Forest & Shade Tree Insect & Disease Conditions for Maine

Summary 2017

Maine Forest Service

MAINE DEPARTMENT OF AGRICULTURE CONSERVATION & FORESTRY

Augusta, Maine

Forest Health & Monitoring
Summary Report No. 28

June 2018

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

Printed under appropriation number: 010-01A-5210-52 and 013-01A-2FHM-52

Issued 06/2018
Initial printing of 125

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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
http://maine.gov/dacf/mfs/forest_health/index htm

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

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

<table>
<tr><th>Insect & Disease Laboratory</th><th>State Entomologist</th></tr>
<tr><td rowspan="4">168 State House Station
Augusta, Maine 04333-0168
Location: 50 Hospital Street
Phone: (207) 287-2431

Patti Roberts, Office Associate
patti roberts@maine.gov

Hours: Mon–Fri. 7:30 a m.– 4:00 p.m.
(call ahead as we are often in the field)

Aaron Bergdahl, Forest Pathologist
(207) 287-3008
aaron.bergdahl@maine.gov

Charlene Donahue, Forest Entomologist
Retired 2/28/2018

Colleen Teerling, Forest Entomologist
(207) 287-3096
colleen.teerling@maine.gov</td><td>David Struble
22 State House Station
Augusta, Maine 04333-0022
Phone: (207) 287-2791
dave.struble@maine.gov</td></tr>
<tr><th>State Supervisor of FH&M</th></tr>
<tr><td>Mike Devine
22 State House Station
Augusta, Maine 04333-0022
Phone: (207) 287-3920
mike.devine@maine.gov</td></tr>
<tr><th>Old Town Office</th></tr>
<tr><td>Allison Kanoti, Forest Entomologist
P.O. Box 415
Old Town, Maine 04468
Location: 87 Airport Road
Ph. (207) 827-1813 Fax. (207) 827-8441
allison m kanoti@maine.gov

Joe Bither, Senior Entomology Technician, Stockholm
Wayne Searles, Entomology Technician, New Gloucester
Regina Smith, Entomology Technician, Portland
Amy Ouellette, Conservation Aide, Augusta Lab</td></tr>
</table>

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

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

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

E-Mail Address _____

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

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

Mailing Address_____

_____

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
http://www.maine.gov/dacf/mfs/forest_health/index.htm

Scan to Sign up On-line

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

MFS Forest Insect & Disease Diagnostic Request and Report Form

Sample provided - yes no Collection date _____

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

Tree species affected _____

Township _____ County _____

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

Property owner, address, and daytime phone number:

_____

_____

_____

_____

Location of affected plants:

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

Has the plant been recently transplanted? Yes No

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

Are they similarly affected? Yes No

Has the plant been recently fertilized? Yes No

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

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

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

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

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

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

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

Describe problem and other additional information:_____

_____

_____

_____

Collector_____ Daytime Phone Number _____email:_____

P.O. Address _____

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

Daytime Phone Number _____ email:_____

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

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

Acknowledgements

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

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

We extend our thanks to Greg Miller, Greg Lord, and Ken Laustsen, Maine Forest Service, for their assistance with mapping, computer, and statistical tasks. Our survey work was greatly enhanced by the efforts of Joe Bither, Amy Ouellette, Wayne Searles and Regina Smith. Patti Roberts does a wonderful job as the first contact for many of the public who reach out to our office; she also is vital in keeping us safe (acting as dispatch for folks in the field) and supplied.

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

Our deepest thanks go to those who volunteer in survey and monitoring as well as other tasks. It would be much more difficult to continue winter moth research and parasite control work without Sharon Whitney. Thank you to Nancy Sferra of The Nature Conservancy and Tim Bickford with Maine Army National Guard who ran traps for the southern pine beetle survey this year. We thank David Bourque and Dana Michaud for their taxonomic contributions and additions to the insect collection. And thanks to Gail Everett for her work on sorting and organizing the insect collection both at the lab and at the Maine State Museum Annex.

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

Introduction

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

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

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

This product was made possible in part by funding from the U.S. Department of Agriculture. Forest health programs in the Maine Forest Service, Department of Agriculture Conservation and Forestry are supported and conducted in partnership with the USDA, the University of Maine, cooperating landowners, resource managers, and citizen volunteers. This institution is prohibited from discrimination on the basis of race, color, national origin, sex, age, or disability.

Insects: Softwood Pests

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

Balsam woolly adelgid (BWA) is established in all Maine counties. BWA 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. Calls from the public and staff observations, particularly regarding trunk-phase populations, were down slightly from 2016. Noticeable trunk phase, gout and/or related fir decline and mortality were observed or reported in Aroostook, Hancock, Lincoln, Kennebec, Knox, Penobscot, Piscataquis, and Washington counties.

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

There were no new detections of elongate hemlock scale (EHS) in 2017. This pest was surveyed for in forested areas in southern Maine; no other forest infestations were found. Elongate hemlock scale is known to be established in the forest in Kittery (York County) and has been found on planted trees in Cumberland County (Brunswick, Cape Elizabeth, Falmouth, Frye Island, Gorham, Portland, Scarborough, Yarmouth), Hancock County (Mount Desert, Sedgwick), Sagadahoc County (Topsham), and York County (Berwick, Kennebunk, Kennebunkport, Kittery, Ogunquit, Old Orchard Beach, Saco, Wells, York). Because it is cryptic and is widespread in other states, it appears establishment of this pest in our forests will be accelerated by importation and out-planting of infested trees.

Several planted hemlocks were found to be heavily infested with EHS on Frye Island in 2016. In November 2017, these trees were cut down since they were deemed to be at very high risk of spreading EHS throughout the island. Maine Forest Service thanks the town of Frye Island for the cooperation and assistance they provided with this. EHS had spread to a few lightly-infested trees in the adjacent forest and these trees along with a wide buffer around them were treated. This area, as well as the rest of the island, will continue to be monitored for EHS.

In Kittery, a predatory beetle was discovered feeding on EHS. It was identified as the generalist non-native scale predator, *Cybocephalus nipponicus*. This predator had been released in the past as a biological control agent for San José scale on euonymus in Massachusetts. Reports from New Jersey and Pennsylvania suggest that this predator may be able to reduce populations of EHS. The establishment and spread of this biological control agent will be monitored in areas where EHS is established in the forest.

See appendix B for more information.

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

Hemlock woolly adelgid (HWA) continues to spread eastward and inland. In 2017 it was found in Newcastle and Edgecomb in Lincoln County. About 137 acres of mortality was mapped, primarily on Great Diamond Island with a small amount in Phippsburg. Hemlock decline, due at least in part to HWA damage, is also apparent from the ground in several coastal communities in York, Cumberland, Sagadahoc, and Lincoln counties.

Biological control establishment efforts continue in Maine. One thousand *Sasajiscymnus tsugae* were released in Woolwich in 2017 and Maine Forest Service assisted with the release of 650 privately-bought *S. tsugae* in Wells. One thousand additional *Laricobius osakensis* were released in the field insectary on Frye Island. A second field

insectary was established in Kittery on land owned by Rachel Carson National Wildlife Refuge, and 500 *L. osakensis* were released there.

In 2017, all 17 previous release sites were sampled for predators (some release sites had multiple locations). Ninety-eight adult *Sasajiscymnus tsugae* were recovered from five different sites in West Bath, Bath, Wiscasset, Woolwich and Freeport. One *Laricobius nigrinus* was recovered in York.

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*)

Contrary to predictions, no significant damage from pine leaf adelgid was mapped in 2017. We will continue to monitor areas affected in 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 beetles were found in either Aroostook or Washington counties in 2017.

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. To date, scale has only been detected off Mount Desert Island in one township (Lamoine, Hancock County), however it is an extremely cryptic insect and limited survey has been conducted by the Maine Forest Service.

Southern Pine Beetle
Dendroctonus frontalis
Hosts: Pitch Pine (*Pinus rigida*), Eastern White Pine (*P. strobus*) and Norway spruce (*Picea abies*)

Southern pine beetle has not been detected in Maine.

In recent years, the US-native bark beetle, *Dendroctonus frontalis* or Southern Pine Beetle (SPB) has been expanding its range north from southern states and hosts. It has now been found as far north as Massachusetts. Currently in Massachusetts, SPB has only been found in traps and not damaging trees yet. This aggressive bark beetle has been observed attacking pitch pine (*Pinus rigida*), eastern white pine (*P. strobus*) and Norway spruce (*Picea abies*) in the Northeast and killing trees on Long Island, NY. For this reason, the Maine Forest Service is concerned about the SPB continuing its northern expansion into Maine. As part of a 2017 USDA-APHIS CAPS grant, traps were deployed to monitor for range expansion of this insect.

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

The 2017 survey was conducted in ten pine stands, one each in Brownfield, Fryeburg, Phippsburg, Alfred, Eliot, Hollis, Kennebunk, Newfield, Waterboro and Wells. These are areas of southwestern Maine where primarily pitch pine (and one stand of red/white pine) are found. A 12-funnel Lindgren trap was set up in each location (Table

1Table 1). Traps were deployed the first week of May and the trap catch collected every other week until the middle of June. This covers the primary long distance dispersal season for SPB, the rest of the summer they only move short distances.

Table 1. Locations of southern pine beetle traps in 2017

Town	County	Location	Target Tree Species	Latitude	Longitude	Install Date	End Date
Brownfield	Oxford	Major Gregory Sanborn WMA	pitch pine	43.9746	-70.8900	5/2/2017	6/14/2017
Fryeburg	Oxford	Eastern Slopes Regional Airport	pitch pine	43.9884	-70.9490	5/2/2017	6/14/2017
Phippsburg	Sagadahoc	TNC Basin Preserve	pitch pine	43.7971	-69.8418	5/5/2017	7/8/2017
Alfred	York	USDA-FS Massabesic Experimental Forest	white and red pine	43.4493	-70.6803	5/3/2017	6/13/2017
Eliot	York	York Pond pitch pine bog	pitch pine	43.1903	-70.7565	5/3/2017	6/13/2017
Hollis	York	ME National Guard Training site	pitch pine	43.6769	-70.6573	5/10/2017	6/14/2017
Kennebunk	York	Kennebunk Plains WMA	pitch pine	43.4025	-70.6277	5/3/2017	6/13/2017
Newfield	York	Vernon Walker WMA	pitch pine	43.6164	-70.8524	5/2/2017	6/14/2017
Waterboro	York	TNC Waterboro Barrens	pitch pine	43.6193	-70.8247	5/2/2017	6/14/2017
Wells	York	TNC Wells Barrens Preserve	pitch pine	43.3778	-70.6456	5/4/2017	6/30/2017

Thank you to Nancy Sferra, The Nature Conservancy, and Tim Bickford, Maine Army National Guard for providing access to some of the survey sites and collecting samples throughout the season. Thanks go out to Regina Smith for sampling the other sites and to Amy Ouellette for pre-processing samples for identification.

Spruce Budworm

Choristoneura fumiferana

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

Spruce budworm is a periodic major pest of fir and spruce in Maine. The Maine Forest Service has been monitoring this insect since the early part of the last century. Since 1992, the Maine Forest Service has been monitoring populations using pheromone traps and catches in a subset of about 80 sites had averaged well below five moths per trap. In 2011, the average moth capture across those sites crept over five moths per trap for the first time in almost two decades. The average continued to climb, and in 2014 and 2015 it was more than 20 moths per trap. 2016 trap catches were down dramatically compared to the previous years and registered at only 7.5 moths per trap across those long-term sites. In 2017 similar numbers were recorded. More information about spruce budworm in Maine can be found in Appendix C.

Insects: Hardwood Pests

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

Defoliation continues to occur in the area of Cherryfield (Washington County) and adjacent Hancock County. Aerial survey detected just 423 acres this year, although from the ground there is much more light to moderate damage to the foliage and some scattered oak mortality.

Browntail Moth
Euproctis chrysorrhoea
Host(s): Northern Red Oak (*Quercus rubra*), Apple (*Malus spp.*), other Rosaceae family trees and shrubs and other deciduous trees and shrubs

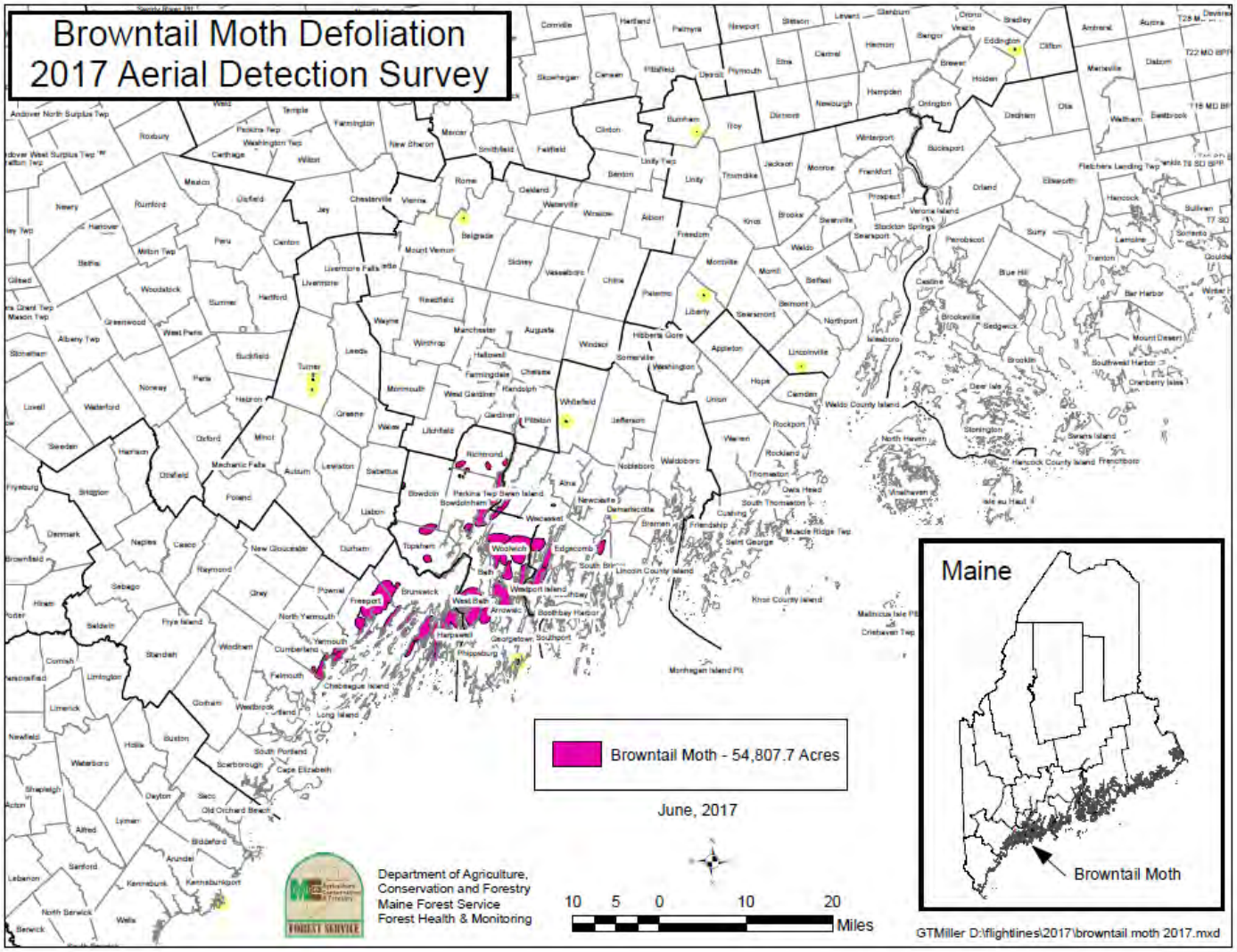


Figure 1. Browntail moth June defoliation 2017

Browntail moth is not only a tree pest but also, and more importantly, has health impacts on humans. Repeated exposure to browntail moth hairs, or single exposures in sensitive individuals, can cause a rash and/or breathing problems. This can be severe in some cases. Browntail moth is an invasive insect from Europe that has been in

North America for over 100 years. It is found only in Maine and Cape Cod, Massachusetts in North America. It is a difficult insect to work with because of the health effects and little work has been done to rigorously study this insect in decades, apart from control work in the 1990's in Maine.

The footprint of browntail moth defoliation expanded as expected over last year's although it was not as bad as it could have been. The 2016 fall defoliation by browntail moth early-instar skeletonizing covered almost 64,500 acres and the 2017 spring damage was down; 'only' 54,800 acres (Figure 1). This is more than twice the area of the 2016 spring defoliation and therefore more people were impacted by the urticating hairs. Areas most affected by spring defoliation still include much of Sagadahoc County and coastal towns in Cumberland County. Small areas mapped from the air plus ground surveys and citizen reports of browntail moth defoliation include an additional eight counties: Androscoggin, Hancock, Kennebec, Knox, Lincoln, Penobscot, Waldo and York. In July moths were collected from light traps in two more counties: Aroostook and Washington – although these may not result in infestations. Thus, 12 out of Maine's 16 counties have some level of browntail moth presence. Only the four most western counties did not have reports of browntail moth this year although two of those counties had browntail moth light traps catches in 2016.

Figure 2. Browntail larva infected with fungus *Entomophaga aulicae.*

It could have been worse. Wet spring weather allowed the fungus *Entomophaga aulicae* to take hold in the most heavily infested areas of Sagadahoc County (**Error! Reference source not found.**). The population dropped from extreme to almost negligible and defoliation was minimal in Bowdoinham and parts of Topsham and Brunswick. The fungus was also found scattered in many other towns as well. The population dropped significantly so that there was not a late summer survey flight due to the trees not being as heavily impacted by the early-instar feeding as the past two years. Hopefully this epizootic will continue to expand and drop the population back to tolerable levels.

Despite the difficulties in working with an insect that causes health issues by just being near the infestation, there is work being done to develop new techniques for reducing the impact and understanding the ecology of the browntail moth. With encouragement from the Maine Forest Service some Licensed Pesticide Applicators are performing late summer treatments where appropriate against the early instar larvae. This timing was first advocated by Edith Patch back in 1916. The difficulty being that is hard to see what trees are infested at that time of year unless the populations are extremely high. The advantages are: small larvae that are more susceptible to treatment, less exposure to the uriticating hairs, plenty of leaf surface to hold the product and another 'window' of time for treatment.

The Maine Forest Service worked with two State Parks that have browntail moth and had a commercial application of Foray 48B (B.t. - *Bacillus thurengiensis* Kurstaki) in May to reduce the populations of browntail moths. This is a bacterial insecticide that only affects caterpillars that eat it and breaks down very rapidly in the environment. It appeared to reduce the population to an acceptable level although larvae were still present.

The University of Maine, in collaboration with the MFS, is testing biorational products for treating browntail moths. The lab tests have some encouraging results for pesticides with fewer non-target effects then more traditional products. Field tests are planned for the spring. This project as well as the next one are supported by the MFS, grants, town contributions and donated products.

Additionally, the University with MFS assistance, is studying the impacts of parasitoids, fungi and virus in the browntail moth populations. This is very difficult work as larvae and cocoons filled with toxic hairs need to be collected, reared and dissected. Our thanks and admiration go out to the students who are doing this work as even

with fume hoods and protective clothing they still get the rash. Hopefully this work will help us better understand the browntail moth and its natural controls.

The end of December and into January brought below zero weather and with it the question of how that might impact the overwintering browntail moth larvae. After two weeks at room temperature the larvae began emerging from webs collected from Eddington (Penobscot County), Belgrade and Waterville (Kennebec County), Turner and Auburn (Androscoggin County), Woolwich (Sagadahoc County) and Brunswick and Harpswell (Cumberland County). The Turner (Androscoggin County) samples were the only ones that had just a few larvae emerging. The silk webs that the larvae spin provide excellent protection from the cold.

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. Reports of fall webworm were down in 2017. Catches in the light traps were also down.

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

Forest tent caterpillar has not been seen at damaging levels in Maine for years. In 2017 a number of people reported the same 67-acre patch of completely stripped oak trees in Blue Hill, Hancock County. It was on a 'main' road and spanned both sides of the road. There were also small areas of light to moderate damage in Stockholm (Aroostook County), Orono/Old Town area of Penobscot County and in Bath (Sagadahoc County.) A small patch of a couple dozen trees with significant defoliation in Brooksville (Hancock County) was not large enough to detect from the air. Light traps did not catch unusual numbers of forest tent adults and a widespread outbreak is not expected.

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

No gypsy moth defoliation was recorded in 2017. Maine Forest Service and USDA APHIS Deployed 516 traps in 2017 in the transition zone (area where reproducing populations of gypsy moth have not been detected). Of those, 487 were retrieved. Egg mass scouting was targeted to areas of Aroostook, central Piscataquis and central Somerset counties where trap catches were highest. Egg masses were detected in Easton, Aroostook County, Maine. A quarantine revision is anticipated.

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

	Number of Traps by County					
	Aroostook	**Franklin**	**Oxford**	**Piscataquis**	**Somerset**	**Statewide**
Missing	*4*	*1*		*4*	*20*	*29*
0	29	36	1	7	25	98
1-15	126	9	18	36	118	307
16-30	23	1	2	10	8	44
31-45	6			8	4	18
46-60	3			2		5
61-75	3			3	2	8
76-90	3				1	4
91-105	1					1
106+	2					2
Total	**200**	**47**	**21**	**70**	**178**	**516**

Within the generally infested area, egg mass counts were low. Significant defoliation is not expected in 2018.

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

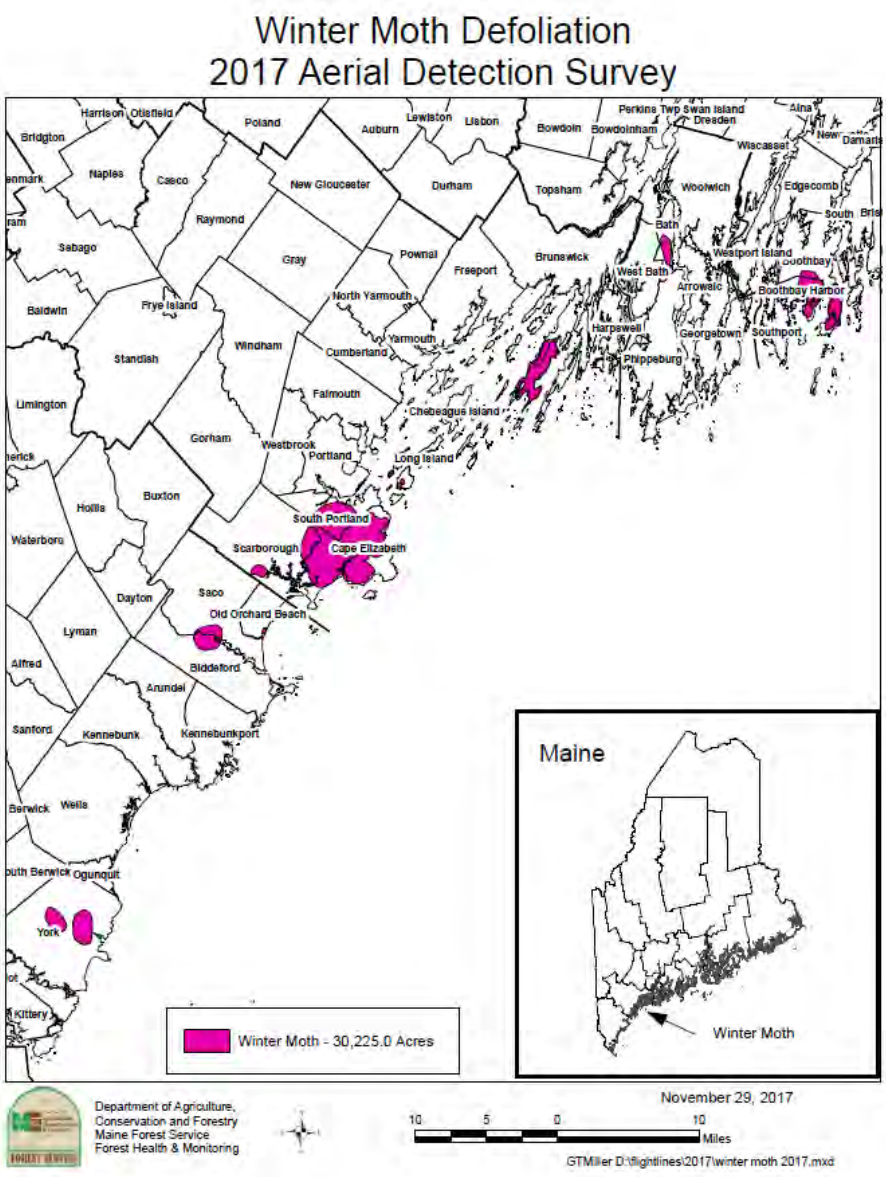


Figure 3. Winter moth defoliation 2017

Winter moth is expanding its range in Maine. In 2017, there were more than 30,000 acres of moderate to severe damage from winter moth feeding on the foliage of oak, maple, apple, birch and other trees. This is a large increase over the 6,000 acres mapped in 2016, and the most mapped since defoliation was first detected in 2012. The winter moth population increased in severity although it has not been detected much further than the past few years and remains in Cumberland, Knox, Lincoln, Sagadahoc and York counties. Moths have been found in traps in Hancock county but no detectable damage has been found there to date.

The MFS continued survey for winter moth males using pheromone traps in December 2016 to determine where winter moth populations were heaviest and to delineate the outer reaches of the infestation. Traps were deployed at 75 locations in towns along the coast and along a transect inland from known infested areas. The survey covered coastal portions of York, Cumberland, Sagadahoc, Lincoln, Knox, Waldo and parts of Hancock, Androscoggin and Kennebec counties. Once again, reports of moth observations were solicited from the public using a Survey Monkey form—over 2,000 reports were received through this method and calls/emails to the office. A map predicting intensity of defoliation was produced from these surveys to help green industry professionals and homeowners prepare for the growing season.

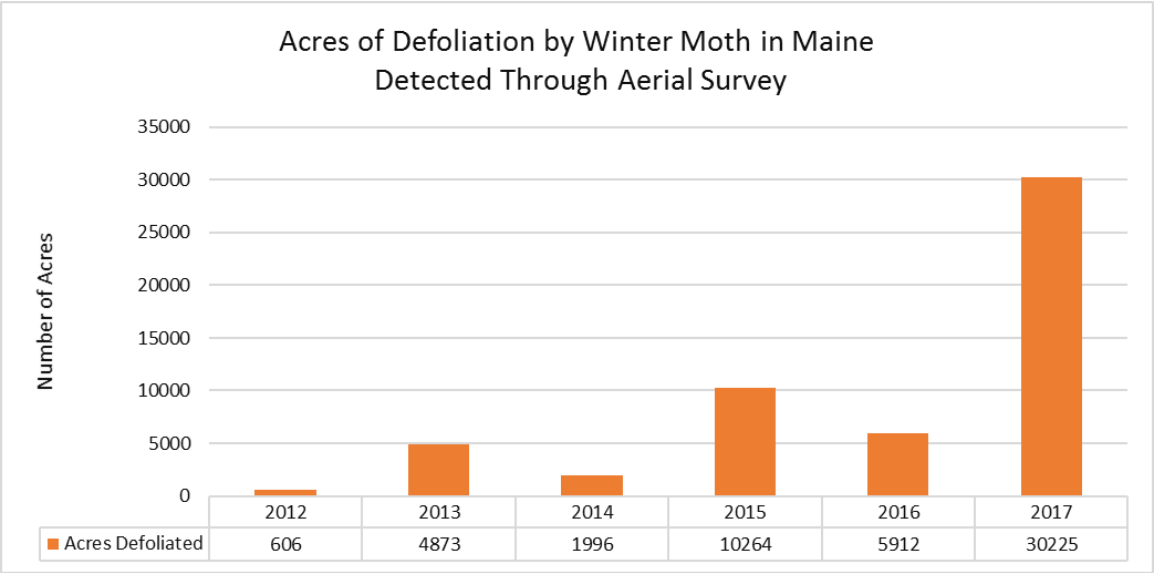


Figure 4. Acres of defoliation by winter moth in Maine detected through aerial survey 2012–2017

Cocoons of the parasitic fly, *Cyzenis albicans*, from Massachusetts were set out in South Portland (Cumberland County) in November 2017 so that they can emerge naturally in the spring. This is the sixth location in Maine to receive the parasitoids from the University of Massachusetts with funding from the USDA Forest Service. Flies were recovered from 11% of the cocoons sampled from Fort McClary, Kittery (York County) in 2017. No parasitoids were recovered at any of the other sites this year.

Table 3. Release and Recovery of parasitic flies, *Cyzenis albicans*, in Maine

Town	County	Dates	Number of *Cyzenis albicans* Released	Comments
Harpswell	Cumberland	1-May-13	2000	survival not good
Cape Elizabeth	Cumberland	1-May-13	2000	First recovery 2016
Kittery	York	16 & 23-May-14	1200	First recovery 2016
Harpswell	Cumberland	16 & 22-May-14	1200	
Vinalhaven	Knox	21-May-14	2000	
Portland	Cumberland	15-May-15	2000	
Cape Elizabeth	Cumberland	15-May-15	1000	
Harpswell	Cumberland	15-Nov-16	2000	caged cocoons set out for release in spring 2017
South Portland	Cumberland	29-Nov-17	3000	caged cocoons set out for release in spring 2018

Figure 5. *Cratichneumon culex* adult
Photo: Saxifraga-Ab H Baas

A new winter moth parasitoid was found in Maine this year. When collecting winter moth larvae in June in both 2016 and 2017, Entomologist Charlene Donahue observed large numbers of ichneumon wasps flying just above the duff layer under winter moth infested trees. The wasps were present in three locations; Cape Elizabeth, Harpswell and Vinalhaven. Samples of the wasps were collected and sent to the University of Massachusetts where they used DNA to determine the species of wasp. It turned out to be *Cratichneumon culex* (Müller) a known winter moth cocoon parasitoid from Europe (Figure 5). At this point we do not know how this wasp got to Maine or how much of an effect it will have on the winter moth population. The Maine Forest Service and University of Massachusetts will be studying this new wasp in the future. It has not been reported from other winter moth infestation in North America.

Insects: Invasive Forest Insects Not Yet Detected in Maine

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

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

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

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

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

No Asian longhorned beetle detected to date in Maine. The MFS did not conduct any formal surveys in 2017.

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

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

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

No brown spruce longhorned beetle (BSLB) has been detected to date in Maine. Traps for this pest were set in Aroostook County by MFS and other locations around the state by USDA APHIS. BSLB is established throughout much of Nova Scotia. In addition, a reproducing population has been detected in Memramcook, NB. The province is carrying out activities to slow the spread of BSLB from that location. Through the Forest Health Working Team of the Northeast Fire Compact, MFS personnel assisted with survey at the Memramcook site in April 2017.

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

The MFS continues to work with cooperators to look for this destructive insect that has already become established as close as New Hampshire, northeastern Massachusetts and the Eastern Townships area of the province of Québec. Emerald ash borer (EAB) is known to be within less than 10 miles of our western border, and part of Lebanon in York County is within the 10-mile 'expansion range' of a known infestation in Strafford County New Hampshire. In December 2017, Québec expanded its EAB quarantine to include areas adjacent to the northern border of Maine (See Appendix D).

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

Woodpeckers often feed heavily on EAB larvae and pupae, especially during the fall, winter, and early spring. As they feed, they flick off the brown outer bark, exposing the blonde inner bark. This "blonding" is highly visible and is a good sign that EAB may be present. Recent new infestations in MA and NH were found because of woodpecker feeding.
**Post 2017 season EAB update: EAB was found in Madawaska in late May 2018. Comprehensive information regarding this detection will be included in the 2018 Annual Summary, as well as other 2018 reports, publications and on the Maine Forest Service website.*
See Appendix D for more information on the 2017 emerald ash borer survey efforts.

Exotic Wood Borers and Bark Beetles of Spruce and Pine
Various
Host(s): Spruces (*Picea* spp.), Pine (*Pinus* spp.) and other conifers

Maine Forest Service conducted a Cooperative Agricultural Survey Program funded trapping effort focused on early detection of potentially destructive exotic pests of spruce in Aroostook County and pine in southern Maine (**Table 1**). Pathways of spread for these insects could include raw wood, camp firewood, and solid wood packing material. Samples were screened by Carnegie Institute. None of the target beetles were found.

Table 4. Exotic wood borer and bark beetles of spruce targets 2017

Survey Name	Survey Target Common Name	Survey Target Scientific Name
Ips – 5 sites – Aroostook Co.	Six-toothed bark beetle	*Ips sexdentatus*
	European spruce bark beetle	*I. typographus*
	Mediterranean pine engraver	*Orthotomicus erosus*
BSLB – 5 sites – Aroostook Co.	Black spruce beetle	*Tetropium castaneum*
	Brown spruce longhorned beetle	*T. fuscum*
Mono – 5 sites – Southern Maine	Japanese pine sawyer	*Monochamus alternatus*
	Black fir sawyer	*Monochamus urussovii*
	Large pine weevil	*Hylobius abietis*

Insects: Other

Boxelder Bug

Boisea trivitatta

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

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

Springtails

Collembola

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

In 2017 we again received many reports of masses of springtails, sometimes in very large quantities. For springtails, management outside the immediate home environment really is not necessary. However, keeping areas around building foundations and entrances free of rotting debris including decaying mulch and leaves, and reducing moisture around the building can limit swarming around the home and prevent infiltration into the home. If they do make it inside, snowfleas or springtails are not likely to survive long in a dry indoor environment. Persistent populations of springtails within homes should be addressed with moisture control, not chemical control.

Diseases and Other Injuries

Overview: The Forest Pathology program has completed numerous field visits and has travelled the state of Maine to better understand the state's current forest health conditions. The program was granted funding by the USDA Forest Service for a multi-state Evaluation and Monitoring effort aimed at enhanced monitoring of white pine needle disease and overall white pine health. The pathology program wrote the grant and has a lead role in the design and implementation of the survey. Also, in cooperation with the University of Maine, State of New Hampshire forest health professionals and the USDA Forest Service Durham Field Office forest pathologist, work was started on a white pine management guide. The program is also active in a national white pine health group.
Four presentations were given on various forest and shade tree pathology and forest health topics and contributions were made to several other presentations given by forest health staff. In 2017, approximately 144 tree disease clinic diagnoses were provided to landowners, homeowners, foresters, and others. An additional thirty-seven on-site visits were documented involving tree and forest disease diagnostic assistance. Contributions were made to five issues of the *Forest and Shade Tree Insect and Disease Conditions for Maine* newsletter, which, in addition to this publication, is also coordinated by the staff pathologist. Other significant monitoring and evaluation work included white pine crown evaluations, a survey of spruce needle diseases (*Rhizosphaera kalkhofii and Stigmina lautii)*, assistance to the USFS collecting Dutch elm disease isolates around Maine, locating butternut trees for potential study by Canadian researchers and a significant amount of time was devoted to further learning about the unique disease conditions in Maine.

Diseases and Injuries: Native

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

Anthracnose diseases were rarely encountered in 2017. This was due to the lack of longer periods of moisture in summer needed for the disease to cyclically re-infect foliage and build inoculum.

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

The *Armillaria* root rot fungus is present throughout the environment and several species are thought to occur in Maine. *Armillaria* is typically only able to parasitize stressed trees, except for certain species of *Armillaria* that are sufficiently virulent to alone cause rapid decline and mortality. *Armillaria* root rot was seen in several areas in Maine in 2017 parasitizing stressed trees. Samples were received and collected from various sources and from several areas of the state. The *Armillaria* root rot disease complex is of concern due to the current widespread stress to pines, especially white pine that have suffered several years of heavy defoliation due to white pine needle diseases described later in this report.

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

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

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

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

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

Fire blight was observed at a residence in Kennebec County in 2017. The disease was severe, causing cankering and dieback of many branches.

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

Many Christmas tree plantations have been moderately to heavily affected by needle cast diseases in the past several years. In 2017, disease incidence appeared to be quite light with few reports of the disease and two samples processed at the lab and one request for a field visit that will occur in early 2018. The disease was also noticed at a choose and cut Christmas tree farm also in Kennebec County. Needle diseases tend to occur in lower lying areas, whereas areas with better air circulation suffer less disease pressure.

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

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

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

Several reports of *Phomopsis* galls on oaks are received annually, largely due to the unusual appearance and often the large numbers of the galls which develop on the branches and main stem of individual trees. The galls may be pea-sized up to softball-sized or sometimes larger. Some heavily infected tree crowns may have hundreds of galls, with subsequent branch dieback which can occasionally result in tree mortality. The galls are thought to be initiated by infection from a *Phomopsis* spp. fungus, but the subsequent growth of the gall continues for a number of years as woody host tissue. The disease is native, and is usually considered to be inconsequential in forest settings. Requests for on-site assistance regarding this issue were attended to at Colby College and a residence in Vassalboro in 2017.

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

Diplodia tip blight is widespread and moderately damaging to exotic hard pines (Scots, Austrian, and Mugo pines) throughout the state. Red pines showing symptoms of tip blight and shoot blight are commonly infected with both *Diplodia pinea* and *Sirococcus conigenus* (described below). This was confirmed at several large red pine plantations visited in 2017. General observations from Maine indicate that the relative rate of development of *Diplodia* infections in red pines is considerably slower than that of *Sirococcus* infections. However, taken together, these shoot and tip blights continue to pose a significant threat to red pine in native and plantation stands. Infection levels have remained high for the past several years due, in large part, to favorable wet weather conditions during springs and summers.

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

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

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

Sirococcus shoot blight remains a significant threat to red pine in native and plantation stands throughout the state. In 2017, heavy infection levels were observed in red pine plantings in Lincoln, Aroostook, Penobscot, Hancock, Androscoggin and Oxford counties. Larger land owners applied for variances to harvest large areas of red pine based in the severity of the disease and rapidly declining tree health. Most of this damage has been attributed to *Sirococcus conigenus*. *Diplodia* tip blight is widespread and moderately damaging to red pine in these same areas.

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

In 2017, damage to white spruce, black spruce, red spruce and balsam fir by eastern dwarf mistletoe was frequently seen along coastal areas of Maine. The parasite was also seen in several inland areas, but only minor severity was observed. A particularly heavy infestation was observed on Swan's Island (Hancock County) in early 2017.

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

Spruce needle cast diseases continued at moderate to high levels across the state, wherever the hosts occur. It has been especially damaging to ornamental plantings in suburban settings, in public parks, and along community streets. Severe damage to trees from the needle casts has resulted in some mortality, but more often the aesthetics of trees has been so affected as to warrant a considerable number of tree removals. A spruce needle cast disease survey continued in 2017. Results from the first two years indicate that *Stigmina* needle cast disease is far more common than *Rhizosphaera* needle cast and is the predominant needle cast disease in all counties surveyed.

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

Incidence of tar leaf spot diseases was very high in 2017 due to higher than average spring precipitation. The disease is common wherever Norway maples are planted as ornamentals, especially in urban and suburban communities. Many reports of heavy premature defoliation were received from several counties in 2017, with a large number of calls for assistance from the Bangor and Augusta areas.

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

In 2017, potential *Verticillium* wilt was seen from the road, but was not confirmed. This disease is fairly infrequent and seems to affect primarily maples in Maine, despite the disease's wide host range.

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

The spring of 2016 was quite dry leading to milder disease symptoms associated with white pine needle diseases (WPND). The needle disease complex that has been impacting white pine trees, for what is believed to be 10 consecutive years, has continued to result in extensive pre-mature needle shedding wherever white pines grow across the state. Losses of one-year-old needles during late May and through June resulted in relatively few disease clinic requests for assistance compared to earlier years, although this was still a significant disease complex affecting white pines in 2017. The diseases remains widespread, but most severe throughout central, western, and southern Maine. A July aerial survey revealed over 61,000 acres of declining white pine in Androscoggin, Cumberland, Kennebec and Oxford counties. Due to the mostly consistent disease level over the past years, the implications of this chronic stress and mortality remain a concern, especially as prolonged periods of wet weather during the infection period of the causal agents in 2017. A multi-state evaluation and monitoring project funded by the US Forest Service began in 2017 to address white pine health concerns; the effort will continue in 2018. Continued monitoring of this situation will be prioritized for early detection of any emerging insect or disease agents that could serve as further factors leading to white pine decline and mortality.

Diseases: Non-Native

Butternut canker
Ophiognomonia clavigignenti-juglandacearum = Sirococcus clavigignenti-juglandacearum
Host: Butternut (*Juglans cineria*)

The health of butternut trees continues a steady decline across the state wherever butternut trees grow. Informal survey of the disease continues, while plans are underway in Maine for a more formal regional survey based on a regional 2010 USFS-funded survey.

Dutch Elm Disease (*Ophiostoma ulmi; O. novo-ulmi*)
Hosts: *Ulmus* spp.
Dutch elm disease (DED) reports were common in Maine wherever American elm trees grow. Overall, the level of disease is judged to be at moderate levels in younger elms in mixed forest and roadside stands. Landowner requests for assistance have been up slightly from previous years, but the anecdotal information from field staff and land managers has indicated that, from a statewide perspective, DED levels are about normal this year.

Oak Dieback
***Diplodia corticola* (=*Botyrosphaeria corticola*)**
Hosts: Oak (*Quercus* spp.)

In 2017 symptoms of oak dieback were observed in Cumberland and Kennebec counties. Symptoms include the drying and death of leaves and branch tips, often with a clearly delimited canker separating the dead portion from the live portion of the branch. Leaves on affected branches become brown and persist on the tree for several weeks or more. Occasionally, twigs of branches more proximal to the stem are affected first, rather than those at the branch tip itself. 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): Eastern White Pine (*Pinus strobus*)

White pine blister rust remains a significant threat, especially to white pine regeneration and sapling-sized trees and stands throughout Maine. A 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. In Maine, 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. Planned efforts to assess overall white pine health, associated with the Evaluation and Monitoring project funded by the USFS during the 2018 field season, will provide more information about the current impacts of this non-native disease.

Abiotic/Weather Events

Drought

The weather conditions during July – October were unusually dry and led to drought conditions in much of the southern half of Maine. Drought was especially severe in coastal and island areas. A similar situation occurred in summer 2016, leading to dieback and even mortality of trees in 2017. Approximately 430 acres of drought-related damage were mapped through aerial survey in 2017. Further dieback and mortality could be expected due to the 2017 drought in 2018.

Herbicide

Reports of herbicide damage to trees in residential areas were up in 2017 compared to 2016. Harm to non-target trees and shrubs due to improper application of broad-spectrum herbicide and broadleaf weed control products was seen in these cases.

Wind Event

A strong wind event on October 30th toppled trees across much of the southern half of Maine. Coastal areas reported more extensive acreages of windthrown trees and several recently thinned forest areas were severely affected. Aerial survey was conducted to estimate the extent of forest damage in central and southern Maine. There was minimal damage visible from the air. In general, individual trees or very small groups of trees were uprooted or snapped off, most visible along opening edges. Ground checks showed pines tended to be most affected in the interior but the surrounding canopy obscured the downed trees and they occurred singly, not in patches large enough to be seen from the air.

Division Activities

Northeast Forest Fire Protection Compact - Forest Health Working Team

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

There were six mobilizations associated with the NFFPC Forest Health Working Team in 2014 and 2015, none in 2016 and two in 2017. In April 2017, crews from ME, NH and VT mobilized to NB to survey for brown spruce longhorned beetle. Travel funds for this mobilization were paid by voluntary dues submitted by working team member jurisdictions. In July 2017, a training for recognition and management of oak wilt and emerald ash borer was held in Pittsburgh, PA. Crews from within and outside of the compact participated in the training.

Mobilization efforts are a definite success from Maine's "sending jurisdiction" perspective: response was expedited and finance and logistical matters were facilitated through the Compact's oversight. More importantly, we were able to provide survey and response training to MFS staff so that we are better prepared to address emerging threats before they arrive in Maine. We also now have a way to call for assistance when Maine has a pest problem requiring additional resources. In these times of shrinking resources, this initiative is proving to be extremely beneficial.

The Maine Forest Service has promoted a suggestion that the USFS release some of the funds currently targeted for other projects and reallocate them to maintain a standing pool of funding to underwrite survey mobilizations under the NFFP Compact's forest health working team. We also believe that, where all states in the Northeast Area are members of analogous mutual aid Compacts, this approach would be beneficial for the entirety of the region. This effort resulted in funds awarded to the compact for Asian longhorned beetle in September of 2017.

Aerial Survey

Aerial survey flights were flown from June into November in 2017 for both delineating forest pest problems and overflights detecting potential damage and stress situations. Damage by the following damage agents was mapped: bare-patched oak leafroller (*Pseudexentera spoliana*), browntail moth (*Euproctis chrysorrhoea*), hemlock woolly adelgid (*Adelges tsugae*) winter moth (*Operophtera brumata*), drought, logging damage, shoot blights, and white pine needle damage. Trees along the margins of ponds, beaver flowages, heaths, etc., are in poor health across the

entire state due to fluctuating water levels in recent years. Birch at high elevations is in poor condition overall. Beech in northwestern parts of the state, where beech bark disease is killing trees on the hardwood ridges, is also noticeable.

We continue to balance the need to survey the forest with the cost of flights. The survey flights were made from MFS aircraft. In addition, trained, unaccompanied MFS pilots conduct initial aerial reconnaissance in sections of the state where no new detectable stress events are anticipated. This effort is incorporated into fire detection and other MFS routine flight activities. If they see anything unusual in the forest they give a call to the Entomology Lab. We also solicit ancillary ad hoc reports from outside cooperators. These efforts augment our internal capacity and provide a cost effective initial detection tool for triggering targeted survey and evaluation.

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

Firewood and Invasive Insects Awareness Campaign

Maine Forest Service continues to partner with the DACF Division of Animal and Plant Health on invasive insect outreach – in particular, hemlock woolly adelgid, winter moth, and browntail moth, and emerald ash borer. In 2017, the Maine Association of Conservation Districts contracted with DACF Division of Plant and Animal Health to do outreach on invasive insects. This was funded by a Farm Bill cooperative agreement with USDA-APHIS.

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

The firewood message was promoted in several ads in various camping magazines and newspaper supplements. The goal of these ads was to reach out-of-state campers before they left home with their firewood. Cooperators serving the camping/outdoor recreation public also help promote the message.

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.

DACF Plant Health Division has partnered with Firewood Scout to showcase local sources of firewood within the state. More information can be found at: www.firewoodscout.org/s/ME.

Insect Collection

The Maine Forest Service Insect Collection has over 70,000 specimens in the reference portion of the collection. Additionally, there are now more than 5,000 ant specimens stored in alcohol, more than 60,000 spider records, and in excess of 10,000 bark beetle and woodborer specimens. Besides having most of the specimens 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 collections 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.

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 2017 in locations from South Berwick to Ashland to Topsfield (Table 5). Rothamstead light traps are used in most locations with blacklight (BL) traps at the remaining sites. The Rothamstead trap has a 150W light bulb inside a protective casing with an entry for moths. The moths fall down a funnel into a can where they die. Blacklight traps have metal fins that the moths hit as they fly toward the light and then fall into a collecting can. One light trap runs on batteries as there is no power at Frost Pond. Trap operators collect the catch daily and send it in weekly to be processed. Traps run for 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. 2017 light trap locations

Trap Location	County	Start Date	End Date	No. Nights	Trap
Turner	Androscoggin	6/17/2017	7/31/2017	45	Rothamstead
Ashland	Aroostook	7/1/2017	7/31/2017	30	Rothamstead
Crystal	Aroostook	7/1/2017	7/31/2017	30	Rothamstead
New Sweden	Aroostook	7/1/2017	7/31/2017	30	Rothamstead
T15 R15 WELS	Aroostook	7/1/2017	7/31/2017	30	Rothamstead
Cape Elizabeth	Cumberland	6/17/2017	7/31/2017	45	Rothamstead
Freeport	Cumberland	6/17/2017	7/31/2017	45	Rothamstead
Rangeley	Franklin	6/17/2017	7/31/2017	45	Rothamstead
Salem Twp	Franklin	7/1/2017	7/31/2017	30	Rothamstead
Bar Harbor	Hancock	6/17/2017	7/31/2017	45	Rothamstead
Hope	Knox	6/17/2017	7/31/2017	45	Rothamstead
Exeter	Penobscot	6/17/2017	7/31/2017	45	Rothamstead
Millinocket	Penobscot	6/17/2017	7/31/2017	45	Rothamstead
Bowerbank	Piscataquis	6/17/2017	7/31/2017	45	Rothamstead
T3 R11 WELS	Piscataquis	6/17/2017	7/31/2017	45	BL-Battery
Big Six Twp	Somerset	7/1/2017	7/31/2017	30	Rothamstead
Jackman	Somerset	6/17/2017	7/31/2017	45	Rothamstead
Calais	Washington	6/17/2017	7/31/2017	45	BL-110V
Topsfield	Washington	6/17/2017	7/31/2017	45	Rothamstead
South Berwick	York	6/17/2017	7/31/2017	45	Rothamstead

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 2017 growing season. Our use of web-based vehicles continued to increase our readership with now over 2100 people choosing to use the electronic format (an increase of ~400 over 2016 subscriptions). We also continue to offer these products in the traditional paper format (approx. 64 subscribers for the paper format). Both these formats continue to be 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 – 2017.**

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 thuringiensis* 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.

46. Houston, D. R. and W. D. Ostrofsky. Patterns of Infection and Spread of European Larch Canker on Tamarack in Eastern Maine. March 2017. 29 pp.

Appendices

Appendix A
Forestry Related Quarantines in Maine – 2017

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

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

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

I. White Pine Blister Rust

a. Rules and Regulation

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

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

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

Gypsy Moth

c. Rules and Regulation:

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

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

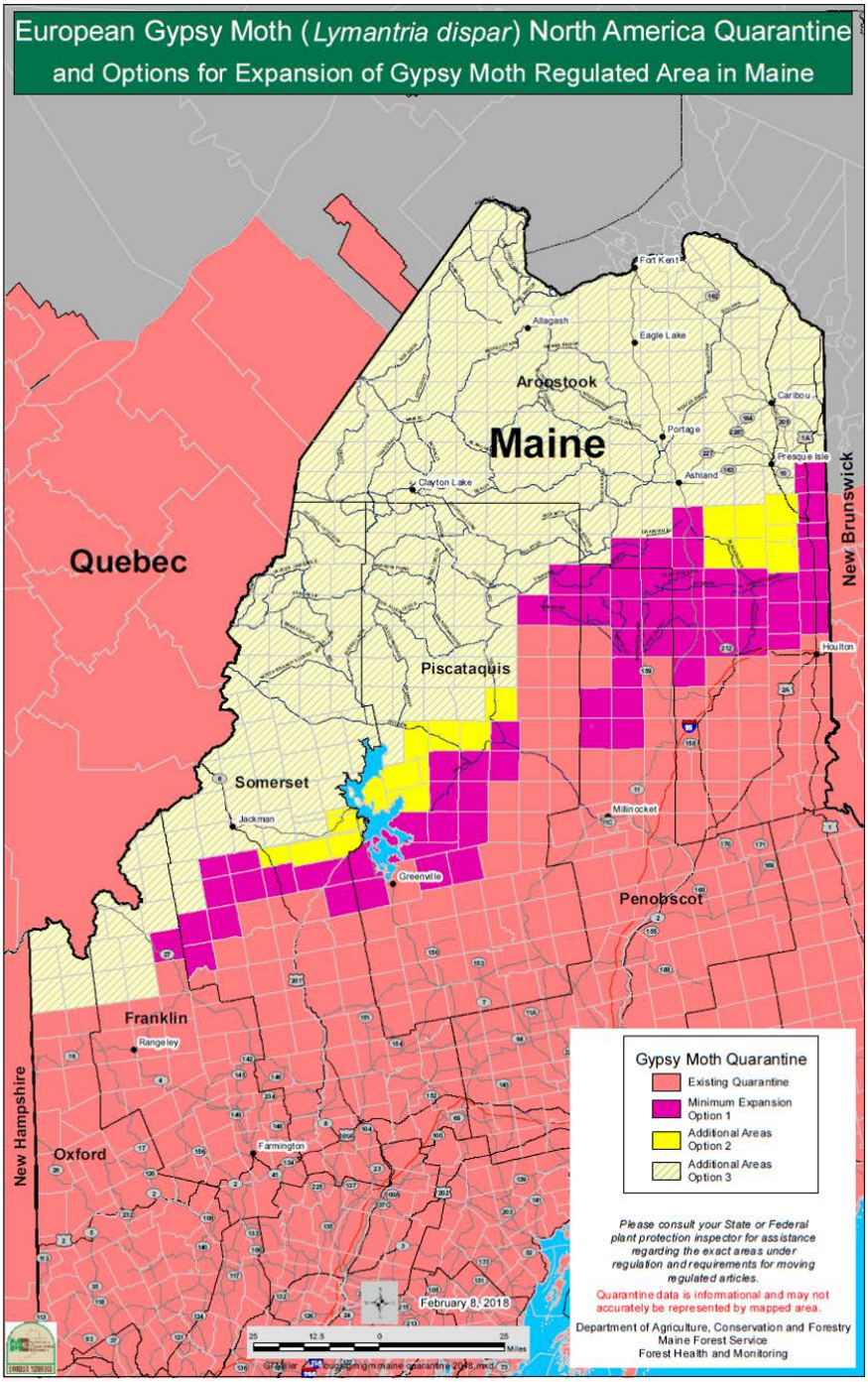
Since **Maine is not completely infested and quarantined**, wood or regulated articles moving *from the infested area* of the state *to the non-infested area* of the state must be accompanied by a certificate or go to a facility under state compliance agreement which allows the reception of such articles. Regulated articles moving *from the non-infested* area of the state *to other non-infested states or non-infested parts of Canada* must be accompanied by a state permit stating that the regulated article originated outside of the infested area of the state. This is managed by the Forest Health & Monitoring Division of the Maine Forest Service, phone (207) 827-1813 or (207)287-2791.

e. **Note:** The regulated area for the gypsy moth quarantine is due for expansion, see discussion below.

Potential Options for Expansion of The Gypsy Moth Quarantine in Maine

The following map illustrates three potential options for expansion of the gypsy moth quarantine in Maine which were floated to stakeholders in preparation for beginning rulemaking. The options were detailed as follows:

1. Allow the entire state to become regulated for gypsy moth. This is what will happen with no change to our state-level quarantine rules.
2. Add the smallest area of the state practical to the new regulated area. This option would work with our weather in the uninfested region to continue to slow the spread of gypsy moth, but would entail change in regulation on a more frequent basis than option 3. A compliance agreement or similar would be needed to move material within the state from within the regulated area to outside the regulated area. Material originating in the unregulated area would not be constrained by the gypsy moth quarantine rules. (See Option 2 Map)
3. Add a larger area of the state, but not the entire state to limit the number of times we need to change the rules regarding this pest, but reduce the restraints on movement of products from uninfested areas. (See Option 3 Map)



II. European Larch Canker

a. Rules and Regulation:

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

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

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

III. Hemlock Woolly Adelgid

a. Rules and Regulations:

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

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

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

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

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

IV. Pine Shoot Beetle

a. Rules and Regulations:

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

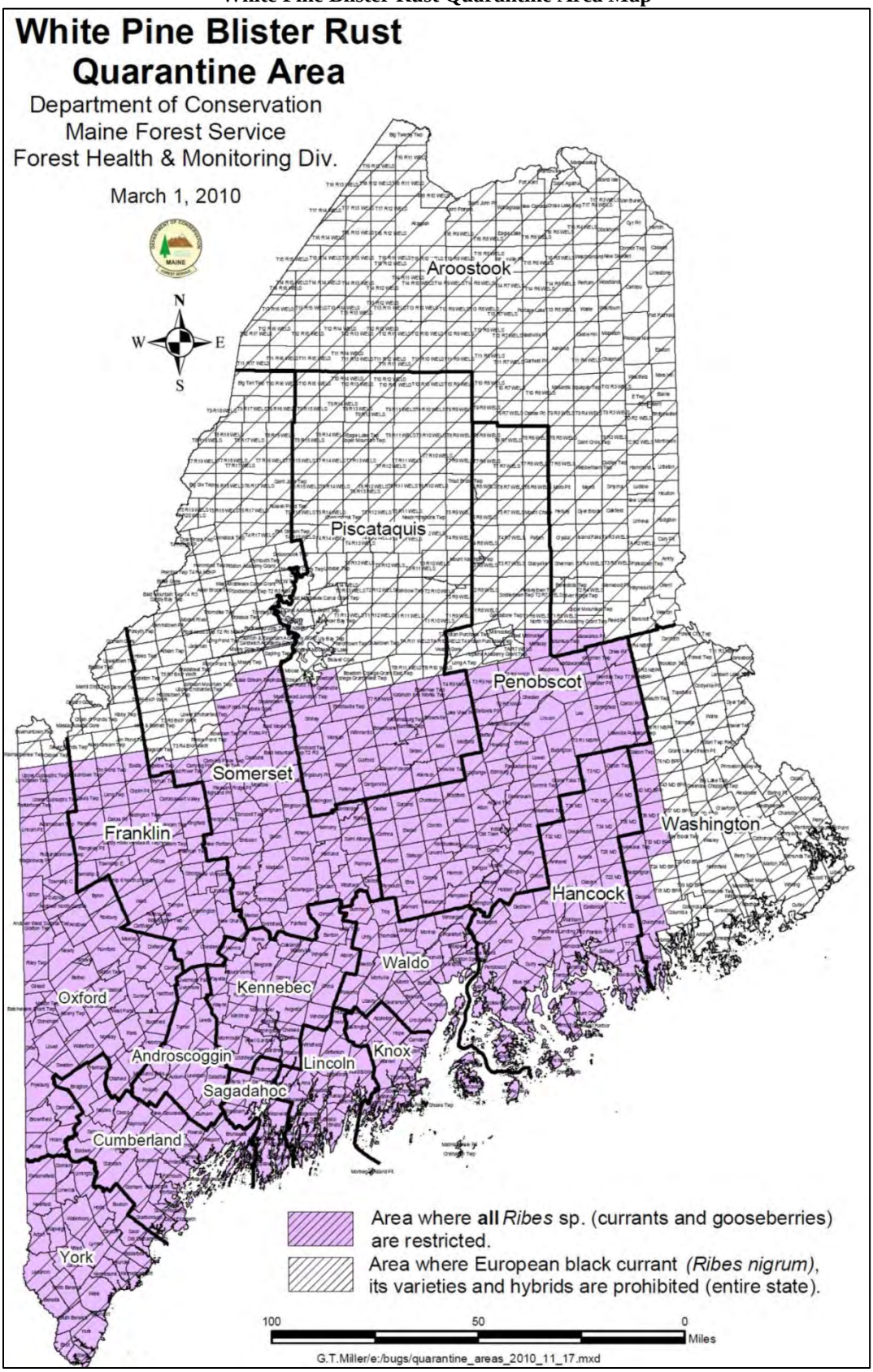
ii. 7 MRSA, Chapter 409, Section 2301 of the Laws of the State of Maine.

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

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

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

White Pine Blister Rust Quarantine Area Map



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

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

Androscoggin County: The entire County.

Aroostook County: Macwahoc Plt, Molunkus Twp

Cumberland County: The entire County.

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

Hancock County: The entire County.

Kennebec County: The entire County.

Knox County: The entire County.

Lincoln County: The entire County.

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

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

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

Sagadahoc County: The entire County.

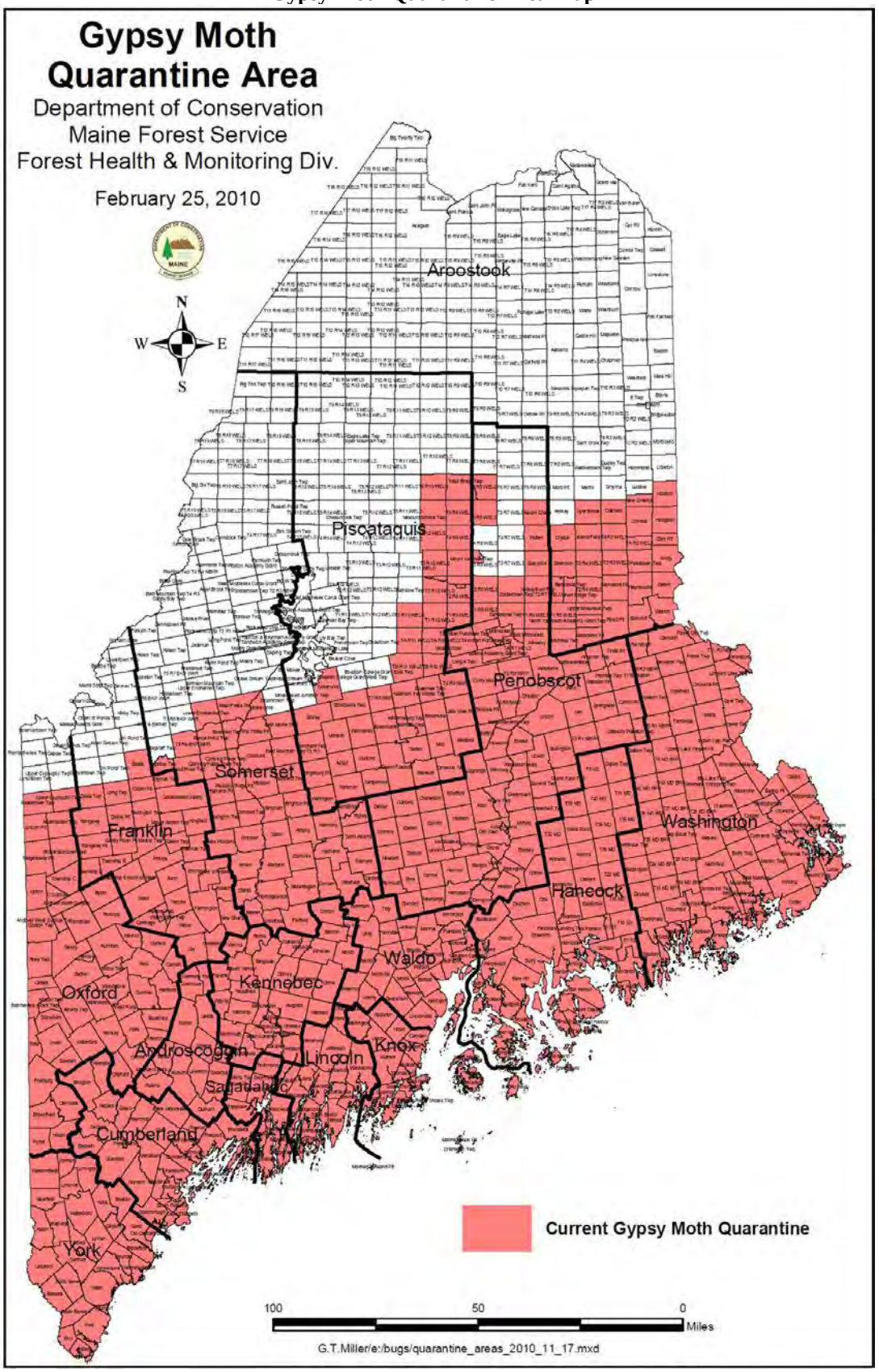
Somerset County: Anson, Athens, Bald Mountain Twp T2 R3, Bigelow Twp, Bingham, Bowtown Twp, Brighton Plt, Cambridge, Canaan, Caratunk, Carrying Place Town Twp, Carrying Place Twp, Chase Stream Twp, Concord Twp, Cornville, Dead River Twp, Detroit, East Moxie Twp, Embden, Fairfield, Harmony, Hartland,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

Waldo County: The entire County.

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

York County: The entire County.

Gypsy Moth Quarantine Area Map



Areas Regulated by Maine's Gypsy Moth Quarantine

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

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

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

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

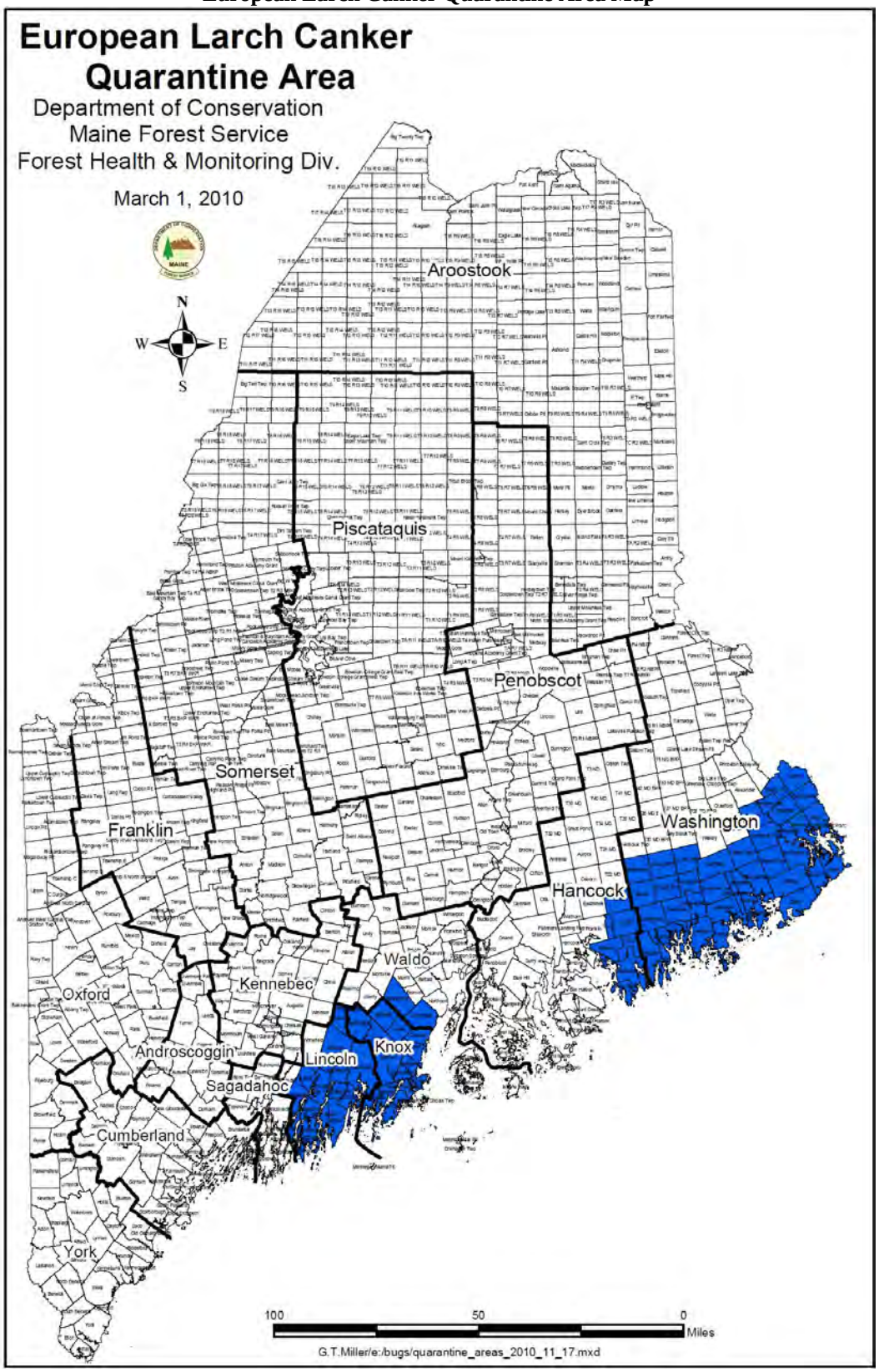
Oxford County- Adamston Twp, Albany Twp, Andover, Andover North Surplus, Andover West Surplus Twp, Batchelders Grant Twp, Bethel, Brownfield, Buckfield, Byron, C Surplus, Canton, Denmark, Dixfield, Fryeburg, Gilead, Grafton Twp, Greenwood, Hanover, Hartford, Hebron, Hiram, Lincoln Plt, Lovell, Lower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

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

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

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

European Larch Canker Quarantine Area Map



Towns Regulated by Maine's European Larch Canker Quarantine

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

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

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

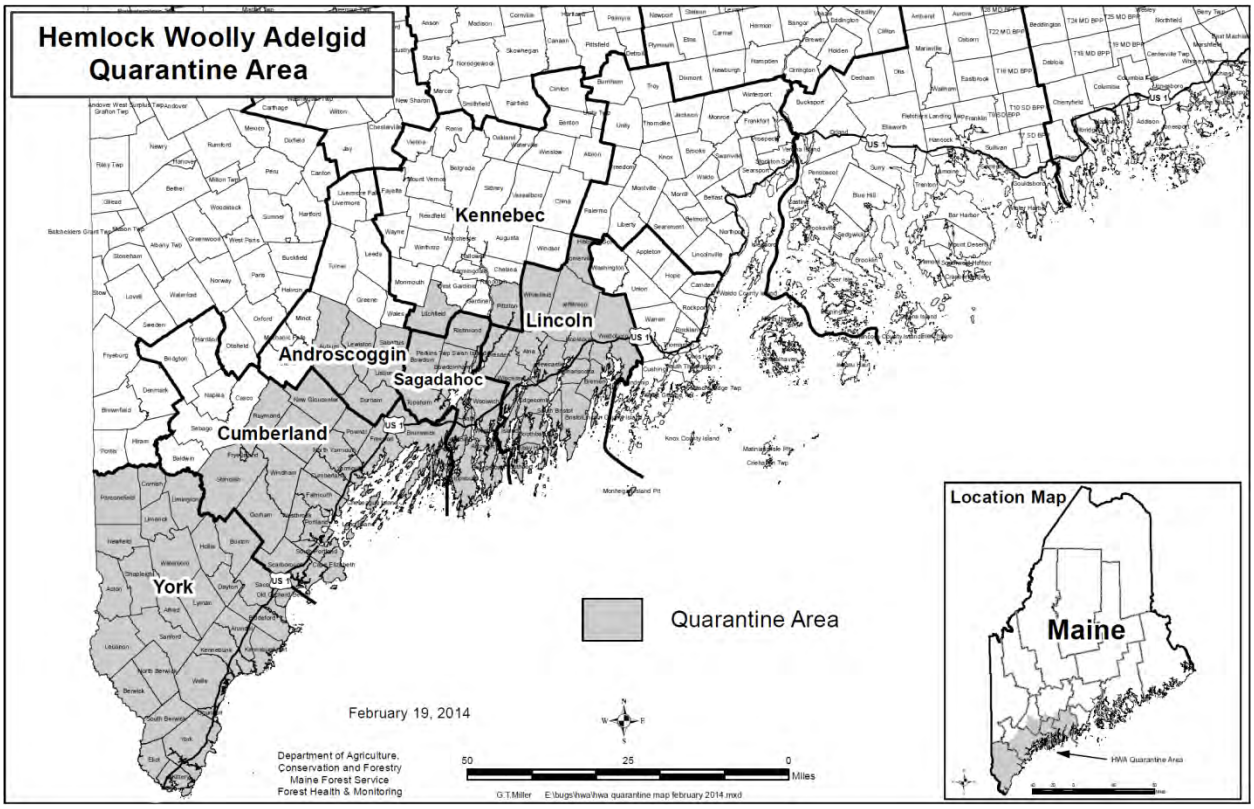
Waldo County - Lincolnville and Searsmont

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

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

Quarantined Areas in Maine:

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



Quarantined Counties in New Hampshire:
Belknap, Carroll, Cheshire, Grafton, Hillsborough, Merrimack, Rockingham, Strafford, Sullivan

Quarantined Counties in Vermont: Bennington, Windham, Windsor

Other Quarantined Areas:

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

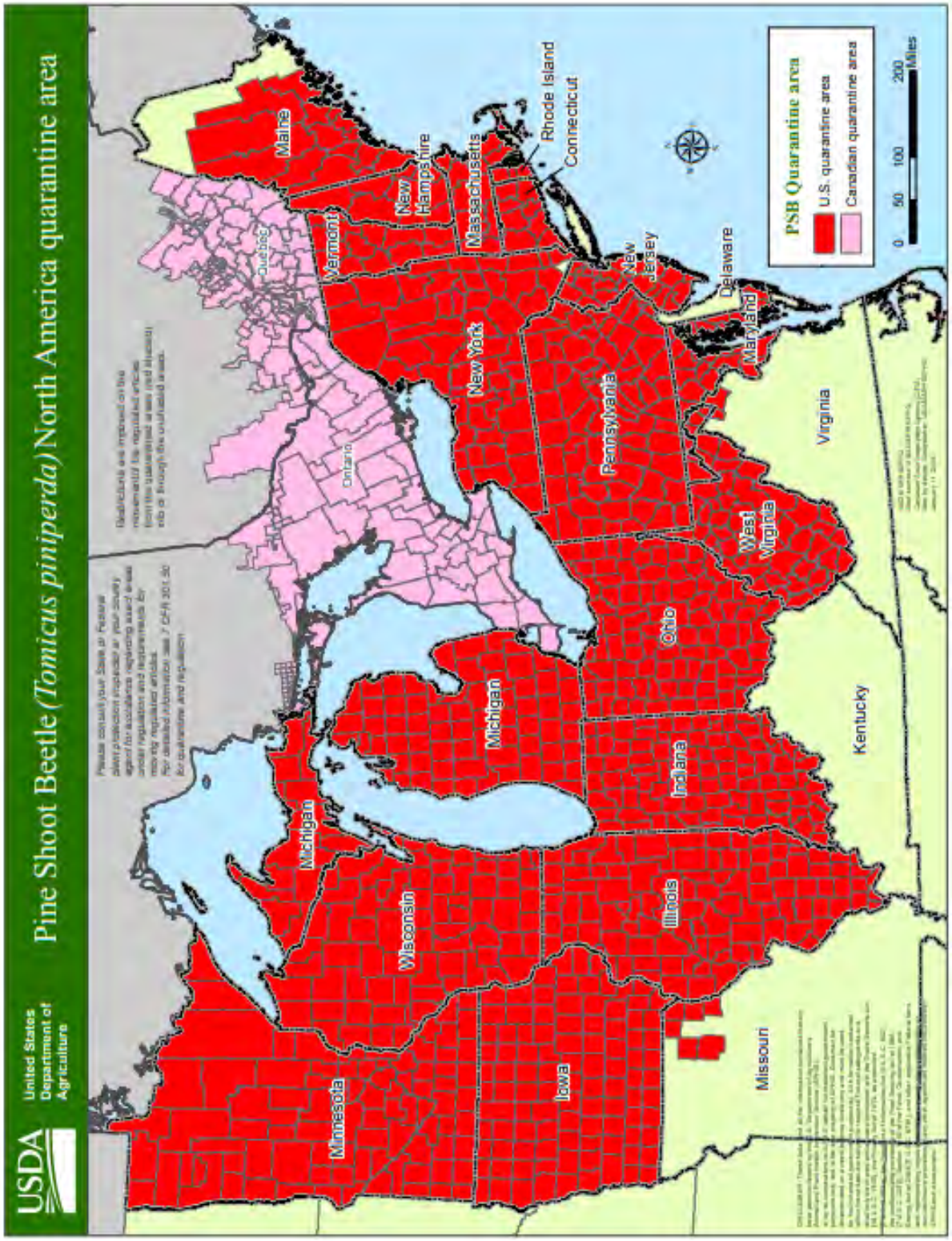
All or Parts of:
Connecticut (All)
Delaware (All)
Georgia (Parts)
Kentucky (Parts)
Massachusetts (All)
Maryland (All)
Michigan (Parts)
New Hampshire (Parts)
New Jersey (All)
New York (Parts)
North Carolina (All)
Ohio (Parts)
Pennsylvania (Parts)
Rhode Island (All)
South Carolina (Parts)
Tennessee (Parts)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

Western United States:

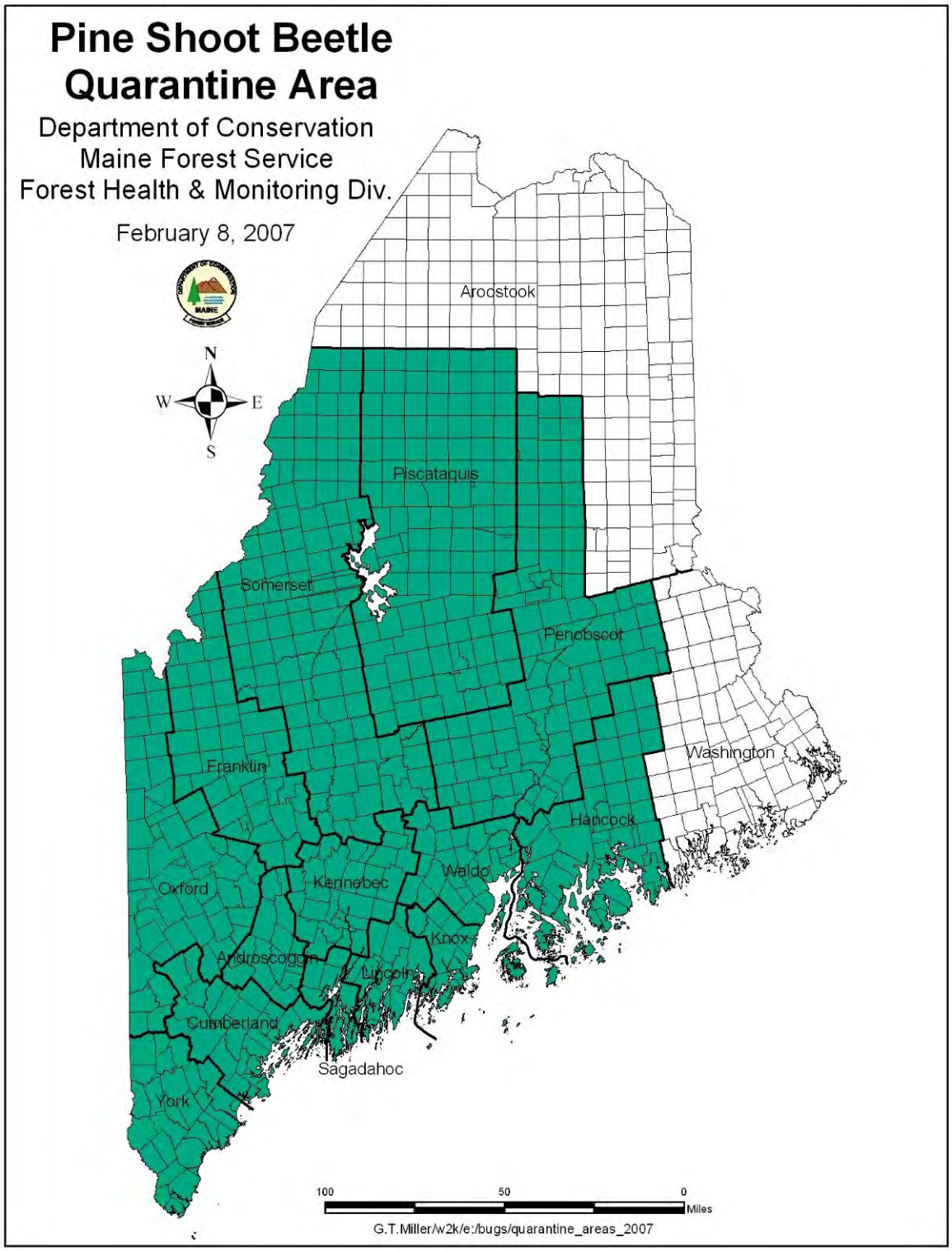
The Entire States of:
Alaska
California
Oregon
Washington

Western Canada
British Columbia

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



Maine Pine Shoot Beetle Quarantine Area Map



Maine Counties Regulated by the Pine Shoot Beetle Quarantine

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

Appendix B

2017 Hemlock Woolly Adelgid and Elongate Hemlock Scale Report

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

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

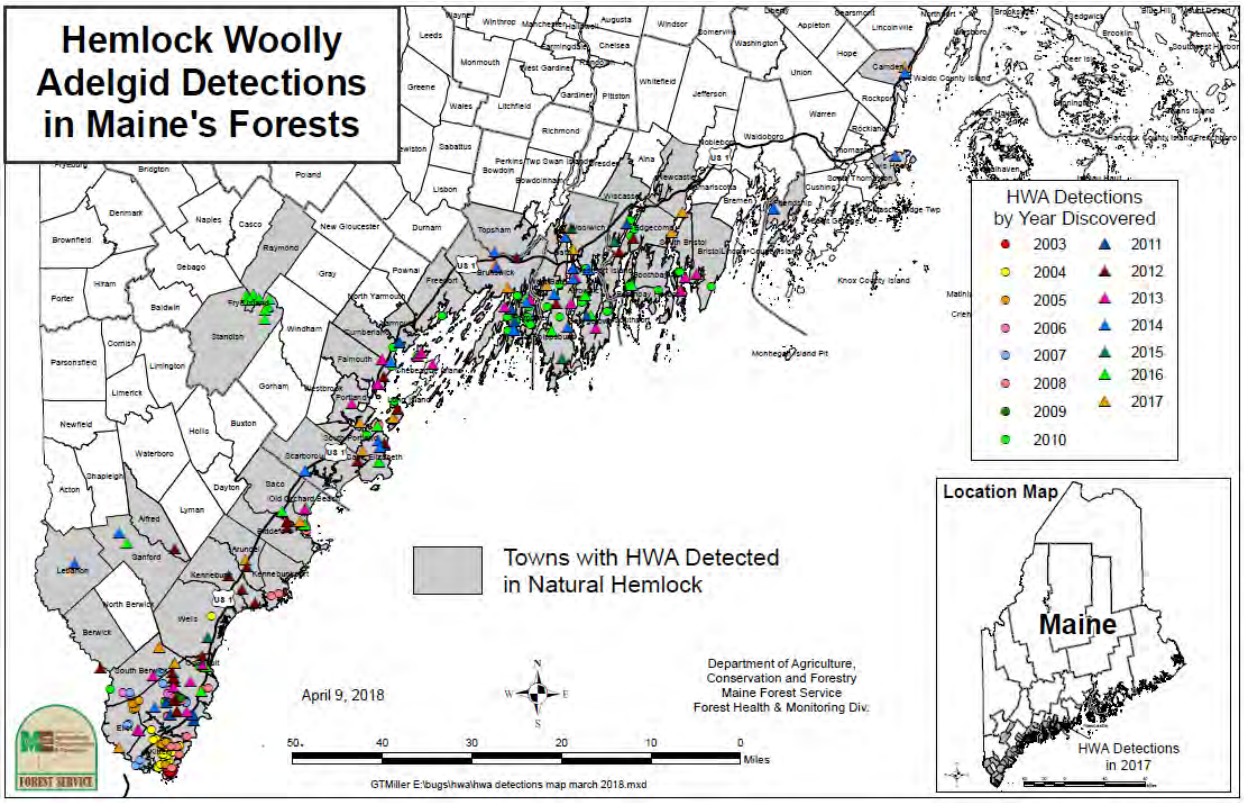


Figure B1. Hemlock woolly adelgid detections in Maine's forests

Elongate hemlock scale (EHS) (*Fiorinia externa*) is an emerging invasive forest insect problem in the state of Maine. It was first recognized in the state in 2009, and MFS has had spray programs to contain individual sites of infestation on planted trees since then. EHS was detected in the forest for the first time on Gerrish Island (Kittery) York County) in fall of 2010. Until 2016, all subsequent forest detections were in forests of one town (Kittery, York County). However, in 2016, EHS was discovered on planted trees outside a fire station in Frye Island, and has spread to a few trees in adjacent forested land. Because the infested trees brushed against emergency vehicles every time they left the station, EHS has very likely been transported to other areas on the island, although there have as yet been no further detections. Several detections on ornamental trees are usually reported each year, so far scattered from Kittery to Mount Desert (Figure B2). There were no new detections of EHS in 2017.

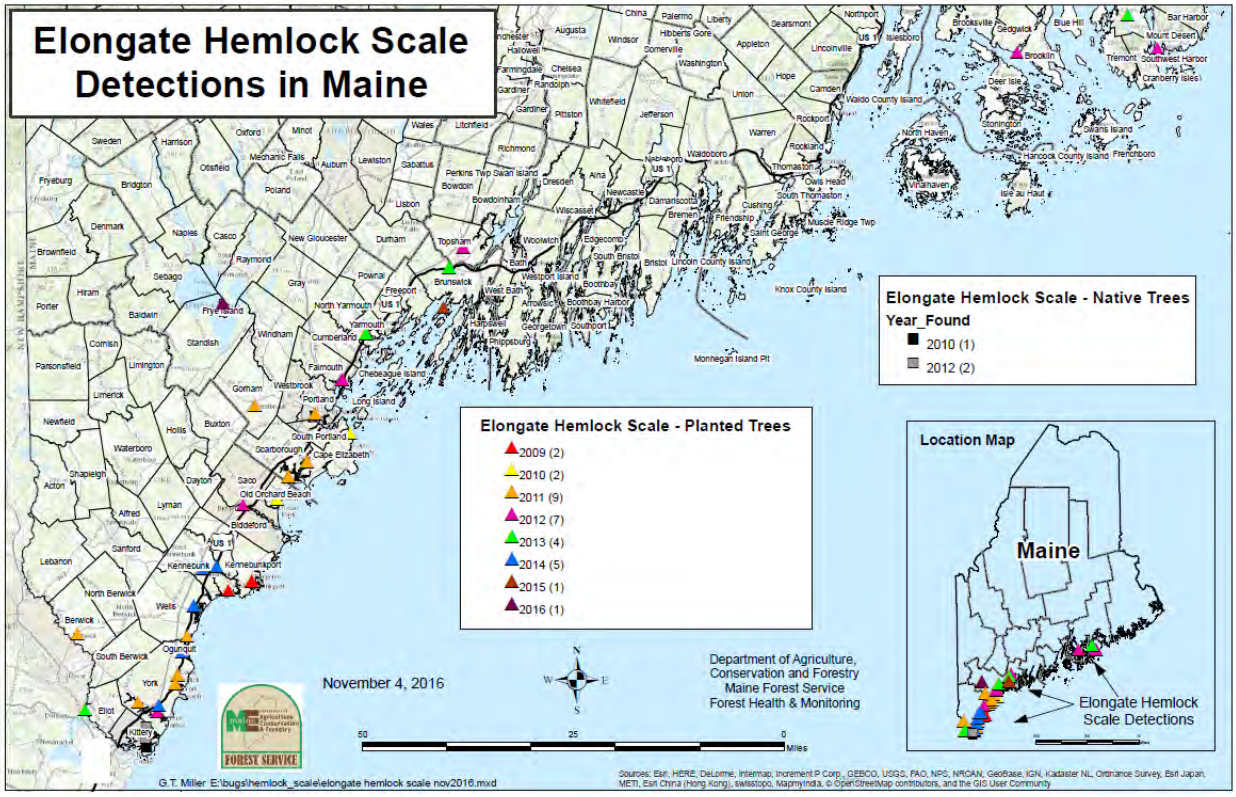
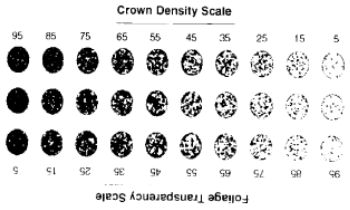


Figure B2. Locations of forest and planted tree detections of elongate hemlock scale in Maine

The bulk of the field work for these projects was conducted by Wayne Searles and Regina Smith. We had additional assistance from Greg Bjork (MFS-FIA), Amy Ouellette, Melanie Duffy (MFS-FIA), and others. A summary of 2017 activities related to these two pests follows.

Hemlock monitoring plots were established in Maine to assess hemlock crown health and presence of three stressors (HWA, EHS and hemlock tip blight (*Sirococcus tsugae*)). Five sites were established in 2011, one in 2015 in Hallowell, outside the infested area of Maine, and one in 2016 in an uninfested area of Frye Island, Maine's most inland HWA infestation. Crown indicators and damage agent information was collected on each of the plots during December 2017 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 plots. Infestation status (infested or not) of individual trees is based on what observers can see from the ground. 2014 values are reported for uncompacted live crown ratio (uLCR) and retained foliage: variables that were not collected in 2011. Values for retained foliage (Orwig) and training aid for crown density and foliage transparency are as follows:

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



A non-statistical comparison of average values on the impact plots is presented below (Table B1).

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

Location (Year Established)	**Infestation Status**	**No. Infested Hemlock/ No. Live Hemlock**		**Average Crown Density**		**Average Foliage Transparency**		**Avg. uLCR**		**Average Retained Foliage**	
		2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Hallowell (2015)	No HWA detected	0/52	0/52	44%	43%	20%	19%	44%	45%	1.1	1.1
		2011	**2017**	**2011**	**2017**	**2011**	**2017**	**2014**	**2017**	**2014**	**2017**
Pownal (2011)	No HWA detected	0/59	**Not recorded	56%	40%	20%	20%	63%	63%	1.2	1.4
Wiscasset (2011, partial harvest 2014)	Light HWA infestation, detected 2011	0/50 0/31*	Not recorded	60% 62%*	32%	18% 18%*	23%	68%	66%	1.2	1.2
Freeport (2011)	Moderate HWA infestation, detected 2010	2/63	Not recorded	48%	36%	21%	33%	52%	44%	1.3	1.8
York (2011)	Light HWA, detected 2006	6/63	Not recorded	45%	26%	25%	40%	65%	60%	2.0	2.4
Kittery (2011)	Heavy HWA & EHS, detected 2003 (HWA) and 2010 (EHS)	58/58 (HWA) 40/58 (EHS)	46/47 (HWA) 35/47 (EHS)	34%	32%	37%	30%	63%	66%	2.4	2.5

* Values with * for trees present at 2011 and 2017 measurements.

** presence of HWA not recorded because foliage was too far from ground

Detection Surveys

Maine Forest Service conducts an annual detection survey for HWA in towns along the border of the quarantine area for the pest. Limited detection surveys are also conducted within the quarantine area in towns without adelgid detections. In 2017, detection surveys were conducted on 67 sites across 13 towns and 3 counties (Table B2). The target of at least 200 branches surveyed was achieved at all of these sites. In this survey, EHS was watched for, but was not detected. Given size and location of EHS, adelgid focused surveys are not necessarily going to be efficient in detecting trace amounts of scale.

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

County	Town	# Sites	Sites with >200 Branches	Town HWA Detection Status	Town in HWA quarantine?
Androscoggin	Greene	7	7	not detected	no
Androscoggin	Minot	5	5	not detected	no
Androscoggin	Poland	6	6	not detected	no
Androscoggin	Turner	5	5	not detected	no
Androscoggin	Wales	6	6	not detected	no
Cumberland	Baldwin	6	6	not detected	no
Cumberland	Casco	5	5	not detected	no
Cumberland	Naples	5	5	not detected	no
Cumberland	Sebago	5	5	not detected	no
Kennebec	Monmouth	5	5	not detected	no
Kennebec	W. Gardiner	2	2	not detected	no
Oxford	Hiram	5	5	not detected	no
Oxford	Porter	5	5	not detected	no

Winter Mortality Survey

Winter mortality data has been collected for several years for a project in cooperation with Virginia Tech's Tom McAvoy (Figure B3). Adelgid infested branches are collected from five sites for observation under a dissecting scope in early March. Sistens and progrediens density counts were conducted at three sites and results were submitted to our cooperator. Mortality ranged from 59-86% across the five sites, and averaged 68% (Table B3). In comparison, mortality over the mild winter of 2011–2012 was less than 18% across five sites.

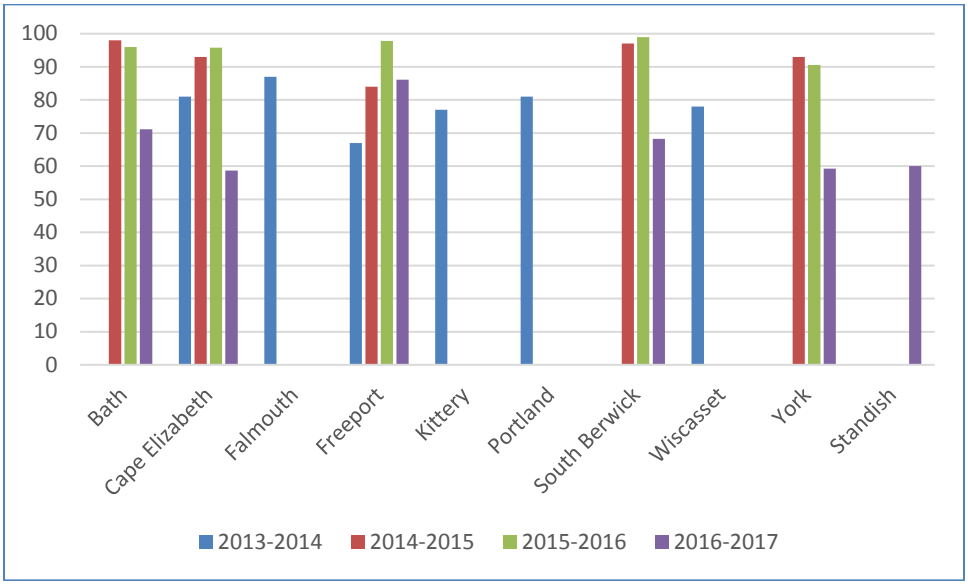


Figure B3. Overwintering mortality of hemlock woolly adelgid in Maine 2014–2017

Table B3. Hemlock woolly adelgid overwintering mortality (Winter 2017)

County	Town	Date Collected	Date Counted	# HWA dead	# HWA alive	% mortality
York	York	3/21/2017	3/22/2017	303	208	59.3
York	South Berwick	3/21/2017	3/22/2017	318	148	68.2
Cumberland	Cape Elizabeth	3/20/2017	3/22/2017	310	218	58.7
Cumberland	Freeport	3/20/2017	3/23/2017	485	78	86.1
Cumberland	Standish	3/21/2017	3/24/2017	312	208	60.0
Sagadahoc	Bath	3/20/2017	3/23/2017	364	148	71.1
			totals	**2092**	**1008**	**67.5**

Biological Control

Sasajiscymnus tsugae beetles were released in two location this year in Maine. A group of homeowners in a subdivision in Wells bought 650 beetles from Tree-Savers which were released in May. In June 1000 beetles were given to Maine Forest Service by Tree-Savers and released in Woolwich. *Laricobius osakensis* was released at the field insectary on Frye Island, with 1000 beetles released on each of two dates in November. In addition, Maine Forest Service assisted the Rachel Carson Wildlife Refuge in creating a field insectary on their property in southern Kittery, and 500 *L. occidentalis* were released there. These beetles were obtained from Virginia Tech.

In past years, since the initial detection of HWA in Maine's forests, the MFS has facilitated the release of over 100,000 *S. tsugae* beetles and more than 5000 *Laricobius nigrinus* beetles (Table B4). These sites range along the known distribution of HWA (Figure B4). In addition, MFS conducted experimental pre-inoculative releases of *S. tsugae* on other adelgid species in three sites in Maine prior to HWA detection (Table B5).

Table B4. Hemlock woolly adelgid biological control releases 2004–2016

County/Town	***Laricobius nigrinus*** **Released**	***Laricobius osakensis*** **Released**	***Sasajiscymnus tsugae*** **Released**
Cumberland		**1450**	**24,303**
Cape Elizabeth			5,000
Freeport			10,500
Harpswell			7,500
Portland			1,303
Frye Island		1450	
Lincoln			**6,500**
Wiscasset			6,500
Sagadahoc			**16,469**
West Bath			4,000
Bath			4,500
Woolwich			7,969
York	**5,272**	**500**	**53,218**
Kittery	900	500	17,734
Saco	500		4,500
Sanford			5,000
South Berwick			14,037
Wells			650

York	3,872		11,297
Grand Total	**5,272**	**1950**	**100,990**

Table B5. 2002 Pre-inoculative release of *Sasajiscymnus tsugae* in Maine

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

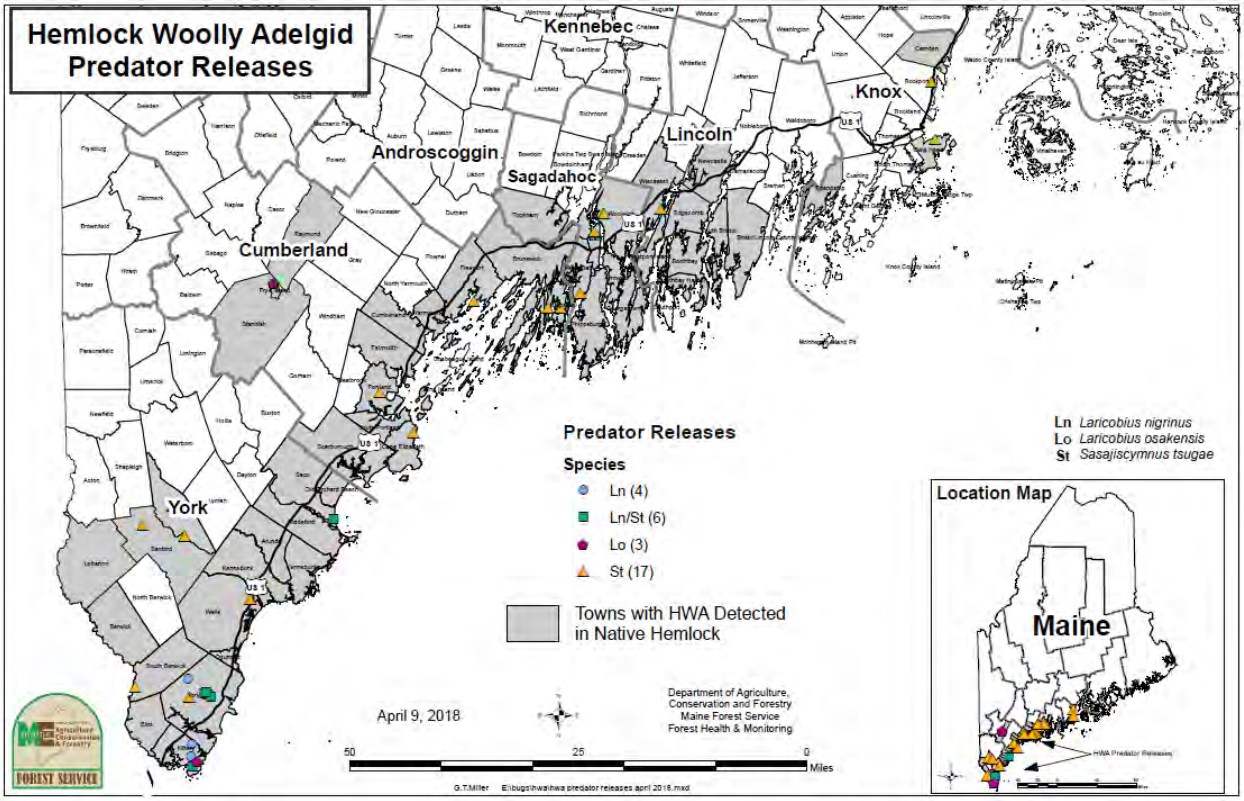


Figure B4. *Sasajiscymnus tsugae* (St), *Laricobius osakensis*(Lo) and *L. nigrinus* (Ln) release sites in Maine 2002–2017

Each fall, all 16 release sites are sampled to determine whether predator beetles have become established. In 2017, one *Laricobius nigrinus* were recovered in York (York County). *Sasajiscymnus tsugae* beetles were recovered from five release sites in Freeport (Cumberland County), Wiscasset (Lincoln County), and Bath, West Bath and Woolwich (Sagadahoc County). (Table B6 and Table B7).

Table B6. *Laricobius nigrinus* recoveries in Maine (2007–2017)

Year	Number per General Location (areas with recoveries only)		
	Kittery	**York**	**Saco**
2006	Release Year		
2007	0	Release Year	
2008	0	0	Release Year
2009	0	**1**	0
2010	**2**	**7**	**1**

2011	**2**	0	0
2012	0	0	0
2013	0	0	0
2014	0	**12**	0
2015	0	0	0
2016	0	0	0
2017	0	1	0

Table B7. *Sasajiscymnus tsugae* recoveries in Maine (2005–2017)

Year	**Number per General Location (areas with recoveries only)**								
	Kittery	**York**	**Harpswell**	**Saco**	**West Bath**	**Freeport**	**Wiscasset**	**Bath**	**Woolwich**
2004	Release								
2005	0								
2006	**17**								
2007	**13**	Release							
2008	**18**	**1**							
2009	**28**	0							
2010	**55**	**1**	Release	Release **1**					
2011	**37**	0	**3**	0	Release **1**	Release			
2012	0	0	**2**	0	0	0			
2013	0	0	0	0	0	0	Release		
2014	**6**	0	**1**	0	0	**1**	**0**	Release	
2015	0	0	0	0	0	0	0	0	Release
2016	**26**	0	**5**	0	0	**1**	**5**	0	0
2017	0	0	0	0	**12**	**20**	**33**	**19**	**2**

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

Twenty-four years ago on Frye Island, three trees infested with EHS had been planted outside the fire station. The infestation was not discovered until 2016. These trees were at extremely high risk of spreading EHS throughout the island on emergency vehicles. These trees, and nearby seemingly uninfested trees were treated with dinotefuron basal bark spray in 2017. In addition, EHS was found on three trees in the forest across road. These forest trees, and all fir and hemlock in a 25-foot radius around each of the were similarly treated. Later in the year, the town cut the three heavily infested trees, as they posed a very high risk of spreading EHS, and we did not believe chemical treatment would offer 100% control. In addition, hemlocks infested with HWA which were deemed at high risk of spreading this insect off island were treated with imidacloprid via basal bark spray. In total, about 100 trees were treated for EHS, and 50 for HWA.

Appendix C
Spruce Budworm in Maine 2017

Allison Kanoti, Forest Entomologist
Maine Forest Service, DACF
PO Box 415, Old Town, ME 04468
(207) 827-1813 allison.m kanoti@maine.gov
March 14, 2018

The Maine Forest Service (MFS) and its cooperators are closely watching spruce budworm in Maine to monitor and prepare for another epidemic of this native defoliator. Over the last several years, many indicators have pointed to the imminence of the next epidemic: pheromone and light trap catches have been above zero for a number of years, defoliation in Quebec has increased year after year, defoliation has been mapped in New Brunswick. This is an insect whose epidemics cover vast regions and flights of moths from heavily infested areas can migrate to new areas. The occurrence of another outbreak in Maine, soon, is undeniable. When, where, how severe, and what the specific impacts and reactions may be remain to be seen.

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

The most sensitive method of monitoring budworm is pheromone traps. Permanent pheromone trap locations were established in the early 1990's across the northern half of the State and have been run yearly for the past twenty years. In recent years, that network has run about 80 sites set up by the Maine Forest Service, J.D. Irving Ltd, Penobscot Nation Department of Natural Resources and the USDA Forest Service. Since 2014, the pheromone trap monitoring program has been significantly expanded, with more than twenty land owners and managers participating in setting and retrieving traps at more than 400 sites. In 2017, we welcomed Passamaquoddy Tribal Forestry Department and The Nature Conservancy as new cooperators.

Spruce budworm pheromone survey cooperators 2017

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

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

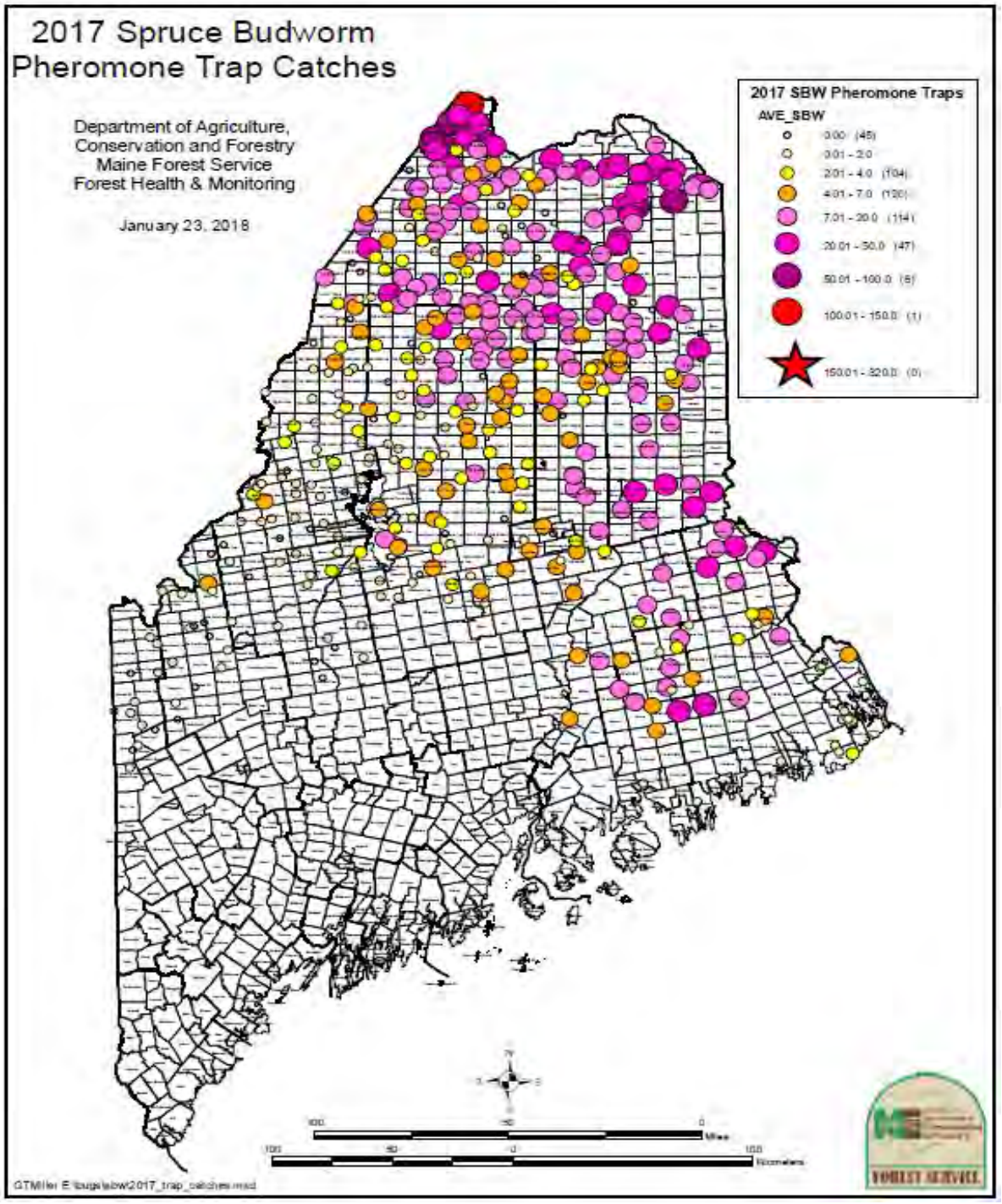


Figure C1. 2017 distribution of spruce budworm pheromone traps and trap catches across Maine.

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

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

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

The expanded spruce budworm pheromone survey shows spruce budworm is widespread but still at low numbers across the trapping range (Figure C1 and Figure C2). Trapping effort was heaviest in the northern third of the state, light across the middle of the state, with no trapping in the south where budworm is not expected to have a direct impact (Figure C1). Across most counties trapped, the average number of moths caught was fairly stable compared to 2016 (Figure C2). As in previous years, most traps (92 percent) captured trace to 50 moths/trap (Figure C3).

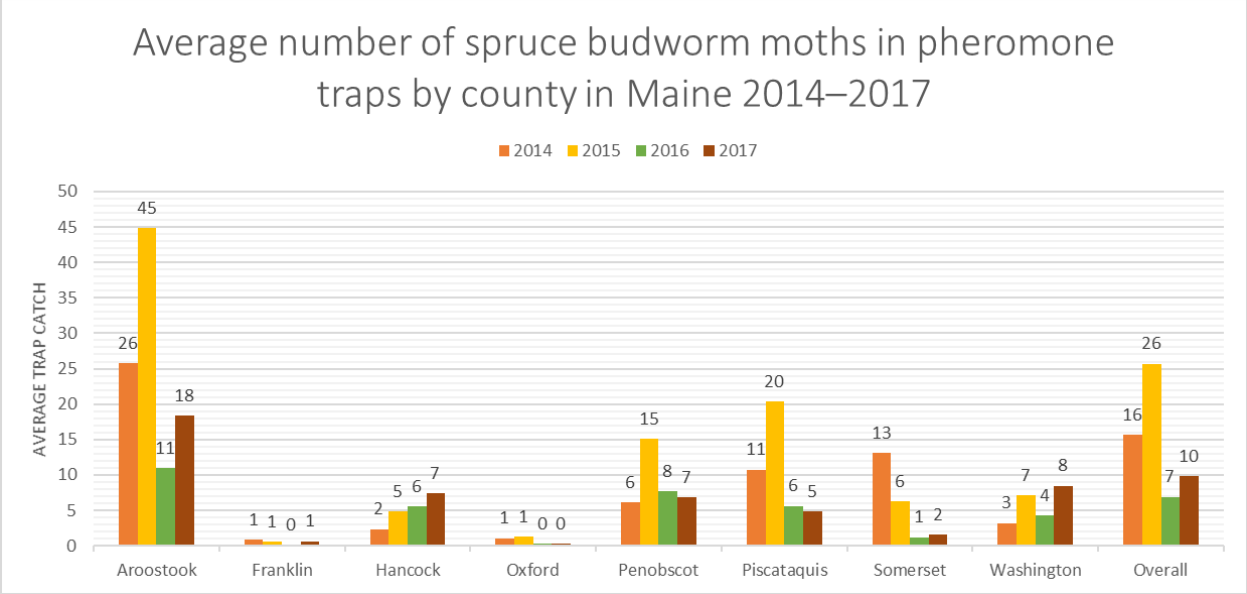


Figure C2. Average number of spruce budworm moths in pheromone traps by county in Maine 2014–2017.

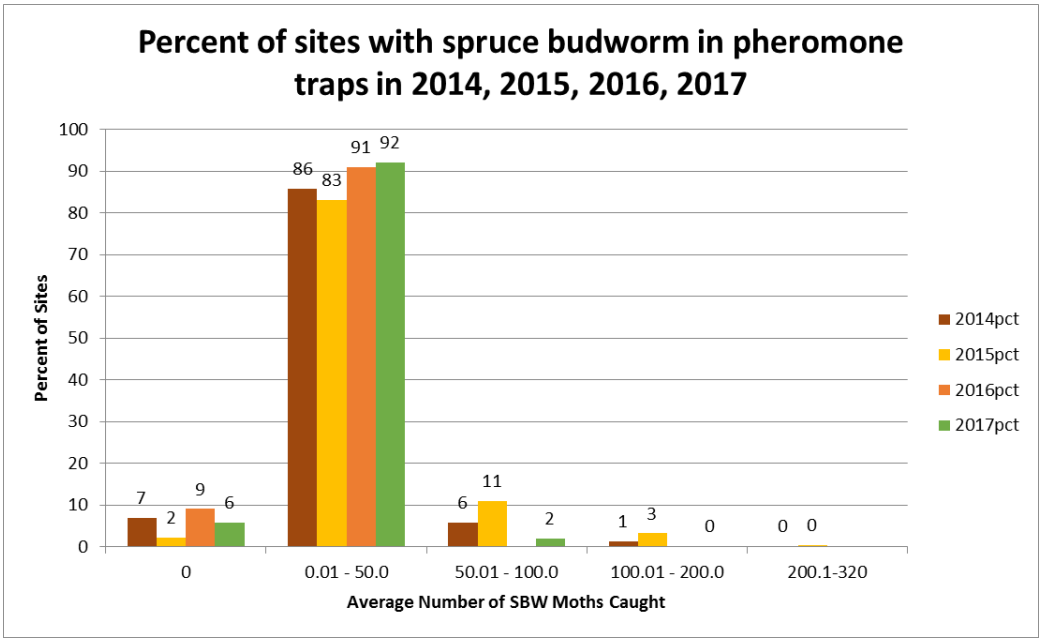


Figure C3. Percent of sites with spruce budworm in pheromone traps by catch 2014–2017.

As noted earlier, the Maine Forest Service has monitored collections at a set of longer term pheromone trap sites for the past 25 years. During that time, the average number of moths/trap stayed well below 10 until 2013 when the number jumped to 18 (Figure C4). In 2014 and 2015 it was above 20 moths/trap. In 2016, average catches declined to seven moths/trap, where they stayed in 2017.

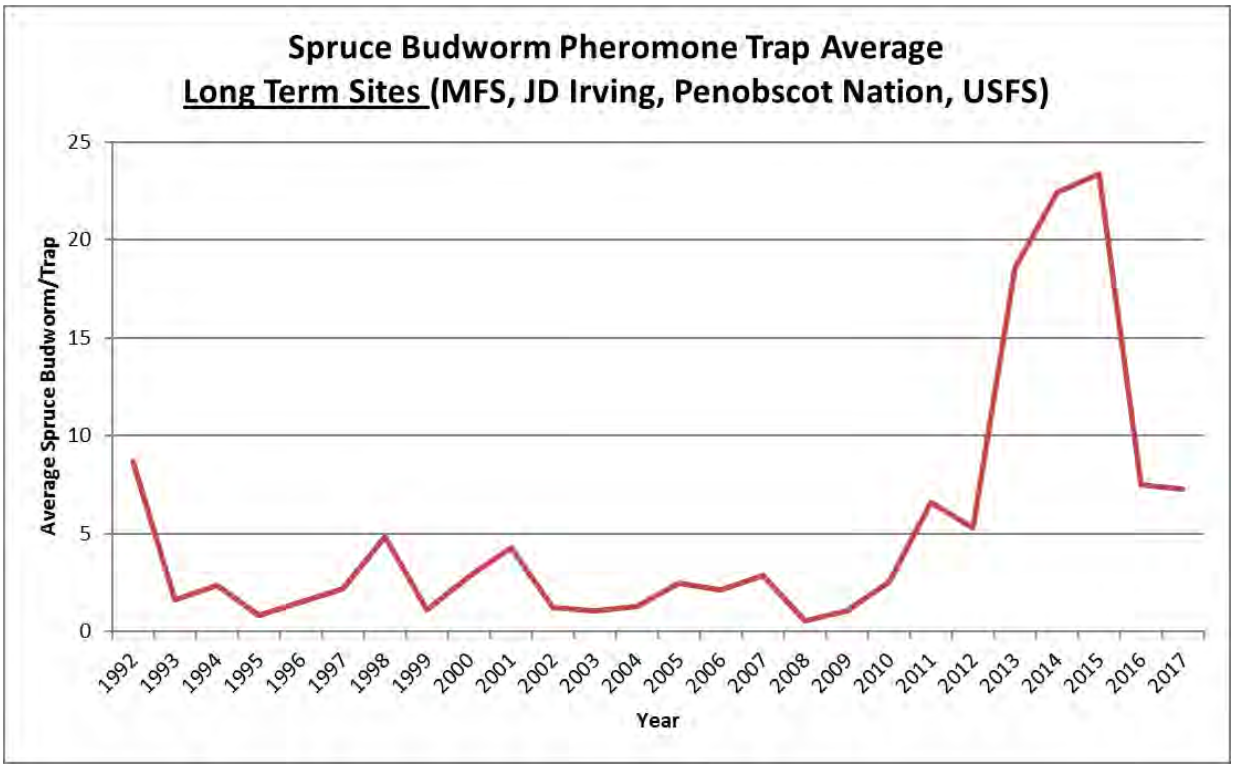


Figure C4. Spruce budworm pheromone trap average catch long term sites only (Maine Forest Service, J.D. Irving Ltd., Penobscot Nation DNR, USDA Forest Service).

Light traps have been used in Maine for more than seven decades to monitor spruce budworm populations and other forest defoliators and continue to be used today. In 2017, 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 similar to 2014 and 2015 levels, down from 2016 (**Figure C5**). Four sites in the network caught a total of 41 moths (**Table C1**). In 2017 there was no trap operated in the Allagash area, a significant gap in our network—over the years 2013-2016 that site had trapped an average of 17 moths/year. In the 10 years before 2013 there were less than 10 spruce budworm moths caught in all the light traps combined. Therefore, the past years are a significant increase. At such low numbers, apparently wide fluctuations are not surprising.

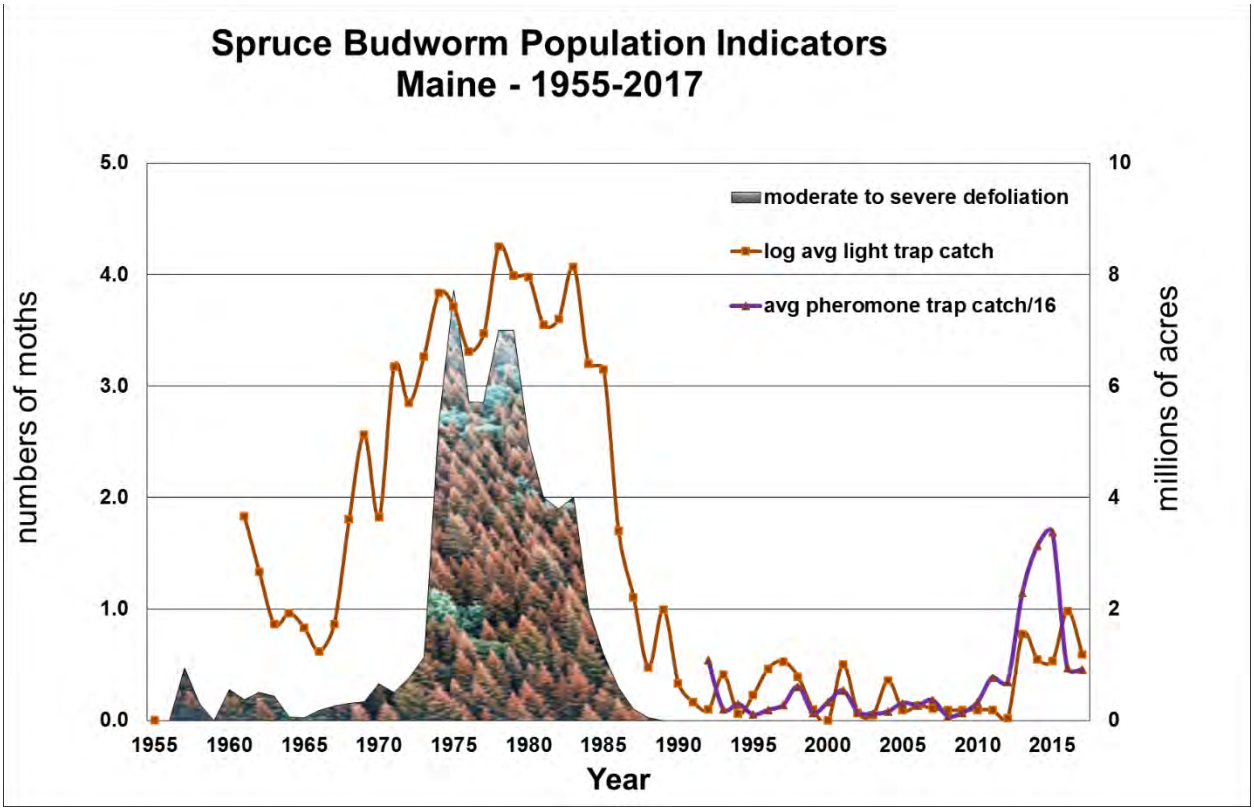


Figure C5. Composite graph of spruce budworm population indicators: defoliation, light trap and pheromone trap data 1955–2017.

Table C1. Spruce budworm caught in light traps in 2015 through 2017.

Town	County	SBW 2015	SBW 2016	SBW 2017
Allagash	Aroostook	**3**	**25**	n/a
Ashland	Aroostook	0	**3**	0
Bowerbank	Piscataquis	**1**	0	0
Calais	Washington	**2**	0	**6**
Crystal	Aroostook	**5**	**53**	**7**
Millinocket	Penobscot	**1**	**1**	0
Mount Desert	Hancock	n/a	**4**	0
New Sweden	Aroostook	**2**	**3**	0
Rangeley	Franklin	**1**	0	0
Topsfield	Washington	0	**44**	**18**
T3 R11 Wells	Aroostook	**17**	**13**	0
T15 R15 WELS	Aroostook	**2**	0	**10**
Total number of moths		**34**	**146**	**41**

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

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

Since 2014, spruce budworm host branch samples have been collected during the fall and winters in areas where pheromone trap catches had been high, modeling predicted at-risk stands, or previous samples had been collected. One 30-inch-long branch is cut from the mid-crown of each of three trees at each sample site. Samples are sent to Canada for processing at the Canadian Forest Service lab in Fredericton. The data can be viewed on the healthy forest partnership research map at: http://www.healthyforestpartnership.ca/en/research/what-where-and-when/. 2017 samples from Maine yielded a total of 32 larvae across 13 sites. No larvae were recovered at 242 of the 255 sites sampled (**Table C2**).

Table C2. Overwintering larvae recovered during L2 surveys in Maine 2014-2017

Year	Town	County	Site ID	L2/ 30-inch Branch
2014-2015 (N sites = 100, 6.0 percent positive)	Saint Francis	Aroostook	IRV-STF-59	1.0
	T12 R12 WELS	Aroostook	OT-1212	0.3
	T14 R13 WELS	Aroostook	OT-1413	0.3
	T14 R7 WELS	Aroostook	IRV-147	1.0
	T14 R8 WELS	Aroostook	IRV-148-15	0.3
	Westmanland	Aroostook	IRV-WES-30	0.7
2015-2016 (N sites = 241, 5.8 percent positive)	Allagash	Aroostook	IRV-ALL-32	0.3
	Dyer Brook	Aroostook	IRV-DRB	0.7
	Perham	Aroostook	IRV-PER	0.3
	Portage Lake	Aroostook	IRV-POL	0.3
	T12 R9 WELS	Aroostook	IRV-129-12	5
	T13 R11 WELS	Aroostook	IRV-1311	0.3
	T13 R7 WELS	Aroostook	IRV-137	0.3
	T15 R11 WELS	Aroostook	IRV-1511	0.3
	T15 R15 WELS	Aroostook	MFS-1515	0.3
	T16 R4 WELS	Aroostook	IRV-164	0.7
	T17 R5 WELS	Aroostook	IRV-175	0.3
	T18 R10 WELS	Aroostook	OT-1810	0.3
	T5 R20 WELS	Somerset	MFS-520	1.3
	T6 R8 WELS	Penobscot	MFS-68	0.3

Year	Town	County	Site ID	L2/ 30-inch Branch
2016-2017 (N sites = 219, 4.1 percent positive)	Lower Cupsuptic Twp	Oxford	SI-LCT	0.3
	New Canada	Aroostook	MFS-VOS	1
	New Canada	Aroostook	MFS-VOS2	0.3
	Portage Lake	Aroostook	IRV-POL	0.3
	Princeton	Washington	MFS-PRI	0.3
	T15 R12 WELS	Aroostook	IRV-1512	0.3
	T17 R5 WELS	Aroostook	IRV-175	0.3
	Topsfield	Washington	MFS-ltTOP	0.3
	Wallagrass	Aroostook	IRV-WAL	0.3
2017-2018 (N sites = 255, 5.1 percent positive)	Connor Twp	Aroostook	MFS-CON	0.3
	Cross Lake Twp	Aroostook	MFS-175	1.3
	Cross Lake Twp	Aroostook	MFS-175-ALT	0.3
	Fort Kent	Aroostook	MFS-FTK	0.7
	Fort Kent	Aroostook	MFS-FTK-2	2.3
	Hamlin	Aroostook	IRV-HML-48	0.3
	Madawaska	Aroostook	MFS-MAD	1
	Saint John Plt	Aroostook	MFS-SAJ	0.7
	T11 R8 WELS	Aroostook	SI-118	0.3
	T17 R4 WELS	Aroostook	IRV-174-56	0.3
	T9 R9 WELS	Aroostook	SI-99	0.3
	TC R2 WELS	Aroostook	IRV-TC2-05	2.3
	Wallagrass	Aroostook	IRV-WAL	0.3

Both ground and aerial surveys were conducted in 2017, looking specifically for spruce budworm in northern Maine where damage would first appear. This year we looked for defoliation on a subset of MFS-sampled L2 sites and additional sites in northern Maine. The Fettes Method was used to quantify defoliation on current-year growth. This method provides a systematic approach to measuring defoliation. It was employed during the last budworm outbreak in Maine, and is currently in use in Quebec. MFS staff received training on implementing the method in a July 2016 field training held in the Matapedia Valley in Quebec. The Fettes Method captures defoliation from all causes and can be used to estimate both current-year defoliation and cumulative defoliation. Trace defoliation was recorded at all 26 sample sites, with levels ranging from 0.2 to 3.9 percent foliage missing. Only four sample sites had defoliation that was in a pattern typical for the feeding behavior of spruce budworm. These were found in two sites near Estcourt Station in Big 20 Twp, one site in Cross Lake Twp and one site in Connor Twp (**Figure C6**). We plan to repeat this survey in July 2018. CFRU is contemplating collecting Fettes data for all L2 survey samples collected in 2018. A brief introduction to the Fettes Method is provided in this document: http://www.sampforestpest.ento.vt.edu/defoliating/spruce-budworm/pdf/montgomery-etal1982-sbw.pdf. A sample data sheet is shown in **Figure C7**.

No defoliation was detected during aerial survey. Feeding needs to be approaching a moderate level of damage before it is visible from the air. All population measures indicate that numbers are too low everywhere in Maine to expect that level of feeding yet.

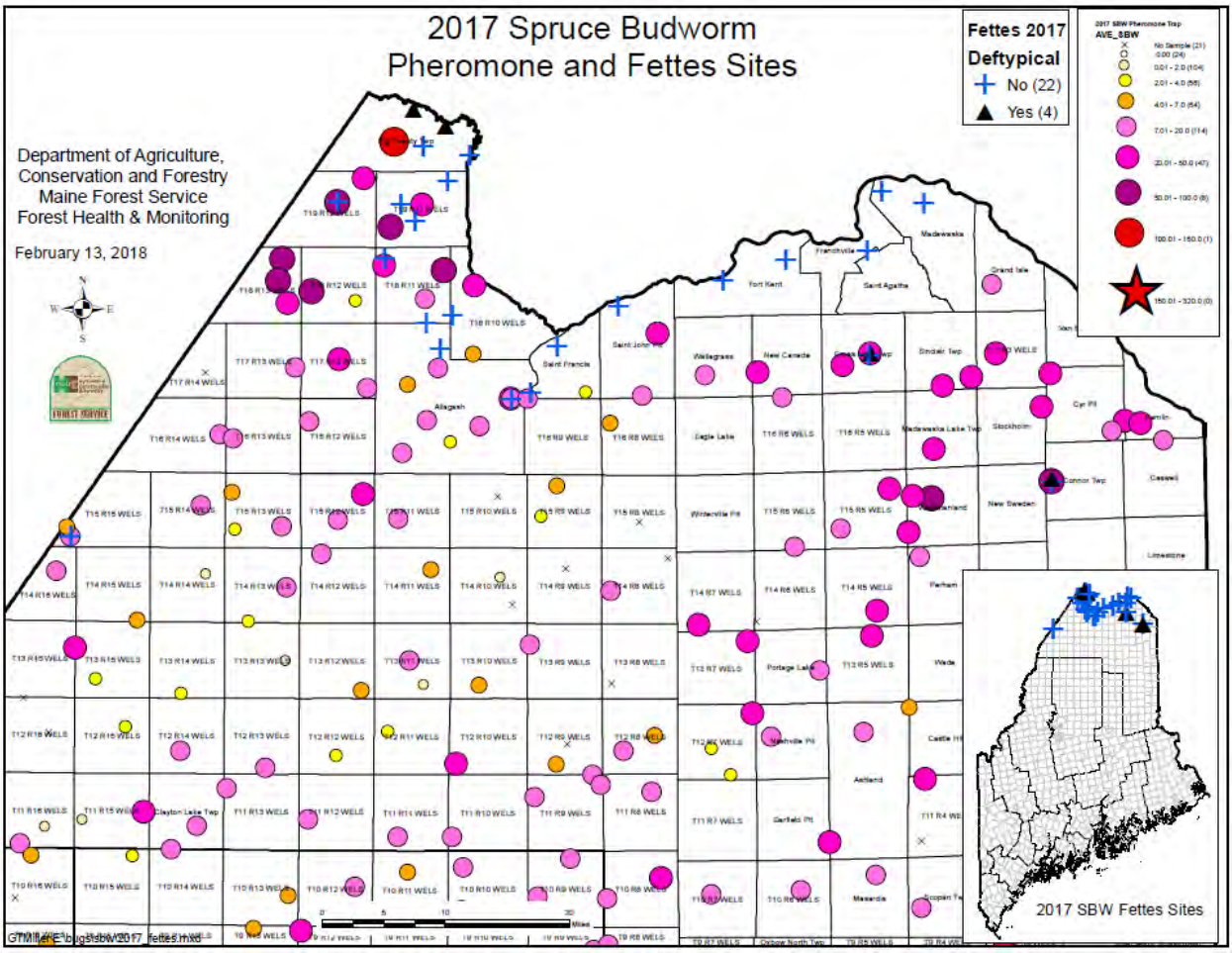
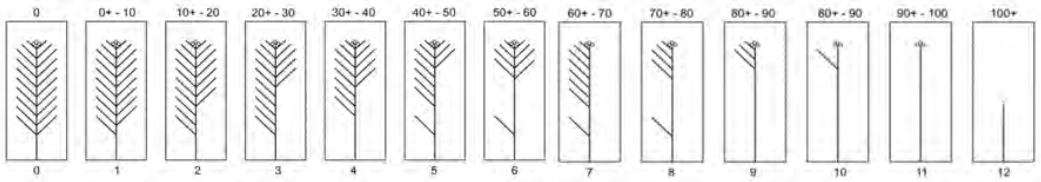


Figure C6. Locations of Fettes defoliation survey sites and pheromone trap sites. Triangles indicate sites where defoliation pattern was typical of that which would be expected from spruce budworm feeding.

SBW Defoliation--Fettes Method, CURRENT YEAR: Examine 20 tips per mid-canopy branch and rate using graphic, multipy N*Value, Sum products and divide by Total number of tips to get percent defoliation by branch or site. Try to do 3 branches from 3 trees at each site.



Lat: _____ **Long:** _____ **Date:** _____ **Operator:** _____

Township: _____ **No. Branches:** _____ **Species:** _____

Tally													**TOTALS:**
N tips													**N:**
(Value)	0	5	15	25	35	45	55	65	75	85	95	100	100
Product													**Σ:**

OWNER INFO (Optional)

Branch Defoliation (Σ/N): _____

Figure C7. Sample data sheet (Excel file available upon request). Data were generally collected on hand-held tablets using DoForms, however paper data sheets were made available.

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

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

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

Thanks to the MFS field crews that helped with the surveys this year. Special thanks to Mike Devine who provided hands-on training in recognizing subtle signatures of spruce budworm feeding and is a valuable sounding board for the project. Charlene Donahue (retired, MFS) coordinated the light trap program, Amy Ouellette screened the catches. Patti Roberts was instrumental in procuring supplies for the survey.

Appendix D

Monitoring for Emerald Ash Borer

Colleen Teerling, Forest Entomologist
Maine Forest Service, DACF
168 State House Station, Augusta, ME 04333

The Maine Forest Service (MFS) continues to work with cooperators to monitor for this destructive insect that has already become established as close as New Hampshire, northeastern Massachusetts and south of Montreal (Figures D1 through Figure D3). Emerald ash borer (EAB) is known to be within about 10 miles of our western border.

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

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

The Maine Forest Service and its partners have continued to educate the public about EAB and other invasive insects in workshops and exhibits at various venues. These and active public involvement with biosurveillance and trap tree programs, continue to heighten public awareness and reporting of EAB symptoms – particularly "blonding", the signs of woodpecker feeding. In 2017, MFS and its partners within the State Horticulturists office received over 50 reports of EAB symptoms/sightings. We responded to all such reports, many involving on-site visits. To date all have proven to be something other than EAB.

In addition to visually surveying trees for EAB damage and woodpecker feeding, and educating and recruiting the public to watch for signs of EAB, three other methods were used to monitor for EAB in 2017: a purple trap survey (Figure D4) which was carried out by a private company and overseen by USDA-APHIS, the girdled trap tree survey and biosurveillance (Figure D5), programs which were conducted by MFS.

Purple Trap Survey: In 2017, the US Department of Agriculture contracted with a private company to hang purple traps throughout the country. Maine Forest Service was only minimally involved in this project. The contractor placed 1165 traps throughout the state.

Girdled Trap Tree Survey: In 2017, the MFS coordinated with private landowners, municipal governments, and multiple state and federal agencies (including Charleston Correctional Facility and Acadia National Park) to create, harvest and peel girdled ash trap trees for EAB. In the spring of 2016, 24 girdled trap trees were created throughout the state. In the winter and early spring of 2017, 4 log-peeling workshops were held and 164 three-foot bolts from these trees were peeled and examined for signs of EAB. No EAB were found. In the spring of 2017, 20 trap trees were girdled and will be peeled early in 2018.

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 2017, 24 new potential sites were surveyed for *C. fumipennis* resulting in 7 new wasp colonies found, ranging in size from 3 to 91 nests. In total, biosurveillance was carried out at 40 sites and buprestids were collected at 23 of these sites. This effort generated 253 beetles collected; none were EAB.

The following maps show the known distribution of EAB outside of Maine (as of March 2018), the federal purple trap survey, and the locations of girdled trap trees and *Cerceris fumipennis* biosurveillance sites in Maine for 2017.

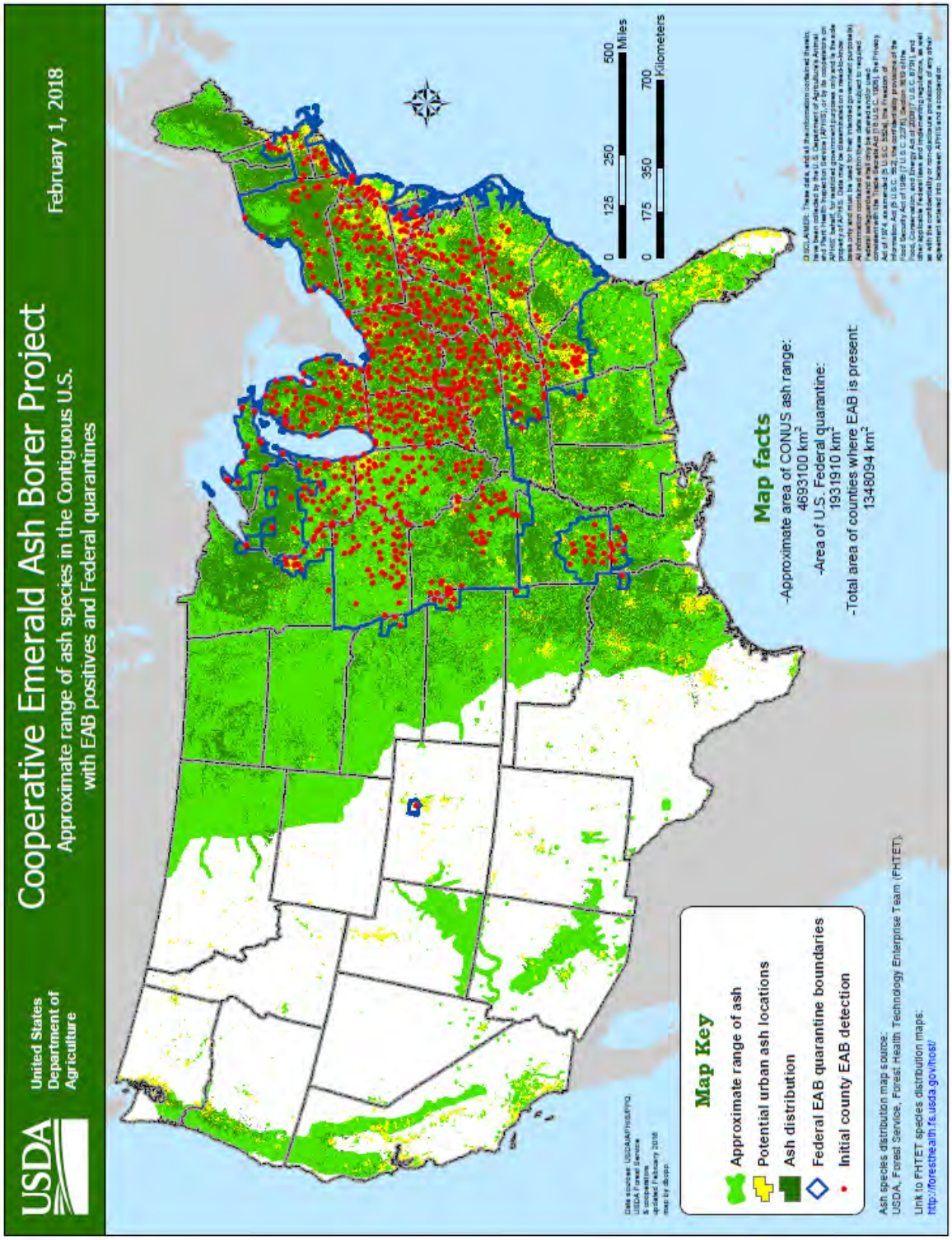


Figure D1. Range of ash and initial county detection of emerald ash borer in the USA (USDA APHIS, May 2017).

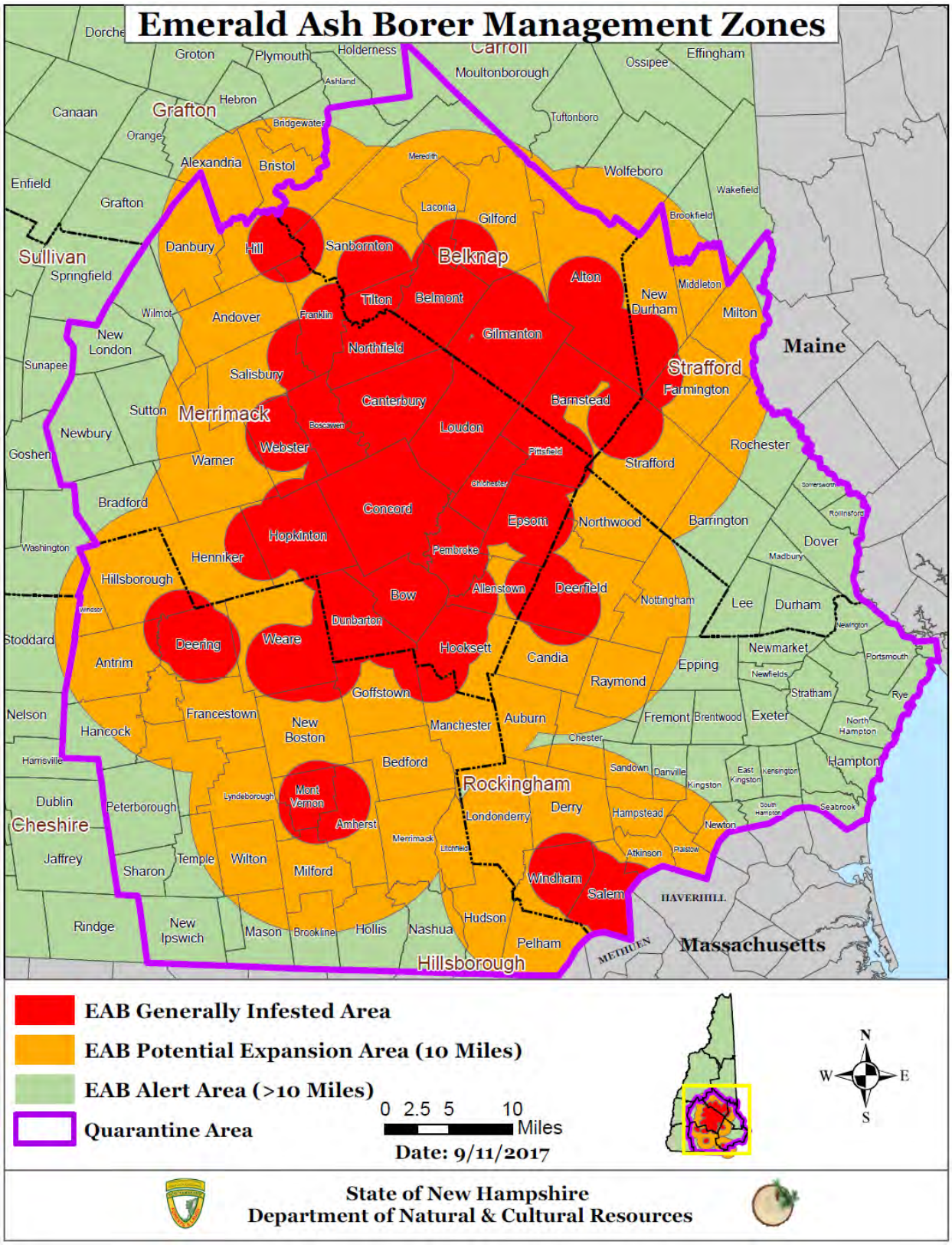


Figure D2. Emerald ash borer infested areas and quarantine in New Hampshire (NH DRED, DFL).

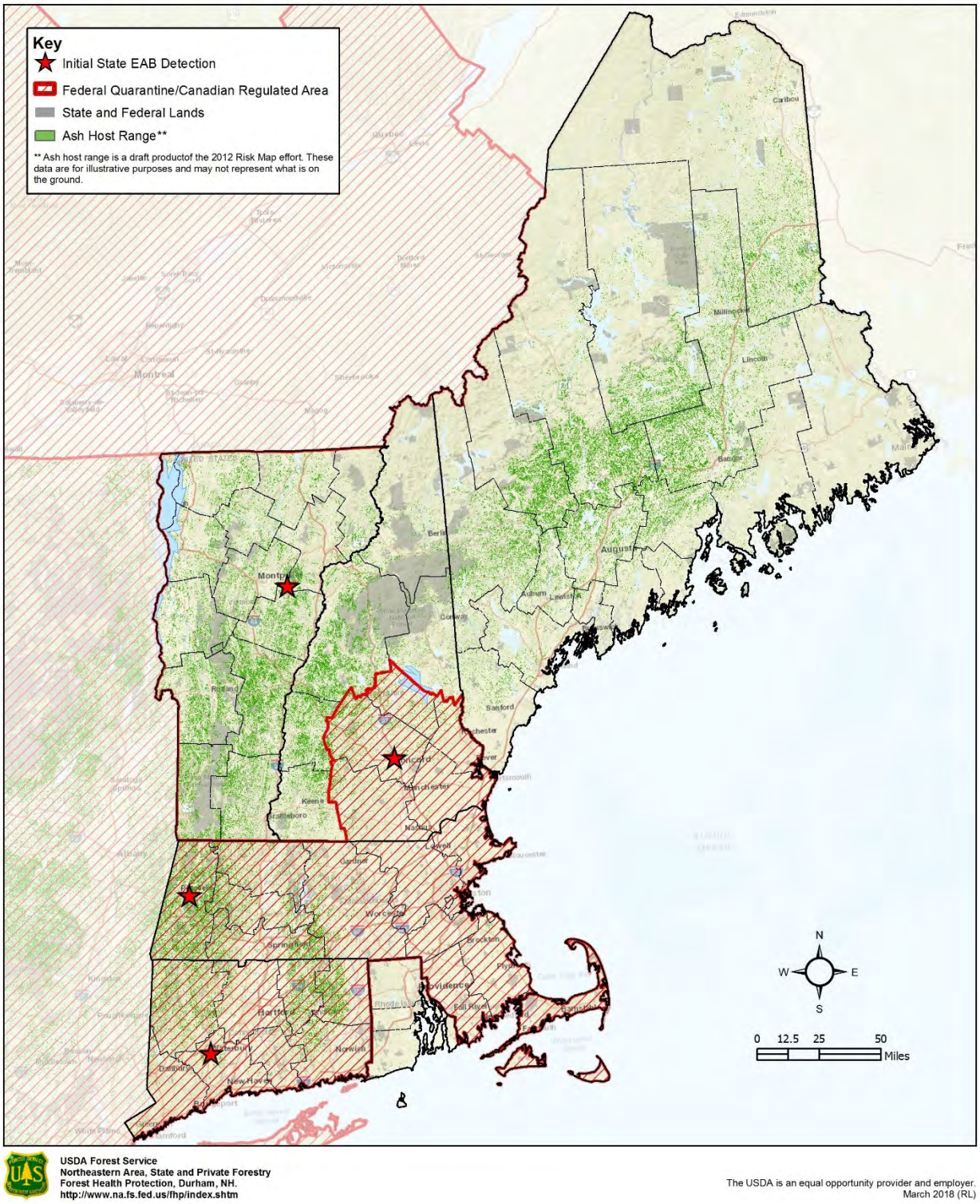


Figure D3. Emerald ash borer quarantine areas near Maine (and not-yet quarantined find in Vermont). (USFS)

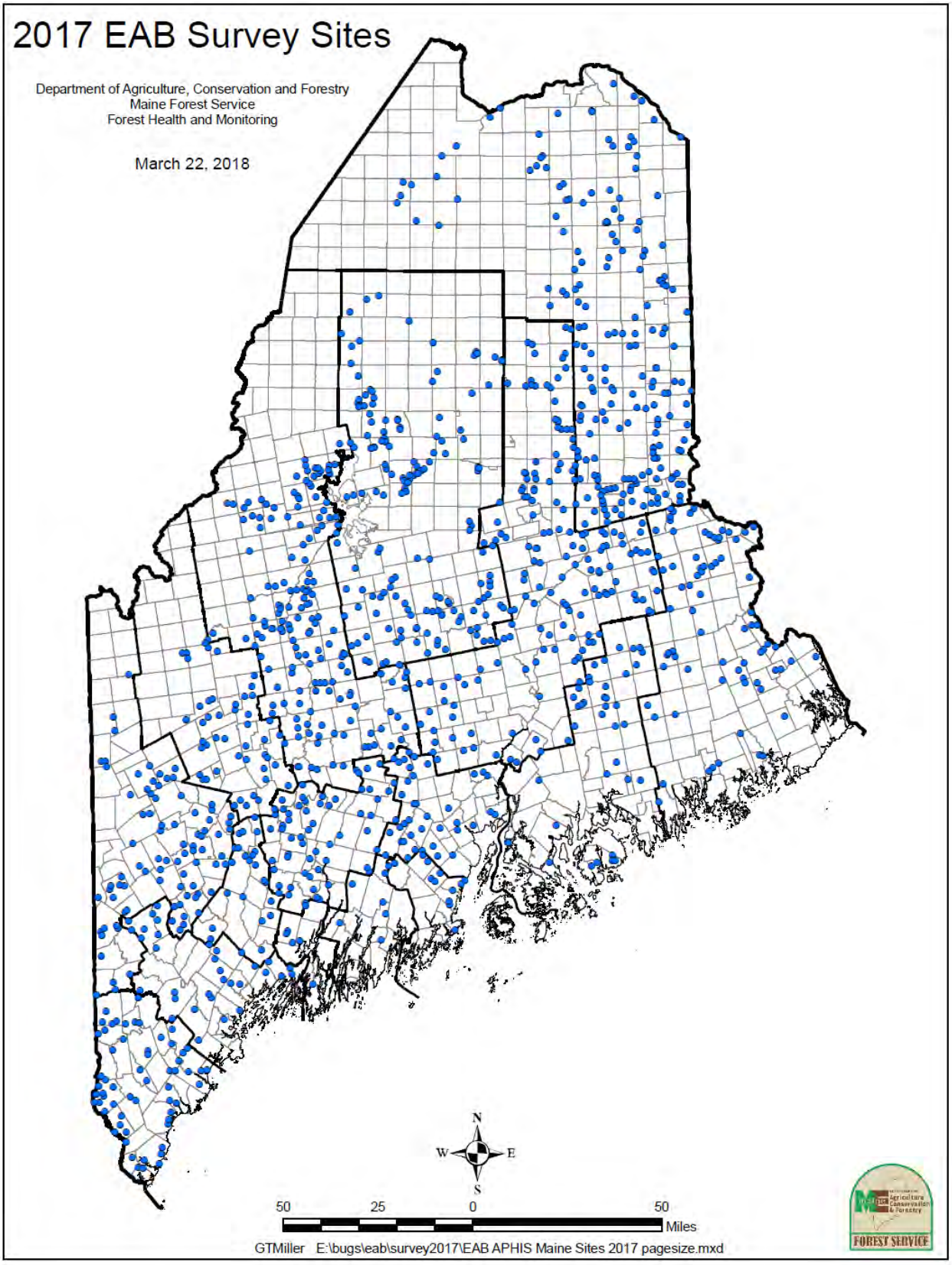


Figure D4. Maine survey grids for national purple trap survey overseen by USDA-APHIS 2017.

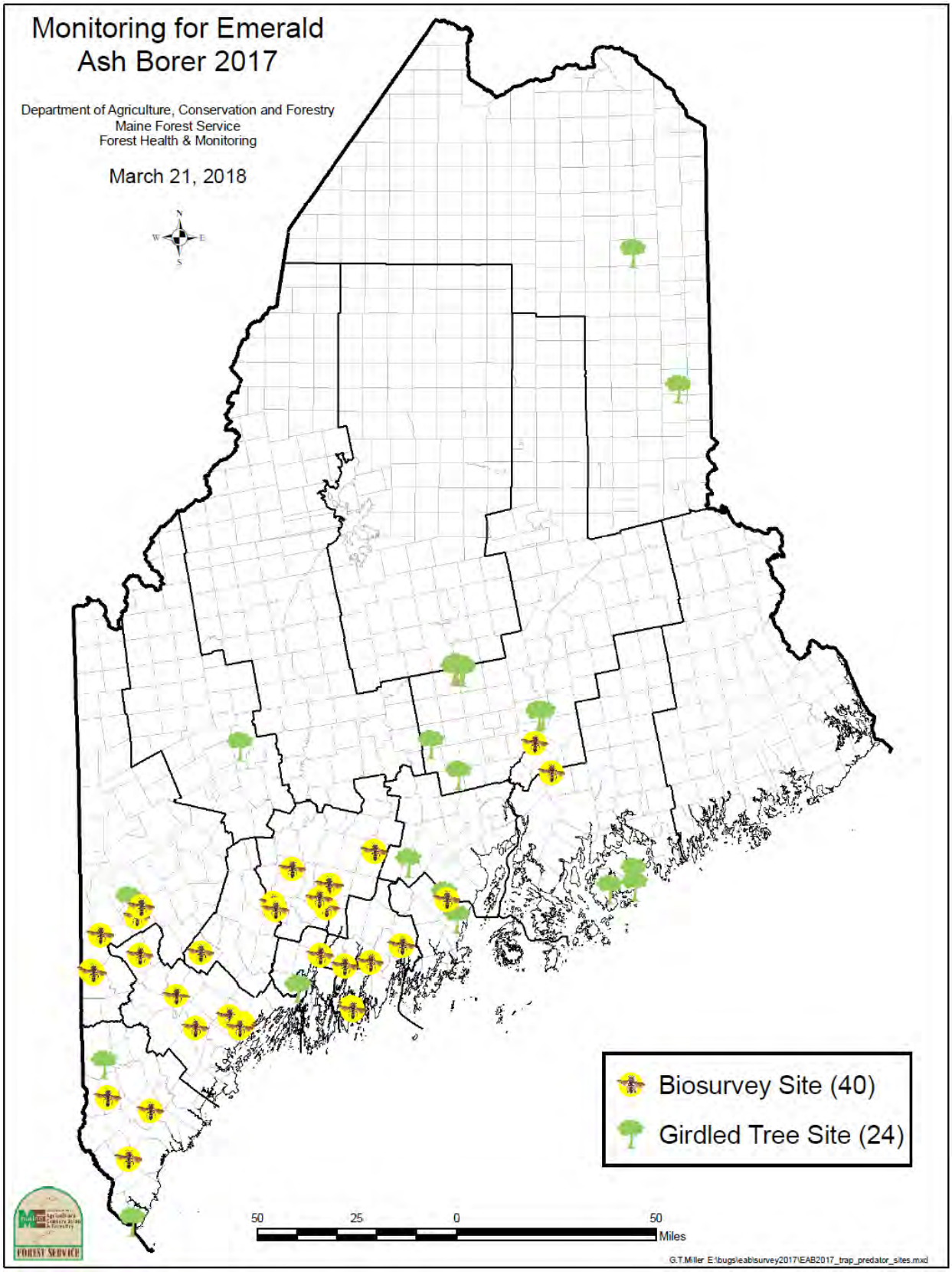


Figure D5. Emerald ash borer monitoring locations with biosurveillance and trap trees, 2017.

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