Forest and Shade Tree Insect and Disease Conditions for Maine

Summary 2024

Maine Forest Service

MAINE DEPARTMENT OF AGRICULTURE CONSERVATION AND FORESTRY

Augusta, Maine

Forest Health and Monitoring

Summary Report No. 35

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Forest Insect and Disease – Advice and Technical Assistance

Maine Department of Agriculture, Conservation, and Forestry, Maine Forest Service
Insect and Disease Laboratory
Phone: (207) 287-2431
www.maine.gov/foresthealth

The Maine Forest Service (MFS), Forest Health and Monitoring (FHM) program maintains a diagnostic laboratory in Augusta, staffed with three forest entomologists and a forest pathologist and a field office in Old Town where the State Entomologist, Resource Management Coordinator, and two additional forest entomologists are based. Their field work is supported by a team of field technicians located throughout the state. The staff can provide practical information on various forest and shade tree problems for Maine residents. Our technical knowledge, reference library and insect collection enable 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 provided for diagnosis should have as much information as possible including: host plant, type of damage (i.e., canker, defoliation, wilting, wood borer, etc.), date, location, and site/land use 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. Also on our website, you can find our on-line report form for forest health concerns. Using this form, you can provide digital images which may eliminate the need to mail in samples.

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Forest and Shade Tree – Insect and 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 and 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. Diagnostic services are provided as time and personnel resources permit. We are always interested in what you see affecting your trees – let us know and your observation may be part of our Conditions Report!

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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 and Disease Laboratory
168 Statehouse Station
Augusta, Maine 04333-0168
Phone (207) 287-2431

www.maine.gov/foresthealth

Scan to sign up on-line

Email foresthealth@maine.gov or call (207) 287-2431 for a paper subscription form

MFS Forest Insect and Disease Diagnostic Request and Report Form

Sample provided? ☐ Yes ☐ No Collection date _____

Please package disease samples in plastic or paper 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 day-time 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 control products/herbicides 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 to light (<30%) _____ moderate (≥ 30% to 50%) _____ heavy to severe (>50%)

Number of trees affected: none _____ one _____ many _____ OR Number of acres _____

Describe problem and other additional information (if needed you can continue the description on back):

_____

_____

Collector_____ Day-time Phone Number _____email_____

P.O. Address _____

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

Day-time Phone Number _____ email_____

Send sample to: Insect and Disease Laboratory, 168 State House Station, Augusta, ME 04333-0168

(or deliver in person to 201 Deering Building, 90 Blossom Lane or
87 Airport Road Old Town, ME, please call ahead)
Tel. (207) 287-2431
e-mail: foresthealth@maine.gov

Please send diseased herbaceous material to: Pest Management Office, Plant Disease Diagnostics Lab, 17 Godfrey Drive Orono, ME 04473-3692, http://extension.umaine.edu/ipm/

Acknowledgements

The information in this Annual Summary Report has been assembled and reviewed by Aaron Bergdahl, Michael Parisio, Thomas Schmeelk, Colleen Teerling, Gabe LeMay, Brittany Schappach, Jeff Harriman, Ronna Coleman, Amy Emery, and Allison Kanoti of the Maine Forest Service, Forest Health and Monitoring Division (MFS FHM). Many other individuals and organizations have contributed to the information on forest health presented here.

The Forest Inventory and Analysis Unit (FIA) of our Forest Health and Monitoring Division provided invaluable assistance in a number of areas, including survey for beech leaf disease, European larch canker, surveying for browntail moth, collecting data on hemlock woolly adelgid impact plots, and reporting various insect and disease occurrences.

We extend our thanks to MFS employees Greg Lord, and Jereme Frank for their assistance with computer and statistical tasks, respectively. Our survey work was greatly enhanced by the efforts of Joe Bither, Wayne Searles, Elicia Dionne, Zoe Albion and Abby Karter. Amy Emery is also thanked for her work in the office, being the first contact for many of the public who reach out to our office, managing day-to-day administrative tasks, and supporting staff in numerous other ways. We would like to recognize Jeff Harriman for his versatility in providing support for a wide range of tasks, enhancing personnel effectiveness, and the MFS FHM work environment.

We would like to acknowledge Maine Department of Agriculture, Conservation and Forestry (DACF), Division of Animal and Plant Health staff for their assistance with regulatory issues and appreciate their cooperative efforts towards our overall mission to protect Maine's forest resources through the use of forest pest quarantine rules and regulations.

Thanks are also extended to many other administrative and field staff of the DACF and to our many contacts in the United States Department of Agriculture (USDA) Forest Service (USFS), Northeastern Area – Forest Health and Protection, the USDA Animal and Plant Health Inspection Service, and to our other cooperators in the Northeastern States of the United States and Eastern Provinces of Canada. We also thank the Forest Ecosystem Monitoring Cooperative (FEMC) for their assistance with survey efforts in Maine and for help addressing priority issues. Thanks to Dr. Angela Mech of the UMaine SBW Lab and Dr. Neil Thompson of the University of Maine, Fort Kent and Regina Smith of the University of Maine's Cooperative Forestry Research Unit (CFRU) for their partnership in Maine's statewide spruce budworm monitoring program.

Our sincere thanks go to those who volunteer in survey and monitoring as well as other tasks. Sharon Whitney and Peter Darling both run daily traps for winter moth each holiday season. Thank you to Jon Bailey, Kelsie Daigle, Nancy Olmstead of The Nature Conservancy and Jesse Wheeler of Acadia National Park for running traps for the southern pine beetle (SPB) survey and for helping to organize a forest health tour of Acadia National Park for members of the National Plant Diagnostic Network, led by MFS Forest Health staff. Thanks also to Tim Bickford with the Maine Army National Guard for coordinating the SPB trap in Hollis. We also want to thank every one of the cooperators who maintain moth light traps throughout the summer, some of whom have participated in the annual survey for decades.

Cameron McIntire and Isabel Munck of the USFS Durham office are acknowledged for their continued assistance with forest pathology issues in Maine; in particular beech leaf disease-related issues and projects and establishing two chaga cultivation demonstration sites in Maine in 2024 to address the new

practice of chaga farming in Maine. Also associated with the chaga demonstration sites, Keith Kanoti and The University of Maine Forests are thanked for cooperation in providing a demonstration site location. North Spore, of Westbrook, Maine, is gratefully thanked for fungal work with *Inonotus obliquus* isolates and producing the colonized dowels used to inoculate the birch trees for the chaga demonstration area. Inland Fisheries and Wildlife is thanked for cooperation in locating groups of beech bark disease-resistant beech trees for a beech leaf disease treatment trial. Jack Chappen is especially thanked for helping our group on-site to locate and evaluate trees for treatment. Also acknowledged for identifying and providing beech sites for this effort are The Greater Augusta Utilities District, specifically Brian Tarbuck, and the District's forester, Andy Schultz. Additionally, Viles Arboretum is thanked for hosting and facilitating a second year of a Polyphosphite 30 soil drench trial for evaluating the effectiveness of this treatment for mediating the impacts of beech leaf disease.

We thank the members of the Maine Entomological Society for their ongoing interest in insects and contributions to our knowledge of them in Maine. We gratefully acknowledge all the landowners in Maine that allow us access to their properties for important activities in insect and disease survey and monitoring. We would like to acknowledge the support of Dr. Elkinton, Dr. Andersen and their lab at the University of Massachusetts in Amherst for rearing the *Cyzenis albicans* pupae and determining parasitism levels at release sites in Maine. Finally, special thanks go to the vigilant residents of Maine who keep extra eyes on our forest resources and alert us to issues impacting tree and forest health.

Introduction

This annual summary report describes the efforts made by the Maine Forest Service Forest Health and Monitoring and their many partners toward 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 negative impacts to wood production and quality, water quality, the enjoyment of recreational opportunities, and, in some cases, human health. The great majority of these biotic species are native to Maine and are elements of productive and balanced, functioning forest ecosystems. However, non-native-invasive species and changes to climate disturb this balance and bring into question some natural relationships that were previously understood. Therefore, our evolving 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 Division's Forest Inventory and Analysis group; 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) **administering the forest pest-related quarantines** established by state and federal 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.

2024 Personnel Updates

On the FIA team:

Roman Meneghini was hired in May of 2024 as an Entomology Technician for the Washington County area. Roman has a Master's in Applied Biology and a Bachelor of Science in Biological Sciences from the University of Massachusetts Lowell.

Skipper Chaney was hired in October of 2024 as a Conservation Aide for the Portland area. Skipper has a Bachelor of Science Degree in Biology, with a Minor in Art from Northeastern University, and runs a hobby business working with bees in Portland.

Dalton Kelly was hired in October of 2024 as a Conservation Aide for the Northern Aroostook County area. Dalton has a Bachelor of Science Degree in Parks, Recreation, and Tourism with a concentration in Conservation Law Enforcement from the University of Maine, Orono. Before joining FIA, Dalton worked as an Assistant Park Ranger for the Allagash Wilderness Waterway.

Angelo Palome was hired in November of 2024 as a Conservation Aide for the Howland/Argyle area. Angelo has a Bachelor's Degree in Ecology and Environmental Science from the University of Maine Orono. Angelo was an intern for the MFS working on multiple GIS projects that assisted with Maine's Hazard Fuel Reduction Project, as well as an intern for the MFS– Forest Health and Monitoring Division assisting in numerous insect surveys, beech leaf disease treatments, and establishing the chaga study site in Old Town.

Employees **Adam Raven**, **James Canwell**, **Roman Meneghini**, and **Kelby Leary** left to pursue other opportunities.

On the IDM team:

Zoe Albion was promoted from entomology technician to the newly created senior entomology technician position in the Central Region in November 2024. Previously, Zoe served in the entomology technician position in the Central Region since July 2023.

Abby Karter left FHM in October 2024 after serving in the entomology technician position in the Southern Region since July 2021.

Additionally, we shared one summer student intern, **Angelo Palome,** with MFS Forest Protection in 2024.

Elicia Dionne temporarily served as a senior entomology technician in 2024 in a position that was created on a limited term. Elicia returned to her role as a member of our FIA staff in June 2024.

Employee Recognition

In September of 2024, **Aaron Bergdahl**, **Ronna Coleman** and **Gabe LeMay** received recognition from the State Forester and the FHM Division Director at the MFS annual staff meeting. **Aaron** was recognized for his flexibility in managing the deluge of forest pathology inquiries that arose because of the coincident

timing of the expression of beech leaf disease and white pine needle damage early in the growing season. **Ronna** was recognized for her growth into the leadership role at FIA as the new field supervisor. **Gabe** was recognized for his leadership in creating GIS products for the Division as well as his work in establishing the ash treatment demo project.

In November 2024, **Allison Kanoti** was awarded DACF Manager of the Year. Allison is the State Entomologist and FHM Division Director. She joined DACF in 2006 as a forest entomologist after graduate school and was previously an entomology technician in the FIA unit, beginning in 2001. Allison's current role encompasses strategic planning, research, monitoring, education, and policy development related to forest health and pest management.

Per Commissioner Beal: “Allison is a constant professional who recognizes the value of her team in relation to the significant threat of invasive insects and disease to Maine's forests. She strikes the right balance with all partners in prevention, outreach, and response and effectively leads with trust, honesty, and service.”

Insect Conditions

Insects: Softwood Pests

Balsam Gall Midge (*Paradiplosis tumifex*)
Primary Host(s): Fir (*Abies spp.*)

Balsam gall midge (BGM) reports remained limited in 2024. The most significant inquiry regarding BGM in 2024 came from one of the largest wreath producers in Downeast Maine seeking advice on developing a BGM monitoring and treatment program. This company manages some 17,000 acres for balsam fir wreath brush and was seeking to increase the scale of their monitoring to encompass as much of this area as possible. MFS organized a Zoom meeting and met with company representatives to provide technical support for the creation of a pest monitoring program. Guidance focused on establishing monitoring plots to detect damage and determine action thresholds. MFS also suggested implementing a sticky trap network to track adult BGM populations and identify hotspots.

Aside from this, two additional reports of BGM came in late 2024, one from a tree farmer who had reported damage in previous seasons and one from a person who inherited a Christmas tree plantation where management had lapsed and has subsequently experienced an increase in BGM damage. Many Christmas tree growers are accustomed to this periodic pest, and those with treatment experience likely do not feel the need to call and report or request advice from MFS. Additionally, the University of Maine Cooperative Extension has expanded its services for Christmas tree growers in recent years.

Balsam Woolly Adelgid (*Adelges piceae*)
Primary 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 (FIA) plots when encountered, but no special measurements were taken in 2024, nor were any additional surveys conducted for this pest. Public reports of BWA remained limited in 2024, usually pertaining to ornamental balsam trees in unfavorable growing sites where BWA seems to take full advantage of stressed trees. BWA damage was observed causing notable crown deformation during a field tour with industry foresters in Magalloway Twp in northern Oxford County. Damage from this insect continues to become more obvious at more northerly latitudes with the trend towards warmer extreme cold winter temperatures. BWA damage was not recorded during aerial survey in 2024, though it has been in recent years.

Brown Spruce Longhorned Beetle (*Tetropium fuscum*)
Primary Host(s): Spruce (*Picea* spp.)

Despite not participating in the national Exotic Wood Borer and Bark Beetle program in 2024, MFS implemented its own trapping efforts for brown spruce longhorn beetle (BLSB). This was following detections of BSLB near the Maine border in Quebec and in Fredericton, NB, as well as trap recoveries in Nova Scotia after years of not being recovered in that province. MFS installed ten black cross-vein pheromone traps in three different regions in the state, in locations where cross-border traffic is common. Three traps were placed in western Maine, along Route 201 between Jackman and the Quebec border. Three were placed near the eastern border with New Brunswick, in the Houlton area. Four were placed in the Downeast region along Route 1, between the towns of Princeton and Whiting.

Traps were serviced biweekly between May and July. While the 2024 trapping survey did not capture any positive targets, our native *T. cinnamopterum* was the most prevalent beetle in most of the traps. As in previous years, diagnostics for this survey were aided by pinned and identified specimens of *T. fuscum* provided by our colleagues at the Canadian Forest Service. No other reports of BSLB were received throughout the year.

Elongate Hemlock Scale (*Fiorinia externa*)
Primary Host(s): Fir (*Abie*s spp.), Eastern Hemlock (*Tsuga canadensis*), and other conifers

Elongate hemlock scale (EHS) is well-established in southern Kittery (York County) forests. It has been found on planted trees in Cumberland, Hancock, Lincoln, Sagadahoc, and York Counties and has moved from planted trees to the surrounding forest in some of these locations. In many locations where it has only been found on planted trees, it is likely to have moved into the forest but has gone undetected due to the cryptic nature of EHS.

No infestations of EHS were found in new towns in 2024. However, EHS has been found spreading throughout forested areas in the town of York (York County), far from planted trees. Previously, it had only been seen in landscaped areas in this town. This is the second town in Maine where EHS is known to be well established in the forest. It has long been established in forests in neighboring Kittery.

Twelve individuals of the generalist scale predator, *Cybocephalus nipponicus*, both male and female, were found and collected in November 2024 in Kittery in forested areas infested with EHS. This predator was introduced in many locations in Massachusetts, as well as other states to the south of Maine for control of Euonymus scale possibly other scale pests. It has likely moved into Maine from these introductions. Anecdotal evidence suggests that it may have some effect on EHS populations.

Hemlock Borer (*Melanophila fulvoguttata*)
Primary Host(s): Eastern Hemlock (*Tsuga canadensis*)

The hemlock borer is one of our native jewel beetles and is considered a secondary pest that attacks hemlocks that are already under stress. These stressors can include things like drought, poor site conditions, windthrow, defoliators/insect feeding and root compaction. We have seen an uptick in this native insect during the past few years due to drought stress and pressure from HWA populations. Many of these reports have come from southern Maine where we are seeing the worst effects of HWA. This beetle is active from May through August and like most jewel beetles their larvae feed under the bark on the cambium. Although hemlock is the primary host it has been found in dying eastern white pine, spruce, and larch.

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

In 2024, hemlock woolly adelgid (HWA) was found in two new towns: Parsonsfield (York County) and Liberty (Waldo County). Both lie within Maine's HWA quarantine area. The winter of 2023-2024 was mild and HWA winter mortality was lower than ever seen before, averaging just under 33% at monitoring sites. HWA populations are starting to increase, but as of the end of the growing season of 2024, they remain low overall. Many trees in infested areas still appear to have improved vigor after extreme cold killed high numbers of adelgids in many parts of Maine during the previous winter in February 2023.

Organizations and individuals purchased and released 38,300 *Sasajiscymnus tsugae* in 53 locations in 22 towns in seven counties. A total of 1,975 lab-reared *Laricobius osakensis* were released between three sites in Lincoln, Waldo, and Hancock Counties. An additional 1,000 early emerging *L. osakensis* were released in Acadia National Park. It is uncertain whether these would be able to feed on HWA, which had not yet broken aestivation, but releasing them was the alternative to euthanizing them. Five hundred *Laricobius nigrinus* collected from Delaware Water Gap National Recreation Area were released in York County. The rearing and collection of *Laricobius* species were supported by funding from USDA Forest Service (USFS).

Predator surveys detected probable *L. nigrinus* in three locations in York County. They will be sent to USFS for genetic identification. No *S. tsugae* were found during recovery efforts.

Red Pine Scale (*Matsucoccus matsumurae*)
Primary Host(s): Red Pine (*Pinus resinosa*)

Red pine scale (RPS) infestations persist in the Downeast region of the state, affecting portions of Hancock and Washington counties. In 2024, aerial survey attempted to fly over previously detected RPS damage along the coast to observe later stages of infestation, in addition to newly reported detections and uninfested red pine stands. A total of 1,800 acres of red pine scale damage were documented, primarily affecting areas surrounding blueberry barrens in the towns of Deblois, T18 MD BPP, and Columbia. The town of Osborn was newly confirmed to have red pine scale.

A new monitoring program was tested this year which used sticky traps to detect the crawler stage of RPS, a passive capture method which has been used successfully in Canada to detect hemlock wooly adelgid crawlers. Traps consisted of a small, simple platform staked to the ground in a red pine stand, which held interchangeable slides that were replaced biweekly. Fourteen traps were placed in infested and uninfested stands throughout the Downeast region. Due to continued concern over the potential presence of red pine scale in the Machias River Corridor Public Lands, which contain several thousand acres of mature, even-aged red pine, approximately half of the traps were placed north of Route 9.

Due to the difficulty of crawler identification using morphology, a genetic method of species confirmation was pursued. The University of Maine Integrated Pest Management laboratory sequenced a subsample of 12 collected specimens. Nearly half of the submitted samples returned positive matches for *Matsucoccus matsumurae*, and were often supported by matches of multiple gene markers for the same sample.

This data confirmed the presence of red pine scale in three new towns (T36 MD BPP, T30 MD BPP, and Beddington) as well as the positive control site of Columbia. The confirmation in T36 MD BPP is particularly concerning, given the trap's location in the Machias River Corridor Public Lands. This site, as well as the site in T30 MD BPP, displayed no obvious symptoms of infestation. Both sites also collected far fewer crawlers than the positive control site, indicating the infestation at both locations is in very early stages.

The ability of the sticky trap to detect red pine scale crawlers in stands displaying no symptoms lends credence to the effectiveness of this survey method. However, it also recovered low numbers of crawlers in a second positive control site where the infestation was very mature (Spectacle Ridge), though this could be due to specific trap placement.

Table 1: Red pine scale crawler sticky trap survey results

Trap ID	Trap name	Town	County	Latitude	Longitude	# specimens	Genetic subsample result
RPS_01	Horse Back Rd	T32 MD BPP	Hancock	44.967346	-68.445256	0	untested
RPS_02	Dead Stream	Great Pond	Hancock	44.961843	-68.352003	0	untested
RPS_03	3200 Junction	T34 MD BPP	Hancock	44.969168	-68.128128	7	Oribatid mite
RPS_04	Horseshoe Lake Rd	T35 MD BPP	Hancock	44.999373	-68.069239	0	untested
RPS_05	1st Machias Lake	T37 MD BPP	Washington	45.023776	-67.862314	3	Fungus
RPS_06	Machias River	T36 MD BPP	Washington	44.977080	-67.864660	6	*Matsucoccus matsumurae*
RPS_07	Salmon Pond	T30 MD BPP	Washington	44.921061	-67.863560	0	untested
RPS_10	Airline Rd parking area	T30 MD BPP	Washington	44.871063	-67.939705	90	*Matsucoccus matsumurae*
RPS_12	Ranger Station Rd	T28 MD BPP	Hancock	44.894240	-68.102176	0	untested
RPS_13	193 junction	T22 MD BPP	Hancock	44.830361	-68.084921	3	Fungus
RPS_14	Spectacle Ridge	Osborn	Hancock	44.764281	-68.187162	3	untested (known positive)
RPS_15	Town line	Beddington	Washington	44.766137	-68.028616	29	*Matsucoccus matsumurae*
RPS_17	Donnell Pond	T10 SD BPP	Hancock	44.599906	-68.030991	0	untested
RPS_16	Cherryfield Barrens	Columbia	Washington	44.671902	-67.870748	165	*Matsucoccus matsumurae*

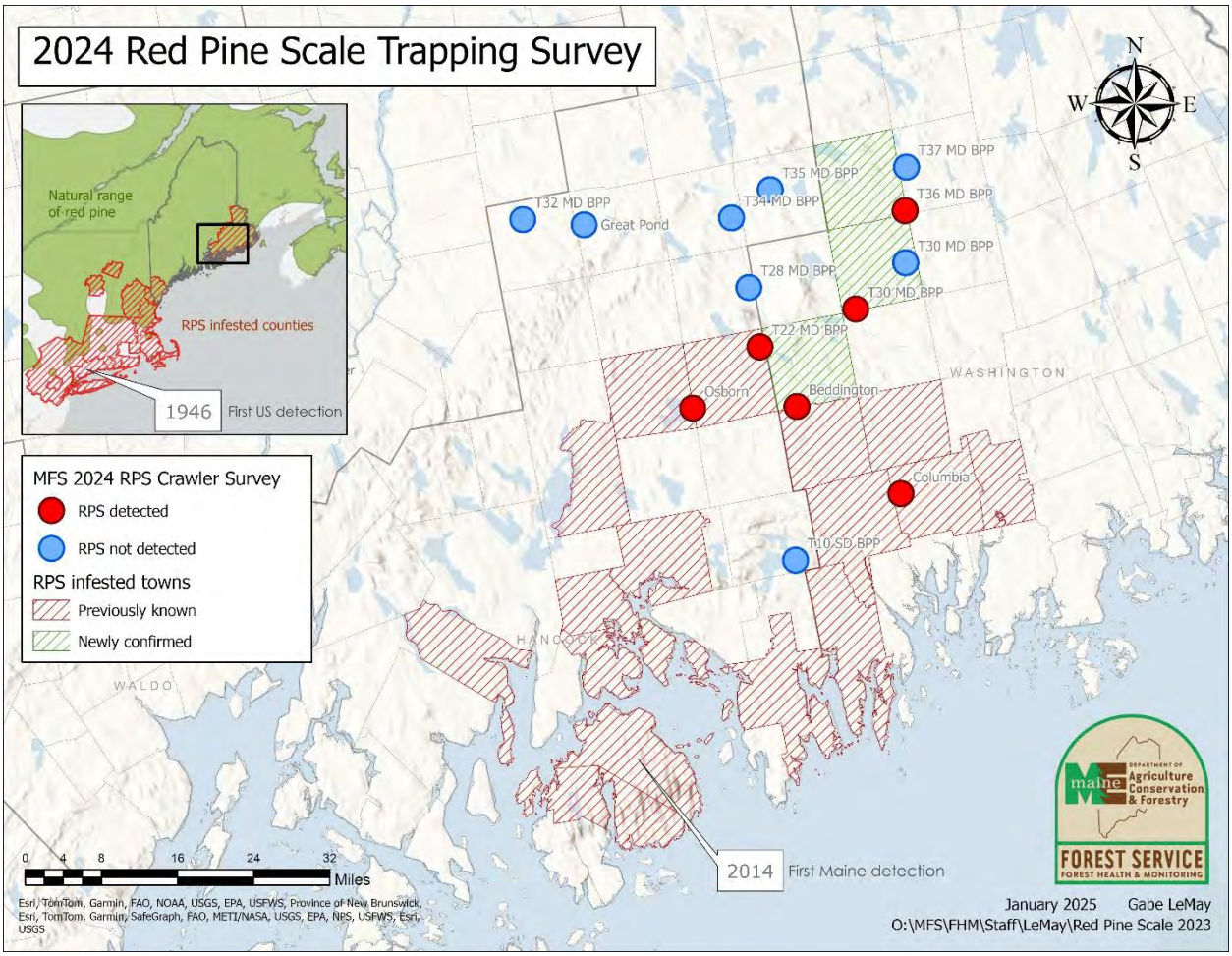

Figure 1: 2024 Red pine scale survey locations in Washington and Hancock Counties, ME.

Southern Pine Beetle (*Dendroctonus frontalis*)
Primary Host(s): Pitch Pine (*Pinus rigida*), Red Pine (*Pinus resinosa*), Jack Pine (*Pinus banksiana*), and other conifers

Southern pine beetle (SPB) was first detected in October 2021 in the Waterboro Pine Barrens. In response to that detection, we have adapted the timing of our monitoring program to better cover SPB's fall dispersal, whereas previous monitoring had focused on spring dispersal. Traps were operated from September 16 to November 15 with no lure change.

In 2024, 20 Lindgren funnel traps were deployed at 14 sites throughout the state, placed in key areas to monitor Maine's hard pine resources. A portion of these traps are run by our cooperators at The Nature Conservancy and the National Park Service. In addition to these monitoring traps, an additional nine traps were deployed for year two of a lure study conducted by researchers through the USFS. The purpose of this study is to develop an enhanced lure that is suited to early detection and response. The samples from our trapping program yielded no SPB specimens in 2024.

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

Reports of discolored fir trees near the Quebec border in far northwestern Aroostook County began to trickle in in June. MFS took care to gather evidence and generate a full search area prior to performing the first aerial survey targeting spruce budworm damage in early July. The timing of these flights was perfect, and 3,455 acres of discolored spruce-fir forests were easily observed and mapped. Prior to 2024, the only observable defoliation damage from the air was around 800 acres in 2021. Prior to that, no SBW damage had been mapped during aerial surveys since the early 1990s.

While this acreage is what was visible to MFS during our aerial survey flights, reports from large landowners claim several thousand more acres of damage was visible on the landscape. In the upcoming year, we will likely look to historic satellite imagery to see if we can generate other estimates of the damage area. Regardless, this represents a sizeable population of SBW within Maine's borders, capable of persisting, causing damage, and expanding its range. At the writing of this report, a large-scale aerial spray program is being organized by a coalition of landowners in northern Maine.

Data from L2 samples collected by landowners, managers and MFS and processed at The Spruce Budworm Lab at the University of Maine has fed an interpolation model produced by Dr. Neil Thompson at the University of Maine in Fort Kent. At the end of 2024, the model showed approximately 240,000 acres of spruce-fir forest type in northern Maine with SBW populations high enough to warrant treatment following an early intervention strategy.

Please see Appendix B for the full 2024 annual review and outlook report for spruce budworm in Maine.

Insects: Hardwood Pests

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

No confirmed public reports of Asian longhorned beetle (ALB) in Maine in 2024. Outreach efforts continue in conjunction with Soil and Water Conservation District staff in Maine as part of a Plant Protection Act-funded initiative.

Beech Leaf Mining Weevil (*Orchestes fagi*)
Primary Host(s): Beech (*Fagus* spp.)

Beech leaf mining weevil was confirmed in the nearby Canadian province of Nova Scotia in 2011 and is not currently known to occur the United States. Considering the additional factors of beech leaf disease and beech bark disease in Maine, the introduction of the beech leaf mining weevil to the state could be disastrous to local beech populations. Therefore, a statewide visual survey was implemented alongside the existing beech leaf disease survey.

Leaf mines caused by the weevil larvae are highly diagnostic for the species and were used as the primary sign for survey. No signs of leaf mines or the beech leaf mining weevil were observed at 59 sites surveyed across 53 towns and 14 counties.

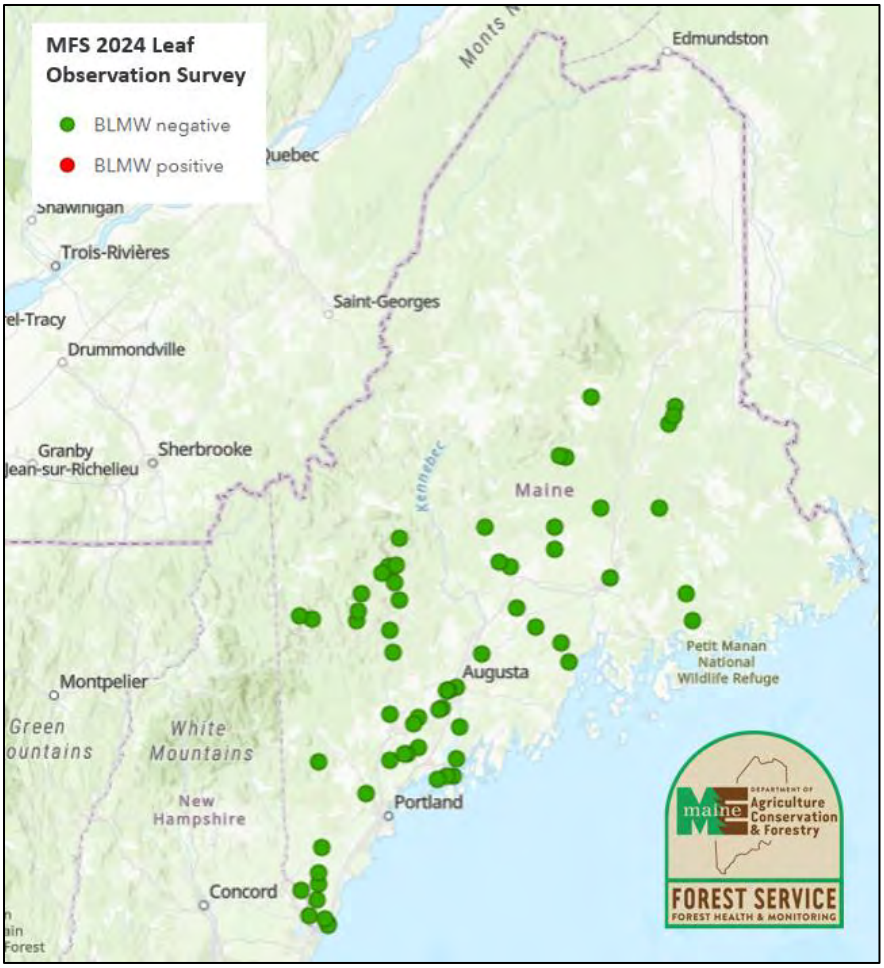

Figure 2: 2024 Beech leaf mining weevil visual survey.

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

Browntail moth (BTM) populations have shrunk dramatically. In 2024, our aerial surveys captured just 2,119 acres of defoliation damage from BTM, compared to 46,727 acres of defoliation documented during aerial surveys in 2023. Although the locations of damage seen in the 2024 aerial surveys are similar to the year prior, there was a significant decrease in the amount of acres defoliated; a trend that has now occurred over multiple seasons.

A more comprehensive report on browntail moth can be found in Appendix C.

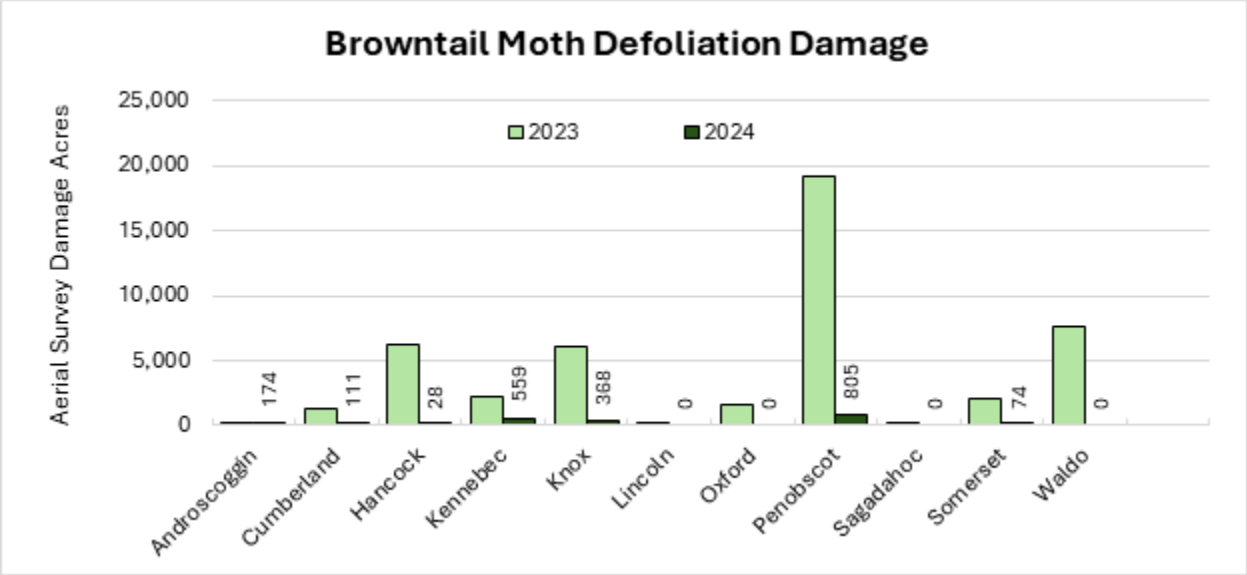

Figure 3: Acres of browntail moth defoliation damage captured via aerial survey organized by county during 2023 and 2024. Number labels represent the number of defoliated areas seen during aerial survey in 2024.

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

Two separate populations of emerald ash borer (EAB) were detected for the first time in Maine in 2018. One of these populations spread into southern Maine from nearby infested areas of neighboring New Hampshire. The other spread into northern Maine from nearby infested areas across the Saint John River in New Brunswick. Since these initial detections, both populations have expanded significantly through natural spread. The rate of spread in southern Maine appears to be faster than in northern Maine, but this might be confounded by the high concentration of people residing in southern Maine. In addition to more public reporting potential in these areas, the spread of EAB in these areas has likely also been accelerated due to human handling of infested materials. In contrast, the infested areas in northern Maine appeared to progress much more slowly. There were several significant detections of EAB in new locations of northern Maine in 2024, indicating rates of spread could be increasing now that populations have had years to build. These detections via the survey efforts of MFS field staff resulted in another revision to the EAB-regulated areas of northern Maine.

A report with full details on 2024 detection efforts and the most recent quarantine revision can be found in Appendix D.

Forest Tent Caterpillar (*Malacosoma disstria*))
Primary Host(s): Aspen (*Populus* spp.), Sugar Maple (*Acer saccharum*), and other hardwoods

2024 marks the third consecutive year of substantial forest tent caterpillar (FTC) defoliation in northern Maine. Although an area of FTC defoliation totaling 240 acres was documented in Aroostook County as early as 2021, beginning in 2022, the outbreak affected 16,974 acres surrounding Fort Kent and, to a lesser extent, Caribou. The following year, the affected area almost doubled to approximately 30,500 acres, largely affecting the same region of Aroostook County. This doubling was repeated this year, with

over 60,000 acres defoliated statewide. The vast majority of affected trees were in the northeast portion of Aroostook County, between Presque Isle, Fort Kent, and Van Buren. As in previous years, aspens were the most affected tree species and trees produced a second set of leaves across the affected area. Widespread mortality has not been observed at this point.

There was one notable outlier in the distribution of this year's defoliation, however. On the western border in T7 R19 WELS (Big Six Twp), MFS staff observed forest tent caterpillar defoliation on sugar maple and yellow birch, in addition to aspen. An aerial survey flight was arranged to survey the affected area in late June, mapping 3,385 acres of FTC defoliation, primarily in Big Six Twp. Additional defoliation occurring just across the border in St. Aurelie, QC was confirmed by the Quebec Ministry of Natural Resources and Forests. Overstory maples in Big Six Twp appeared to be up to 50% defoliated by mid-June, with private forest management companies reporting similar levels of damage in the area. Satellite imagery indicated that the affected sugar maple stands experienced a second flush of leaves by late July, which was also confirmed by ground surveys.

Figure 4: Sentinel II imagery of forest tent caterpillar defoliation along the Quebec border.

This is the first documented case of FTC defoliation of sugar maples in Maine in recent history, though it has been observed in Vermont and New Hampshire in recent years. To address the concerns of local landowners and sugarbush operators in western Maine, a two-day workshop was arranged by MFS detailing patterns of FTC outbreaks, management options, and potential effects on sugarbush operations. Special attention was given to winter FTC egg mass surveys, which can be used to predict expected defoliation the following spring. No egg masses from the previous 2023 season were observed during the workshop in Big Six Twp, which suggests this was the first year this area of Maine was affected. In terms of 2024 FTC egg masses, preliminary survey results of roughly two to three egg masses per tree indicate that there could be noticeable defoliation in 2025 based on the predictions of protocols developed in other states. Overcast survey conditions during the survey may have hampered

egg mass detections and masses found at ground level suggest there may have been more in the canopy overhead.

FTC outbreaks are generally expected to last anywhere from two to five years in Maine before populations subside due to natural controls. These include fungal and viral pathogens, as well as "friendly flies" (*Sarcophaga aldrichi*). Private landowners are considering aerial pesticide applications in commercial sugarbushes, which could have some effect on the Big Six Twp population.

It is unknown whether FTC populations will escalate or subside in 2025. Three years would be an appropriate length for the Aroostook population, though it may continue for another year or more. In addition, it is unclear whether the population in Big Six Twp represents a continuation of the Aroostook outbreak or should be considered a separate epidemic with its own natural control timeline. MFS staff have observed caterpillars killed by fungal agents in Big Six Twp – an encouraging sign that the outbreak could potentially resolve soon. MFS will continue to monitor northern Maine for signs of FTC activity, with an added focus on sugar maples near the western border.

Oak Twig Pruner (*Anelaphus parallelus*)
Primary Host(s): Oak (*Quercus* sp.), Hickory (*Carya* sp.), Elm (*Ulmus* sp.), Walnut (*Juglans* sp.) and several fruit trees

We did not receive any reports concerning this insect in 2024. The lifecycle of this species typically spans two years, so we expected to receive some reports during the 2024 season based on historical reporting patterns.

Spongy Moth (*Lymantria dispar dispar*)
Primary Host(s): Oak (*Quercus* spp.), Birch (*Betula* spp.), Aspen (*Populus* spp.), Larch (*Larix* spp.), Pine (*Pinus* spp.), and many other hardwood and conifer species

Now that the spongy moth population in western Maine has effectively collapsed, we can begin to understand the effects of this most recent outbreak. To review, the core outbreak spanned from 2020 until 2023, with over 50,000 acres of damage documented in both 2021 and 2022 during its peak. At this scale, the defoliation data was collected primarily through aerial survey. Even though populations had begun to recede, we were still able to capture 10,973 acres of canopy damage during aerial survey in 2023. It was too early to determine whether visible damage was due to defoliation by remaining pockets of spongy moth caterpillars, or whether trees may have already succumbed to previous defoliation damage coupled with multiple years of drought conditions. To complicate matters, a severe late frost event in 2023 affected oak canopies in the same area, which had not recovered by the time of aerial survey.

Aerial survey conditions proved favorable in 2024 however, allowing us a clearer picture of the aftermath compared to 2023. In total, 7,926 acres of tree mortality is being attributed to the combined stress of this concurrent defoliation and drought event. Among hardwoods, the abundant oak in this region was the clear host preference for feeding caterpillars. As is typical of these population levels, caterpillar feeding spilled over onto conifer hosts such as eastern white pine and hemlock, causing considerable mortality to these species as well.

At the beginning of 2024, there were two northern red oaks in Maine tied for the title of State Champion tree. One was in Kennebec County and fell from the podium following the loss of a massive

stem in a storm event. The Oxford County co-champion was among the casualties of the recent spongy moth outbreak.

Spotted Lanternfly (*Lycorma delicatula*)
Primary Host(s): Nursery stock

MFS received a single report of suspected spotted lanternfly (SLF) in 2024, which turned out to be nothing more than squash bugs in a vegetable garden in southern Maine. Unlike typical years, there were no interceptions reported from warehouse packaging or agricultural products. Some treatments occurred in southern Maine in 2024 to eliminate small areas of tree-of-heaven, a preferred host tree of SLF, which has not yet taken hold in Maine as it has elsewhere in southern New England and the greater Northeast.

Winter Moth (*Operophtera brumata*)
Primary Host(s): Oak (*Quercus* spp.), Maple (*Acer* spp.), Apples (*Malus* spp.) Ash (*Fraxinus* spp.), Birch (*Betula* spp.), and other trees and shrubs

We received many reports of severe winter moth defoliation from Phippsburg and Georgetown as well as the surrounding area including Boothbay Harbor, West Bath, and Bristol. This was confirmed during our aerial surveys in late spring. This area of Maine has been under intense winter moth pressure for several years now. Some areas with building winter moth populations are Deer Isle and Yarmouth. Deer Isle was confirmed during ground truthing of damage detected by aerial survey as well as through DNA confirmation of a sample sent in by a landowner earlier in the year. Our collaborators at University of Massachusetts Amherst were able to do a DNA confirmation of the specimen for us.

As in previous years, we are continuing releases of the biocontrol agent for winter moth, the parasitic fly *Cyzenis albicans*, in Midcoast Maine. The goal of this program is to bring winter moth into equilibrium with the rest of our native insect fauna so that it does not outbreak or outbreak as severely. We performed our annual release of *C. albicans* flies on April 26 in West Bath releasing 1,293 fly pupae obtained from our caterpillar collection efforts at our previous release sites. Next year's *C. albicans* release in Phippsburg is slated for May 2025 and was chosen due to the severe defoliation present on the peninsula. The emergence cage, with 2,242 *C. albicans* pupae, was placed in the ground on a Nature Conservancy property and will be monitored for emergence next spring.

Each year in late May we collect winter moth caterpillars from our previous biocontrol sites to obtain more *C. albicans* for new release sites along the coast. On May 29, field staff, with help from our collaborators at University of Massachusetts Amherst, collected over 9,237 caterpillars from five sites. The following week, a smaller group spent two days collecting an additional 3,784 caterpillars at five sites further north along the coast, where development was delayed. Two of those sites, Lubec and Mount Desert Island (MDI), are not previous release sites for *C. albicans* and we wanted to see if any of these biocontrol agents would be detectable in populations far from our release sites. Both sites yielded the parasitoid, with 13% of 291 caterpillars from MDI yielding flies, and 1 of the 2 caterpillars from Lubec that also yielding a fly.

Table 2: Percentage of parasitism at winter moth caterpillar collection sites in 2024

Caterpillar Collection Site	Number of Live Pupae Assessed	2024 Parasitism Rates
Bath	4	0%
Boothbay Harbor	97	47%
Cape Elizabeth	105	11%
East Boothbay	18	50%
Harpswell	7	0%
Kittery (Braveboat Harbor Rd, No Release)	2,179	40%
Kittery (Release Site)	230	40%
Lubec (No Release)	2	50%
Mount Desert Island (No Release)	291	13%
South Bristol	38	74%
South Portland	2,934	37%

Table 3: Releases of parasitic flies, Cyzenis albicans, in Maine

Town	County	Release Dates	Number of *Cyzenis albicans* Released
Cape Elizabeth	Cumberland	1-May-2013	2,000
Harpswell	Cumberland	16 & 22-May-2014	1,200
Kittery	York	16 & 23-May-2014	1,200
Vinalhaven	Knox	21-May-2014	2,000
Portland	Cumberland	15-May-2015	2,000
Cape Elizabeth	Cumberland	15-May-2015	1,000
Harpswell	Cumberland	Cage set: 15-Nov-2016	2,000
South Portland	Cumberland	Cage set: 29-Nov-2017	3,000
Bath	Sagadahoc	21-May-2019	500
Boothbay Harbor	Lincoln	29-April-2020	500
East Boothbay Harbor	Lincoln	17-May-2021	150
South Bristol	Lincoln	5-May-2022	329
South Bristol	Lincoln	1-May-2023	447
West Bath	Sagadahoc	26-April-2023	1,293
Phippsburg	Sagadahoc	Cage set 15-Oct-2024	2,242

Diseases and Other Injuries

Overview: The MFS forest pathology program had another very busy year in 2024 fielding high volumes of service requests, requests for information and reports of forest diseases and abiotic disorders of trees. We received over 300 reports of beech leaf disease alone, for a total of 434 reports and requests for assistance regarding tree health issues. The high volume of requests for assistance attests to the extent and significance of pathology-related problems facing Maine's trees and forests. The MFS forest pathologist gave six presentations and contributed to four presentations in 2024 and coordinated and wrote all pathology-related materials for federal Conditions and Highlights reports, all monthly Forest & Shade Tree – Insect & Disease Conditions for Maine editions, and this Annual Summary report.

In 2024, MFS pathology cooperated with several federal, State, public and private groups in various efforts to promote tree health understanding in Maine. MFS pathology facilitated work by the University of Maine School of Forest Resources leading to the publication, "*Modeling forest canopy structure and developing a stand health index using satellite remote sensing.*" Additionally, MFS pathology's cooperative efforts with the USFS and Bartlett Tree Experts led to submission of a BLD-related research article. MFS pathologist Aaron Bergdahl and MFS entomologist Tom Schmeelk, in cooperation with Acadia National Park Naturalist Jesse Wheeler, planned and led a forest health tour of Acadia National Park for the National Plant Diagnosticians National Meeting hosted in Portland. MFS pathology also assisted USFS in Durham on BLD long-term monitoring plots data collection and long-term eastern white pine crown health assessments in Bethel. Additionally, MFS pathology cooperated with the USFS Durham office, The University of Maine Forest and North Spore from Westbrook. on establishing a chaga inoculation study at two sites in Maine. Finally, MFS forest pathology partnered with the Greater Augusta Utility District, Maine Inland Fisheries and Wildlife, Viles Arboretum and other public and non-profit partners to trial Polyphosphite 30 and Arbotect 20S beech leaf disease treatments.

Diseases: Native

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

Armillaria root disease (ARD) has a broad host range, is present throughout the environment in Maine, and is routinely seen in Maine's forests and landscape trees that have experienced stress. ARD was seen in Hancock, Knox, Kennebec, Penobscot, Waldo and Washington Counties in 2024, but the disease could easily be found in any county in areas where trees are stressed. Environmental pressures in 2024 that have the potential to predispose Maine's trees to attack by ARD include: delayed response to previous years' adverse weather conditions like droughts or inundation of soils, chronic disease pressure in eastern white pine from the white pine needle disease complex, previous and current defoliation by insects like browntail moth, spongy moth and winter moth in oaks and other various damaging insect and disease agents that impact other deciduous and conifer species in a given year. Armillaria was suspected as the secondary responsible agent in scattered oak mortality in southwestern Oxford County.

Ash Rust (*Puccinia sparganioides*)
Host(s): Ashes (*Fraxinus* spp.)

In 2024, there was a limited outbreak of ash rust in the Columbia Falls area, not far from a 2022 outbreak of the disease. There was also a considerable outbreak of ash rust that impacted ash

throughout most of the southern half of Thomaston (a land area of roughly 3,000 acres). Ash rust has rarely been documented killing large landscape trees. However, this area will be monitored in 2024 to assess dieback, mortality and recurrence of disease. Affected areas in Washington County will also be surveyed in 2025 for this disease and possible secondary pests of ash.

Bot Canker (*Diplodia corticola*)
Host(s): Oaks (*Quercus* spp.), primarily Northern Red Oak (*Q. rubra*) in Maine.

Bot canker was occasionally observed in red oaks in Maine in 2024 and confirmations of this pathogen often originate as reports of oak wilt. It was not possible to verify all reports of Bot canker due to access to samples often occurring out of the reach of pole pruners. Kermes scale infestation, which is randomly encountered in Maine, has similar visual symptoms and has been reported as oak wilt by the public in the past. False reports of Bot canker due to oak twig pruner (*Anelaphus paralellus*) damage did not occur this year due to a lack of reports of this insect in 2024. This is not surprising due to the cyclical nature of this oak tree insect pest. Typically, Bot canker is associated with oaks growing on drought-prone soils and is reliably found causing damage on sandy soils in York County. As Bot canker incidence is thought to be associated with tree stress, the impacts of weather extremes may increase incidence of Bot canker, among other stress-related disorder affecting oak. Bot canker surveys will continue in association with informal annual surveys for oak wilt disease.

The continued inquiries about oak branch flagging and wilting from the public, foresters and other natural resource professionals who are informed and concerned about oak wilt is reassuring. We will continue oak wilt-related outreach in our Conditions Reports, presentations, and other communications that reach a wide audience.

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

During visits to white pine stands in 2024, *Caliciopsis pinea* was seen affecting the health of codominant and suppressed white pine trees and seems to be responsible for mortality among white pine seedlings and saplings in the understory of infected stands. This disease continues to impact especially low-vigor stands of white pine in Maine, with increased incidence and severity in areas heavily impacted by the white pine needle damage disease complex and on drought-prone soils in southwestern Maine.

Chaga/Cinder Conk (*Inonotus obliquus*)
Host(s): Birches, primarily Yellow Birch (*Betula allegheniensis*) and less often on Paper Birch (*Betula papyrifera*) in Maine. Rarely found on American Beech (*Fagus grandifolia*) and Hophornbeam (*Ostrya virginiana*).

Beginning in early 2024, MFS began a cooperative *Inonotus obliquus* inoculation project with the USFS Pathologists in Durham, NH, the Massabesic Experimental Forest, the company North Spore of Westbrook, Maine, and the University of Maine Forests. The goal was to establish two sites (a southern site and a northern site in Maine) to closely monitor disease development associated with infection by the pathogen that causes chaga formation (*I. obliquus*) in white and yellow birch trees. The trial includes trees inoculated with three different local strains of the fungus and control trees for comparison. The chaga isolates were collected by USFS and MFS personnel in Maine and North Spore provided another Maine strain. North Spore also generously grew out the strains and inoculated small wooden dowels

used for the tree inoculations. Several tree health metrics were recorded on all included trees at the beginning of the trial to monitor tree health impacts over time. It is hoped that this long-term project will contribute to information on aspects of *I. obliquus* disease development and resulting chaga formation, as well as provide insights into the impacts of the practice of chaga farming on Maine's forests.

Christmas tree plantation root disease issues (*Phytophthora spp. and yet unconfirmed pathogens*)
Host(s): Firs (*Abies* spp.)

MFS forest pathology received reports of unexplained wilting and tree mortality from five Christmas tree growers in 2024. The growers described all age classes of trees being affected. Visits were made to these locations for inspection and sample collection or samples were submitted to the pathology lab in Augusta by the growers. Analysis of the samples provided no clear conclusions. When MFS pathology reached out to the University of Maine Plant Diagnostic Clinic in Orono later in the year, the Head Diagnostician confirmed that she too had received several reports of fir mortality from Christmas tree growers. In some cases she had confirmed a species of Phytophthora as the agent causing wilting and mortality.

Another instance of wilting conifers occurred in Hancock County where an estate had established a nursery to supply trees for its own landscaping. Transplanted spruce seedlings had wilted at the nursery site and where they had been transplanted at the estate property. Two root disease fungi were isolated from these samples by the UMaine Plant Diagnostic Clinic: A *Phytophthora* species and a species in the genus *Cylindrocarpon*. It was later learned that the spruce trees had originally been dug from a Christmas tree farm. Hopefully, more will become clear about these concerning situations and efforts to better understand this phenomenon will be a priority in 2025.

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

Eastern dwarf mistletoe is encountered along Maine's coast where the hosts are common and the conditions for disease development are favorable to this parasitic plant pathogen. A handful of reports were called in to MFS pathology in 2024. These typically occur early in the year when the brooms are more easily seen by the public.

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

Fir needle blights were not reported to the MFS pathologist by the public or Christmas tree growers in 2024. However, *Rhizosphaera pini* was seen in a handful of visited Christmas tree farms visited for other reasons in 2024.

Fire Blight (*Erwinia amylovora*)
Host(s): Trees and shrubs in the Rosaceae family. Apple (*Malus* spp.), Pear (*Pyrus* spp.), Cherries (*Prunus* spp.), and Mountain Ash (*Sorbus* spp.) account for most instances of fire blight in Maine.

MFS pathology did not receive many reports of fire blight in 2024. However, in a conversation with an arborist from southern Maine, the arborist remarked that fire blight was frequently encountered by his crews and the increased incidence was notable (primarily Cumberland County). Understanding the fire blight situation in Maine will continue to be part of MFS Pathology's efforts in 2025.

Foliar Diseases
Host(s): Several species of trees and shrubs

Prior to 2024, foliar diseases like Anthracnose diseases and apple scab were common and severe in 2023. This was due to the wet weather that persisted for most of June, a common infection period for many foliar diseases, and sporadic prolonged periods of wet weather for the remainder of the growing season. This meant heavier-than-normal disease incidence and severity in 2023 and could be responsible for abundant inoculum for infections in 2024, given the right combination of weather conditions during critical spore dispersal times. Fortunately, late spring/early summer weather conditions in 2024 were not particularly favorable to foliar disease development in many parts of Maine. Still, some severe cases of defoliation from anthracnose diseases of oak and river birch were reported and defoliation from apple scab was particularly severe in some areas. Several reports of dead apple trees in the central and southern Maine (Cumberland, Hancock, Kennebec and Penobscot Counties) turned out to be cases of severe defoliation and these trees are expected to leaf out next year.

Giant Tar Spot of Maple (*Rhytisma acerinum*)
Host(s): Norway Maple (*Acer platanoides*); occasionally other Maples (*Acer* spp.) are impacted by other *Rhytisma* spp.

Reports of this pathogen were down significantly in 2024. Based on field observations in several Maine counties where the invasive host (*A. platanoides*) of giant tar spot is abundant, disease incidence was lower than usual. The reason for this is unclear and is very likely due to specific weather conditions not conducive to disease development. While the disease was clearly present in areas of Cumberland, Kennebec and Penobscot Counties, it could be that the public has become familiar with this conspicuous, yet low-damage disease and no longer reports this to MFS.

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

Hemlock shoot blight was rarely seen in 2024 and not reported by the public. The disease was noted at the long-term monitoring plots for eastern white pine crown health metrics in Bethel (Oxford County).

Oak Decline (multiple causes)

Oak decline describes the general characteristic of declining oak health seen as progressive crown dieback over several years leading to mortality in some cases. A principal component of oak decline is stressors, which have been numerous and widespread in Maine over the past several years. Biotic pest stressors of oaks in Maine often associated with furthering the overall oak decline process include: defoliating insects like spongy moth (*Lymantria dispar*), browntail moth (*Euproctis chrysorrhoea*) and

winter moth (*Operophtera brumata*); the wood-boring insect, the two-lined chestnut borer (*Agrilus bilineatus*); fungal root rots like Armillaria root disease (*Armillaria* spp.). Abiotic causes for decline, mostly adverse weather conditions, have also been usual in recent years. These include extended drought periods, extended wet periods, and severe weather events leading to branch and stem breakage. Sometimes adverse-weather-related conditions predispose oaks to attack by biotic agents of decline (such as summer flooding or drought predisposing oak to attack by Armillaria root disease or two-lined chestnut borer), other times defoliating insects predispose oaks to further decline and mortality when they experience adverse growing conditions. Oak decline is not reported as such due to the complicated nature of its definition and identifying it accurately by natural resource professionals and the public. However, in 2024, the phenomenon was identified on varying acreages in all counties where oak is a common component of forests, which is primarily in the southern half of Maine. Oak decline is a concern primarily because of the economic and ecological value of oak. It can also disguise the symptoms of oak wilt, a serious disease that relies on early detection for effective management.

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

This disease was not reported in 2024, although it is still routinely seen on oaks wherever they grow in Maine. Most years the disease is reported during winter and spring when Phomopsis galls are easily seen.

Red Pine Decline (*Diplodia pinea, Sirococcus conigenus*)
Host(s): Red Pine (*Pinus resinosa*), Scots Pine (*P. sylvestris*), and Austrian Pine (*P. nigra*)

Red pine blights caused by Diplodia tip blight (*Diplodia sapinea*) and Sirococcus shoot blight (*Sirococcus conigenus*) remain significant damaging agents to red pine in native and especially plantation stands throughout Maine. The impacts of *D. pinea* and *S. conigenus* are clear and the diseases occur at high frequency throughout Maine's red pine resource; they often co-occur on sites. These diseases reduce growth and live crown ratios and are overall chronic stressors to red pine trees. Root diseases, such as Heterobasidion root disease (*Heterobasidion* spp., HRD), Armillaria root disease (*Armillaria* spp., ARD), and heart rot fungi may also play a part in deteriorating red pine stand health. Efforts to better understand the distribution of HRD in Maine continue as informal surveys. The increasing distribution of red pine scale and associated rapid red pine mortality further highlights the multiple challenges to growing healthy red pine in many areas of Maine.

Red Ring Rot of Eastern White Pine (*Porodaedalea pini* (formerly *Phellinus pini* and 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

Porodaedalea pini was not reported to MFS in 2024, although it was seen in mature pine forests in Penobscot and Kennebec counties.

Rosellinia mycophila
Host(s): Conifers

In late October 2023, the MFS pathologist was contacted by the University of Maine Plant Diagnostic Lab and the Maine Department of Agriculture about unusual fungal growth on planted white spruce in a

horticultural setting in Northeast Harbor (Hancock County). A few weeks later, another location was reported in Northeast Harbor, this time on *P. pungens* and *P. omorika*. Around the same time the same type of fugal growth was reported on Colorado blue spruce (*Picea pungens*) in Connecticut and New Hampshire. The MFS forest pathologist visited the Northeast Harbor sites, made collection and submitted them to the USFS Durham Field Office, who then forwarded the samples to USDA Agricultural Research Service (ARS) for official identification. When first collected and examined in Maine and Connecticut, the fungus was identified based on morphology as *Rosellinia herpotrichoides*, a fungus previously reported causing severe needle loss in hemlock in Georgia and North Carolina. This caused concern for hemlocks in Maine already facing threats from hemlock woolly adelgid and elongate hemlock scale. However, in 2024 USDA ARS identified the *Rosellinia* species collected on spruce in Connecticut, Maine and New Hampshire as *R. mycophila*. While this was somewhat relieving, the more precise species identification by the USDA ARSrevealed that a similar fungal sample collected later in 2023 on hemlock in New Hampshire was *R. herpotrichoides*. Thus, MFS will remain vigilant in informal surveys for this potentially damaging disease of hemlock. MFS forest pathology has kept in contact with the managers of locations where *R. mycophila* was collected. Neither location has had a recurrence of *R. mycophila*.

Spruce Needle Casts (*Rhizosphaera kalkhoffii, Stigmina lautii*)
Host(s): White Spruce (*Picea glauca*) and Colorado Blue Spruce (*P. pungens*), Norway Spruce (*P. abies*) is typically more resistant, but is also affected.

Spruce needle cast diseases continue at moderate to high levels across the state, wherever hosts occur. The diseases have been especially damaging to ornamental plantings in suburban settings, in public parks, and along community streets. These instances are commonly reported to our office by the public. Severe damage to spruce trees by the spruce needle cast diseases has resulted in some mortality, but more often, trees are removed prior to mortality because of reduced aesthetics or decreased function as privacy screens. Survey efforts to map the distribution of these diseases were minimal in 2024. Based on observation, reports and earlier surveys, it is believed that both *Stigmina* and *Rhizosphaera* are found throughout Maine. Accurate species identification is important to effective management.

White Pine Needle Diseases (*Mycosphaerella dearnessii* (*= Lecanosticta acicola*), *Lophophacidium dooksii*, *Bifusella linearis and Septorioides strobi*))**
Host(s): Eastern White Pine (*Pinus strobus*)

Fungi of the white pine needle disease (WPND) complex continued to impact white pine trees in 2024. This was not surprising due to the very wet June 2023, the period of peak spore dispersal for the WPND fungi (these diseases take a full year to develop symptoms and spore-producing structures for re-infecting pine). Even though it seems as if the WPND pathogens require little moisture to complete their life cycles and cause severe premature needle loss in eastern white pine, prolonged wet conditions during the June infection period could have been a strong predictor of widespread disease in 2024. This was indeed realized in 2024 such that during 2024 aerial survey, WPND impacts were so widespread, all white pine trees seemed to be impacted to some extent, making the aerial survey mapping of WPND extremely difficult. A total of 21,037 acres of damage were mapped during aerial survey where larger, more concentrated stands allowed. Given the almost universal affliction of WPND on individual trees or small groups of trees that were unmappable, this was an underestimation of total acres. Luckily, the USFS Durham Field Office was able to provide assistance with this using satellite imagery and GIS tools.

In the USFS's final analysis of the WPND situation in Maine in 2024, they estimated that between 600,000 and 800,000 acres of white pine and mixed white pine forests were impacted.

Diseases: Non-Native

Beech Bark Disease (*Cryptococcus fagisuga*, *Nectria coccinea* var. *faginata*)
Host(s): American beech (*Fagus grandifolia*)

Beech bark disease continues to severely affect beech trees throughout the state. Efforts continue to locate and map the location of beech trees showing resistance. Due to the new presence of beech leaf disease in Maine, the future health of beech is uncertain. Because of this, MFS has begun an effort to macroinject beech trees that show high levels of resistance to beech bark disease with a product containing the active ingredient Thiabenzadole, a product with demonstrated fungicidal and nematicidal function. The aim is to protect the genetics of some of these rare trees. Beech stands were surveyed in all of Maine's counties in 2024 related to beech bark disease and beech leaf disease.

Beech Leaf Disease (*Litylenchus crenatae mccannii*)
Host(s): American beech (*Fagus grandifolia*) and non-native and ornamental varieties of Fagus spp.

Since confirmation of beech leaf disease (BLD) in Lincolnville (Waldo County) by MFS and USFS Durham Field Office forest pathology staff in late May 2021, BLD has spread dramatically throughout Maine (Figure 5). The impacts of beech leaf disease have become visible during aerial survey in 2023 and 2024, but the acreage mapped does not capture the widespread nature of BLD impacts, now confirmed in over 220 Maine towns and in 15 of 16 counties (Table 4). 219 new towns were confirmed for BLD presence in 2024 alone. Survey was carried out in all of Maine's counties in 2024, including a winter bud survey based on research by Wolf and Viera (2024) showing that *Litylenchus crenatae mccannii* overwintering in beech buds alters bud scale morphology in a highly characteristic and clearly identifiable way. This allowed BLD survey to be conducted in winter with confirmation of BLD in several new towns (some detections were made in early 2024, some in late 2023). Follow-up surveys to determine the effectiveness of the survey after leaf-out in spring 2024 showed that this winter bud survey is effective in identifying areas with well-established BLD populations but is not reliable for detection of low-level infestations. In late 2024, several towns were confirmed for BLD based on observed banding of persisting leaves.

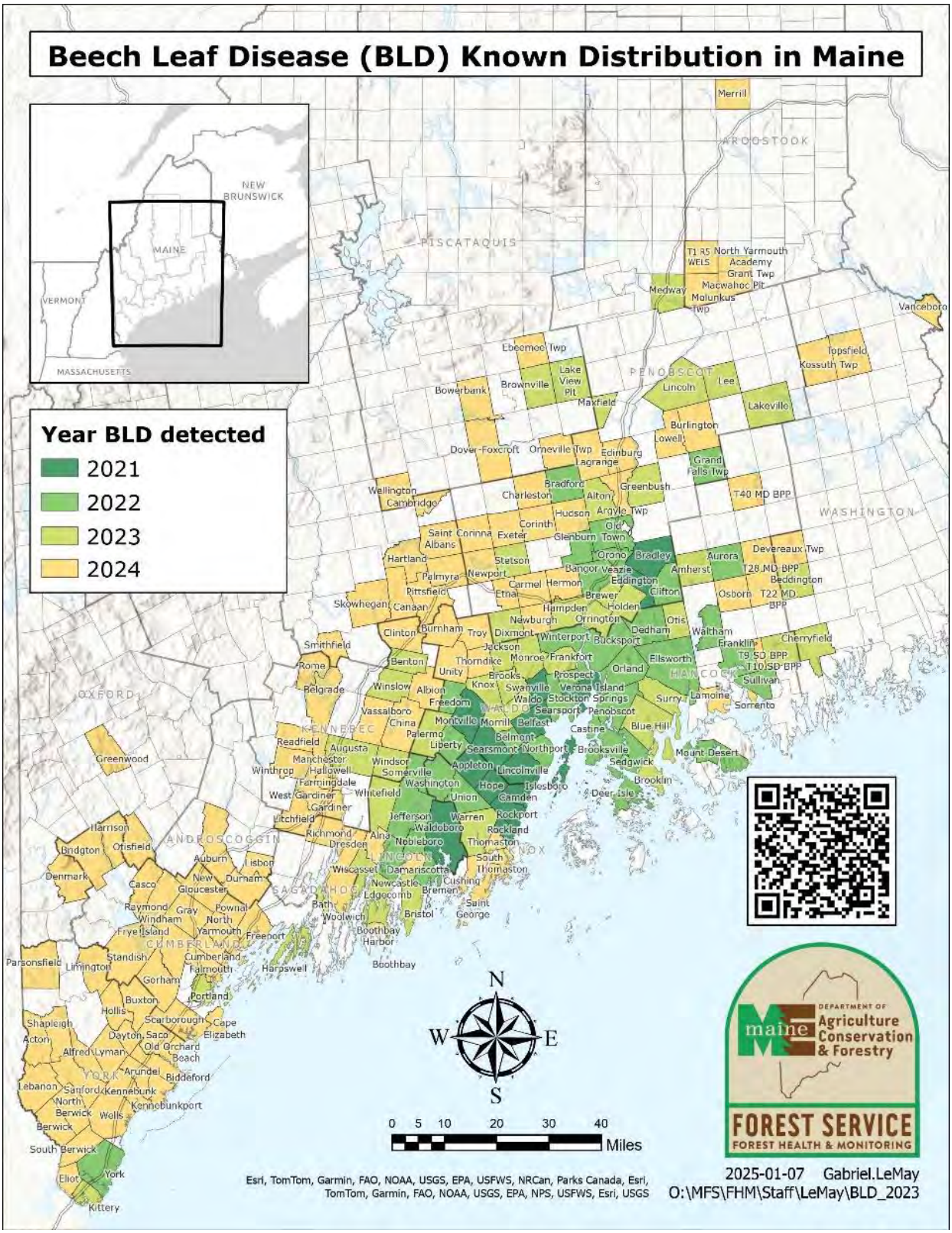

Figure 5: Distribution of beech leaf disease in Maine at the end of 2024.

Table 4: Maine counties where beech leaf disease has been confirmed and year of first detection

County	Year of First Detection
Aroostook	2024
Androscoggin	2023
Cumberland	2023
Franklin	No Confirmation
Hancock	2022
Kennebec	2023
Knox	2021
Lincoln	2021
Oxford	2024
Penobscot	2021
Piscataquis	2023
Sagadahoc	2023
Somerset	2024
Waldo	2021
Washington	2023
York	2022

Work was completed on nine long-term monitoring plots in summer of 2024 in cooperation with a USFS Forest Pathologist from the Durham Field Office. 2024 marked the third year of data collection. A project aimed at protecting beech trees from BLD and preserving the genetics of beech bark-resistant began in 2024. Trees at 4 sites (9 trees total: Charleston, Penobscot County; Windsor, Augusta, Kennebec County; Montville, Waldo County) were injected with the nematicide/fungicide Arbotect 20S (Thiabenzadole) that has shown promising treatment results in beech trees in other states. The aim is to expand the amount of trees and sites over the next two years in an effort to preserve genetic diversity of beech bark disease-resistant beech trees for the future.

Butternut canker (*Ophiognomonia clavigignenti-juglandacearum* (formerly *Sirococcus clavigignenti-juglandacearum*))
Host: Butternut (*Juglans cinerea*)

The health of butternut trees continues to decline steadily wherever they grow in Maine. Populations of butternut persist on the landscape in Maine; however, it is highly unusual to find a butternut tree anywhere in Maine without symptoms and signs of the butternut canker fungus. When trees without symptoms of butternut canker are encountered, more detailed morphological characteristics indicate that these trees are hybridized individuals (although genetic tests to confirm this are not conducted). MFS pathology is looking forward to the publication of a journal article on butternut tree and canker genetics by researchers from Atlantic Forestry Centre, Natural Resources Canada, partially based on fungal canker and leaf collections MFS made in Maine in 2023.

Dutch Elm Disease (*Ophiostoma ulmi; O. novo-ulmi*)
Host(s): Elms (*Ulmus* spp.)

Dutch elm disease (DED) remains a prevalent disease of elms in Maine. Each year MFS receives several reports from the public of DED killing elm trees. The level of the disease remains constant. A notable

detection of DED in 2024 was on two Princeton elms in southern Somerset County. This is an important reminder that DED resistance does not equal immunity from this destructive vascular wilt pathogen. Otherwise, DED is seen regularly along roadsides and field edges during trips to the field.

European Larch Canker (*Lachnellula willkommii*)
Host(s): Native and Non-native Larch (*Larix* spp.)

Winter survey for European larch canker (ELC) continued to be a focus in 2024, but was limited due to weather conditions. MFS technicians surveyed for flagging branches in the fall ahead of winter ground-truthing; however, opportunities for enhanced survey efforts in winter were rare because the bogs and wetter areas where larch often grow were only frozen for a short time. Road accessibility was also an issue during thaw periods. During this narrow window staff availability was limited due to other winter survey work. In a typical winter, bogs and wetlands freeze more thoroughly and for a longer period, allowing easier access to smaller wetland larch. These small larch trees can be thoroughly inspected for ELC, unlike tall, mature trees with unreachable canopies. This also greatly reduces the need for destructive sampling of larger trees with suspected cankers in the upper crown. MFS staff were not able to confirm ELC in any new locations in 2024. The ELC quarantine area was significantly expanded in 2023, which will extend the area for survey in subsequent years.

Cooperative efforts between the MFS and the Brunswick Country Club continued in 2024 to eradicate ELC from this area, which is now within the greater quarantine area but is still considered an outlying occurrence from the known contiguous areas where ELC is found. The Club has continued prioritizing removals guided by our recommendations which are based on late-winter annual surveys carried out by MFS pathology, including a health evaluation of all *Larix* spp. trees on the golf course. Canker counts were made for each tree, and reachable cankers were physically removed using a pole saw. In 2024, we removed roughly 17 cankers from 10 trees, recommended the removal of 12 trees based on disease presence and general health, and pruning requiring a lift was suggested for one tree. This cooperative effort will continue in spring 2025.

Oak Wilt (*Bretziella fagacearum*)
Host(s): Oak (*Quercus* spp.); Red Oak-group Oaks (highly susceptible), White Oak-group Oaks (moderately susceptible)

Oak wilt survey in 2024 was carried out informally by general observation and investigating all reports of summer oak defoliation, flagging/wilting oak branches and unexplained oak tree death. In several investigations of reported oak wilt cases in 2024, the causal agent was determined to be oak anthracnose (*Apiognomonia errabunda*). Other cases were due to storm damage or likely due to chronic stressors like defoliation by browntail moth (*Euproctis chrysorrhoea*) and spongy moth (*Lymantria dispar*). Informal survey for oak wilt will continue in 2025 and oak wilt outreach efforts will continue to be prioritized for early detection of this serious forest pest.

White Pine Blister Rust (*Cronartium ribicola*)
Host(s): Eastern White Pine (*Pinus strobus*), Currants, Jostaberries, and Gooseberries (*Ribes* spp.)

White pine blister rust (WPBR) remains a significant threat to eastern white pine regeneration and sapling-sized trees and stands throughout Maine wherever white pine and the rust fungus's alternate hosts coexist. As time passes since cessation of *Ribes* control efforts, and plants in the genus *Ribes* are

increasingly encountered and interest in planting currants is seemingly on the rise (based on inquiries to the MFS forest pathologist), the incidence of WPBR is expected to rise. MFS will continue to be vigilant in identifying areas where WPBR becomes problematic, and WPBR quarantine regulations remain in place to limit the spread of this disease. The quarantine bans all cultivation of European black currant (*Ribes nigrum*) and its cultivars, including Jostaberries, and further limits legal Ribes cultivation in roughly half of the state. MFS received a small number of inquiries about this pathogen in 2024.

Abiotic/Weather Events

Drought Damage
Host(s): All Species

MFS received late summer reports of extensive oak mortality in the hills near Camden (Knox County). This was also identified as an area of concern during aerial survey and required ground-truthing by an MFS entomologist and pathologist to rule out oak wilt and assess for other possible disorders. The trees impacted were primarily on exposed and rocky slopes. Upon arriving at a symptomatic area, it became clear that while oak was primarily impacted, other tree and shrub species growing in these areas showed similar symptoms of dried, brown and crispy leaves. Without finding any signs of pathogens or insect damage while inspecting affected plants, it was concluded that the trees and shrubs had suffered drought damage. When inspecting the trees, many appeared to still be alive, although the health of trees in this area will be re-assessed in field season 2025.

Herbicide Injury
Host(s): All Species

The number of reports of herbicide damage to trees in residential areas in 2024 was similar to previous years. Harm to non-target trees and shrubs due to improper application of non-selective and selective herbicides used for vegetation control is regularly encountered by MFS staff each year, mostly in residential settings and near rights of way. Instances of nefarious pesticide use are referred to Maine's Board of Pesticide Control.

Freeze Damage to Trees
Host(s): Deciduous Trees

A freeze event on May 18, 2023, impacted trees throughout a large portion of southern Maine, with reports ranging from Moscow (Somerset County) to the north, North Berwick (York County) to the south, east to western Hancock County and west to the New Hampshire border (Oxford County). Severe damage was especially widespread in western Maine, while reports throughout the rest of the affected region were scattered and correlated with exposed areas and cold draws where cold air settled for extended periods. Due to their stage of development, oak and beech leaves were predominantly impacted by the freeze damage, although several other species were also affected.

While 7,250 acres of damage related to this freeze event was mapped during aerial survey in 2023, the full extent of the damage was not able to be accurately represented. This was partially due to aerial survey availability directly after the freeze event. Fortunately, in 2024, the USFS Durham Field Office was able to work on quantifying the damage for the region after the event using remote sensing tools and archived satellite imagery. Using this retrospective method, the area impacted in Maine was estimated to be 576,801 acres. Regionally, the affected areas covered 5.5 million acres spanning eight states. Even

though the USFS emphasized that total acres affected as measured with satellite imagery should be considered a rough estimate, this better characterizes and confirms the serious nature and extensive impacts of this weather event. Justin Williams of the Durham Field Office is acknowledged for his efforts and cooperation in quantifying the extent of this forest health event.

Wind Damage
Host(s): All Species

High wind events during winter 2024 resulted in multiple blowdowns in various parts of Maine. This type of winter weather, in some cases when soils are not frozen, has seemed to occur more frequently in recent years. This represents a cause for concern from a forest fire standpoint, as substantial fuel loading in blowdown areas and the tangled mess of trees created present a substantial barrier to mobility for fire suppression personnel and vehicles, should a forest fire start in a particular blowdown area.

Winter Injury
Host(s): Evergreen trees and shrubs, maples and other thin-barked species

Winter injury occurs to especially conifers each year in Maine. Damage was not reported by the public in 2024, which was surprising and does not indicate absence of this common tree disorder. In particular, winter burn of conifer foliage was not reported. This may be because of the frequent rains into early winter, precipitation in the form of rain in each month of the winter, and perhaps intermittent soil thawing/early thaws increasing water availability during times when in colder years it would be unavailable in the form of ice. This could have kept conifers well-supplied with water, preventing winter burn. Thin-barked species are also damaged in winter occasionally, but this also was not reported by the public in 2024. This could be due to a shorter snow season resulting in less solar reflectance that is often the cause of sun scald of thin-barked trees. Salt damage could also fit into this category of winter injury. Salt damage along roadways was not as severe in 2024, perhaps again due to the rains that would have prevented the build-up of salts on roads and salt spray transported to conifer foliage via vehicle traffic.

Annelids

Jumping worms (*Amynthas spp.*)

This year, we were able to confirm jumping worms in seven additional towns in Maine based on public reporting: Bremen, Brownfield, Farmingdale, Hampden, Hancock, Lee, and Old Town. This is a marked decrease compared to the 90+ towns we confirmed as having jumping worms in 2023. Although jumping worms were only confirmed in a few additional towns in 2024, we still received over 80 reports in 2024, indicating that jumping worms are widespread and continue to spread to new areas in the state. We have not yet detected jumping worms in Piscataquis, Washington, or Aroostook Counties.

It is unclear how the presence of jumping worms may impact Maine's forests; however, due to their ability to rapidly decompose leaves on the forest floor, loose soil, soil erosion, and plant and tree stress may occur. The DACF will continue to establish long-term monitoring sites and monitor for their presence in unconfirmed counties in 2025 to better understand their effect on our forests.

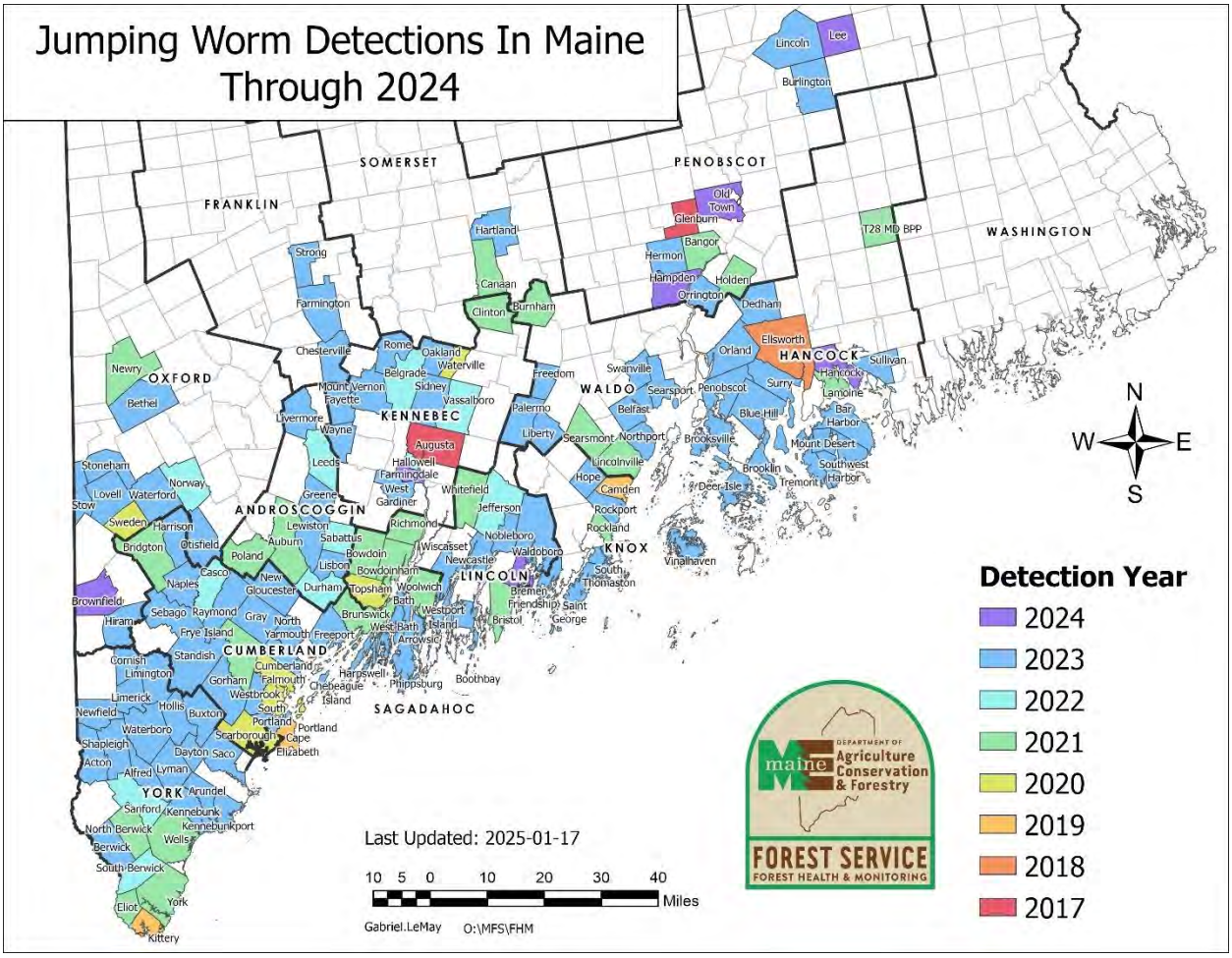

Figure 6: Towns with confirmed presence of jumping worms.

Other Division Activities

Forest Inventory and Analysis (FIA)

Synopsis of the 2024 Measurement and Analysis Effort

The MFS Forest Health & Monitoring Division works with the USFS to implement an annualized forest inventory. Plots are measured by state crews in Maine following federal standards. Data is submitted to the National Forest Inventory and Analysis program. The forest inventory plots are distributed across five panels; each panel is measured in a calendar year. Every panel is distributed evenly across the state; the 2024 panel consisted of 661 plots.

Training and Field Measurement

The 2024 panel of measurements was 100% completed by the MFS crew. Plot measurements for the 2024 panel started the second week in January. Weekly production was limited by staffing shortages until late October, when the new hires to complete crews completed training and FIA was able to begin full measurement production. Overall weekly production on average was 12.02 plots and varied depending on weekly staffing and other factors.

The measurement of 661 plots was completed by January 6, 2025, which was between one and two weeks behind previous years due to inclement weather and lack of crew.

The USFS conducts audits that assess the quality control and assurance of measurements taken by the FIA crews. The FIA crews were rated well above the required compliance score of 90% for the 2024 field season.

Exotic Woodborer and Bark Beetle Survey
Host(s): Spruces (*Picea* spp.), Pines (*Pinus* spp.), other conifers, and Oaks (*Quercus* spp.) and other hardwoods

MFS did not participate in the national EWBB program as it has for many years prior due to alternative funding sources that allowed for work in other program areas. As mentioned in the report, MFS did operate its own small trap network for brown spruce longhorn beetle, a typical target of the EWBB program with several recent new detections in neighboring Canadian provinces. No BLSB were recovered from these trapping efforts in Maine in 2024.

Partnership with the Forest Ecosystem Monitoring Cooperative (FEMC)

Cooperation between the MFS and the Forest Ecosystem Monitoring Cooperative (FEMC) continued in 2024. Maine has two state coordinators who attend monthly meetings, a yearly meeting (although both coordinators were not able to attend the 2024 meeting), and participate in several other functions of the FEMC. Notable FEMC activities in 2024 included completion of FEMC inventory plots by MFS FIA crews and participation in grant review processes providing funding for ecosystem research by regional groups. The FEMC continues to provide support for regional efforts to increase understanding of threats to northern ecosystems, like Maine's forests.

Insect Collection

The MFS Insect Collection contains over 73,000 specimens in the reference portion of the collection. Additionally, there are more than 5,000 ant specimens stored in alcohol, more than 60,000 spider records, and over 10,000 bark beetle and woodborer specimens. Most of the specimens are stored at the MFS Insect and Disease Lab located in the Deering Building in Augusta.

We did not receive any requests for specimens this year for reference or research.

In late July 2024, we were able to send the collection curator to attend the Entomological Collections Network Workshop held at the Yale Peabody Museum in New Haven, CT. This travel was made possible by a generous $1,000 grant from the Entomological Collections Network which is a non-profit organization dedicated to the promotion of entomological science through the preservation, management, use and development of entomological collections and taxonomy.

Through this training many connections were made and techniques learned that will aid in more effective curation of Maine's collection and help shape future plans and directions. The knowledge gained at this workshop will help preserve and grow this important collection so that future generations of researchers will be able to use it to see how things have changed, giving them a baseline and record of species composition and abundance.

Light Trap Survey

Seventeen traps were operated in 2024 in locations from South Berwick to Big Twenty Township. One location was added in Caribou. Traps were operated for 30 days starting on June 16 in the south and for 45 days starting on July 1 in the north. Trap operators collect the catch daily, arrange the specimens in padded boxes, and send them to MFS offices weekly where specimens are processed by FHM technicians.

A checklist of significant insect defoliators is used in sorting the moth catch material, with collection data for many of these species going back over 20 years' worth of trapping. Pest populations of significance are reported in the appropriate section of this report. In addition to providing useful population data, a portion of the collected specimens are saved for use in outreach programs. Sample processing and data entry is currently ongoing.

Table 5: 2024 Light trap locations

Town	County	# nights	start date	end date	Trap type
Ashland	Aroostook	30	7/1/2024	7/31/2024	Rothamstead
Estcourt	Aroostook	30	7/1/2024	7/31/2024	Rothamstead
Portage	Aroostook	30	7/1/2024	7/31/2024	Rothamstead
Littleton	Aroostook	30	7/1/2024	7/31/2024	Rothamstead
Ashland	Aroostook	30	7/1/2024	7/31/2024	Rothamstead
Allagash	Aroostook	30	7/1/2024	7/31/2024	Rothamstead
Caribou	Aroostook	30	7/1/2024	7/31/2024	Rothamstead
Salem Twp	Franklin	30	6/16/2024	7/31/2024	Rothamstead
Rangeley	Franklin	45	6/16/2024	7/31/2024	Rothamstead
Whitefield	Knox	45	6/16/2024	7/31/2024	Rothamstead
East Millinocket	Penobscot	45	6/16/2024	7/31/2024	Rothamstead
Exeter	Penobscot	45	6/16/2024	7/31/2024	Rothamstead
Monson	Piscataquis	45	6/16/2024	7/31/2024	Rothamstead
Montville	Waldo	45	6/16/2024	7/31/2024	Rothamstead
Calais	Washington	45	6/16/2024	7/31/2024	BL-110V
Topsfield	Washington	45	6/16/2024	7/31/2024	Rothamstead
S. Berwick	York	45	6/16/2024	7/31/2024	Rothamstead

Publications

Dendrochronological reconstruction of arborvitae leafminer (Argyresthia spp.) outbreaks on northern white-cedar (Thuja occidentalis) in Maine, USA; Shawn Fraver, Colby Bosely-Smith, Camilla Seirup, Christopher H. Guiterman, Thomas Schmeelk, Aaron Teets, Ruth Van Kampen, and Laura S. Kenefic. Canadian Science Publishing, Vol 54, No. 4. April 2024

Modeling forest canopy structure and developing a stand health index using satellite remote sensing. Ecological Informatics; Pulakesh Das, Parinaz Rahimzadeh-Bajgiran, William Livingston, Cameron D. McIntire, Aaron Bergdahl. Vol 84. October 2024.

Remotely Sensed Damage Estimates for the 2023 Spring Freeze Event in the Northeast: Situation Report; Justin Williams. USDA Forest Service. December 2024. https://digitalmaine.com/usda_feddocs/12/

White Pine Needle Damage in Maine, 2024: Remote Sensing Product Accuracy Report; Justin Weilliams. USDA Forest Service. April 2025. https://digitalmaine.com/usda_feddocs/11/

Appendix A
Hemlock Woolly Adelgid and Elongate Hemlock Scale in Maine 2024

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Hemlock woolly adelgid (HWA, *Adelges tsugae*) was first detected in Maine forests in August 2003. Currently, it is established in forests in towns from Kittery to Bar Harbor. Although it remains more prevalent along coastal regions, in recent years it has been developing further inland. In 2024, HWA was detected in two new towns: Parsonsfield (York County) and Liberty (Waldo County). Of note is that there is a gap of at least one town between these new infestations and any other previously known infested towns.

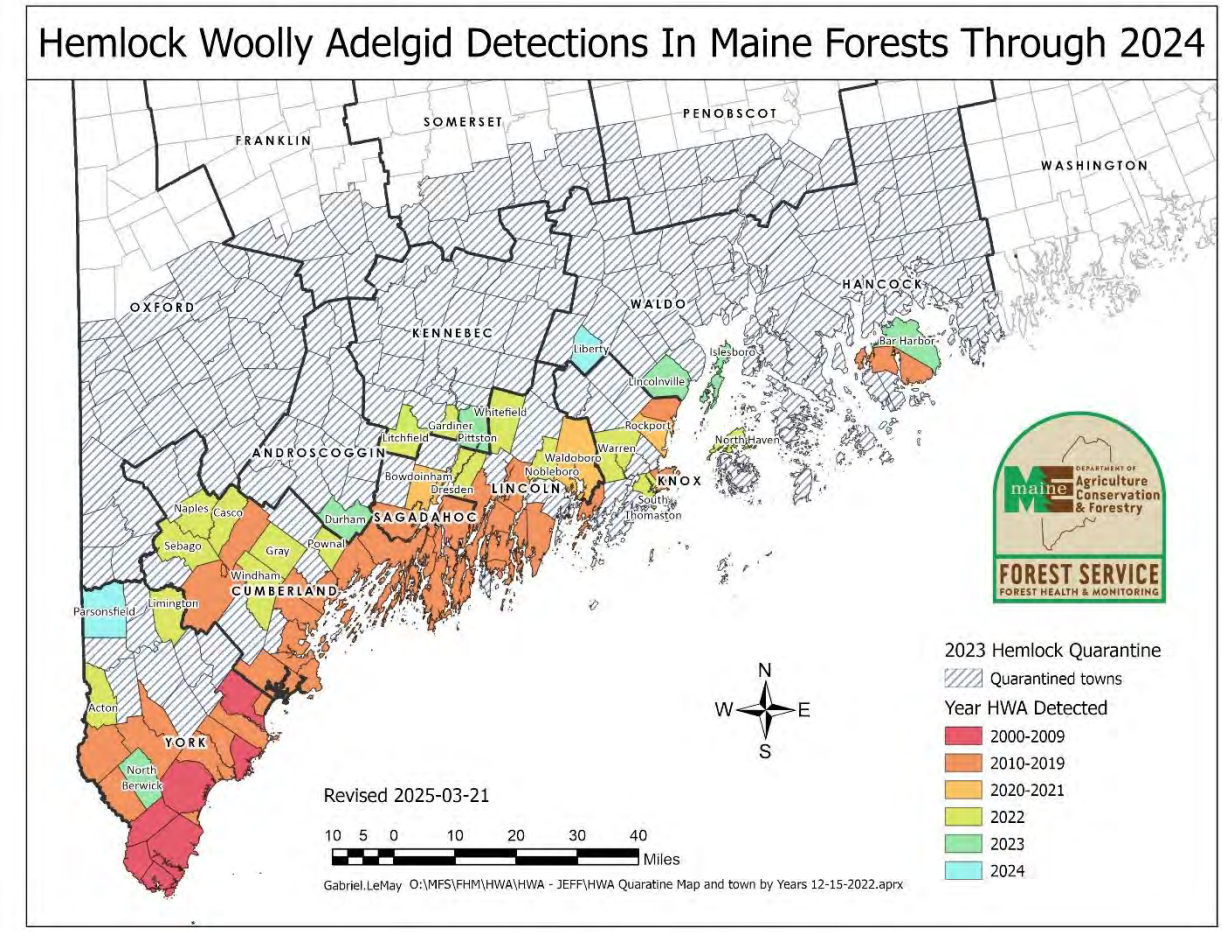

Figure 7: Hemlock woolly adelgid detections in Maine's forests.

Elongate hemlock scale (EHS, *Fiorinia externa*) is a slowly spreading invasive forest insect pest in Maine, first recognized in the state in 2009 on planted hemlocks. EHS was detected in the forest for the first time on Gerrish Island (Kittery, York County) in fall of 2010 and subsequently in mainland Kittery. Until 2024, this was the only area in Maine where EHS was known to be widely established in forests. In 2024, EHS was found to be well established in forested areas in the neighboring town of York (York County). It

had previously been found only on landscape trees in this town. In other parts of the state, infestations on planted ornamental trees have been reported, scattered from Kittery to Mount Desert, and in many cases EHS has moved into the surrounding forest. However, even when it has not been detected in the forest around infested landscape trees, the cryptic nature of EHS suggests that it may be present at undetected levels. There were no infestations found in new towns in 2024 (Table 6).

Table 6: Known infestations of elongate hemlock scale in Maine 2024

County	Town	EHS Status
York	Kittery, York	well-established in forest
Cumberland	Brunswick, Frye Island, Gorham, Falmouth	moved from planted trees, now establishing in forest
Hancock	Mount Desert	moved from planted trees, now establishing in forest
Cumberland	Cape Elizabeth, Casco, Freeport, Portland, Scarborough, Yarmouth	known on planted trees
Hancock	Sedgwick	known on planted trees
Lincoln	Boothbay, Damariscotta	known on planted trees
Sagadahoc	Bath, Topsham	known on planted trees
York	Berwick, Kennebunk, Kennebunkport, Ogunquit, Old Orchard Beach, Saco, Wells, York	known on planted trees

The bulk of the field work for these projects was conducted by Wayne Searles, Abby Karter, Zoe Albion, and Elicia Dionne, with assistance from Joe Bither, Melanie Duffy (MFS-FIA), and others. A summary of 2024 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 in infested areas of Maine, and one in 2015 in Hallowell, outside the infested area. Crown indicators and damage agent information were collected on each of the plots in the first week of January 2025. Crown classification measures follow those established for USFS, FIA plots. Infestation status (infested or not) of individual trees is based on what observers can see from the ground.

An ongoing detection survey is conducted both in towns outside the HWA quarantine and inside the quarantine zone where HWA has not yet been found. In 2024, 59 sites were surveyed in 42 towns in seven counties (Figure 8). At most sites, at least 200 branches were inspected (in 21 sites, fewer than 200 branches were examined) in hemlock stands in areas of high risk for HWA and EHS infestation. Although HWA was detected during two surveys in new areas of towns where it had previously been found, neither HWA nor EHS were found in any new towns.

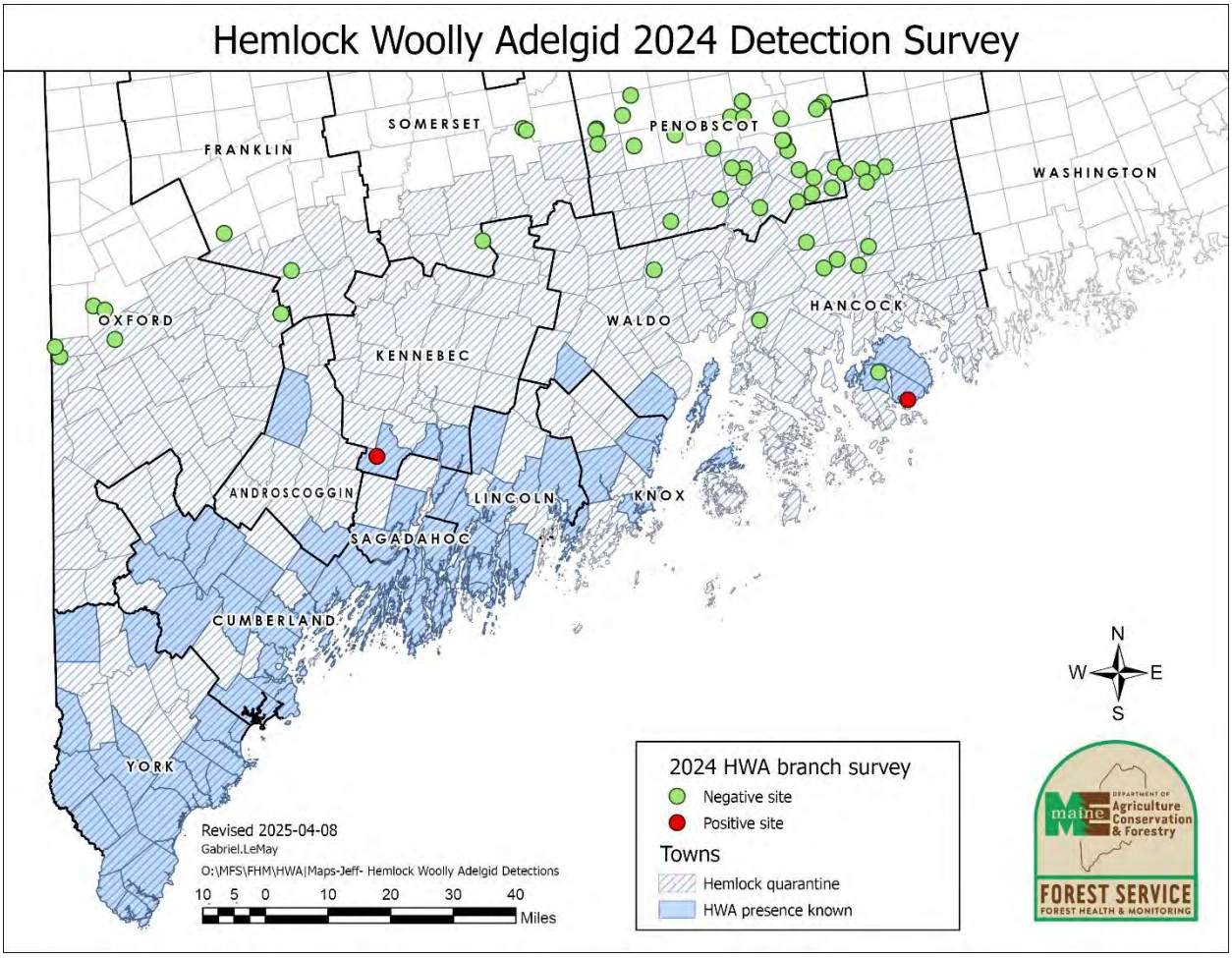

Figure 8: Detection survey for hemlock woolly adelgid and elongate hemlock scale, 2024.

This year, MFS attempted a new method of monitoring for HWA and EHS. Four glass slides smeared with a thin layer of petroleum jelly were mounted on a four-inch square piece of plexiglass. This was screwed to the top of a surveyor's stake driven into the ground under a hemlock tree. Some were placed under trees with known infestations of EHS or HWA and others were placed under seemingly healthy trees in high-risk areas. It was thought that crawlers would drop from infested branches and become stuck to the slides. The slides were replaced every two weeks.

It was hoped that if this was successful at detecting crawlers of these two pests, it might prove useful as a way of supplementing existing visual surveys in more remote areas. It did not prove to be a useful way of detecting EHS or HWA. Relatively few crawlers were actually captured in the petroleum jelly, which tended to dry up or wash off in the rain. Crawlers that were captured were difficult to identify. In some cases, even though the insects on a branch could clearly be seen and identified, no crawlers were captured on the trap below. It was concluded that a single visit to conduct a visual survey was as effective and time-efficient a method of monitoring for HWA and EHS.

Winter Mortality Survey

MFS monitors winter mortality annually in six sites throughout HWA-infested areas of the state. Adelgid-infested branches were collected from these sites in late winter, held in buckets of water in a cool room

for a week to encourage development and make it easier to differentiate between living and dead adelgids, and then mortality was measured under a dissecting microscope. The winter of 2023-2024 was mild and HWA winter mortality was lower than ever recorded during our surveys. Mortality was highly variable between the six sites measured, ranging between 90.5% and 10.5%, and averaged just under 33%. Adelgid populations are starting to increase, but as of the end of the growing season of 2024, they remain low overall due to very cold periods in the previous February of 2023, and many trees in infested areas still appear to have improved vigor.

Table 7: Hemlock woolly adelgid overwintering mortality (Winter 2023–2024)

Site	Dead	Alive	Mortality %
Bath	38	167	18.5
Standish	192	20	90
Waldoboro	21	200	10.5
South Berwick	45	166	21.3
Pownal	29	181	13.8
Camden	116	169	40.7
Total	**441**	**903**	**32.8**

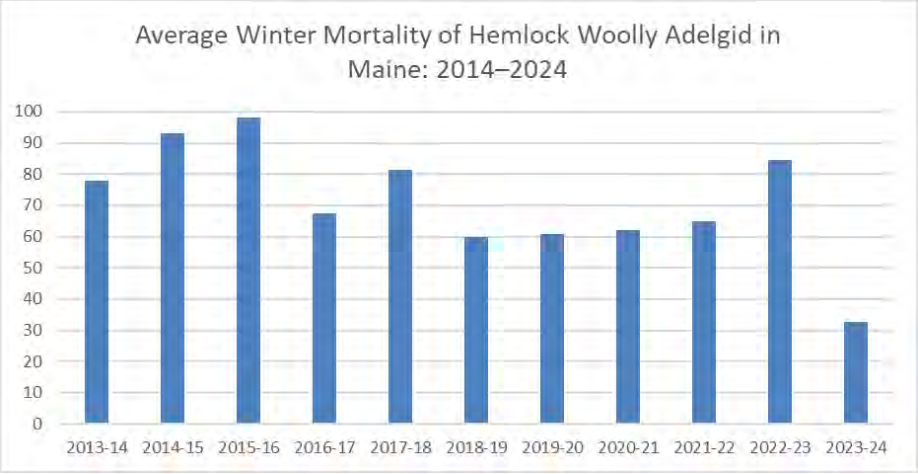

Figure 9: Average overwintering mortality of hemlock woolly adelgid at monitoring sites in Maine 2014– 2024.

Biological Control

In 2024, approximately 35 organizations and individuals purchased and released 38,300 *Sasajiscymnus tsugae* in 53 locations in 22 towns in seven counties (see Figure 10). These included national, state, and city parks, schools, land trusts and other conservation organizations, and private individuals. Particular thanks go to Coastal Rivers Conservation Trust, Coastal Mountains Land Trust and The Nature Conservancy for their work in educating and assisting private landowners, and coordinating bulk purchases of predators.

Just under 2,000 lab-reared *Laricobius osakensis* were released over a total of three sites. One thousand were released on conservation trust property in Bremen (Lincoln County), 500 in Acadia National Park in Mount Desert (Hancock County), and 475 on land trust property in Lincolnville (Waldo County). An additional 1,000 early emerging *L. osakensis* were released in Acadia National Park. It is uncertain whether these would be able to feed on HWA which had not yet broken aestivation but releasing them was the alternative to euthanizing them in the rearing lab. Five hundred *Laricobius nigrinus* collected from Delaware Water Gap were released in York County. The rearing and collection of *Laricobius* species were supported by funding from USFS.

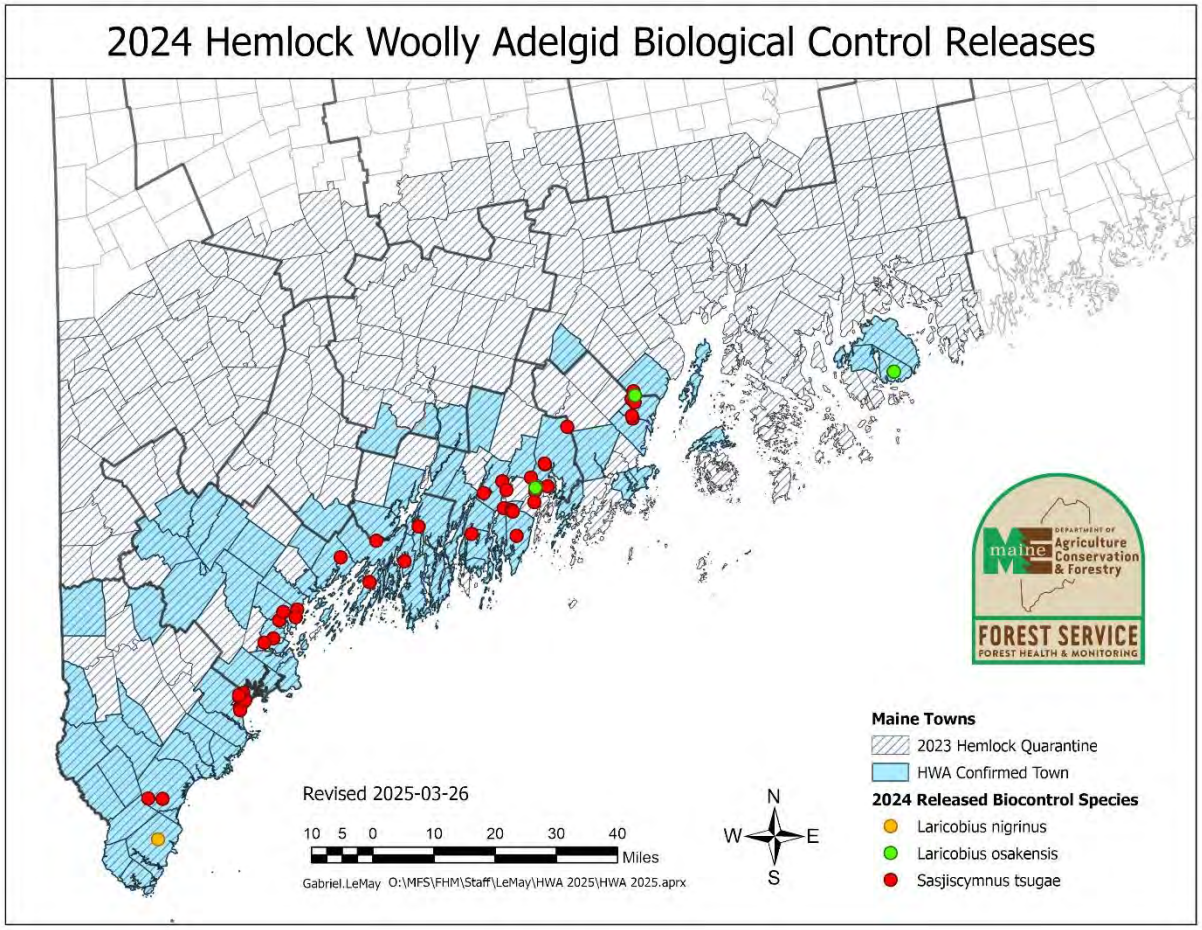

Figure 10: *Sasajiscymnus tsugae, Laricobius osakensis,* and *L. nigrinus* release sites in Maine 2024.

Since the initial detection of HWA in Maine's forests, MFS has facilitated the release of over 178,000 *S. tsugae* beetles, over 6,000 *L. nigrinus* beetles and almost 12,000 *L. osakensis* (Table 8). These biocontrol release sites range along much of the known distribution of HWA.

Table 8: Total numbers of HWA predator beetles released as of 2024

County	*Laricobius nigrinus*	*Laricobius osakensis*	*Sasajiscymnus tsugae*
Cumberland	600	1,950	49,203
Hancock		2,500	1,600
Knox		2,500	3,150
Lincoln		3,000	48,000
Sagadahoc			19,269
York	5,772	2,000	59,268
Waldo		475	2,000
	6,372	**11,950**	**178,190**

Sampling for recovery of HWA predators occurred in six locations in the autumn of 2024. Survey for *Laricobius* species and *Sasajiscymnus tsugae* occurred in Kittery, South Berwick, York (York County), as well as Bath, West Bath (Sagadahoc County), and Wiscasset (Lincoln County). Three probable *L. nigrinus* were recovered from South Berwick, two from Kittery, and one from York. These will be genetically identified by the USFS. No *L. osakensis* or *S. tsugae* were recovered (Table 9).

Table 9: Sasajiscymnus tsugae recoveries in Maine (2005-2024)

Year	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**
2019	0	-	-	-	0	0	0	0	-
2020	**9**	0	0	-	0	0	**2**	0	0
2021	**4** (spring)	0 (spring)	0 (fall)	**-**	**4** (fall)	**3**(fall)	**3** (fall)	**3** (fall)	0 (fall)
2022	0	0	-	**-**	**-**	**2**	**5**	**1**	0
2023	-	0	0	-	0	0	0	0	-
2024	0	0			0		0	0	

Appendix B
Spruce Budworm in Maine 2024

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Maine Forest Service – Forest Health and Monitoring
www.sprucebudwormmaine.org and www.maine.gov/foresthealth

Introduction to Spruce Budworm in Maine

Spruce Budworm (SBW) is a native insect that undergoes regional outbreaks and spreads through eruptive flights as moths disperse from heavily impacted areas to new ones. In northeastern North America, SBW outbreaks occur on average every 30-60 years and the last major SBW outbreak to directly affect Maine peaked from the mid-1970s to the mid-1980s. In neighboring Quebec, an ongoing spruce budworm outbreak has been unfolding since the early 2000s and has damaged upwards of 33.5 million acres during that time frame. Maine has experienced unstable spruce budworm populations since 2013, and in recent years, been on the receiving end of multiple in-flights from adjacent outbreak areas in Canada. 2024 witnessed a dramatic increase in local spruce budworm activity in Maine, with 3,455 acres of defoliation damage documented during aerial survey flights. This is perhaps just the tip of the iceberg however, as a model using data from Maine's overwintering larval (L2) survey predicts that some 230 thousand acres of spruce-fir forest are currently harboring spruce budworm populations capable of escaping natural mortality factors and building to epidemic levels.

Statewide Pheromone Trapping Network (2014 - 2024)

For the past decade, the Maine Forest Service Division of Forest Health and Monitoring has maintained a cooperator-supported network of roughly 350 SBW monitoring sites in spruce-fir forests across Maine using traps baited with pheromone lures. The most recent peak in pheromone trap captures occurred in 2019 following a massive moth in-flight from Canadian SBW outbreak areas, resulting in an average of 67 moths captured per trap. In the years following, the statewide average fell to 36 in 2020, remained at 16 in 2021 and 2022, and fell again slightly to 13 moths per trap in 2023. Although we were anticipating increased moth captures again in 2024, we were surprised to find that average pheromone trap captures plummeted to just 2.8 moths per trap.

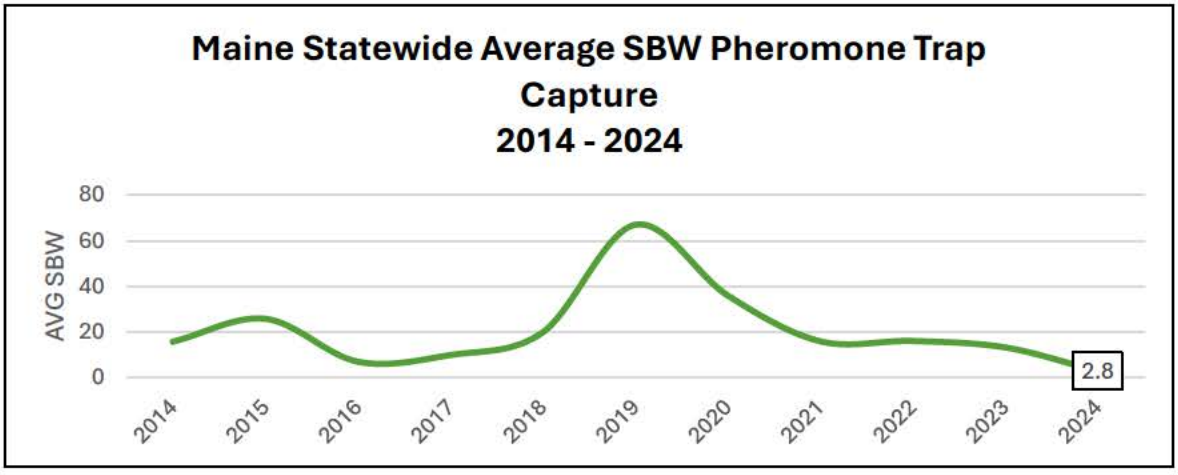

Figure 11: Results of the 2024 SBW pheromone trapping program.
These reveal an unexpected decrease to 2.8 moths per trap despite elevated populations across much of northern Maine.

Given what we know about current spruce budworm population levels in northwestern Maine, we have reason to suspect that some unknown factor resulted in pheromone traps failing to capture moths during the 2024 monitoring season. Although the highest trap captures were logically located in areas with the highest populations, the highest trap captures in 2024 still represented a fraction of what we would expect to be captured. Many sites located within or near the general outbreak areas captured no moths at all, which is again unlikely given what we know about current local populations.

In 2023, there was a change in the manufacturing process for the spruce budworm pheromone lures used by the State of Maine and other Canadian provinces. Due to initial concerns about the performance of the new pheromone lures, we consulted both New Brunswick and Nova Scotia. Conversations with New Brunswick revealed a similar experience to Maine with exceedingly low moth captures, however Nova Scotia saw no irregularities in their program results using the same lure. Due to additional issues with the international supply chain in 2025, Maine Forest Service will be switching lure manufacturers for the 2025 monitoring season.

If not an issue with lure performance, there is also the possibility that other environmental factors could have interfered with moths during the flight season and prevented them from entering traps. It is even possible that pheromone production by female SBW moths in the surrounding environments is now high enough that artificial pheromones have become less effective. Despite our belief that moth captures are well below the levels that should be reflected in our pheromone traps, we have chosen to include the 2024 data in this report. ***The reader should bear in mind that low pheromone trap captures in 2024 do not reflect local populations in Maine, whose growth is revealed through other monitoring techniques and observations***. This highlights the importance of a monitoring program that relies on multiple techniques, demonstrating the value of aerial survey, defoliation survey, and especially the overwintering (L2) larval survey.

As in 2023, there is greater regional interest in knowing what spruce budworm populations are doing in other northern New England states with spruce-fir forest types that could support them. Shown below are the combined results of pheromone trapping for Maine, New Hampshire, and Vermont.

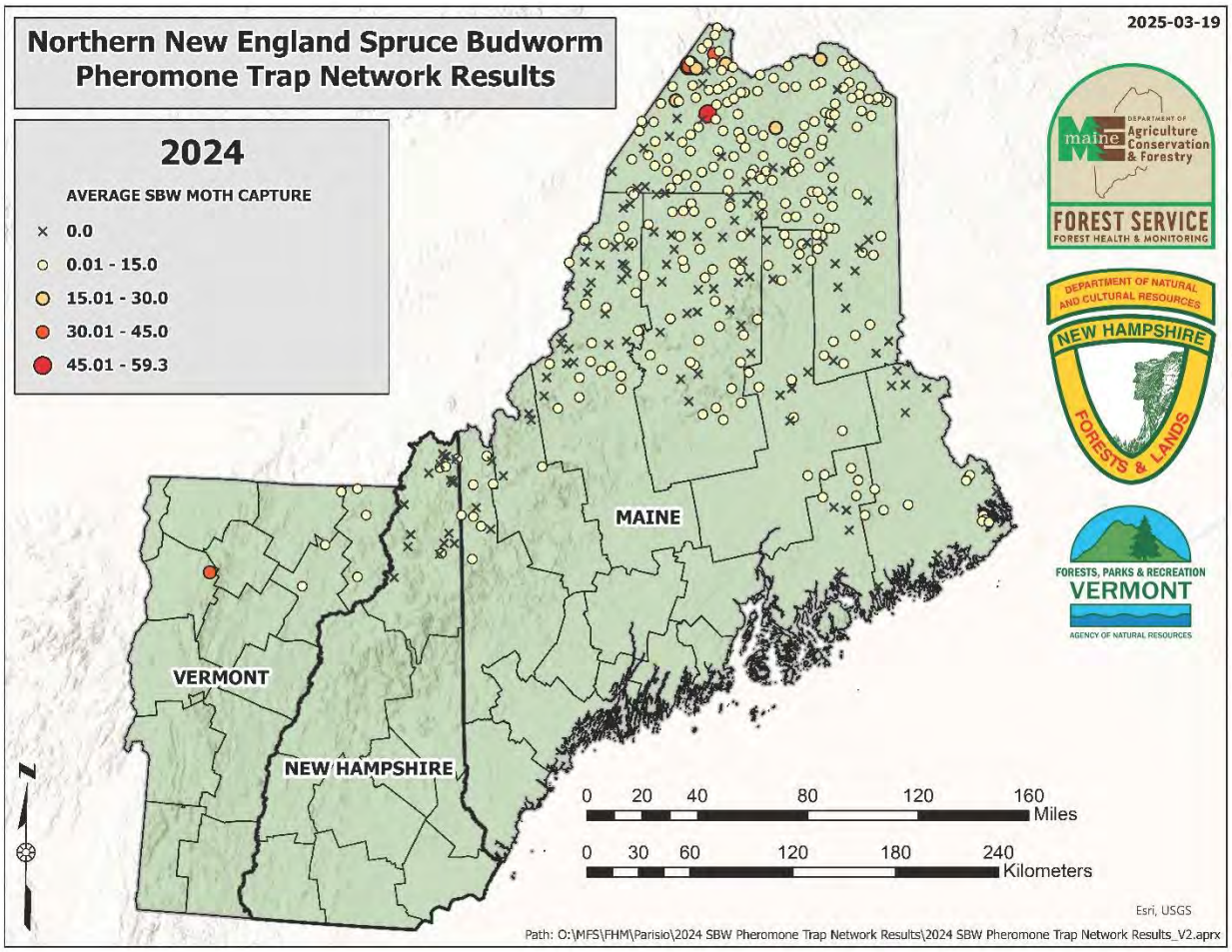

Figure 12: The results of spruce budworm pheromone trapping programs across northern New England.

Vermont shows one site with elevated captures based on their historical norms that could be the result of moth in-flights from Canadian infestation areas. Several sites in New Hampshire could not be monitored due to impassable roads following storm damage, but the remainder returned low captures as typical for New Hampshire's monitoring sites. In Maine, more sites that expected returned zeros or low averages. The sites with the highest captures coincide with areas showing high populations from L2 sampling, however, are still lower than should be expected.

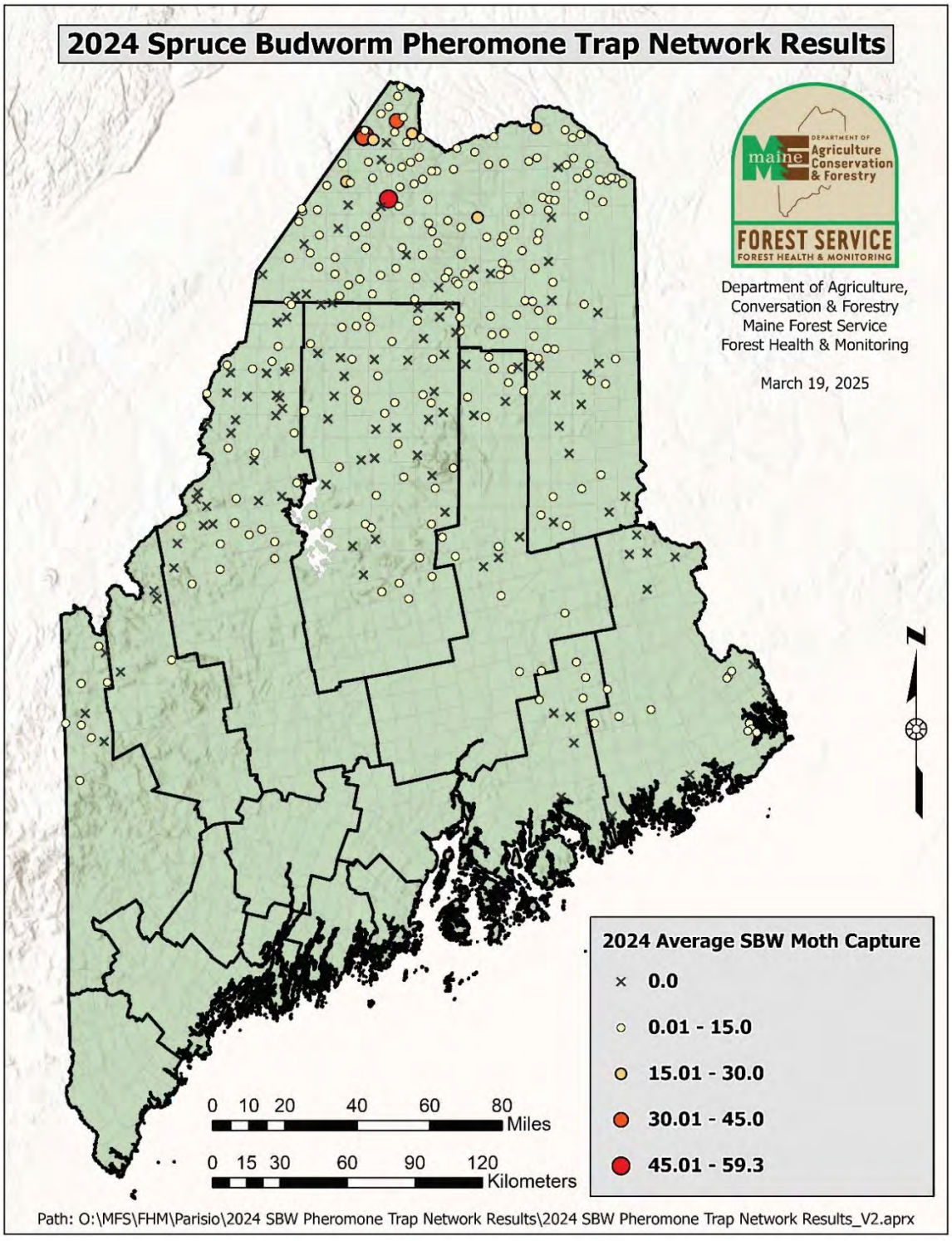

Figure 13: Results of the 2024 spruce budworm pheromone trap monitoring program. Moth captures in 2024 are not representative of local populations, which are much higher. If comparing to maps from 2023 or previous years, the reader should note the major differences in the legend scale from year to year.

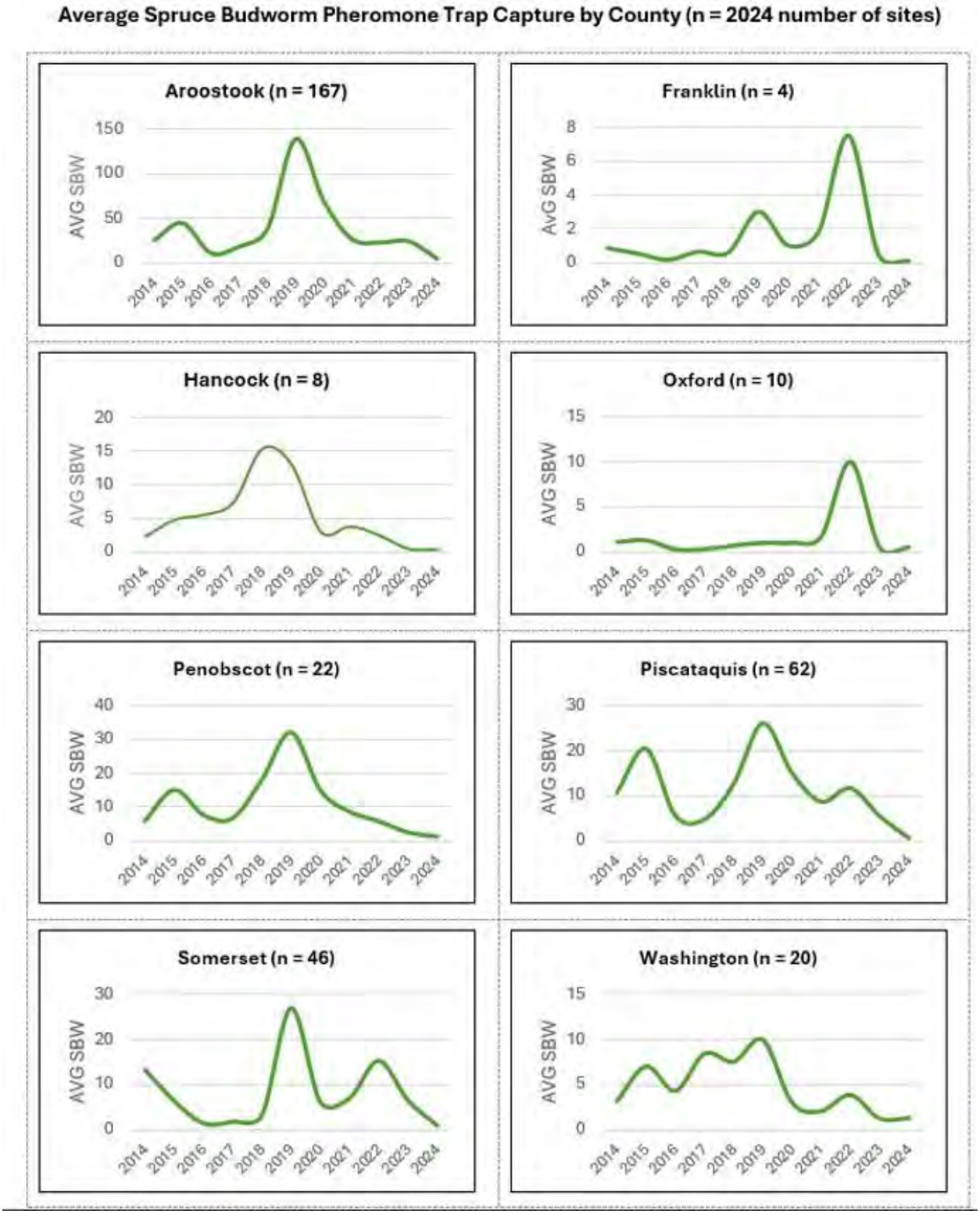

Figure 14: Average spruce budworm pheromone trap captures by county.
While low captures are not a surprise for some counties, we would expect Aroostook County to return higher numbers than documented in 2024. Reader should note difference in scales for each graph when comparing counties.

Long-term Pheromone Trap Monitoring Sites (1993 - 2024)

A subset of pheromone trap monitoring sites has been in service since the last major SBW outbreak in Maine subsided and revealed the first significant fluctuation in SBW populations since the early 1990s. From 1992 to 2012, the average number of SBW captured remained below 10, when it suddenly rose to 18 in 2013, 22 in 2014, and 23 in 2015. As concerns grew, this early data ultimately resulted in the expansion of the statewide pheromone trapping network to roughly 350 sites used today.

Because the forest condition at a monitoring site is an important component of its attractiveness to SBW, stands selected for pheromone trap sites originally consisted of the appropriate pole-sized timbers when they were created in the 1990s. Now some 30 years later, many of these stands have aged into unsuitable sites for SBW monitoring. In fact, many of them have lost so many trees to age and windthrow that few viable spruce-fir hosts remain. Although data from these historical sites has always been a point of interest, we also recognize that many of them have now exceeded their life expectancy and are no longer providing reliable data. This becomes especially concerning if moths are present in the area and sites fail to recover them due to a simple lack of host suitability. Therefore, we are now actively decommissioning many of these sites each year and replacing them with new high-quality sites that can once again prove useful for monitoring modern SBW populations.

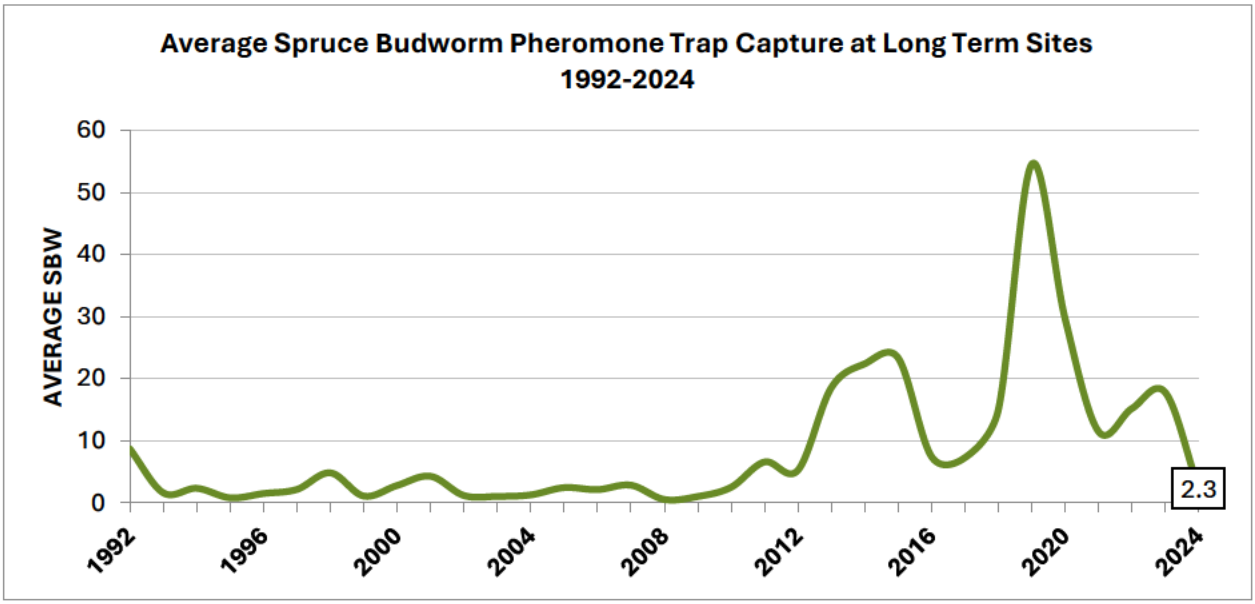

Figure 15: Average spruce sudworm pheromone trap captures.
As with all SBW monitoring activities, peak capture at long-term pheromone trap sites occurred in 2019 following in-flight events and then receded. Despite a slight increase in 2022 and again in 2023, average trap captures at Maine's long-term pheromone monitoring sites remain substantially lower than 2019 levels. The increase in 2023 owes largely to a single outlier site in T15 R15 WELS, while most other long term monitoring sites remained stable at low numbers.

Spruce Budworm in Maine's Light Trap Network (2014 - 2024)

Light trapping has been used in Maine since the 1940s to monitor forest defoliators and spruce budworm captures are also monitored annually in these traps. As expected, the most recent peak in SBW captures in light traps occurred in 2019 (507 SBW moths captured statewide) as moths from Canadian outbreak areas were deposited in Maine. This number has fluctuated since 2019 but has most recently risen again from 60 in 2023 to 120 in 2024. This contrasts with the reduction in spruce

budworm capture in pheromone traps and is in line with expectations based on ground and air observations.

Light traps require human operators and their use in the areas of northern Maine where SBW occurs has been variable from year to year depending on operator availability. We will continue to work on improving the light trap coverage in northern Maine, but for now these data can show very general trends in statewide SBW populations. Despite decreases in pheromone trap captures in many locations, overall capture of spruce budworm moths in light traps increased again in 2024, roughly doubling from 2023.

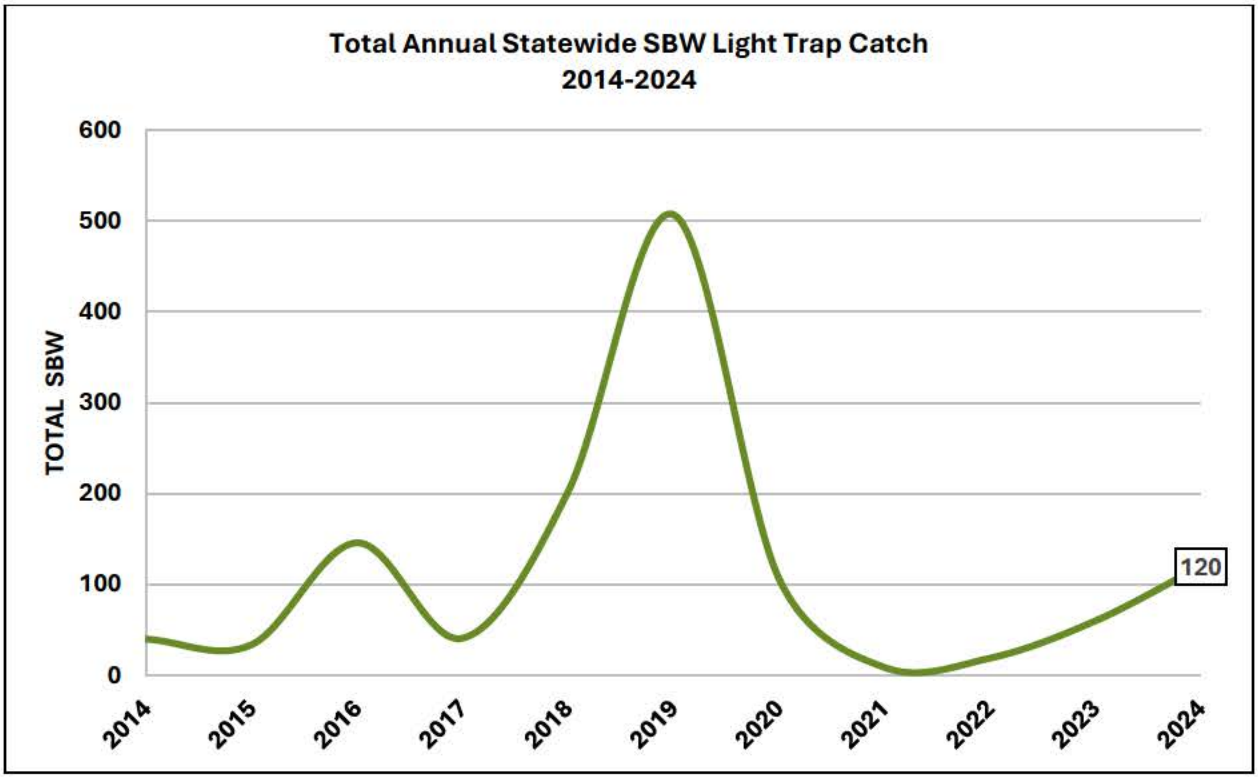

Figure 16: Total annual statewide spruce budworm light trap catches.
Despite the pheromone trap network results, SBW captures in the statewide light trap network indicated increased SBW numbers. Many of these (n=83) were captured at the light trap station in Allagash, which is eastward and downwind of the areas in northwestern Aroostook County where SBW populations are known to be highest.

Larval Monitoring (L2 Survey) and Early Intervention Strategy (EIS) Activities (2019 - 2023)
Spruce budworm overwinters as larvae and branch samples collected from spruce-fir forests across Maine are analyzed at the University of Maine Spruce Budworm lab for the presence of overwintering SBW larvae. An average of seven larvae per branch is the recommended action threshold for a SBW Early Intervention Strategy (EIS) as employed in Atlantic Canada. Sites exceeding the threshold are identified as potential "hot spots" and may undergo additional sampling.

Several hot spots were identified between 2019 and 2023 using this monitoring program. The first of these was identified during winter 2019 - 2020 when a single site in Cross Lake Township exceeded the

EIS threshold with 7.66 larvae per branch. Landowners followed up with more intensive sampling to delimit the extent of the areas with high larval counts and define a treatment area for aerial application of insecticide. This marked the first time aerial spraying for SBW occurred in Maine since the last major outbreak of the 1970s and 1980s. Roughly 5,000 acres were sprayed in late spring 2020 with Foray 76B, a biological insecticide with *Bacillus thuringiensis var. kurstaki* (Btk). Sampling in 2021 indicated the original site had a reduced average of 0.67 larvae per branch.

To our knowledge, there was no aerial spraying performed in 2021.

The next hot spots were identified during winter 2021 - 2022 in two locations. Landowners treated the first with a spray block of roughly 500 acres located on the border of T17 R13 WELS and T17 R14 WELS. The second was treated with a spray block of roughly 1,500 acres in portions of Sinclair Twp, Van Buren Cove Twp, Madawaska Lake Twp, and Stockholm. Foray 76B was the product used in 2022.

To our knowledge, no aerial spraying was performed in 2023.

Larval Monitoring (L2 Survey) and Early Intervention Strategy (EIS) Activities (2024 & 2025)
The hot spot areas identified during winter 2023 - 2024 led to landowner treatment of roughly 6,700 acres of softwood stands located primarily in T17 R13 WELS, T17 R14 WELS, and T18 R13 WELS. The product used in 2024 was Mimic 2LV with the active ingredient Tebufenozide. The areas treated were in the same region where defoliation was observed during aerial survey in 2024, and this continues to be the area of greatest concern given the results of the 2024-2025 L2 survey. Aerial treatments in 2024 did not cover the entire area now identified exceeding the threshold for EIS treatments in 2025.

The winter 2024-2025 L2 survey results have revealed a significant increase in spruce budworm populations in northern Maine. In a typical year, the University of Maine SBW Lab processes branch samples from around 350 sites. Visible SBW damage in 2025 resulted in a large influx of additional samples to delimit spray areas for the 2025 season, stretching the lab to its limits and identifying an immediate need to expand its capacity. As of late April 2025, the lab had processed nearly 700 sites for the entire 2024-2025 winter season. This has revealed dozens of hotspots, with larval densities at several sites in the 90s or 100s. Using this data, population modeling shows that there are nearly 200 thousand acres of spruce-fir forest type in northwestern Aroostook County where SBW populations meet the EIS treatment threshold of an average of seven larvae per branch.

Given the change in the populations and anticipated increase in treatment area, the University of Maine CFRU advocated that this information be made readily available to all parties. Thes map shows modeled areas of spruce budworm overwintering larval densities based on field-collected branch samples and serves as a starting point for landowners planning treatment. Results, which are regularly updated, are now available in real time and accessible to all at: https://www.sprucebudwormmaine.org/map/

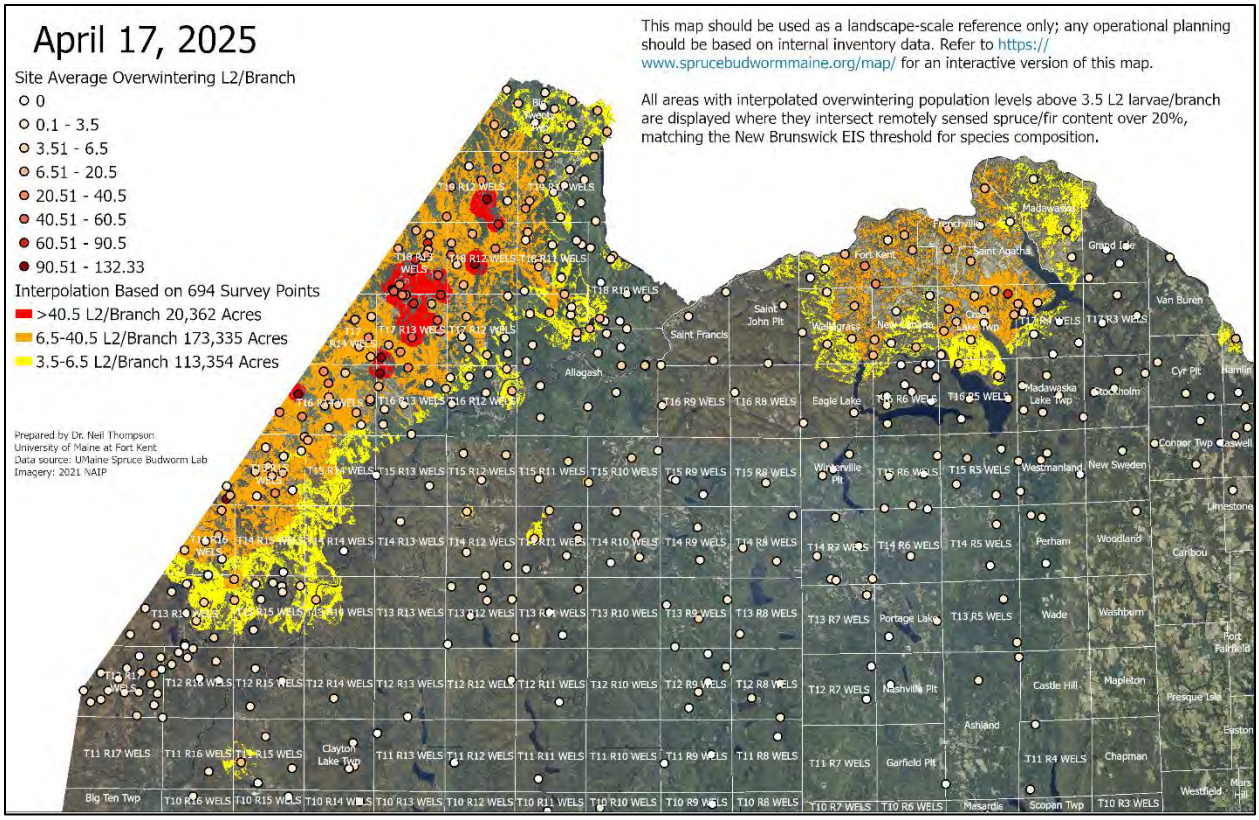

Figure 17: The most recent spruce budworm overwintering larval (L2) population map. This is modeled using data collected from branch samples taken at statewide monitoring sites and sites near or within SBW affected areas documented during the 2024 field season. Courtesy UMaine CFRU / Spruce Budworm Lab.

Aerial Defoliation Survey (2021 - 2024)

The Maine Forest Service performs an annual aerial survey to document landscape-level insect and disease damage. Until 2021, evidence of defoliation from spruce budworm larvae had not been documented during aerial surveys since the 1990s. The damage areas mapped during aerial survey in 2021 comprised 850 acres and occurred in areas where SBW defoliation had been previously documented during ground surveys. Defoliation did not progress and was no longer visible when these areas were flown again in 2022. While some low level of damage was likely present in northwestern Aroostook County preceding 2024, no visual damage was documented during aerial survey between 2021 and 2024. In 2024, we received numerous reports of defoliation witnessed at ground level from landowners in northwestern Aroostook County during early summer 2024. Upon flying these areas in July 2024, significant canopy discoloration from defoliation was immediately apparent, resulting in the mapping of 3,455 acres of visible damage during our Maine Forest Service aerial surveys. Unfortunately, coverage of these areas in 2023 was not possible due to uncooperative weather patterns and interference from wildfire smoke, prohibiting safe flights. Additional acres of damage are believed to have been documented by landowners following these surveys through ground surveys, the use of drones (unmanned aerial vehicles, UAVs), or private aerial surveys.

Figure 18: An example of highly visible SBW defoliation damage.
This photo was documented during aerial survey in T18 R13 WELS in early July 2024. There were 3,455 acres of defoliation damage mapped in Maine, contiguous with many thousands of acres more across the border in neighboring Quebec.

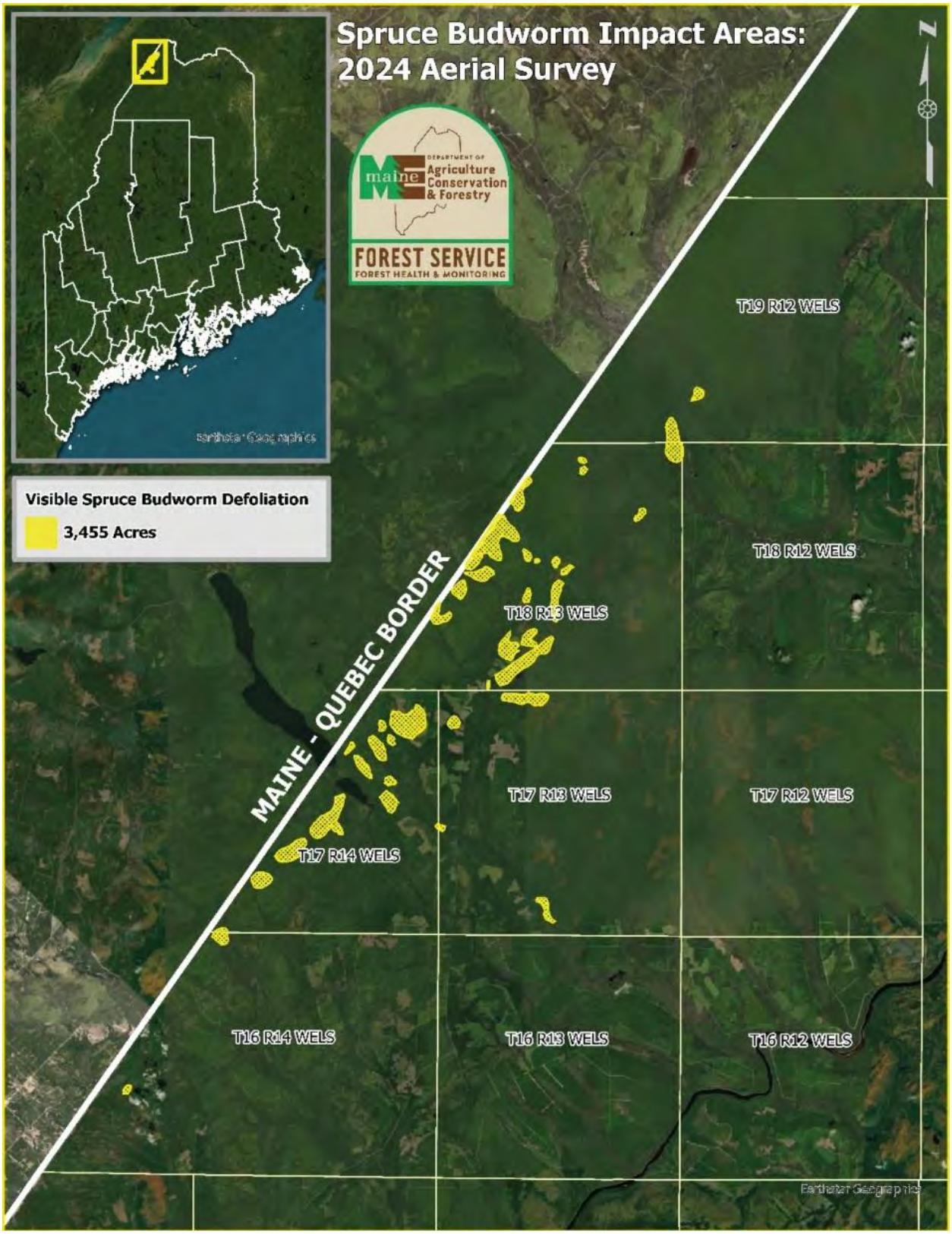

Figure 19: Map depicting 3,455 acres of visible spruce budworm defoliation mapped during Maine Forest Survey aerial survey missions in July 2024.

Aroostook County Ground Defoliation Survey (2020 - 2024)

A repeated ground survey has been conducted at 60 sites in Aroostook County since 2020 to quantify the level of defoliation from SBW larvae using the Fettes Method. This survey effort helps document defoliation not readily apparent during aerial surveys. Percent defoliation observed at these sites has fallen over this period and has been relatively low in recent years, with all samples below 10 percent defoliated in 2022 and below six percent defoliated in 2023. Average defoliation at these recurring monitoring sites remained low at 4.7 percent across 54 sites monitored in 2024.

An additional 29 Fettes assessment points were evaluated in 2024 based on the results of the aerial survey. These spanned from Big Twenty Township to T17 R13 WELS along the Quebec border in northwestern Aroostook County. The average percent defoliation across these 29 sites was 23.7 percent in 2024, with two sites experiencing defoliation rates over 70 percent.

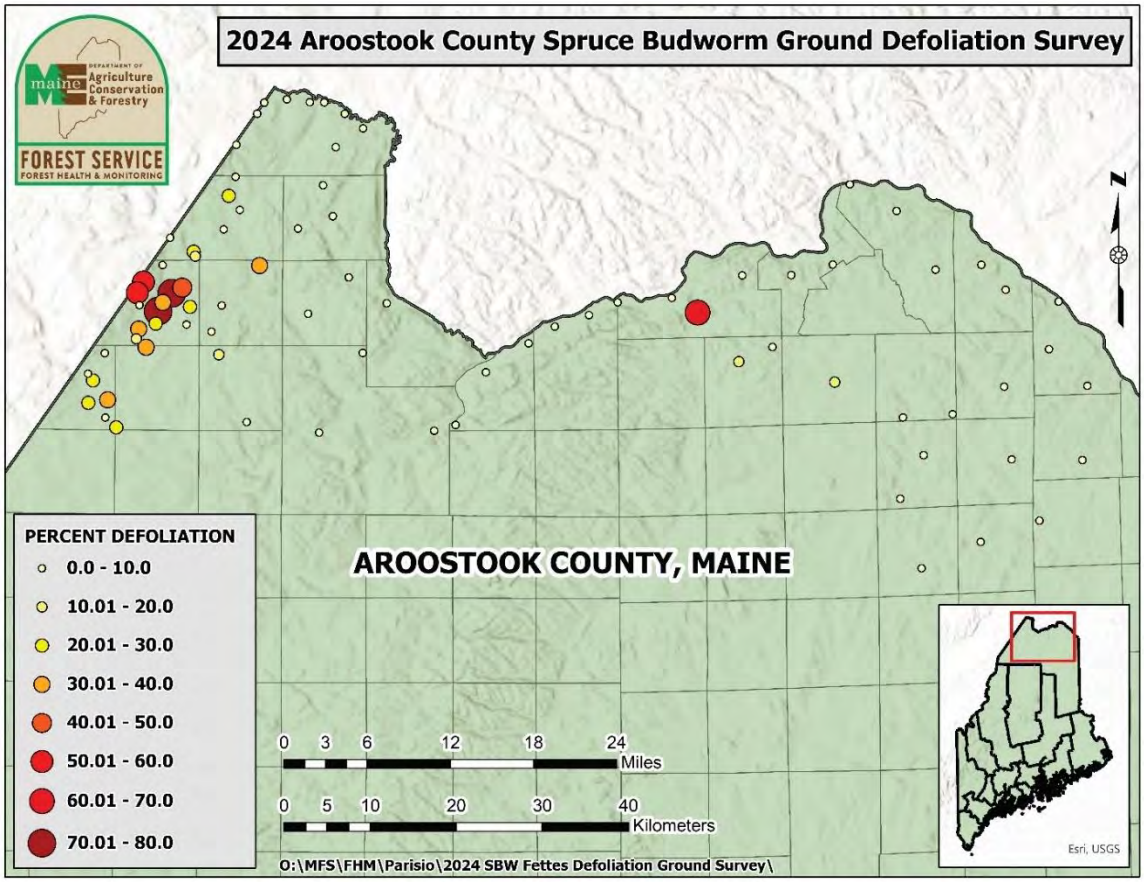

Figure 20: 2024 Aroostook County spruce budworm ground defoliation survey.
Ground defoliation surveys in northwestern Aroostook County along the Quebec border demonstrate high rates of defoliation and confirm the results of visual aerial surveys in these same areas that SBW larval populations were high in 2024 and caused substantial damage

2025 Spruce Budworm Outlook

Although several pieces of evidence from monitoring activities leading up to 2024 indicated a potential problem area in northwestern Aroostook County, none of them truly revealed the magnitude of SBW population expansion that occurred throughout summer 2024. We hope we can look at our data and

determine whether there is a lag time associated with our observations and whether there are any indicators we can use to identify other problem areas in the future. The current events are a reminder of just how quickly forest insect outbreaks can develop. Continued and improved monitoring will be needed if an Early Intervention Strategy is to be successfully implemented in Maine in the coming years.

Recent developments in the spruce budworm situation in Maine have led to a change in monitoring strategy. Issues with the pheromone trap program will be addressed with the trial of new lures and traps in hopes of improving efficacy going forward. An increased reliance on the overwintering larval (L2) survey is also likely to continue.

We expect Maine landowners to implement an EIS approach through an aerial spraying campaign covering roughly 250,000 acres in 2025. Recognizing this major turning point and the management challenges ahead, large landowners in and around the currently affected areas successfully formed the Maine Budworm Response Coalition and advocated for Federal and State funding to support treatment efforts. Ultimately 12 million dollars in Federal assistance were awarded for direct reimbursement of up to 90 percent of costs for aerial spraying activities performed in 2025 and continued L2 monitoring. An additional two million dollars is in the State budget, for which the outcome is still unclear at the time of this report.

Acknowledgments
The Maine Forest Service gratefully acknowledges the large team of cooperators, the University of Maine Spruce Budworm Lab, the University of Maine Cooperative Forestry Research Unit, and the hard work of all field staff on the ground that make this monitoring program possible.

2024 Monitoring Program Cooperators

American Forest Management	***LandVest***
Appalachian Mountain Club	***Maine Forest Service***
Baskahegan Company	***Passamaquoddy Tribal Forestry Department***
Baxter State Park	***Penobscot Indian Nation***
Dunn Timberlands	***Prentiss & Carlisle***
Forest Society of Maine	***Seven Islands Land Company***
Hilton Timberlands, LLC	***The Nature Conservancy***
J.M. Huber Corporation	***USDA Forest Service***
J. D. Irving Ltd.	***Wagner Forest Management, Ltd.***
Katahdin Forest Management, LLC	***Weyerhaeuser***

Appendix C
Browntail Moth in Maine 2024

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Browntail moth (BTM) is an invasive moth species originally from Europe that causes damage to our native trees and can cause an irritating rash in humans. In North America, BTM populations are limited to the coast of Massachusetts and coastal and central Maine. In 2024, BTM winter webs were discovered off the coast of New Hampshire on Star Island (Isle of Shoals), however, they were promptly removed by New Hampshire Division of Plant Industry staff in April 2024.

This year, BTM populations have experienced a large decline statewide, a trend that has now occurred over multiple seasons. At the start of 2024, we surveyed trees statewide in search of BTM winter webs to better understand their population levels before the caterpillars emerged in the spring. We documented fewer clusters of dense BTM winter webs than in 2023. Our aerial surveys were conducted in spring and captured just 2,119 acres of defoliation damage from BTM in 2024, compared to 46,727 acres of defoliation documented during aerial survey in 2023.

We monitored BTM at ten sites across the state throughout spring and summer to document the development of caterpillars, presence of pathogens, and timing of pupation. These monitoring sites were chosen based on the density of BTM winter webs and were located in Bangor, Belfast, Bridgton, Brunswick, Dover-Foxcroft, Hancock, Lincoln, Newport, Turner, and Unity. Sites closer to the coast typically had earlier caterpillar emergence compared to inland sites, but most caterpillars emerged from their winter webs around mid-April. About a month later, we noted the first signs of caterpillars with pathogens at multiple monitoring sites. During this time, we recruited help from the public to report diseased caterpillars so we could track the pathogen-induced mortality statewide. By the end of the BTM caterpillar season, half of our monitoring sites had caterpillars with fungal or viral activity, and we were able to confirm the presence of pathogens in nine additional towns due to public reports. The first reports of adult moths came during the week of June 23, almost two weeks earlier than in 2023. Our observations throughout the BTM season were shared with our BTM mailing list subscribers as weekly updates, complete with photos, rash prevention strategies, and management suggestions; this information was also posted on our MFS BTM website.

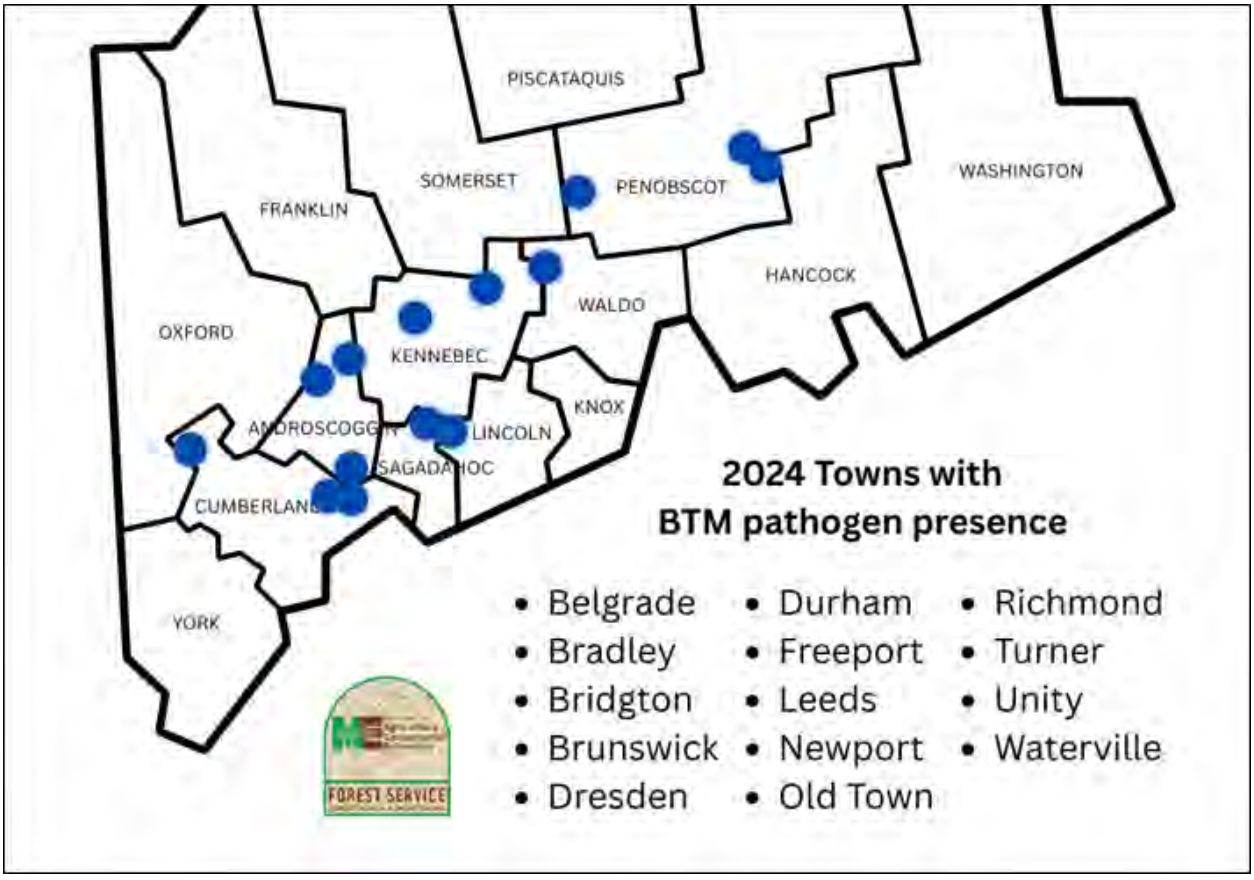

Figure 21: Maine towns with confirmed presence of browntail moth pathogens in 2024.

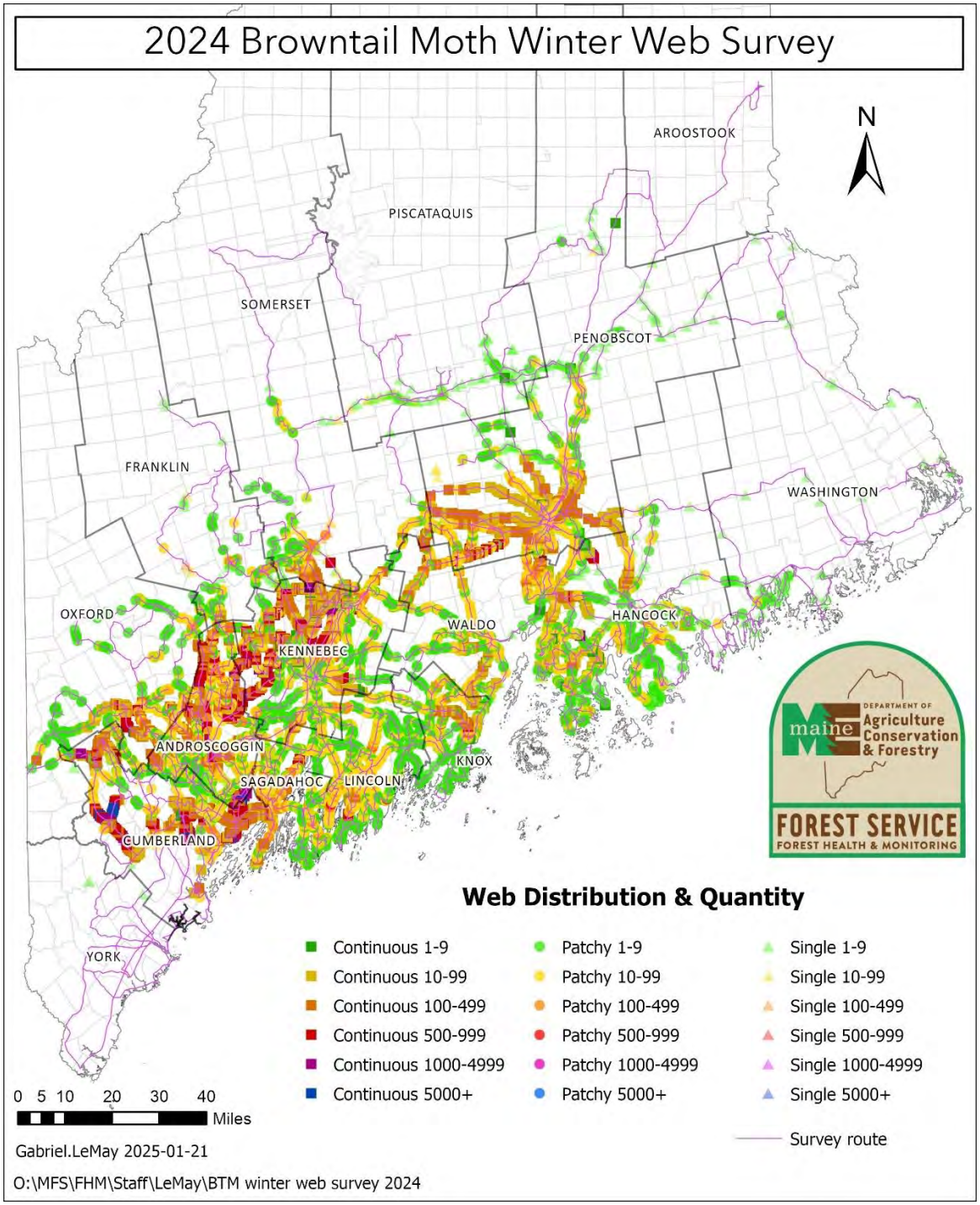

Figure 22: Data points from the 2024 browntail moth winter web survey.

In early fall, we surveyed areas with persistent BTM populations to record defoliation from the newly hatched caterpillars. These young caterpillars do not completely eat the host leaves but skeletonize them by consuming the outer surfaces, resulting in damage that causes leaves to appear copperish in color. We saw significantly less area with skeletonized leaves during ground surveys, indicating the BTM populations may remain subdued next year. Skeletonization damage was so limited, in fact, that we

decided to forego our typical late season aerial surveys to capture this type of damage, which has been prevalent and widespread in previous seasons.

There are a few factors that may have contributed to the decline in BTM populations in Maine this year. In 2023, Maine experienced a very wet spring and summer season, where roughly 27.93 inches of rain fell statewide. Initially, we predicted that this amount of rain would aid the spread of fungal and viral pathogens and help reduce some BTM caterpillar populations. However, it appears that the extensive rainfall may have prevented some fungal spores from becoming airborne, restricting the spread of pathogens. This year, we had 18.01 inches of rainfall during the growing season and experienced significantly reduced BTM caterpillar activity. This may be a "goldilocks" rain situation, where we had enough rainfall to encourage the growth of fungal and viral pathogens, but not so much rain as to inhibit the spread of the pathogens. The combination of fungal and viral pathogens with occasional rainy weather patterns may have contributed to the collapse of BTM populations in Maine for 2024. We will continue to monitor the BTM populations through our winter web survey, which will provide additional information regarding possible hot spots for next year's BTM caterpillar emergence.

Browntail Moth Mitigation Fund Program

In 2024, the Department of Agriculture, Conservation, and Forestry was provided funding from LD1929 to administer a program to assist nonprofit or government organizations' efforts to reduce impacts from BTM. MFS entomologists worked with 14 towns and nonprofit organizations with moderate to severe levels of BTM in Androscoggin, Cumberland, Lincoln, Kennebec, Penobscot, Somerset, and Waldo counties. All funded programs under this grant prioritized timely and appropriate mechanical, cultural, and chemical control methods, including educational programs, and other activities to mitigate browntail populations to reduce and prevent exposure to toxic BTM hairs and minimize damage to community trees.

Grant outcomes completed in 2024

Increased education and awareness of BTM through outreach material development and distribution, informational sessions, and community events.

Outreach material was developed by Coastal Maine Botanical Gardens; who created a "Tent-making caterpillars: friends or foes?" plaque that is placed alongside one of their walking paths in Boothbay, Maine. The plaque contains information about our native caterpillars, how to identify caterpillars, BTM range, and integrated pest management information.

The town of Morrill and Auburn hosted informational sessions with licensed pesticide applicators, entomologists, and others with experience to help educate residents in learning about BTM mitigation strategies and provide a space for questions to be answered. BTM brochures created by MFS were available to all town offices for residents to have additional resources.

The town of Pownal included the local school in the educational program to teach fifth grade students about BTM lifecycle, risks, identification, and management. Students created posters on BTM caterpillars used to advertise the town's winter web clipping event.

Reduced BTM populations in community areas through mechanical removal of BTM winter webs by local arborists and residents.

Many towns hired local licensed arborists to remove BTM winter webs in high traffic areas in their communities and encouraged residents to report and remove BTM webs. Pine Island Camp hired a FAA-certified company that used a drone fitted with pruning shears to remove winter webs on their campus in Belgrade.

Morrill, Pownal, and Orono hosted BTM winter web clipping events, which encouraged residents to scout and remove BTM winter webs in their communities using shared equipment. Pownal and Tremont purchased multiple extendable pole pruners that residents could rent to tackle web removal on their own without needing to purchase their own equipment.

Chemical treatment of trees targeted toward BTM caterpillars in high traffic areas to reduce irritating hairs in the environment and minimize damage to trees.

As a result of the Browntail Moth Mitigation Fund, over 500 trees in towns with high populations of BTM were treated with pesticides effective at reducing BTM. All towns and organizations except for one implemented foliar or injection pesticide treatments to reduce BTM populations in their communities.

Strengthen research dedicated to improving understanding of BTM flight patterns, geographic range expansion as related to climate change, and pheromone trapping.

Plymouth donated funds to Dr. Angela Mech's laboratory at the University of Maine laboratory to support continued development on research projects focused on BTM.

Increased awareness of knowledge gaps with integrated pest management strategies for BTM in high exposure risk communities allows MFS to improve and inform communications to strengthen knowledge.

Through interactions with the public, local government staff, organizations, licensed pesticide applicators, and other personnel involved in the grant process, we began to see areas where we could focus and improve efforts with public communications to close knowledge gaps.

Collaboration and continued sharing of resources from MFS to participating towns and organizations to continue fostering informed management decisions.

All towns and organizations that were awarded funding through the Browntail Moth Mitigation grant had direct access to entomologists and outreach materials to share with their communities throughout the grant period and beyond. Additionally, all MFS-created outreach materials including videos, interactive map content of field survey results, photo identification of winter webs, caterpillars, and moths, brochures, educational stickers, lists of licensed professionals, and a detailed FAQ page are updated regularly and available for free on our website for anyone to use to make informed integrated pest management plans.

Appendix D
Emerald Ash Borer in Maine 2024

Prepared by Forest Entomologists
Michael Parisio, Colleen Teerling, & Gabe Lemay
Maine Forest Service, DACF
168 State House Station, Augusta, ME 04333

Maine continues to survey for emerald ash borer (EAB) in new areas using purple prism traps. Since the first detections of EAB in Maine in 2018 using this method, purple prism traps have been non-productive until 2024. Of the 182 PPTs hung statewide in 2024, six traps were positive for adult EAB. In northern Oxford County, two traps in the town of Andover North Surplus were positive, which are both in proximity of an EAB detection in neighboring Andover that occurred in early 2023. In central Maine in Kennebec County, one trap in Waterville was positive, again adjacent to a larger infestation area uncovered in 2022. Finally, three traps were positive in northern Aroostook County, in the towns of Madawaska Lake Township, Westmanland, and Caribou. This marks some of the most significant EAB movement in northern Maine, which has been largely stable over the past several years.

The EAB detections in Westmanland and Caribou were located just outside of Maine's northern EAB quarantine zone, prompting immediate expansion of the regulated areas in northern Maine. In October 2024, 28 new towns were added to the quarantine zone in northern Maine (Figure 13).

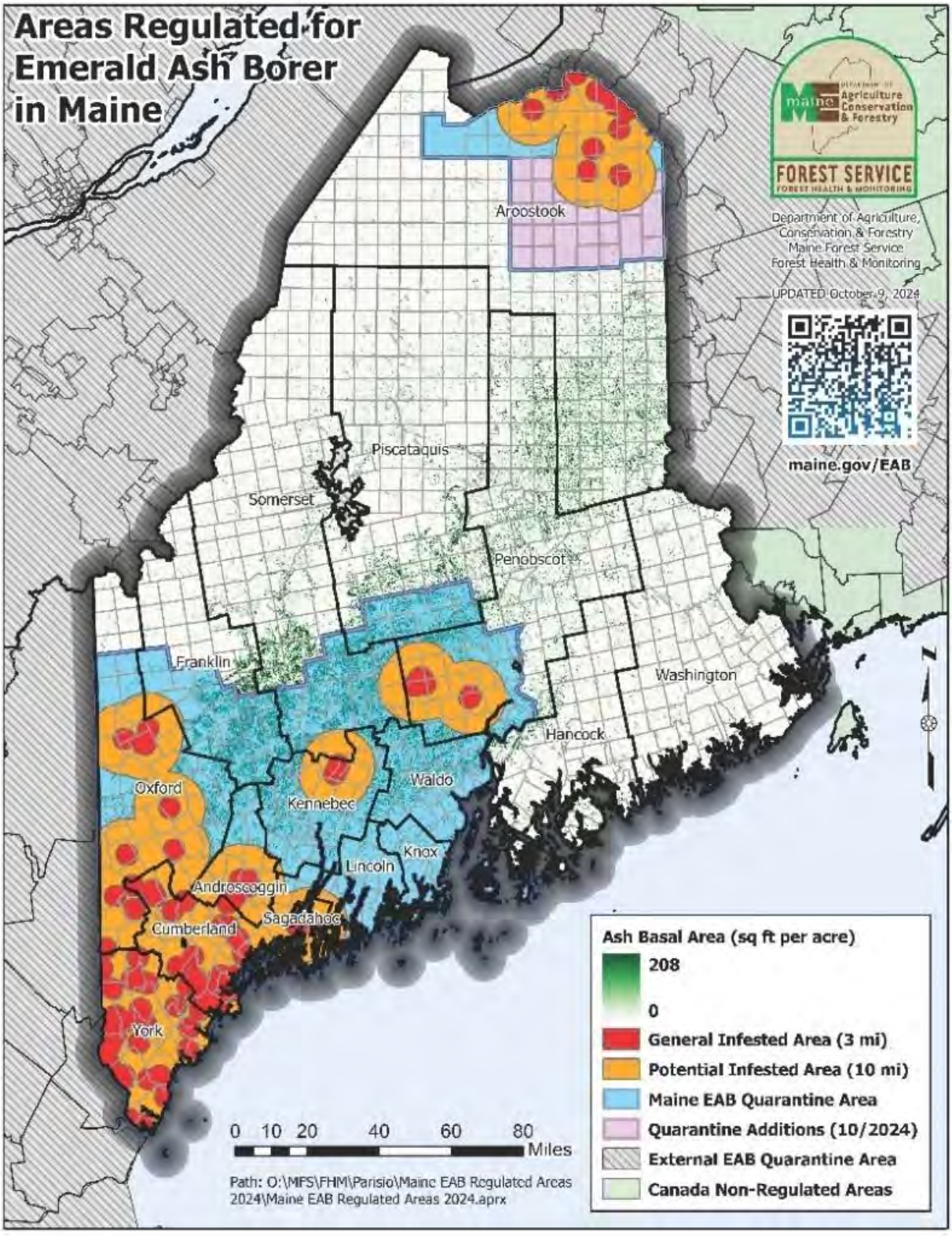

Figure 23: Map of emerald ash borer infested areas in Maine and regulated areas, showing the October 2024 additions to the quarantine zone in northern Maine in purple.

In southern Maine, EAB was reported in the city of Bath, marking the first county record for Sagadahoc County. Again, this detection is near a known infested area in adjacent Brunswick, detected in 2023, just across the county line in Cumberland County. Aside from one heavily infested street tree in Bath, initial survey efforts yielded no immediate visual evidence of other infested trees in the area. The Bath area will be a survey target for 2025 to assess the extent of the population there, as well as search for suitable sites to release biological control agents in Sagadahoc County.

Maine's EAB biological control program continues full steam ahead with annual releases of *Tetrastichus planipennisi, Spathius galinae*, and *Oobius agrili*. Parasitoid releases were initiated at four new sites in 2024: Falmouth (Cumberland County), Andover (Oxford County), Lewiston (Androscoggin County), and Newport (Penobscot County). Parasitoids were released for the second year at four additional sites: Fort Kent (Aroostook County), Portland (Cumberland County), Bridgton (Cumberland County), and Waterville (Kennebec County). Approximately 8,395 *T. planipennisi,* 6,723 *S. galinae,* and 13,800 *O. agrili* were released across all eight sites in 2024. We appreciate the assistance of cooperators who helped with releases, including the City of Portland Forestry Division, City of Lewiston Trees and Open Spaces Division, Loon Echo Land Trust, Colby College, Gilsland Farm Audubon Center, and private landowners.

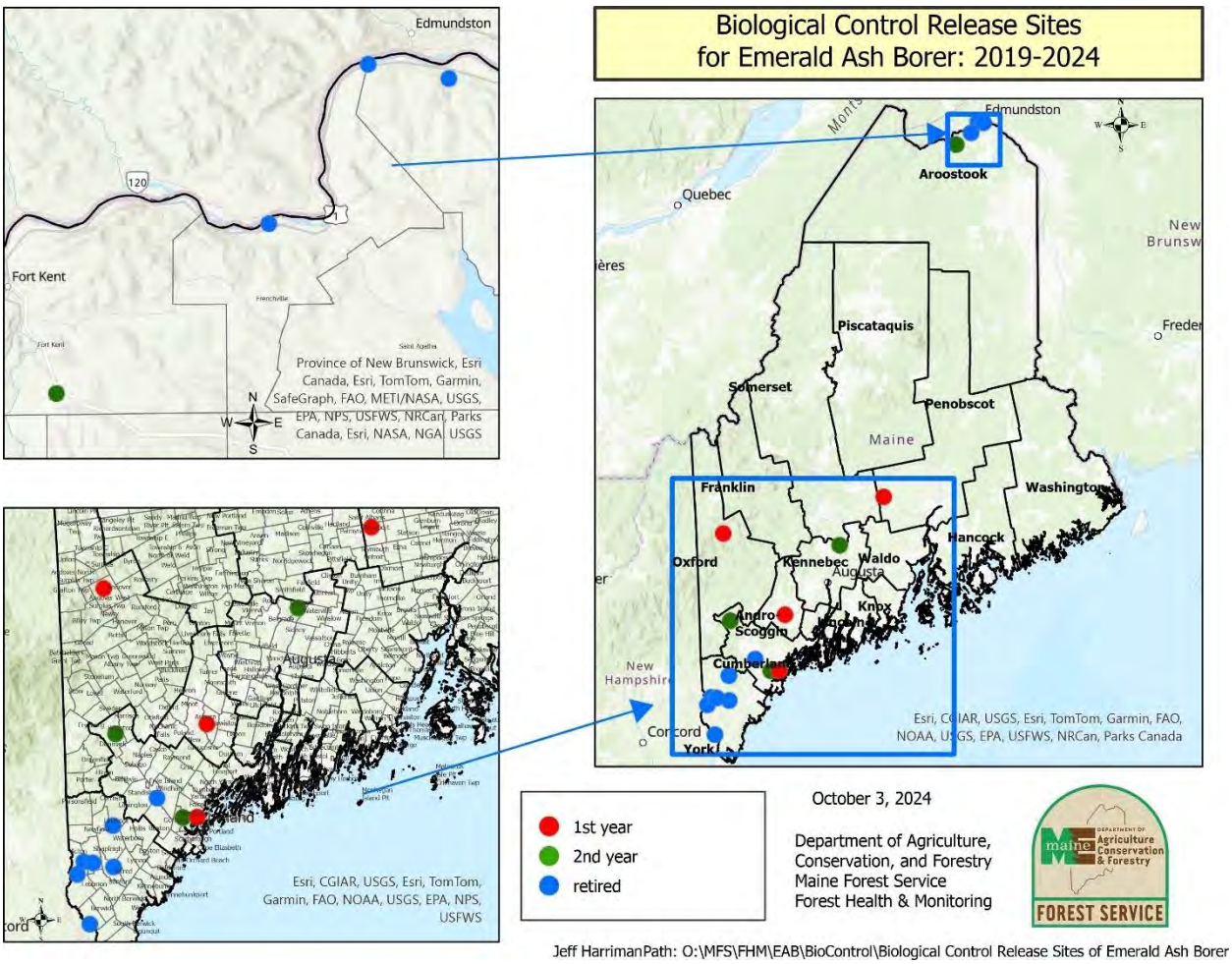

Figure 24: Release sites for biological control of emerald ash borer, 2019-2024

EAB parasitoid recovery efforts at previous release sites entered the fourth year in 2024 with assistance from USDA. Staff from the USFS Durham Field Office joined MFS for field activities. In 2023, four trees were felled at each of seven 'retired' release sites after releases had been carried out for two years. The main stem and large-diameter branches were peeled to look for signs of parasitism, and smaller diameter branches were placed in rearing barrels at the USFS lab in Durham, NH. Although no evidence of parasitism was found during this peeling effort in 2023 and no parasitoids were recovered from yellow pan traps, when the rearing barrels were processed in 2024 parasitoids were found. Two *S. galinae* adults and eight *T. planipennisi* adults were recovered from release sites in Acton, Limington, and Shapleigh in York County.

In spring 2024, four trees were again felled and peeled at each of eight retired sites. At one site in South Berwick (York County), a single EAB larva was found parasitized by *S. galinae*, producing 12 parasitoid pupae. Smaller-diameter material was again placed in rearing barrels and will be processed in early 2025. In four years of recovery efforts, *T. planipennisi* has been recovered at five of the ten retired sites and *S. galinae* was recovered at one of those sites, with most of our recoveries coming from rearing barrels.

Table 10: Results of emerald ash borer biocontrol recovery efforts, 2020-2024

Year First Recovered	Town	County	*Tetrastichus planipennisi*	*Spathius galinae*	*Oobius agrili*	Recovery Method
2021	Madawaska	Aroostook	1			Yellow Pan Trap
2023	Limington	York	2	2		Rearing Barrel
2023	Shapleigh	York	1			Rearing Barrel
2023	Acton	York	3			Rearing Barrel
2024	S Berwick	York		1		Tree Peeling

In 2024, Maine installed 52 girdled trap trees statewide, with 23 located in northern Maine and the remaining 29 located in central and southern Maine. At the writing of this report, all trees in northern Maine have been processed, resulting in two positive trees. Both trees are in Van Buren, a town with an existing EAB population, and were intended to document presence of EAB for potential use as future biological control sites. In southern Maine, all but two trees have been processed to date, yielding negative results thus far.

Maine resumed limited monitoring for emerald ash borer using green funnel traps in 2024. Three clusters of ten traps were deployed in western Maine, northern Maine, and Downeast Maine, primarily along heavily trafficked roads in more remote areas. These traps were monitored for the duration of the summer, but again yielded no evidence of EAB in these areas using this method. Limited biosurveillance was also performed in Maine in 2024, with a focus on re-evaluating many of the *Cerceris fumipennis* colonies monitored in previous years and searching for new ones.

Looking towards the future, MFS completed its first season of our ash preservation project, with insecticide treatments successfully administered at three sites in southern Maine. This project, launched to safeguard ash trees from EAB, focuses on the long-term conservation of healthy trees across the state. This approach aims to not only protect individual trees, but also preserve the genetic diversity of Maine's ash population. Twelve ash trees were injected with a systemic insecticide containing the active

ingredient *emamectin benzoate* at each of this year's selected sites in Scarborough, Falmouth, and Georgetown. MFS plans to revisit these trees to monitor their health and reapply treatments over the coming years. These trees represent the first step in an intended network of protected ash trees across the state, which will act as refugia for Maine's ash population, from which valuable seeds can be collected. New collaborations with landowners are already being formed to incorporate new sites into the program in 2025.

Figure 25: (left) Maine Forest Service staff injects a mature tree with emamectin benzoate; (right) example of a tree tag indicating treatment for emerald ash borer for a long-term project.

Appendix E
Aerial Survey Maps 2024

Insect and Disease Laboratory
Maine Forest Service, DACF
168 State House Station, Augusta, ME 04333

The maps in this appendix show forest damage polygons recorded during aerial survey flights in 2024. These are not meant to provide a comprehensive estimate of damage to Maine's forests. It is impossible to survey the entirety of Maine's forest resources, and surveys are targeted broadly to regions and known problem areas. Some forest damages are not easily detected through this method, and acres damaged are underrepresented for those, in some cases significantly. In areas with a lot of forest damage or when tracking damage from a specific agent, it can be difficult for surveyors to map all damage polygons. While many areas are confirmed through ground-truthing, providing precise acreages and verifying all pest impacts is impossible.

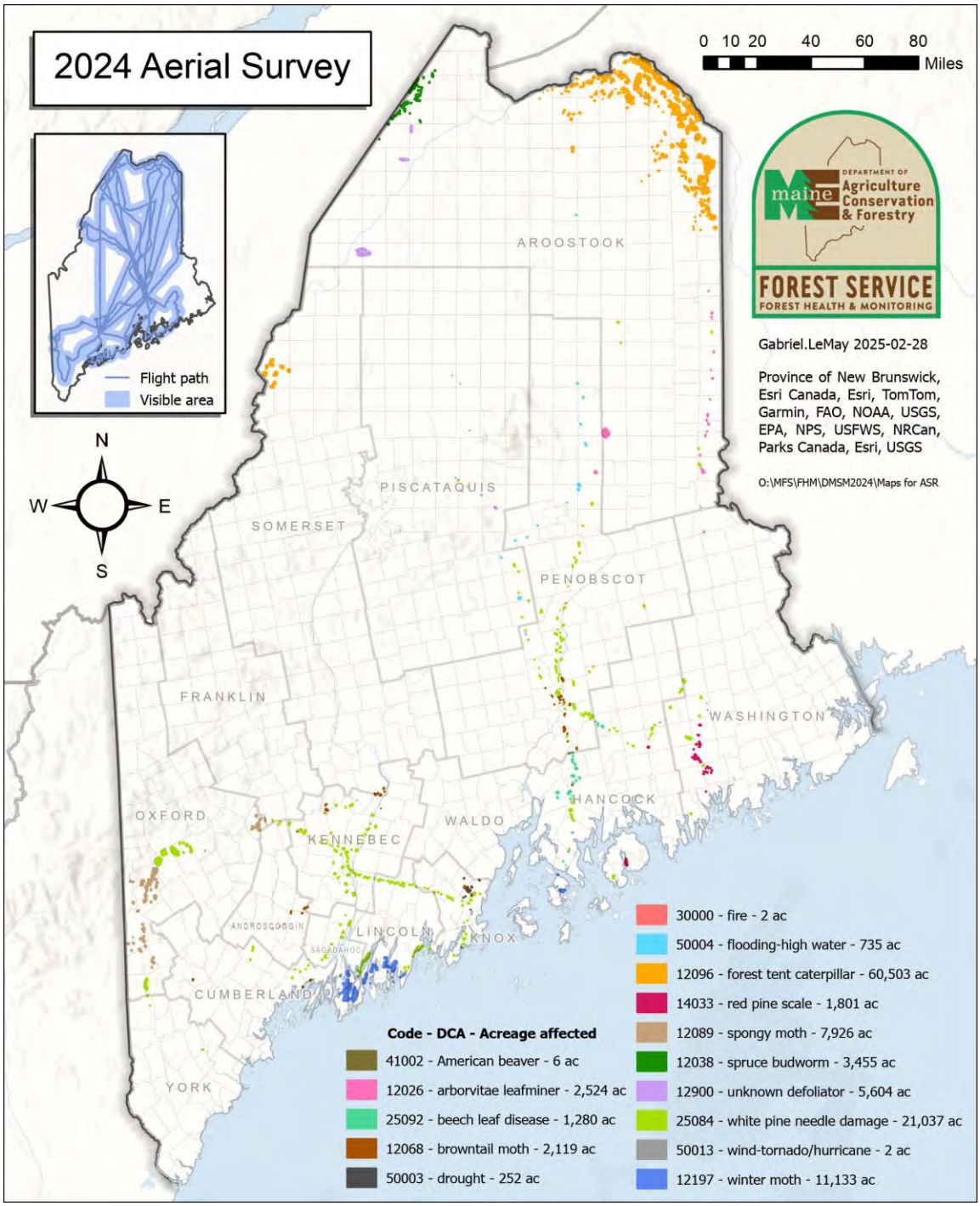

Figure 26: Collective aerial survey map of 2025.

Figure 27: Aerial survey map of damage caused by beavers.

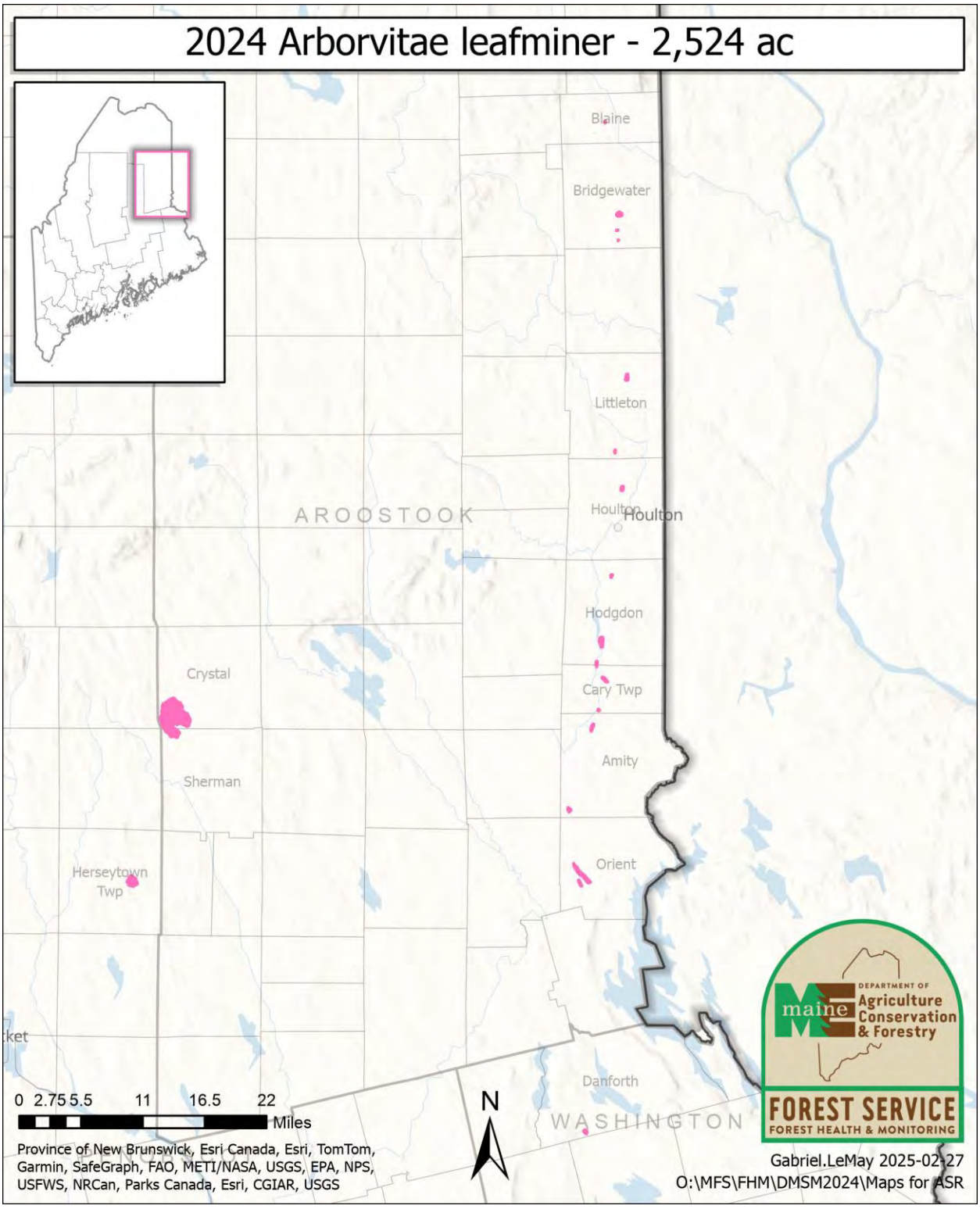

Figure 28: Aerial survey map of damage caused by Arborvitae leafminer.

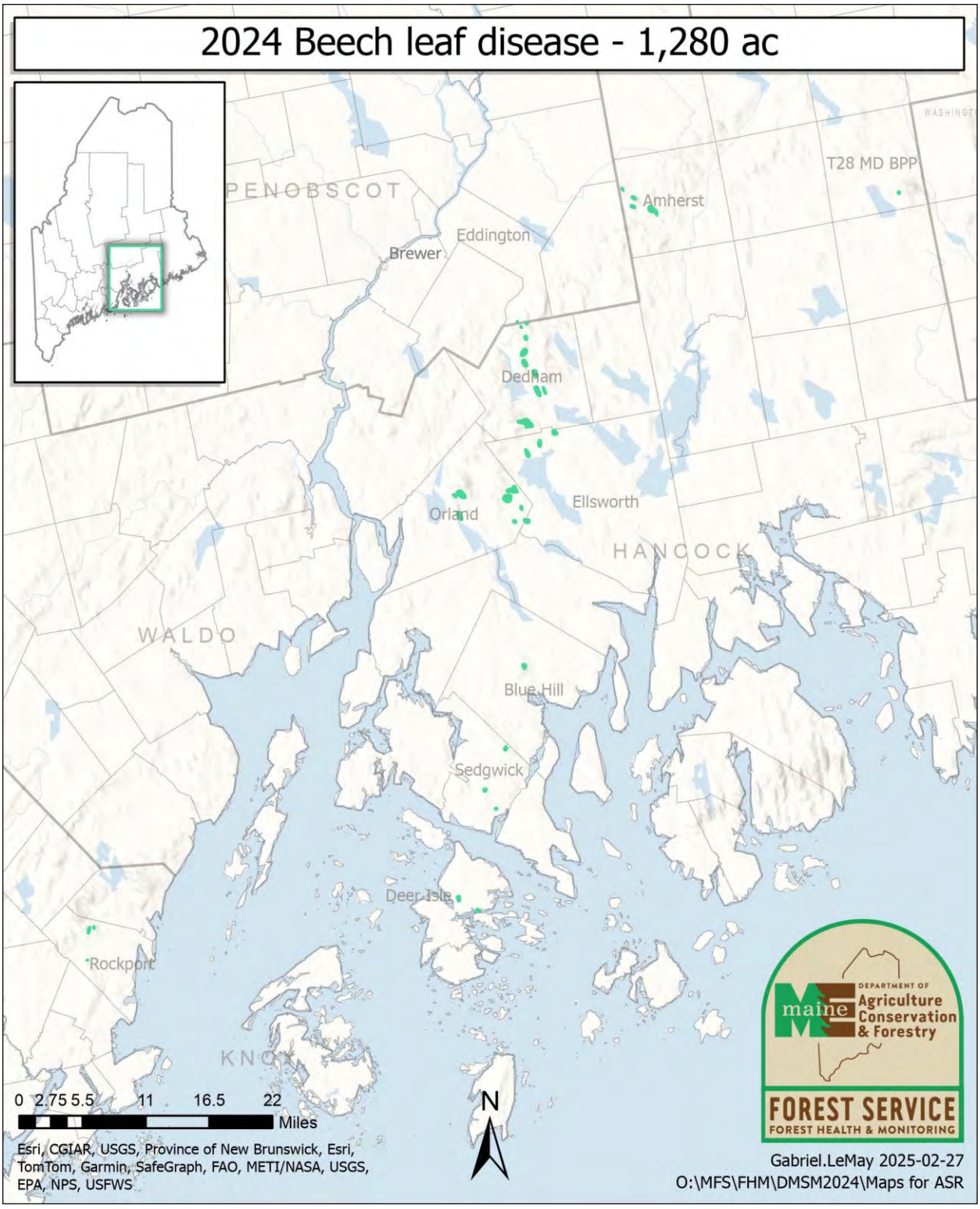

Figure 29: Aerial survey map of damage caused by beech leaf disease.

Figure 30: Aerial survey map of damage caused by browntail moth.

Figure 31: Aerial survey map of damage caused by drought.

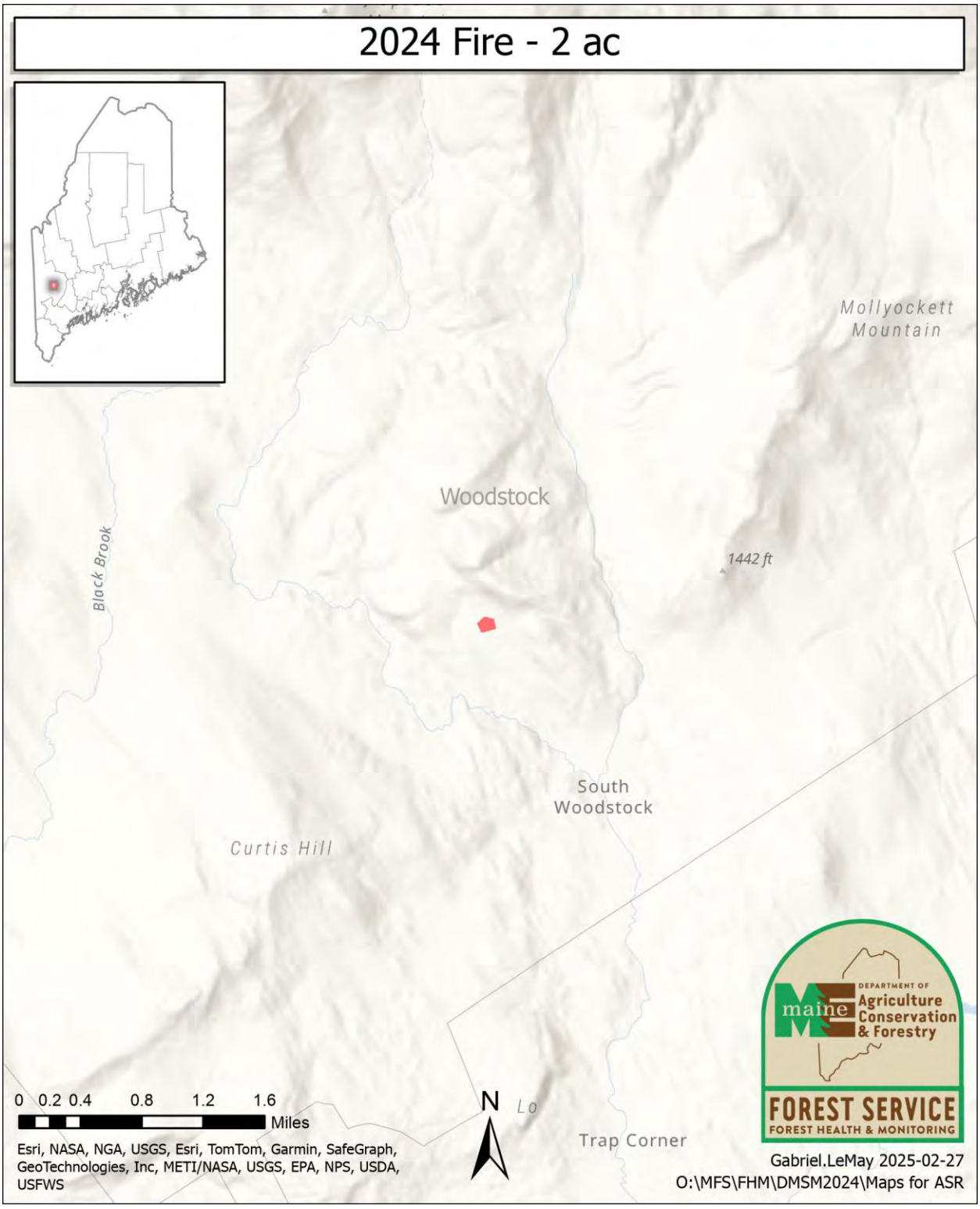

Figure 32: Aerial survey map of damage caused by fire.

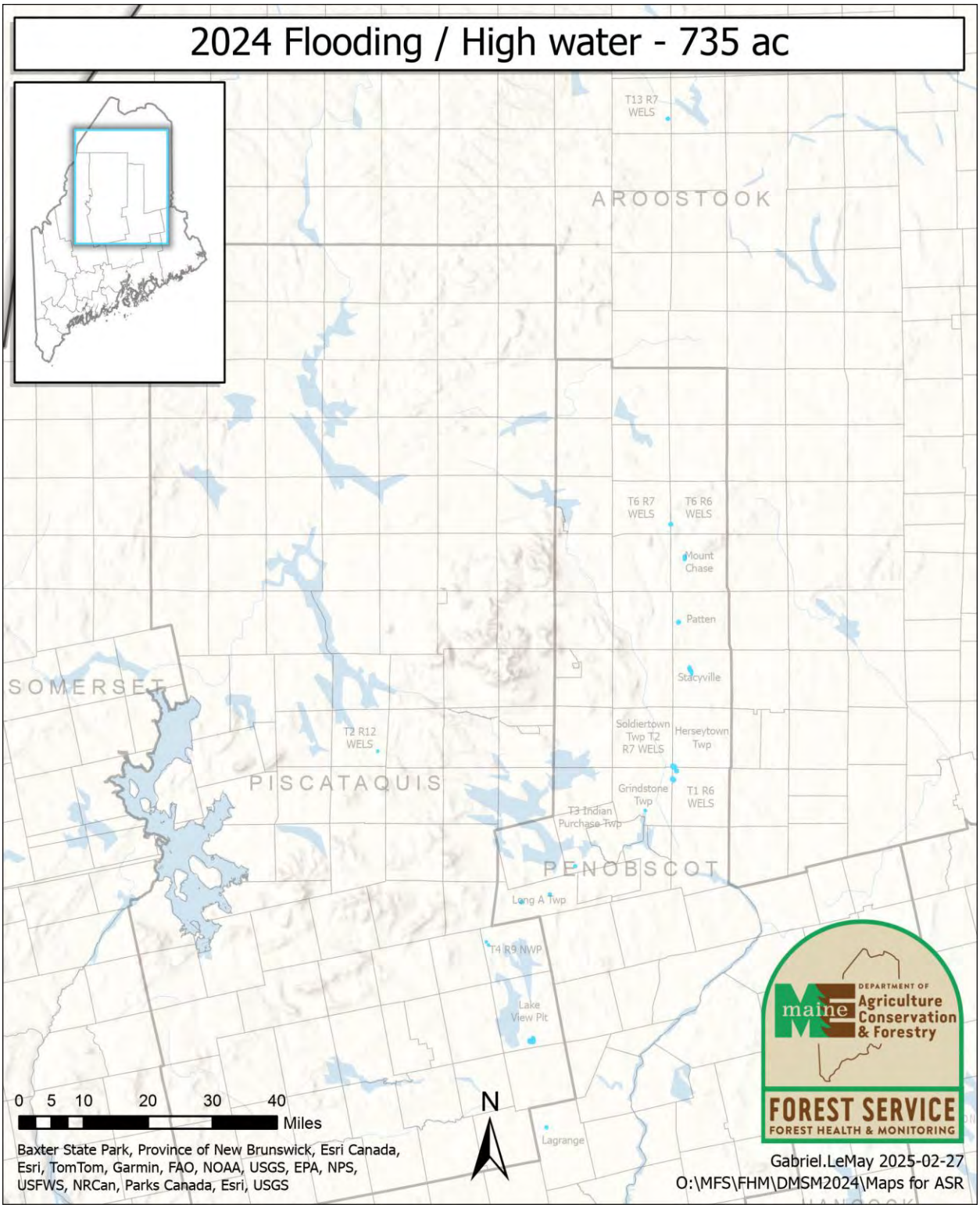

Figure 33: Aerial survey map of damage caused by flooding or high water.

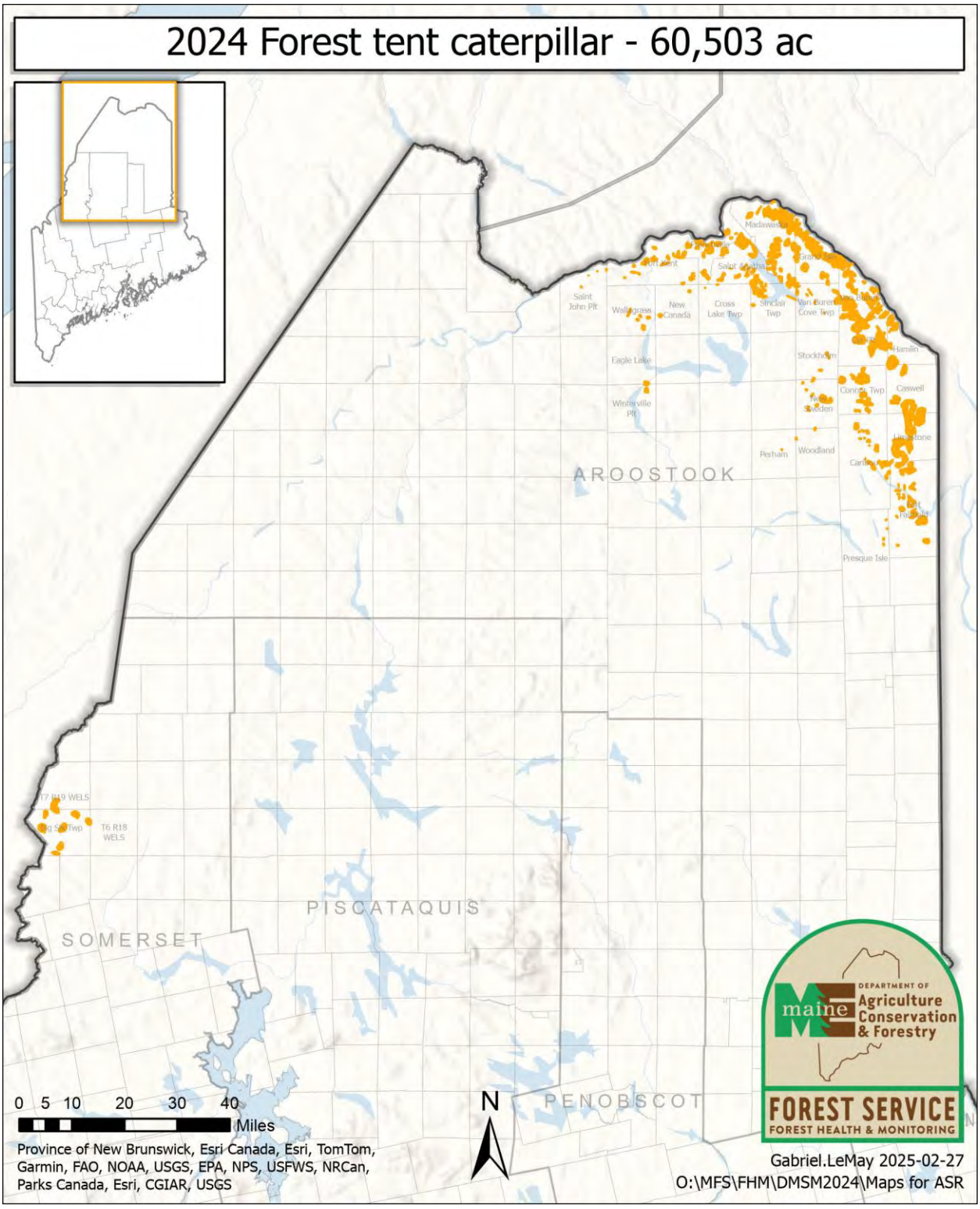

Figure 34: Aerial survey map of damage caused by forest tent caterpillar.

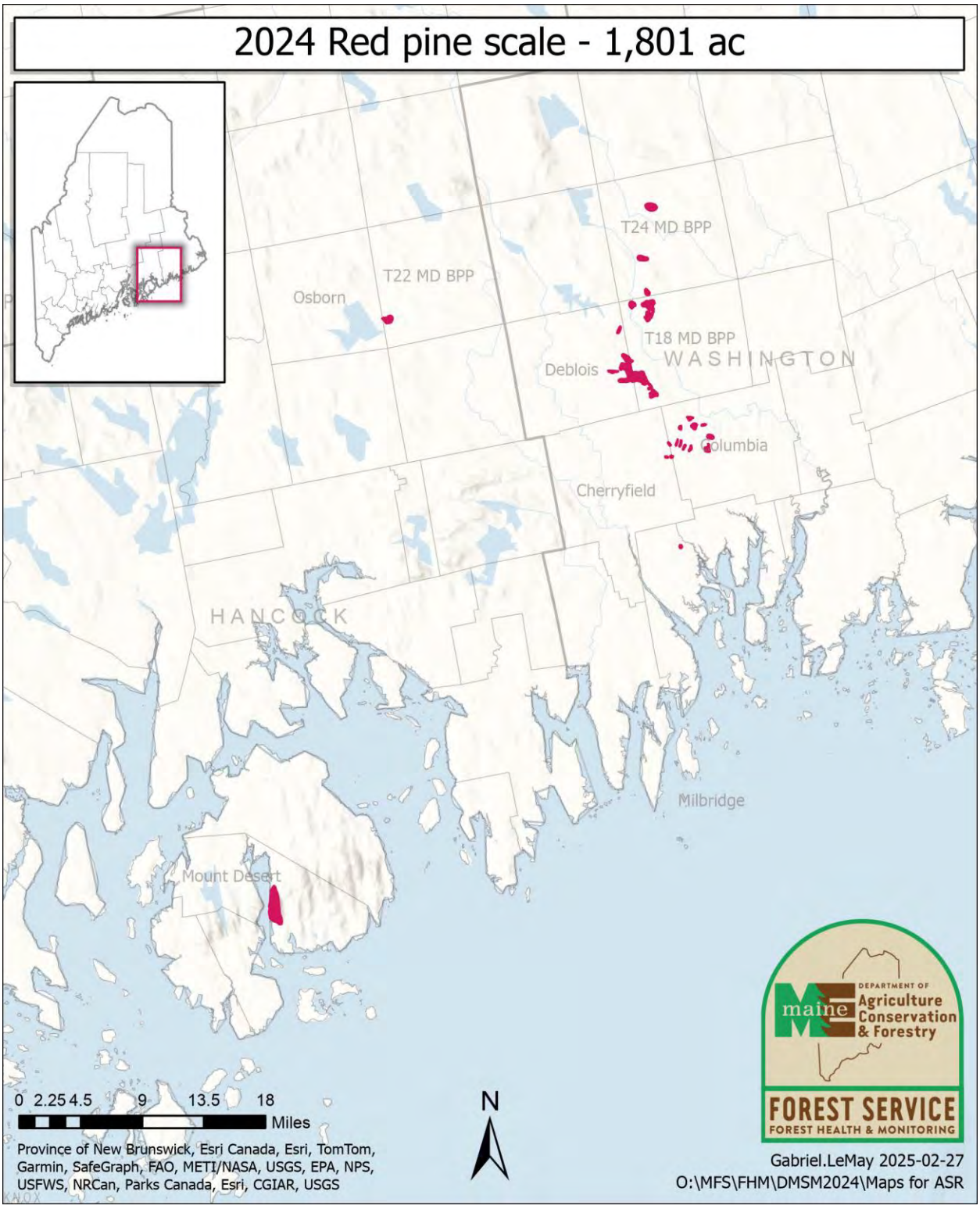

Figure 35: Aerial survey map of damage caused by red pine scale.

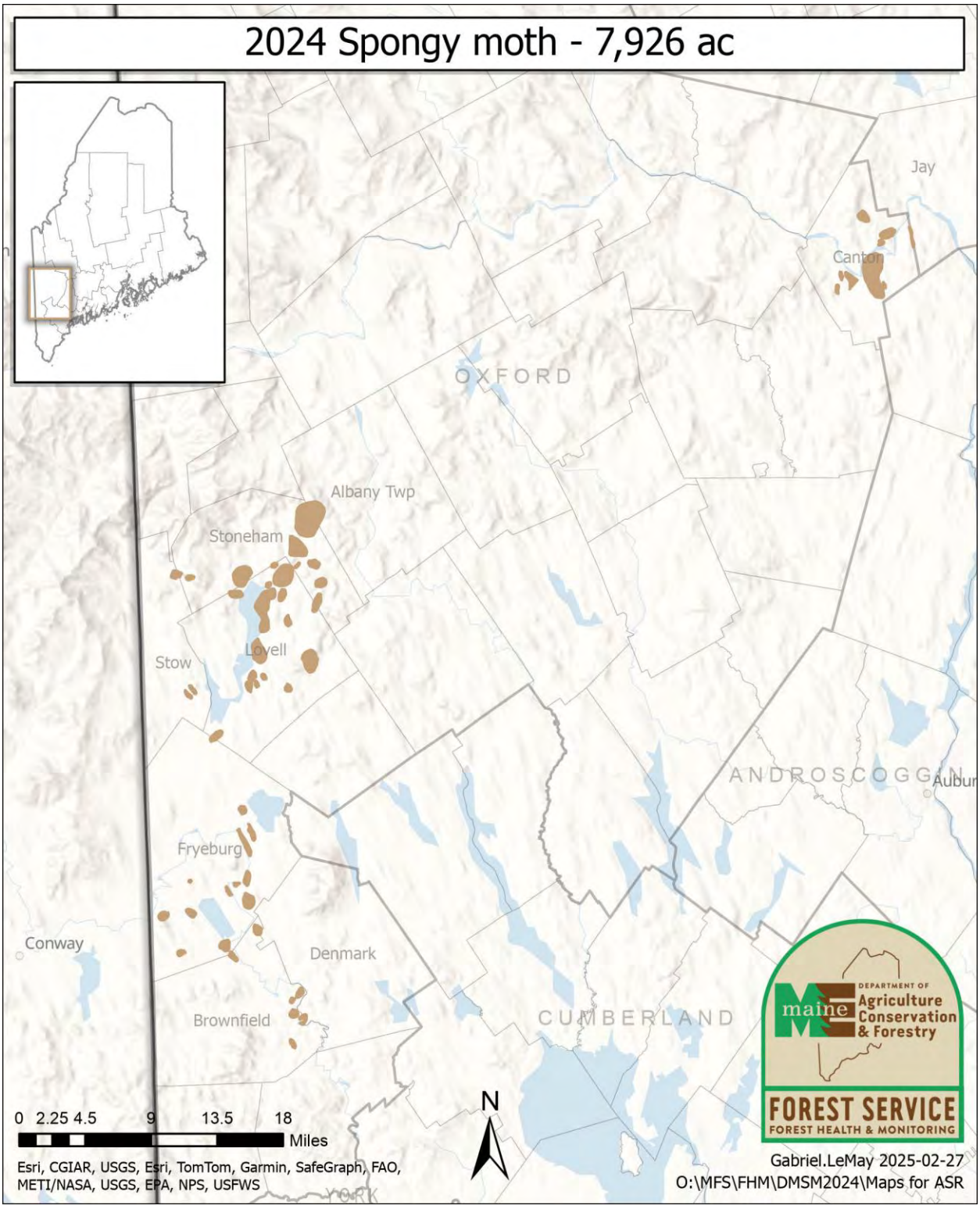

Figure 36: Aerial survey map of damage caused by spongy moth.
Most current-year damage is mortality resulting from a multi-year outbreak preceding 2024.

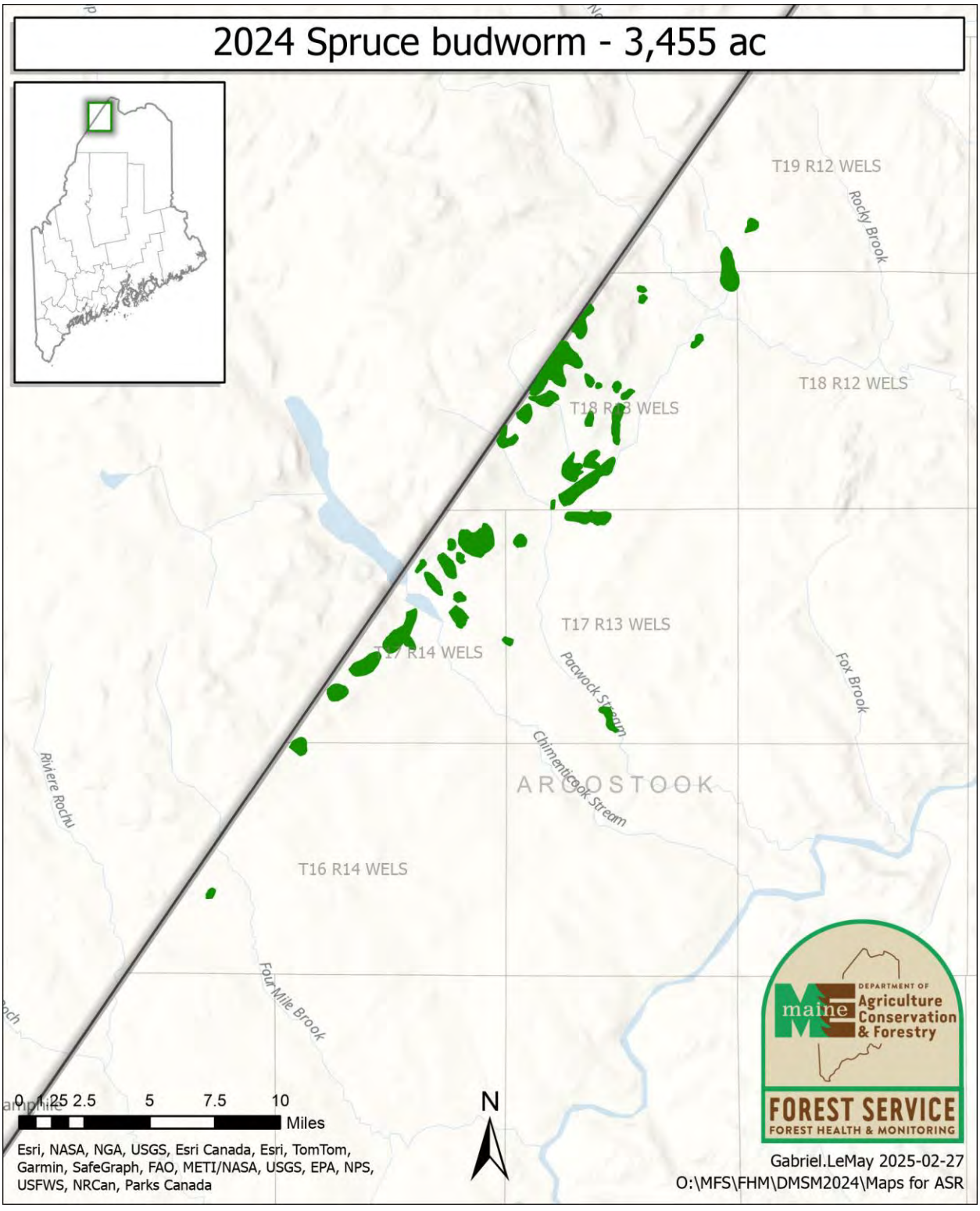

Figure 37: Aerial survey map of damage caused by spruce budworm.

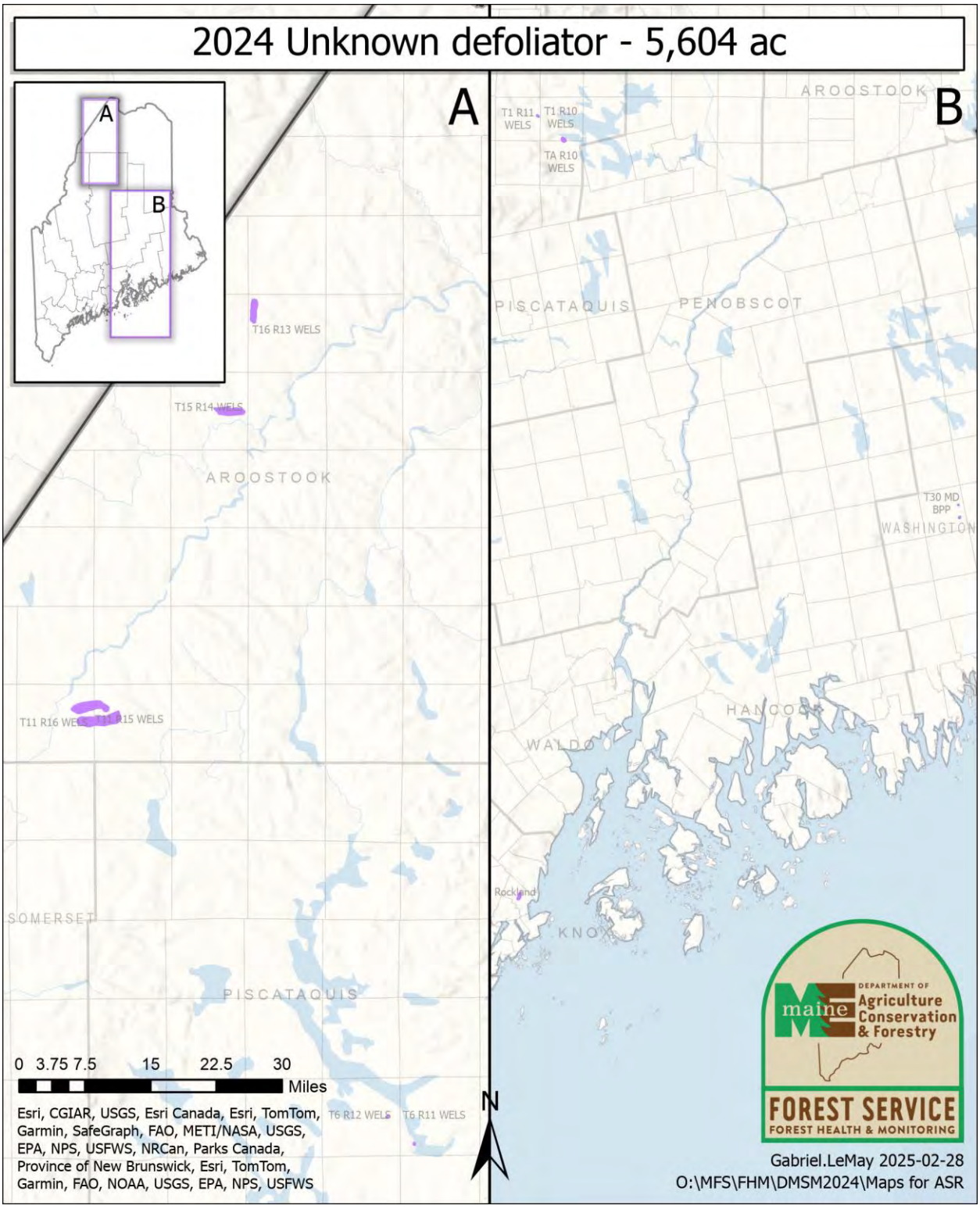

Figure 38: Aerial survey map of damage caused by unknown defoliators.

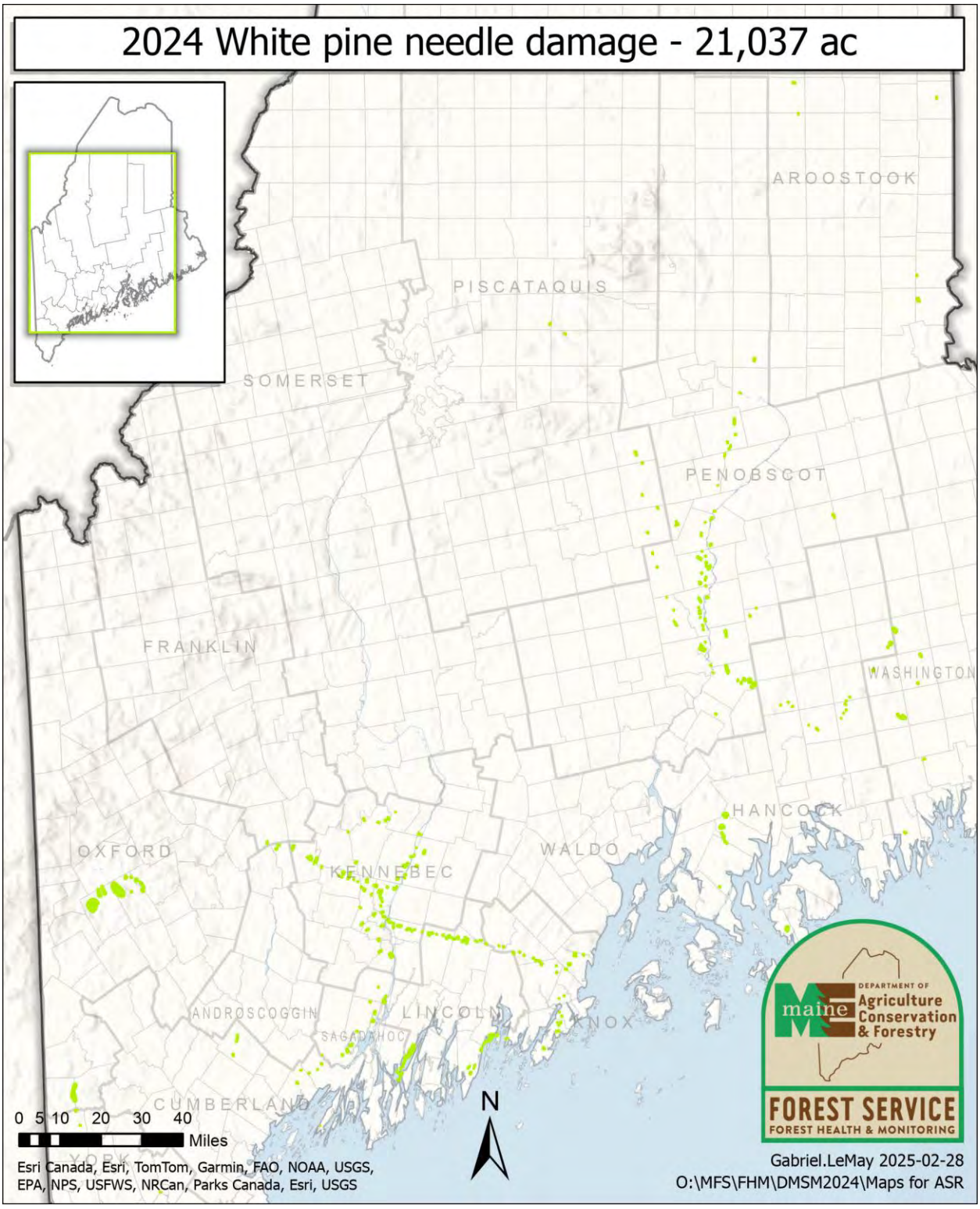

Figure 39: Aerial survey map of damage caused by white pine needle disease complex.

Figure 29: Aerial survey map of damage caused by wind/tornado/hurricane events.

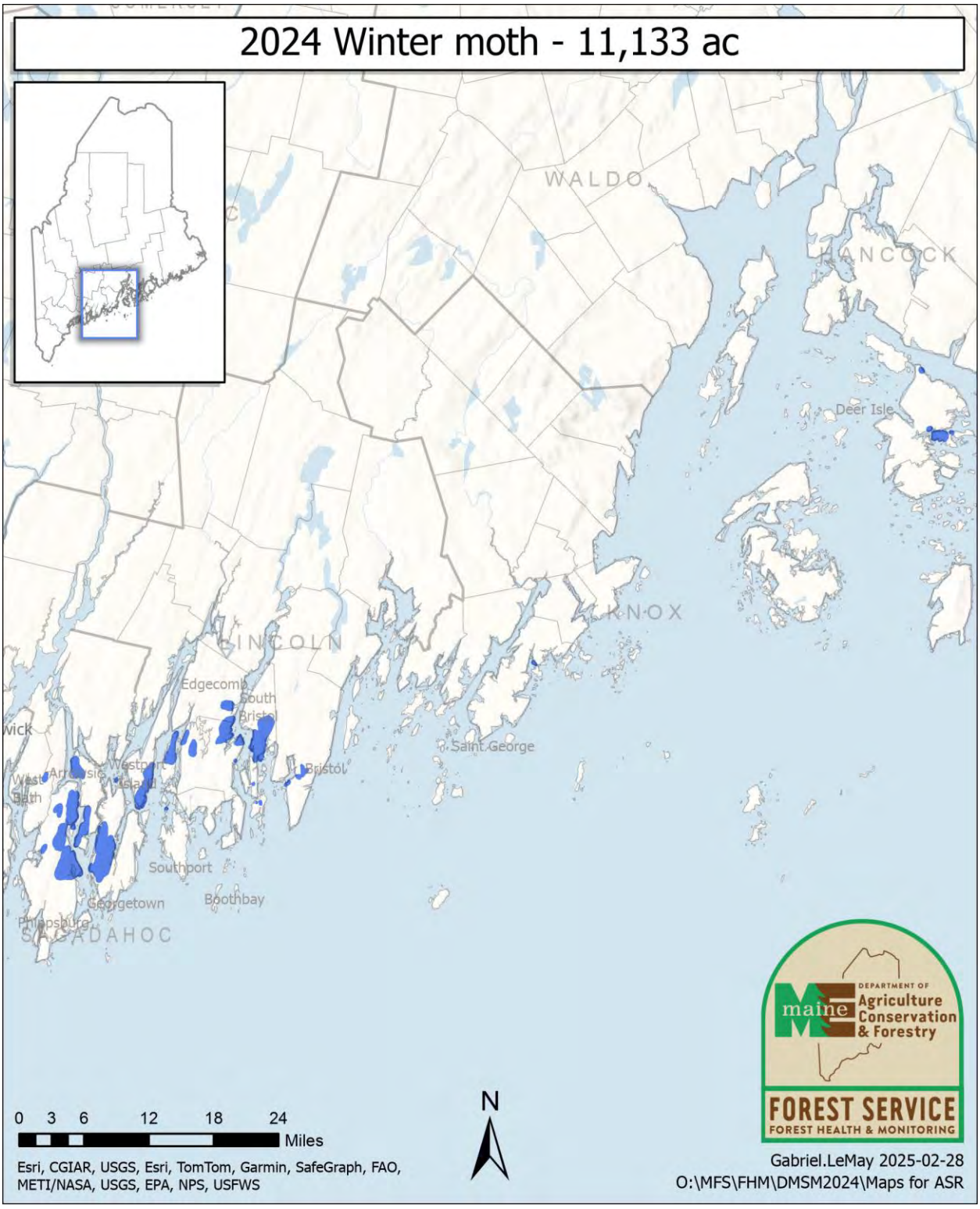

Figure 40: Aerial survey map of damage caused by winter moth.

Index

List of Abbreviations

ALB: Asian longhorned beetle
APHIS: Animal and Plant Health Inspection Service
ARS: Agricultural Research Service
BWA: Balsam woolly adelgid
BLD: Beech leaf disease
DACF: Department of Agriculture, Conservation, and Forestry
DED: Dutch elm disease
EAB: Emerald ash borer
EHS: Elongate hemlock scale
EIS: Early intervention strategy
ELC: European larch canker
EWBB: Exotic woodborers and bark beetles
FHM: Forest Health and Monitoring
FIA: Forest Inventory Analysis
HWA: Hemlock woolly adelgid
GIS: Geographic information system
L2: Refers to second instar spruce budworm larvae
MFS: Maine Forest Service
SBW: Spruce budworm
SLF: Spotted lanternfly
SPB: Southern pine beetle
USDA: United States Department of Agriculture
USDA-APHIS-PPQ: USDA, Animal and Plant Health Inspection Service, Plant Protection and Quarantine
USFS: USDA Forest Service
WPBR: White pine blister rust
WPND: White pine needle diseases