have 10-50% branches infested (site/point).

High: Most trees infested and most have >50% of branches infested (site/point).

Table B3. 2015 Survey sites for elongate hemlock scale and hemlock woolly adelgid in York County

Title	Town	Hemlock Health	HWA Density	EHS Detected?	Comments
Acton 1	Acton	Poor	Absent	N	
Acton 2	Acton	Fair	Absent	N	
Alfred 1	Alfred	Good	Absent	N	
Arundel 1	Arundel	Good	Absent	N	
Arundel 2	Arundel	Good	Absent	N	
Berwick 1	Berwick	Good	Absent	N	
Berwick 2	Berwick	Fair	Absent	N	
Biddeford 1	Biddeford	Good	Absent	N	
Biddeford 2	Biddeford	Good	Absent	N	
Dayton 1	Dayton	Good	Absent	N	
Dayton 2	Dayton	Good	Absent	N	
Eliot 1	Eliot	Good	Medium/High	N	
Eliot 2	Eliot	Fair	Absent	N	Did not meet 200 branch target (~ 20 trees).
Hollis 1	Hollis	Fair	Absent	N	
Kennebunk 1	Kennebunk	Good	Absent	N	
Kennebunkport 1	Kennebunkport	Good	Trace	N	
Kennebunkport 2	Kennebunkport	Fair	Trace	N	
Kittery 1	Kittery	Poor	Medium/High	YES	Trace EHS, found on <10
Kittery 2	Kittery	Good	Trace	YES	Trace EHS, found on <10%
Kittery 3	Kittery	Fair	Medium/High	YES	EHS present on almost all trees edge, thins out in center
Limington 1	Limington	Good	Absent	N	
Limington 2	Limington	Good	Absent	N	
Lyman 1	Lyman	Good	Absent	N	
Lyman 2	Lyman	Fair	Absent	N	
Newfield 1	Newfield	Fair	Absent	N	
Newfield 2	Newfield	Fair	Absent	N	

Title	Town	Hemlock Health	HWA Density	EHS Detected?	Comments
North Berwick 1	North Berwick	Fair	Absent	N	
Old Orchard Beach 1	Old Orchard Beach	Good	Absent	N	
Parsonsfield 1	Parsonsfield	Good	Absent	N	
Parsonsfield 2	Parsonsfield	Good	Absent	N	
Sanford 1	Sanford	Good	Absent	N	
Sanford 2	Sanford	Good	Absent	N	
Shapleigh 1	Shapleigh	Good	Absent	N	
Shapleigh 2	Shapleigh	Good	Absent	N	
South Berwick 1	South Berwick	Fair	Absent	N	
South Berwick 2	South Berwick	Fair	Absent	N	
Waterboro 1	Waterboro	Good	Absent	N	
Waterboro 2	Waterboro	Good	Absent	N	
Wells 1	Wells	Fair	Absent	N	
York 1	York	Good	Absent	N	
York 2	York	Poor	Medium/High	N	

Winter Mortality Survey

Winter mortality data was collected for a project in cooperation with Virginia Tech's Tom McAvoy for the first year in 2014. As a result, the approach to sampling changed slightly. Adelgid infested branches were collected from five sites for observation under a dissecting scope in early March. The USFS collected samples from a sixth site in Maine. Sistens and progrediens density counts were conducted at three sites and results were submitted to our cooperator. Mortality ranged from 67 to 87% across six sites, and averaged 78% (Table B4). In comparison, mortality over the mild winter of 2011-2012 was less than 18% across five sites.

The study was repeated in 2015 at a different set of sites—two of the five sites sampled were repeat sites. Sampling is planned for 2016—as much as is possible the sampling will take place on the same sites as in 2015.

Table B4. Hemlock woolly adelgid overwintering mortality (Winter 2013-2014 & 2014-2015)

Location	County	Date Collected	Live HWA	Dead HWA	% Mortality
Cape Elizabeth	Cumberland	3/10/2014	101	424	81
Falmouth	Cumberland	3/10/2014	65	440	87
Freeport	Cumberland	3/11/2014	202	407	67
Portland	Cumberland	3/10/2014	55	229	81
Wiscasset	Lincoln	3/11/2014	139	500	78
Kittery	York	3/7/2014	121	398	77
Winter 2013-2014 Summary			**683**	**2398**	**78**
Cape Elizabeth*	Cumberland	2/23/2015	38	469	93
Freeport*	Cumberland	2/23/2015	54	275	84
Bath	Sagadahoc	2/23/2015	11	467	98
South Berwick	York	2/23/2015	14	464	97
York	York	2/23/2015	33	467	93
Winter 2014-2015 Summary			**150**	**2142**	**93**

* Site sampled in 2014 and 2015

Biological Control

Biological control establishment efforts continue in Maine. In 2014, 14,000 *Sasajiscymnus tsugae* (St) lady beetles were released in Maine (Table B5). Some of the beetles were received from North Carolina Department of Agriculture through a cooperative agreement with USDA APHIS PPQ. Others were purchased from a commercial supplier through a grant with USDA Forest Service. Release sites were in Bath (Sagadahoc County), Portland (Cumberland County), Sanford and South Berwick (York County) and Wiscasset (Lincoln County). In 2015 MFS purchased 6969 St beetles under a USFS grant, and an additional 303 were purchased with funding from the City of Portland. Release sites were in Woolwich (Sagadahoc County) and Portland (Cumberland County).

Table B5. 2014 and 2015 *Sasajiscymnus tsugae* releases

County	Town	nRelease	Release Month and Year
Cumberland	Portland	1,000	May 2014
Lincoln	Wiscasset	1,500	May 2014
Sagadahoc	Bath	4,500	June 2014
York	Sanford	5,000	May 2014
York	South Berwick	2,000	May 2014
Cumberland	Portland*	303	June 2015*
Sagadahoc	Woolwich	6,969	June 2015

*Purchase and release by the City of Portland

Since the initial detection of HWA in Maine's forests, the MFS has facilitated the release of over 98,800 St beetles and more than 5000 *Laricobius nigrinus* beetles (Table B6). 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 B7).

Table B6. Hemlock woolly adelgid biological control releases 2004-2015

County/Town	*Laricobius nigrinus* Released	*Sasajiscymnus tsugae* Released
Cumberland		**24,303**
Cape Elizabeth		5,000
Freeport		10,500
Harpswell		7,500
Portland		1,303
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**	**98,840**

Table B7. 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

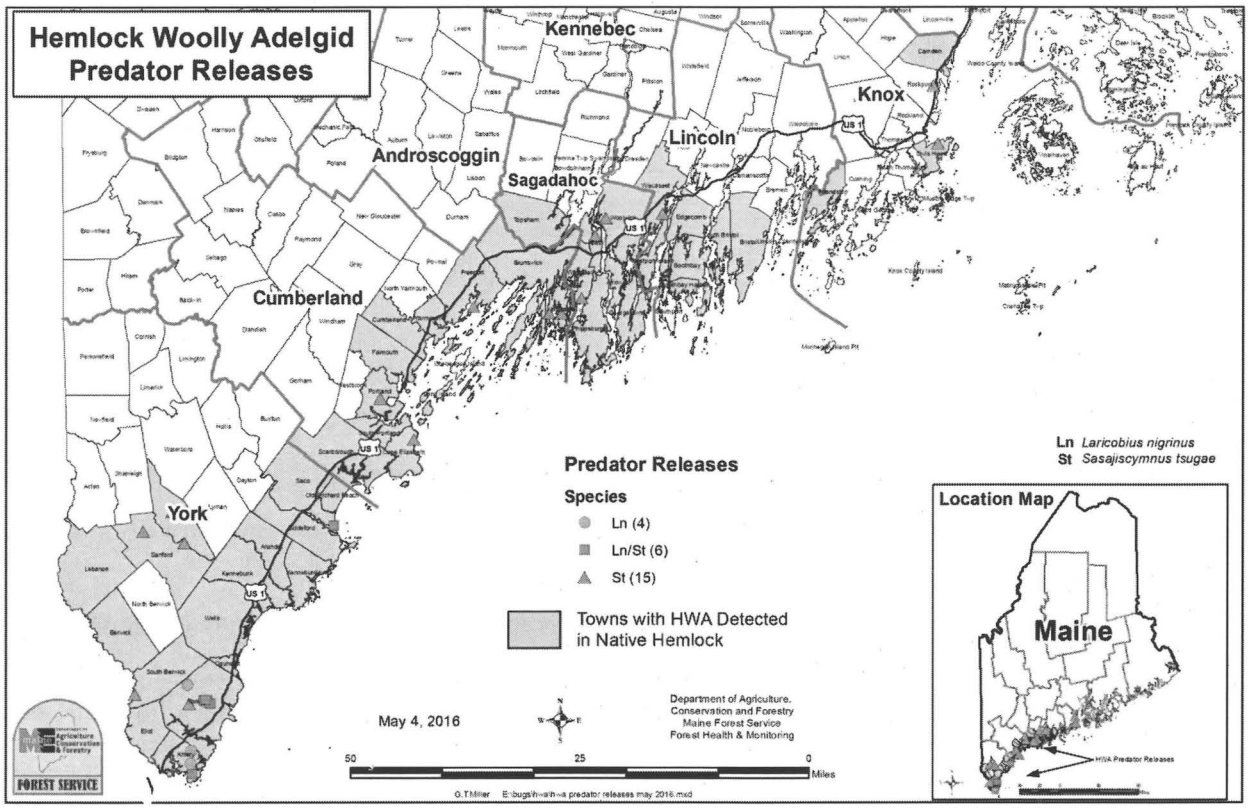


Figure B3. *Sasajiscymnus tsugae* and *Laricobius nigrinus* release sites in Maine 2002-2015

Each fall release sites are sampled to determine whether the predator beetles have become established. In 2014, *Laricobius nigrinus* were recovered from two sites in York (York County). A subsample was submitted to USFS for genetic evaluation which confirmed they were indeed offspring of a *L. nigrinus* mother. Genetic analysis to confirm identity is required due to hybridization with the native *L. rubidus*. *S. tsugae* beetles were recovered from release sites in Harpswell and Freeport (Cumberland County). No beetles were recovered during 2015 sampling (Table B8 and Table B9).

Table B8. *Laricobius nigrinus* recoveries in Maine (2007-2015)

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

Table B9. *Sasajiscymnus tsugae* recoveries in Maine (2005-2015)

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

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 2014 a site in Brunswick (Cumberland County) was treated to contain EHS. The site was within a housing development with abundant planted and native host. The infested planting consisted of a row of heavily infested fir. Those and neighboring fir and hemlock were treated by the MFS contractor with dinotefuran.

In 2015 hemlock at a high-traffic site in Camden (Knox County) at the northern leading edge of the known distribution of HWA were treated to slow the spread of that insect. Trees were either treated with dinotefuran/imidacloprid tank mix or an imidacloprid-only systemic application. This was considered a high risk site due to its location at the leading edge of known natural spread and potential traffic from the site to natural areas including Camden Hills State Park. Treatment at this site is expected to delay introductions to natural areas within a reasonable driving distance of the site. Approximately 290 dbh inches were treated across approximately 30 stems.

Treatments to contain EHS were planned in 2015 but were not undertaken due to difficulties with the contracting process.

Appendix C
Spruce Budworm in Maine 2014 & 2015

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Part I: Spruce Budworm (*Choristoneura fumiferana*) in Maine 2014

After the spruce budworm (SBW) outbreak in the 1970-80's the SBW populations declined sharply and remained at very low levels in Maine until recent years. The number of SBW moth caught in both pheromone traps and light traps are now on the rise. The number of SBW moths caught in New Brunswick is on the rise as well. Quebec has a very large and severe SBW outbreak to our north with 10.5 million acres of SBW-caused defoliation. This is an insect that goes into outbreak mode over vast region and flights of moths from heavily infested areas can migrate to new areas.

The Maine Forest Service (MFS), cooperators within and outside the state, and Canadian provinces use pheromone traps located throughout the spruce-fir resource to forecast SBW trends. In addition the MFS has a light trap system that has a long history of budworm trend prediction in Maine.

Light traps have been used in Maine since the 1940's to predict trends in budworm populations and continue to be employed for tracking forest defoliators. Evaluation of 15 years of light trap data from 10 permanent location showed that the data predicted an upturn in defoliation 4 to 7 years prior to budworm outbreaks. Pheromone traps are more sensitive to low level SBW populations than are light traps and improve predictive abilities. The Province of Quebec has employed a pheromone trapping system for years and has reported a good correlation between moth catches and the resulting larval populations and subsequent defoliation. Pheromone traps are also relatively inexpensive and easy to deploy and retrieve. If moth catches exceed threshold levels, then larval sampling could be used to check pheromone predictions (given enough human resources.)

Fifteen 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 with additional sites slowly being added to the array. In recent years the MFS has run 40 sites, Irving 26 sites, the Penobscot Nation 12 sites, Baxter Sate Park two and the USDA-FS seven for a total of 85 locations potential sample sites in a year. Not all the sites are run each year for various reasons but entities try to run as many as possible.

Methods:

Pheromone Trapping

Spruce budworm traps were placed at 412 sites (precise locations available upon request) across the northern half of Maine in 2014. Traps were placed by the following 21 land owners or managers:

American Forest Managment
Appalachian Mountain Club
Baskahegan
Baxter State Park
HC Haynes/Lakeville Shores
Huber Corporation
J. D. Irving
Katahdin Forest Management
LandVest
Materiax Blanchet
Maine Forest Service
North Maine Woods
Orion Timberlands
Maine Bureau of Parks and Lands
Penobscot Experimental Forest (USFS)
Penobscot Nation
Plum Creek
Prentiss and Carlisle
Seven Islands Land Company
USDA Forest Service
Wagner Forest Management

It was requested that traps be placed approximately one per township of every six miles with traps were placed in stands that were 25 acres or larger and at least 50% pole-sized or larger spruce/fir. Cooperators chose the sites based on where they had an interest in monitoring for SBW. The trapping method follows standardized protocol used by both Canadians and Americans since 1986. http://phero.net/iobc/montpellier/sanders.html.

Each site was a three trap cluster located in a spruce-fir stand. The trees were mature or pole sized trees, uncut or lightly cut spruce-fir stands and could be pre-commercially thinned or shelterwood stands. Cooperators were told to place traps at a point of average elevation for the general area or higher. The trap arrays were 130 feet from the road and arranged in a triangle with traps 130 feet from each other. Traps were set out during the first three week of June before the moth flight which usually occurs at the end of June- July. Traps were retrieved after mid-August, the catch from the three traps were combined and put in one gallon ziplock bag. The number of traps successfully retrieved was recorded along with the date (in most cases). The catch was mailed to the MFS Entomology lab for counting.

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/html/lures_-_baits.html and is the same lure used in Nova Scotia, Prince Edward Island and Newfoundland. This is a different brand from past years when Contech lures were used. The insecticide used in the traps is a 1" x 4" strip (10% DDVP) brand Vaportape II.

Seven of the traps, six run by gate keepers for the North Maine Woods and one by a light trap operator in Allagash, were checked on a regular basis to see when the spruce budworm moths were flying.

Light Traps

Light traps have been used to monitor spruce budworm populations in Maine for decades and continue to be used today. In 2014 there were 21 traps run by Maine residents in their backyards. They are paid a small stipend for checking the traps daily. All but two of the traps are Rothamstead style traps utilizing a 150 W light bulb to attract moths. The other two traps are black light traps and one of those is battery powered. Traps are run for either 45 days (June 17-July 31) or for 30 days (3-31 July) depending on the trap location.

Damage Survey.

Both ground and aerial surveys were conducted in 2014 looking specifically for spruce budworm in northern Maine where damage would first appear. Due to a lack of personnel the ground surveys were limited to roadside surveys in areas where trap counts were highest.

Results:

No feeding damage from SBW was apparent in either ground or aerial surveys. 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.

Moth counts from light traps were low with six traps catching just 43 moths. Last year seven traps caught 84 moths. Only two of the traps caught budworm in both 2013 and 2014. These traps were in Allagash and T15 R15 WELS in the most northern part of the state. In the 10 years previous to 2013 there were less than 10 spruce budworm moths caught in all the light traps combined. Therefore the past two 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 get caught.

The expanded SBW pheromone survey shows SBW widespread but at low numbers across most of the trapping range (Figure C1). 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 an impact. Of the 412 trap sites 19 had no sample, most often due to bears, while the remaining 393 sites had at least one trap out of three intact. Twenty-seven

sites had no budworm leaving 366 sites with budworm. Therefore 93% of the sites had budworm. The majority of the sites (98%) have moth catches in the detectable but low range (Table C1). Once numbers start to get above 100 moths/trap then defoliation may become detectable.

This year Maine switched brands of pheromone for both quality and economic reasons. We did not do any lure brand comparisons but Newfoundland did. Correspondence with Dan Lavigne, Newfoundland Department of Natural Resources, indicates that the potency of the Synergy brand pheromone is higher than the Contech brand pheromone that MFS has usually used in the past. So care should be taken comparing to past years.

Table C1.Number of sites and percentage of spruce budworm moths caught 2014

Average Number of Moths Caught	Number of Sites	Cumulative % of Sites
0	27	6.87
0.01 - 2.0	59	21.88
2.01 - 4.0	56	36.13
4.01 - 7.0	56	50.38
7.01 - 20.0	110	78.37
20.01 - 50.0	56	92.62
50.01 - 100.0	23	98.47
100.01 - 150.0	5	99.74
150.01 - 211.0	1	100

Aroostook County encompasses the most northerly part of state and was the most heavily trapped with 163 locations. It had the highest average number of moths at 25.79 per trap (Table C2). Somerset, Piscataquis and Penobscot Counties were trapped primarily in the northern half of each county accounting for the lower number of traps in those jurisdictions. Somerset and Piscataquis had half as many moths/trap at 12.79 and 10.22 respectively. The percentage of traps with no budworm in Washington may be higher than reality as there was concern by the trapper that there should have been some moths in those traps as there had been some in at least some if the traps in past years.

Table C2. Average spruce budworm moth catch/pheromone trap by county 2014

County	**Average SBW/Trap**	**Number of Traps**	**% with Budworm**
Aroostook	25.79	163	99.39
Somerset	12.79	54	92.59
Piscataquis	10.22	82	95.12
Penobscot	6.31	32	90.63
Washington	3.20	28	71.43
Hancock	2.36	10	80.00
Oxford	1.06	12	75.00
Franklin	0.85	12	83.33
Total		**393**	**93.13**

Looking at just the sites that have been trapped for the past 22 years the trend toward increasing numbers of budworm is apparent (Figure C2). Even taking into account the lure brand change may have doubled the trap catch, the trend continues to be upward. Also budworm catches tend to seesaw up and down as can be seen over the past two decades.

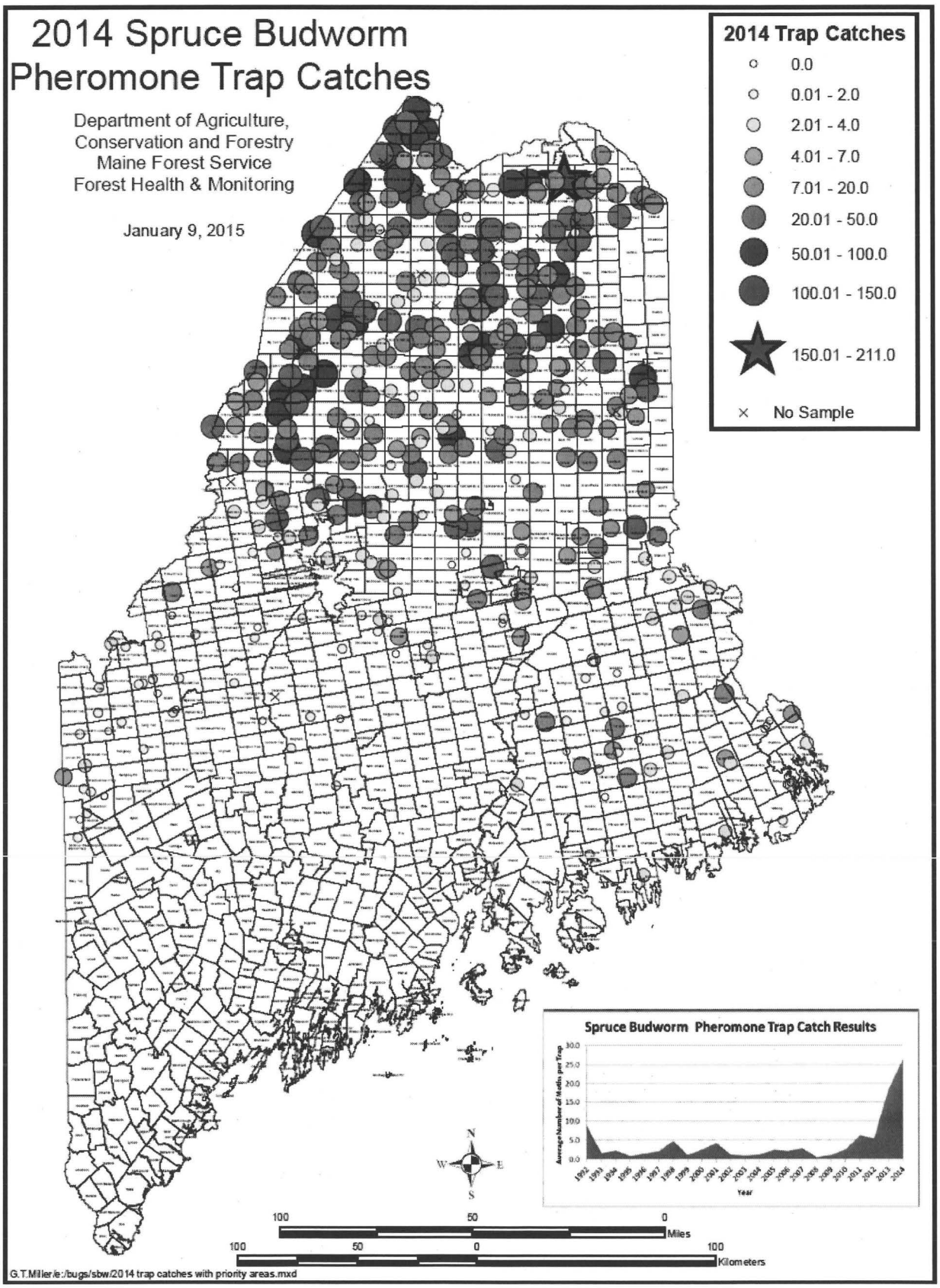

Figure C1. 2014 Spruce budworm pheromone trap catches

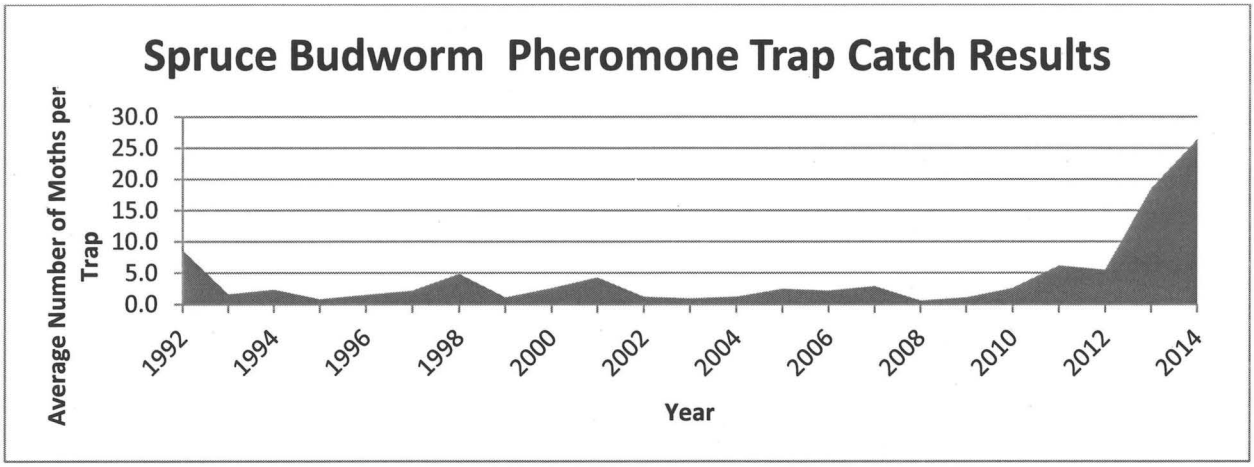

Figure C2. Long term budworm pheromone average trap catches 1992-2014

There were seven pheromone traps and six light traps (that caught spruce budworm) that were checked on a daily basis in order to track when the budworm were flying. This may give us insight as to whether the moths are 'home-grown' or in-flights from north or west of Maine. This monitoring is being integrated into an on-going regional international study of SBW moth flight patterns. It is still too early to say very much about the current relative importance of in-flights.

The pheromone survey went extremely well considering that the scope was increased by an order of magnitude and there were twenty-one cooperators involved with many people on the ground setting out and collecting traps. We need to look at coverage and decide if there are holes in the current trapping network where we should deploy additional traps in future years. Companies now have the bulky traps on hand. Lures, kill strips and replacement parts can be mailed if no new training is need although I would recommend having training sessions where updates can be provided and questions answered.

Pheromone traps should be out by June 14th to catch local flights in warm years. Daily pheromone traps and light traps should begin checks at this time as well based on data from the very warm year 2013 (Figure 3. Cooke, B., personal communication).

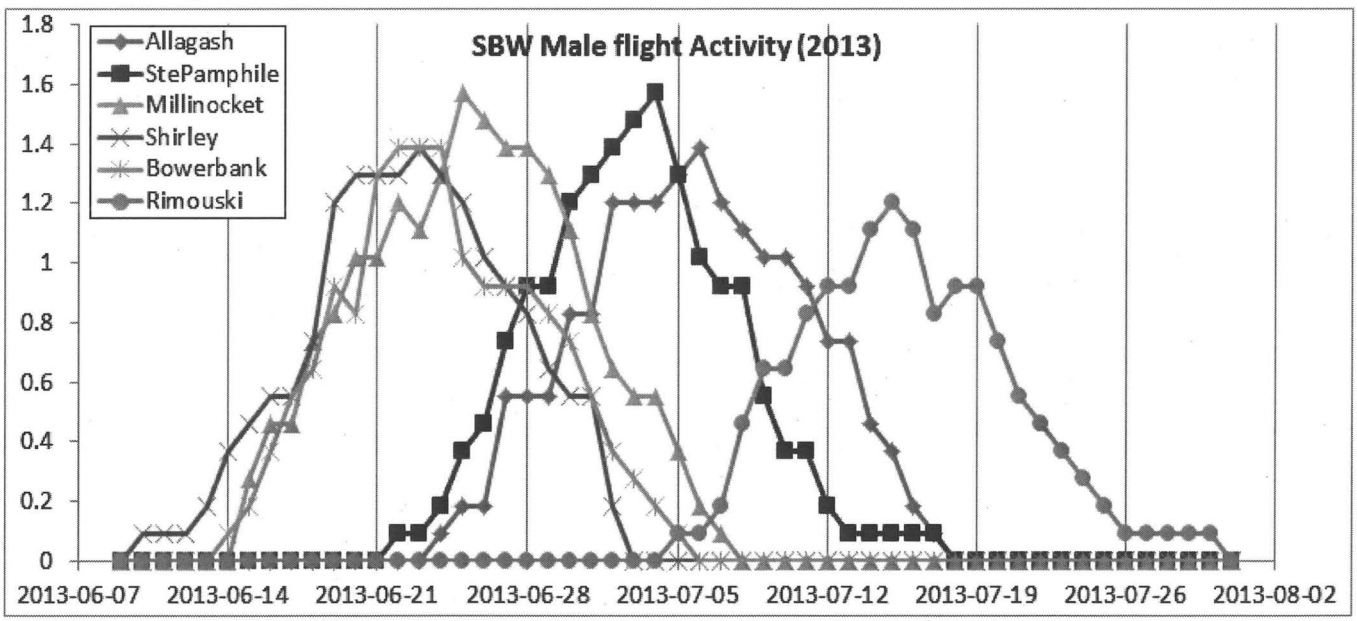

Figure C3.Spruce budworm male flight activity (2013)

Part II: Spruce Budworm (*Choristoneura fumiferana*) in Maine 2015

Spruce budworm is being closely monitored in Maine in order to plan for another outbreak of this native defoliator. Spruce budworm populations have shown a steady rise over the past four years from almost non-existent to moths being present in most pheromone traps set out. Defoliation has not been observed in Maine yet but increasing levels of adults here and in New Brunswick indicate that noticeable feeding on fir and spruce may not be far off. Quebec's infestation now encompasses over 15.6 million acres and has spread south onto the Gaspe Peninsula from north of the Saint Lawrence Seaway. This is an insect that goes into outbreak mode over vast regions and flights of moths from heavily infested areas can migrate to new areas.

The Maine Forest Service (MFS), 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 Maine forests. Pheromone traps, light traps, overwintering larval samples, ground and aerial surveys are being employed to determine the trend of spruce budworm.

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. Last year the monitoring program was significantly expanded with 21 land owners and managers participating in setting and retrieving traps at 412 sites. The pheromone trap monitoring program was run again in 2015.
In 2015 spruce budworm pheromone traps were placed at 448 sites (precise locations available upon request) across the northern half of Maine by 21 land owners or managers (Table C3).

Table C3. Spruce budworm pheromone survey cooperators 2015

American Forest Management	North Maine Woods
Appalachian Mountain Club	Orion Timberlands
Baskahegan	Maine Bureau of Parks and Lands
Baxter State Park	Penobscot Experimental Forest (USFS)
Forest Society of Maine	Penobscot Nation
Huber Corporation	Plum Creek
J. D. Irving	Prentiss and Carlisle
Katahdin Forest Management	Seven Islands Land Company
LandVest	University of Maine
Maine Forest Service	USDA Forest Service
	Wagner Forest Management

It was requested that traps be placed approximately one per township or every six miles with traps placed in stands that were 25 acres or larger and at least 50% pole-sized or larger spruce/fir. Cooperators chose the sites based on where they had an interest in monitoring for spruce budworm. The trees were mature or pole sized trees, uncut or lightly cut spruce-fir stands and could be pre-commercially thinned or shelterwood stands.

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

At most site there was a three trap cluster with traps arranged in a triangle with traps 130 feet from each other, away from the road and at an average elevation for the area. Traps were set out during the first three weeks of June and retrieved after mid-August. The catch was mailed to the MFS Entomology lab for processing.

At ten of the locations traps were checked twice a week. This allows us to see when moth flights peak and compare it to predicted emergence for the location. Late season flights indicate in-migration from north of us i.e. the Quebec infestation. Additionally, a University of Maine graduate student was doing a bird study and he put out 129 traps in Maine (plus more in New Hampshire!!). Those trap numbers have been averaged for the townships where they were placed and added to the other data.

The expanded spruce budworm pheromone survey shows spruce budworm is widespread but still at low numbers across the trapping range (Figures C4 and Figure C5). 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 an impact. Of the 448 trap sites, 11 had no sample, most often due to bears, while the remaining 437 sites had at least one trap out of three intact. Only ten sites had no budworm in any of the traps which translate into 98% of the sites with budworm. The majority of the positive [?] sites (98%) have moth catches in the detectable but low range and the number are slightly higher than in 2014 (Figure C6). Once the number of moths/ pheromone trap rise above 100 moths/trap then defoliation may become detectable.

Aroostook County encompasses the most northerly part of state and was the most heavily trapped with 181 locations as compared to 164 sites in 2014. It had the highest average number of moths up from 25.8 per trap to 44.9 moths in 2015. Somerset, Piscataquis and Penobscot Counties were trapped primarily in the northern half of each county accounting for the lower number of traps in those jurisdictions. The average numbers of moths per trap in Piscataquis and Penobscot counties doubled from last year while the number in Somerset fell by half (Figure C4). One possible explanation for the 2015 decrease in moths in Somerset County may be that there was a moth flight from Quebec in 2014 that bumped up counts in a cluster of traps. The numbers of moths is still very low and fluctuations of just a few moths can make the numbers change dramatically. The other counties, Franklin, Hancock, Oxford and Washington all had fewer than ten moths/trap. These very low numbers in all but Aroostook County mean there is still time to plan for a spruce budworm outbreak.

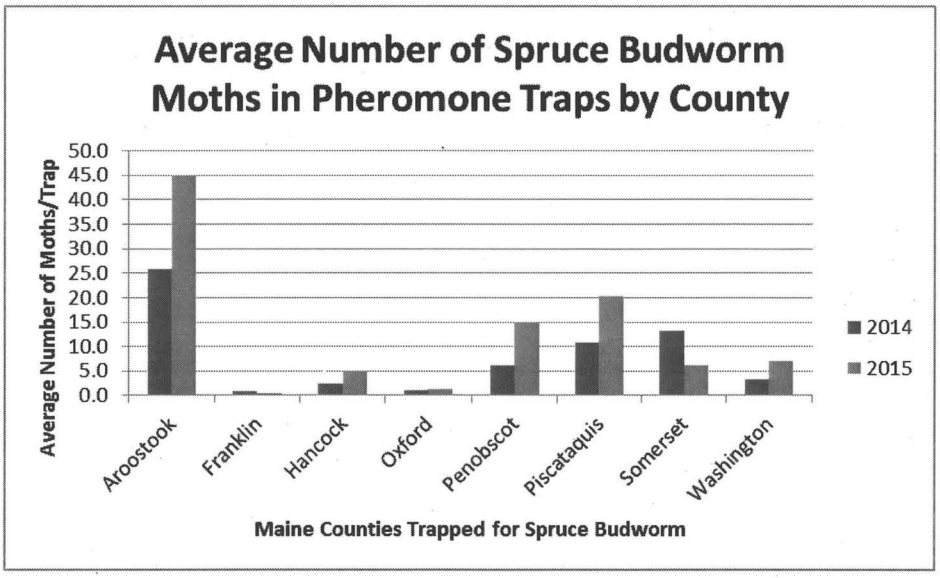

Figure C4. Average number of spruce budworm moths in pheromone traps by county in Maine 2015

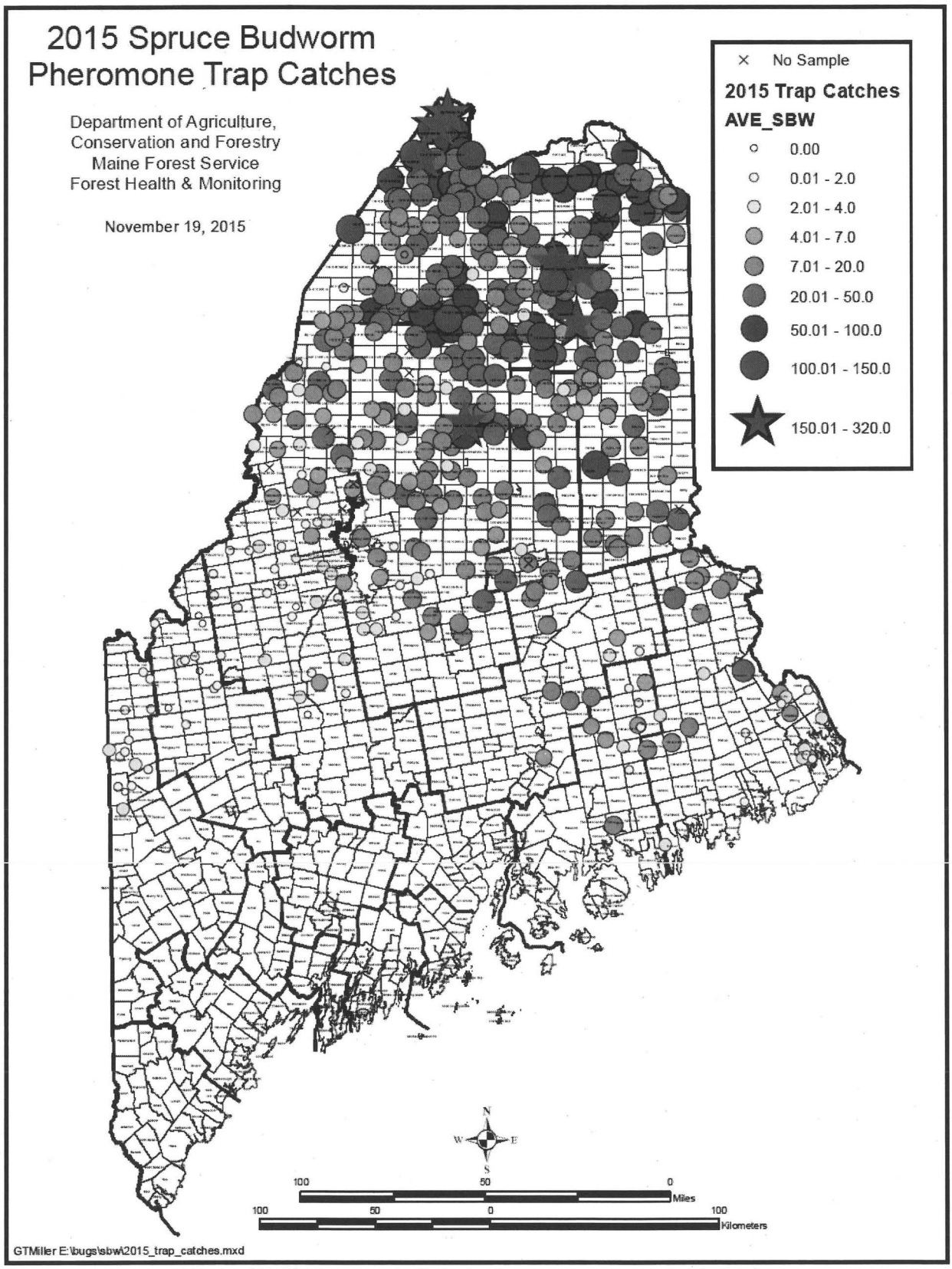

Figure C5. 2015 Spruce budworm pheromone trap catches in Maine

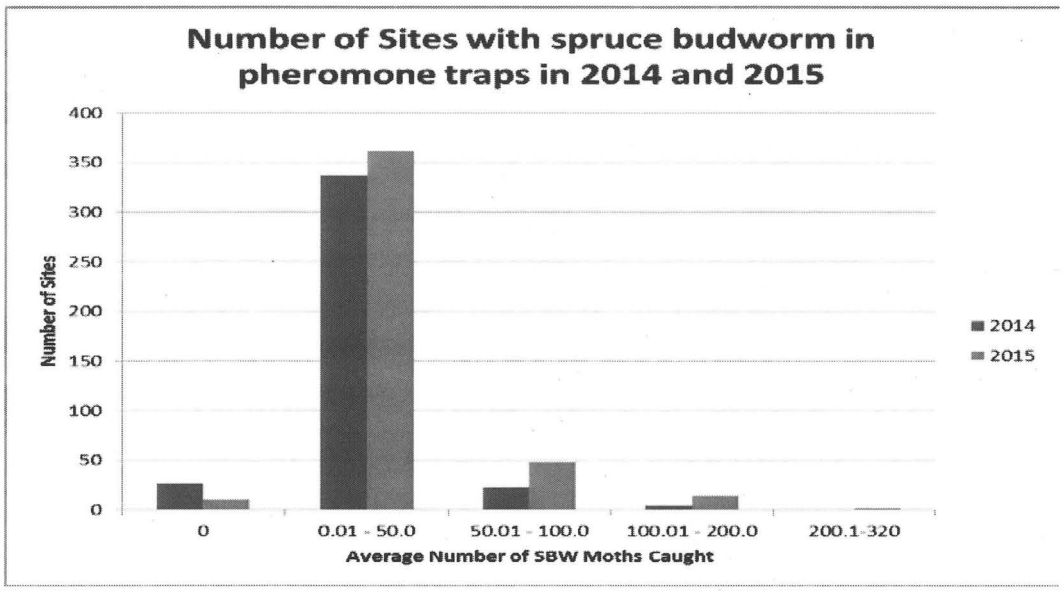

Figure C6. Number of sites with spruce budworm in pheromone traps by catch in 2014 & 2015

As noted earlier, the MFS has been running spruce budworm pheromone traps for the past 23 years. During that time the average number of moths/trap stayed well below 10 moths/trap until 2013 when the number jumped to 18 moths/trap (Figure C7). In 2014 it went up to 25 moths/trap and this year is at 27 moths/trap.

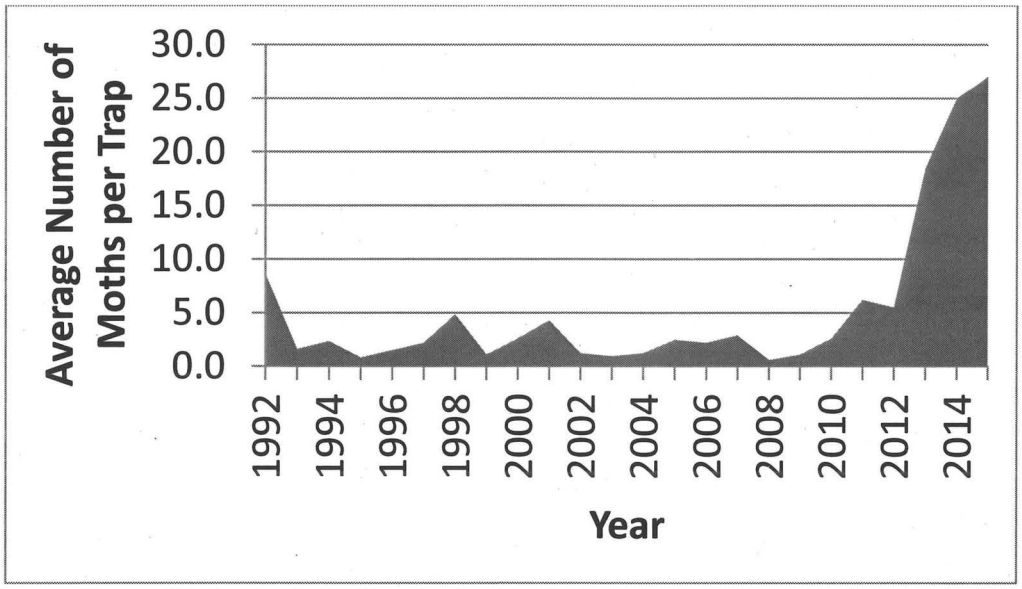

Figure C7. Spruce budworm ONLY long term pheromone trap catch results

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 18 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 low with nine traps catching 34 moths (Table C4) Last year seven traps caught 84 moths. For the past three years five to seven traps have caught spruce budworm moths but, with the exception of Allagash and T15 R15 WELS, it has been varying traps over the years. In the 10 years previous to 2013 there were less than 10 spruce budworm moths caught in all the light traps combined. Therefore the past three 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 get caught.

Table C4. Spruce budworm caught in light traps in 2015

Town	County	SBW Moths
Allagash	AROOSTOOK	3
Bowerbank	PISCATAQUIS	1
Calais	WASHINGTON	2
Crystal	AROOSTOOK	5
Millinocket	PENOBSCOT	1
New Sweden	AROOSTOOK	2
Rangeley	FRANKLIN	1
T3 R11 (Frost Pond)	AROOSTOOK	2
T15 R15 WELS (Ste. Phamphile)	AROOSTOOK	17
Total number of moths		**34**

The University of Maine Cooperative Forestry Research Unit headed up an "L2" sample program in conjunction with the Canadian Forest Service in both 2014 and 2015. Branch samples were taken during the fall and winter in areas where pheromone trap catches had been high or modeling predicted at-risk stands. Three branches were cut from the mid-crown at 100 sites in 2014 and samples were taken at approximately 300 sites this in 2015. Samples are sent to Canada for processing to look for overwintering larvae on the branches. Only eleven larvae were found in 2014 (Table C5)

Table C5. Number of overwintering spruce budworm larvae (L2) in 2014

Township	Latitude	Longitude	Number of Larvae
Saint Francis	47.1092	-68.851	3
T12 R12 WELS	46.68416	-69.27611	1
T14 R13 WELS	46.87841	-69.35405	1
T14 R7 WELS	46.8369	-68.6586	3
T14 R8 WELS	46.8767	-68.8077	1
Westmanland	46.9437	-68.2978	2
Total			**11**

Both ground and aerial surveys were conducted in 2015 looking specifically for spruce budworm in northern Maine where damage would first appear. Due to a lack of personnel the ground surveys were limited to roadside surveys in areas where trap counts were highest.

No feeding damage from spruce budworm was apparent in either ground or aerial surveys. 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.

The pheromone survey went extremely this year and a big hand needs to go out to all those boots on the ground who paid attention to the detail and got the traps out, back in and provided the data. Companies now have the bulky traps on hand so lures, kill strips and replacement parts can be mailed. I would recommend having training sessions where updates can be provided and questions answered. Thank you to companies who send in site coordinates electronically, it reduces transcription errors.

Appendix D
Monitoring for Emerald Ash Borer

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The Maine Forest Service (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 (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 feeding 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.

In addition to visually surveying trees for EAB damage and woodpecker feeding, and educating and recruiting the public to watch for signs of EAB, the MFS employed three means of monitoring for EAB in 2014 and 2015 (Figure D3 and Figure D4).

Purple Trap Survey: In both 2014 and 2015, MFS coordinated the state's participation in the national EAB survey with purple panel traps. In 2014, 587 purple prism traps were hung throughout the state. In 2015, 710 purple sticky traps and 20 green funnel traps were hung throughout the state. All traps were examined and were negative for EAB.

Girdled Trap Tree Survey: In both years, 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 2013, 33 girdled trap trees were created throughout the state. In January and February of 2014, three log-peeling workshops were held (in northern, central and southern locations) and 250 3-foot bolts from these trees were peeled and examined for signs of EAB. None were found.

In 2014 twenty-four trap trees were created throughout the state in. Between January and March 2015, 174 3-foot bolts from these trees were peeled with no sign of EAB found. In the spring of 2015, approximately 20 trap trees were girdled and will be peeled early in 2016.

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 2014, four new wasp colonies were found, ranging in size from 2-90 nests. In total, biosurveillance was carried out at 35 sites and buprestids were collected at 25 of these sites. This effort generated 370 beetles; none were EAB.

Fourteen new colonies of Cerceris fumipennis were found in 2015, ranging in size from 3 to over 150 nests. Biosurveillance was conducted at 55 sites and beetles were collected at 25 of these sites. A total of 445 beetles was collected. No EAB were found.

The following maps show the known distribution of EAB and the locations of purple prism traps, girdled trap trees and *Cerceris fumipennis* biosurveillance sites in Maine for 2014 and 2015.

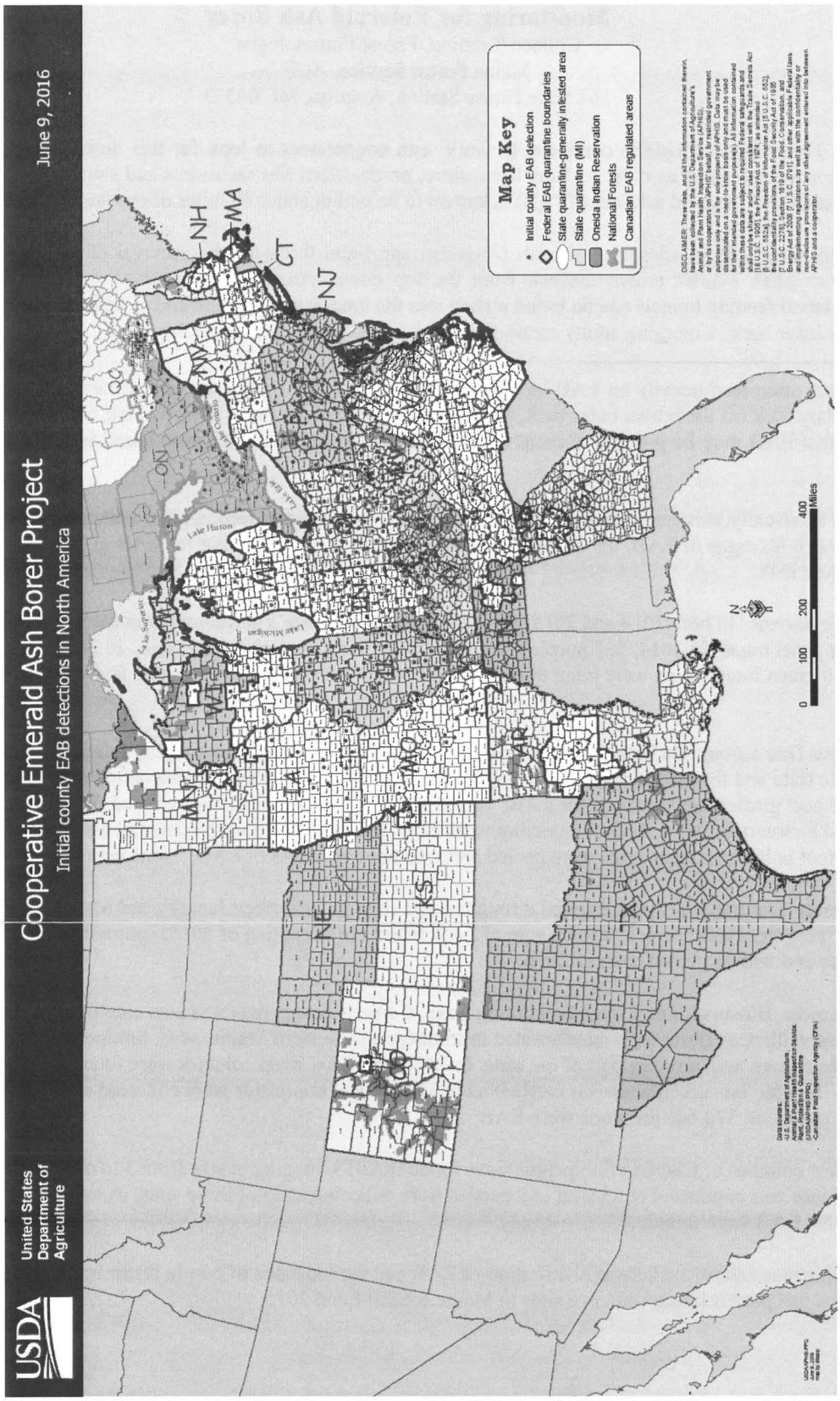

Figure D1. Initial county detection of emerald ash borer (USDA APHIS, June 9, 2016)

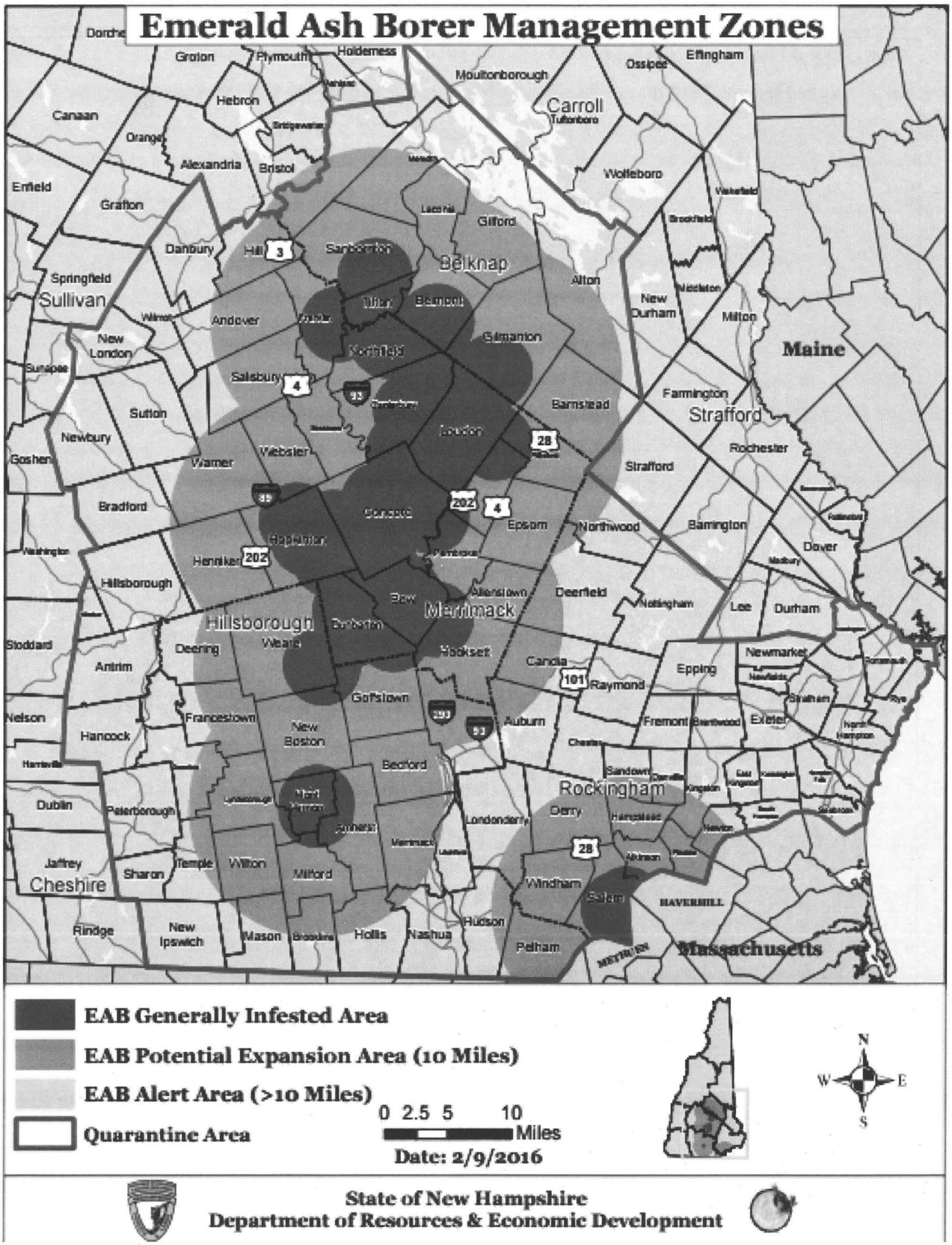

Figure D2. Emerald ash borer infested areas in New Hampshire (NH DRED, DFL)

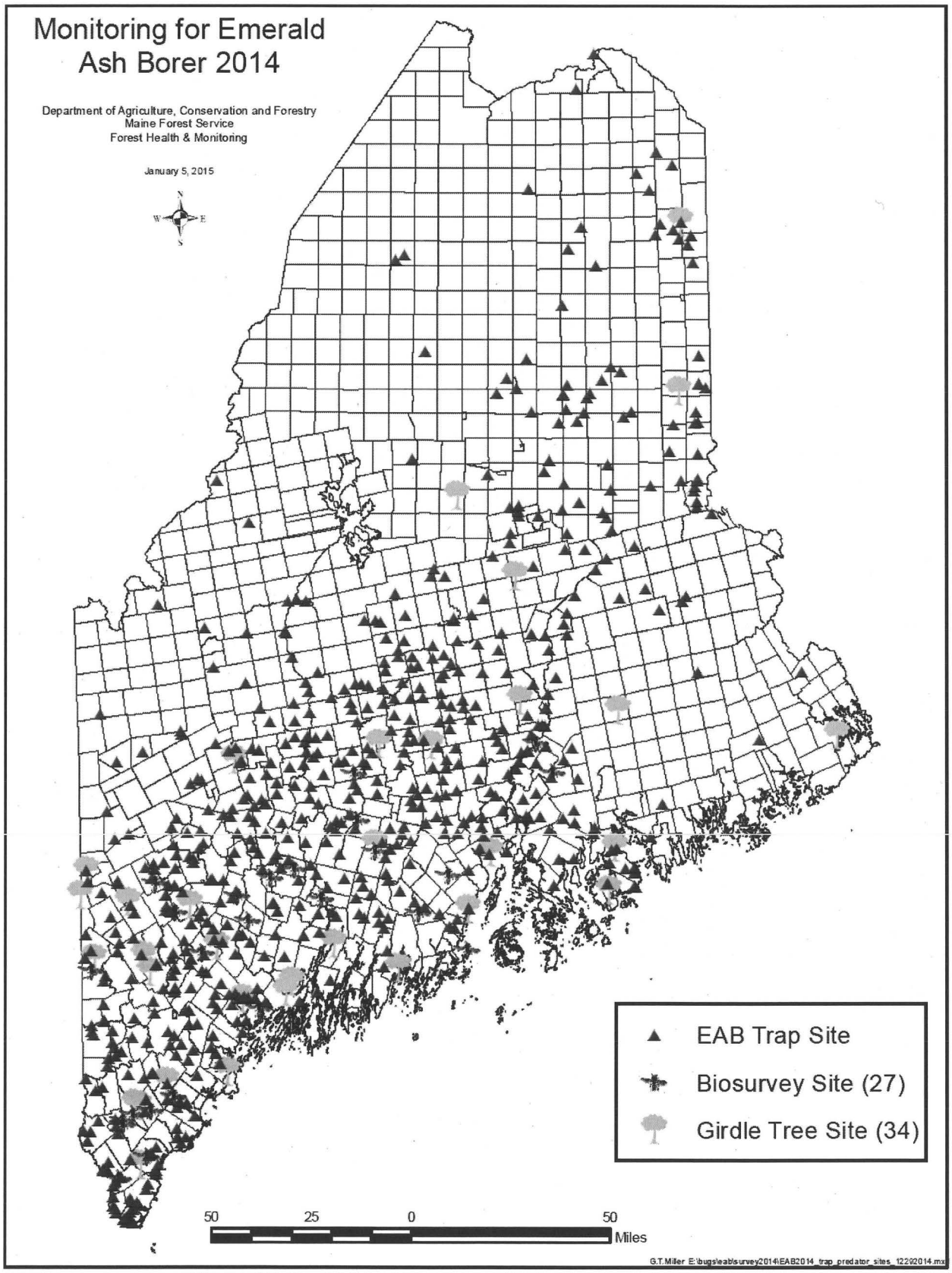

Figure D3. Emerald ash borer monitoring locations by type 2014

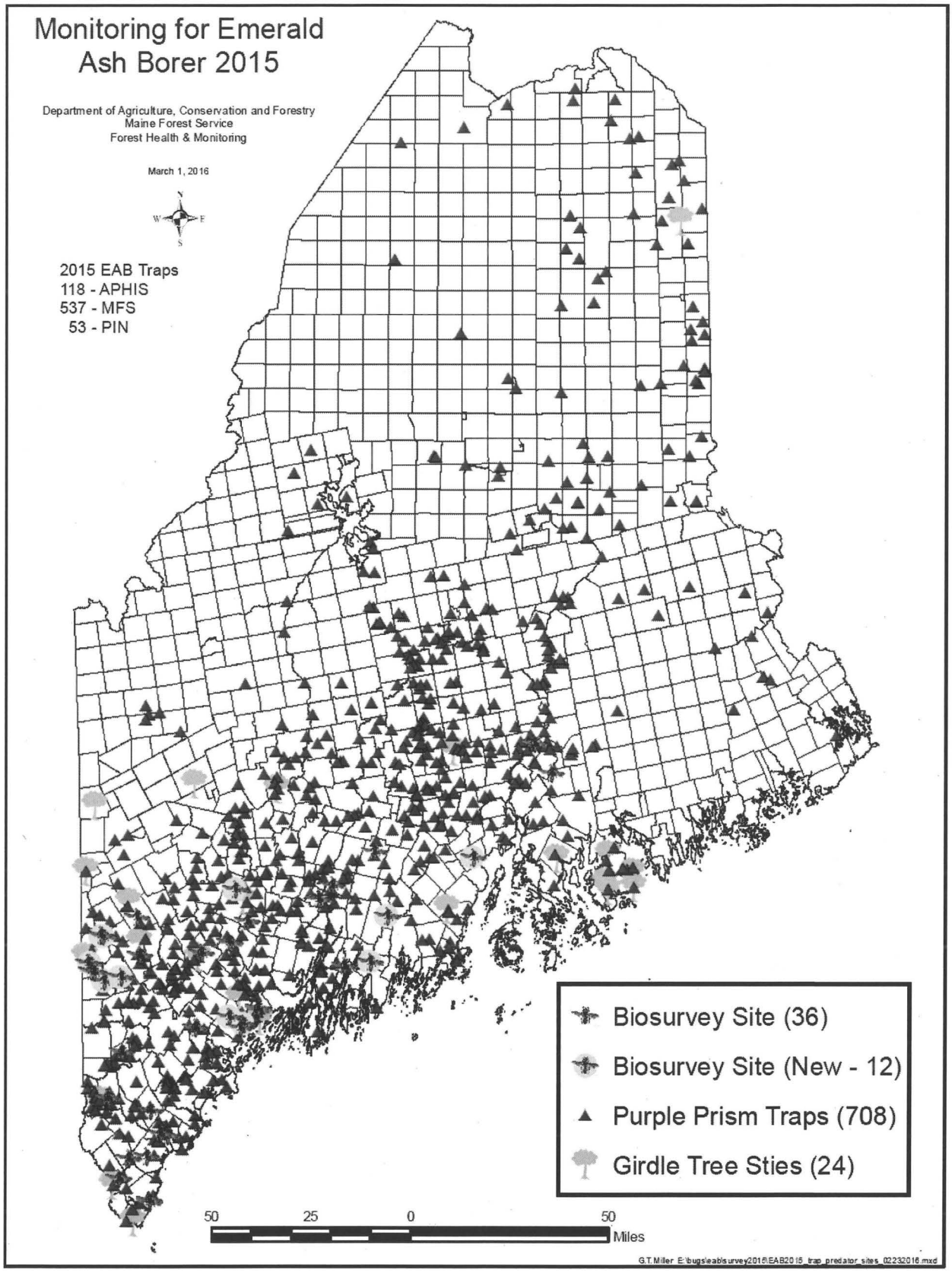

Figure D4. Emerald ash borer monitoring locations by type 2015

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