

MAINE FOREST SERVICE

FOREST HEALTH AND MONITORING

FOREST HEALTH HIGHLIGHTS

ANNUAL REPORT

2024



MAINE DEPARTMENT OF
**AGRICULTURE
CONSERVATION
& FORESTRY**



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2024 Maine Forest Health Highlights



Report to the USDA Forest Service

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CLIMATE SUMMARY

The Maine Climate Office (MCO) and Northeast Regional Climate Center (NRCC) provide detailed summaries of climate variables such as temperature and precipitation.

This year's growing season (May 2024 through September 2024) was roughly 4.0°F warmer statewide compared to historic Maine average temperatures recorded from 1901-2000. Maine received closer to average rainfall during the 2024 growing season, with only 0.04 inches of precipitation above average statewide.

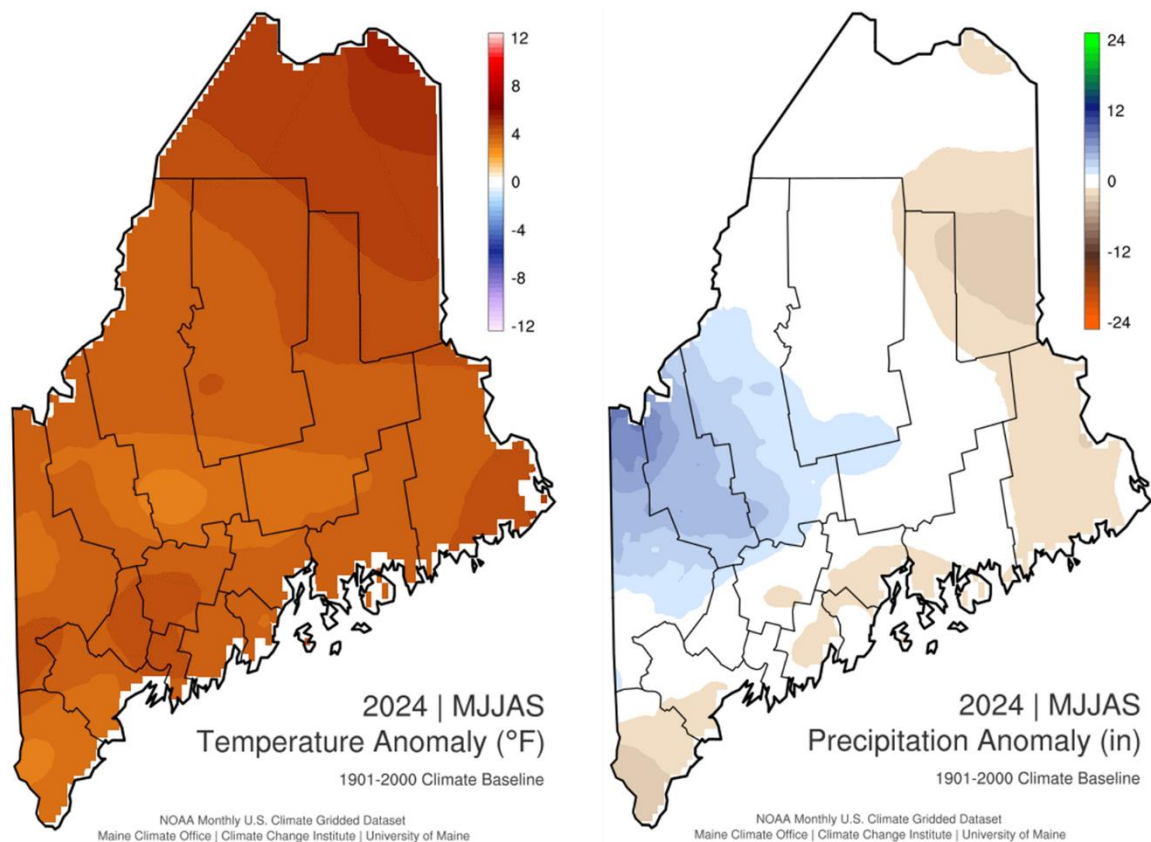


Figure: 2024 growing season temperature (left) and precipitation (right) anomalies across Maine (MCO).

Maine's frost season (November 2023 through March 2024) was similar to the frost season we had last year in 2023. Temperatures statewide during the frost season were approximately 6.4°F warmer than the 1901-2000 historical average. During the 2024 frost season, precipitation was 4.88 inches above average across the state. However, most of this increase in precipitation was seen in the coastal regions. Northern Maine had close to normal precipitation during the frost season this year.

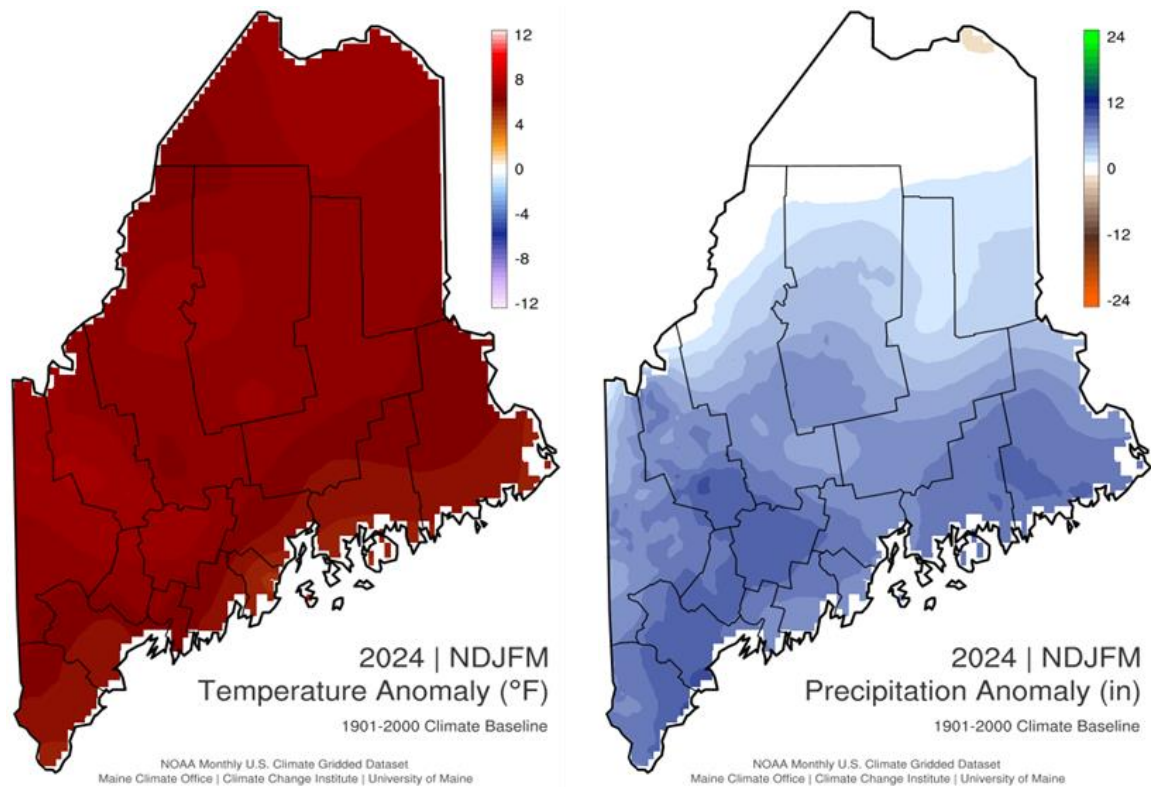


Figure: 2024 frost season temperature (left) and precipitation (right) anomalies across Maine (MCO).

Unlike the abundant periods of precipitation last year, the precipitation throughout 2024 was sporadic and led to numerous drought events in the latter half of the year despite the additional rain brought on by a couple of tropical storms passing through the state. There were abnormally dry conditions in June and August. However, September and November experienced heightened periods of drought for weeks at a time. The drought conditions were the most extreme in mid-November, where all regions of the state were experiencing some level of drought; western regions were abnormally dry (35 percent), central and eastern regions were recorded with moderate drought (64.73 percent), and southern regions were recorded as having severe drought (0.14 percent) conditions (U.S. Drought Monitor). Soil moisture levels and stream flows were below normal levels during periods of drought, contributing to elevated fire risk statewide.

These conditions are an annual snapshot, and the cumulative impacts of anomalous seasons, affect forest health both in ways we have a strong grasp of and in ways we do not fully understand.

FOREST RESOURCE SUMMARY

With an estimated 17.52 million acres of forest land covering 89 percent of the land area, Maine continues to boast the highest percentage of forest cover of any state. This forested acreage has decreased slightly from an estimated 17.57 million acres in 2016 but remains impressive. As part of the USDA Forest Service Forest Inventory and Analysis (FIA) program, Maine monitors its forests using 3,518 sample plots. Data is collected on a rotating schedule from approximately 20 percent of these plots each year. The summary statistics presented here have been generated using FIA data accessed on March 1, 2023.

The number of live trees on forest land has decreased slightly from 2016 to 2021, from 24.03 to 22.93 billion trees, respectively. Despite the overall decrease in number of trees, the volume of live trees on forest land increased from 27.02 billion cubic feet in 2016 to 27.70 billion cubic feet in 2021. Annual removals decreased from an average of 637 million cubic feet in 2016 to 521 million cubic feet in 2021, while annual mortality has increased to an average of 305 million cubic feet in 2021, up from 271 million cubic feet in 2016. Positive annual net growth has been maintained in Maine at 1,013 million cubic feet.

It is estimated that 9,528 acres of non-forest land revert to forest land, and 20,060 acres of forest land are converted to non-forest land annually in Maine, down from 11,306 and 22,128 acres reported in 2016, respectively. Acres of forest land under active management decreased from an estimated 446,336 in 2016 to 352,400 acres in 2021. Weather events and other disturbances impact an average of 12,448 acres of forest land annually in Maine, down from an average of 21,698 over the prior reporting period.

Land ownership by broad owner type has remained relatively constant in Maine. An estimated 91.74 percent of the land base is privately owned, state and local governments own 6.84 percent, and 1.42 percent is federally owned.

Adapted from USDA Forest Service. 2022. Forests of Maine, 2021. Resource Update FS-366. Madison, WI: U.S. Department of Agriculture, Forest Service. 2p. <https://doi.org/10.2737/FS-RU-366>. The estimates presented are based on data retrieved from the FIA database (03/01/2023) and may not reflect the most recent data available from the FIA program. Note – this publication does not include estimates of uncertainty. Average annual estimates are based on data collected across 5-10 years and may not be indicative of the nominal year presented in the title itself.

AERIAL SURVEY SUMMARY

In stark contrast to 2023, the 2024 aerial survey season provided ideal flying conditions and ample opportunities to document the major forest health disturbances happening across Maine's landscape. For the second year in a row, aerial surveyors in the Northeast were able to gather for a "fly-in" training to map damage happening in a set area and compare notes. Special thanks to NYSDEC for organizing this training in the Capital Area and to our NY State Police pilot. We are hoping to repeat this beneficial group training again in 2025, with Maine as the host state.

The early-season star of the show was white pine needle damage. This has historically been a very difficult forest health disturbance to document accurately from the air and is often better viewed from the ground. However, given the extreme prevalence of WPND in 2024 and weather conditions that allowed white pines to retain their diseased needles for a longer time frame, we captured evidence of WPND virtually everywhere we went, mapping 21,027 acres, more than ever before. Even this is a significant underestimate of the total area experiencing this damage.

Later in the season, all attentions were turned to northern Maine. In June 2024, we began to receive rumblings of significant spruce budworm (SBW) defoliation damage along the Quebec border in northwestern Aroostook County. As we pieced together location information from ground reports and satellite imagery, affected fir trees in this region continued to become more discolored. Our flight plan called for hitting the damage area in early July to capitalize on the peak occurrence of reddened foliage in the host trees. Weather and pilot availability were perfect and there was no doubt what we were looking at was spruce budworm feeding damage, and it encompassed over three thousand acres of damage in Maine, connected to many more thousands of acres of damage visible across the border looking into the forests of Quebec.

Meanwhile, the ongoing forest tent caterpillar (FTC) outbreak in northern Aroostook County continued to grow in 2024, doubling in size again from around 30,000 acres in 2023 to just over 60,000 acres in 2024. The damage was so extensive that it was difficult to map in places and required multiple flights to capture the entire damage area. We also looked to alternative methods of documenting damage areas, leaning on our USFS colleagues to help us decipher damage areas using satellite imagery analyses. Similar to SBW, this outbreak is contiguous with a much larger regional outbreak, and vast damage areas were visible looking across the Saint John River into neighboring New Brunswick. Aspen was by far the most heavily affected species in these northern areas. There were several large areas of birch host that appeared defoliated in remote areas of northern Maine that were inaccessible for ground-truthing. These were mapped prior to other large-scale reports of FTC defoliation in other parts of the state, and it is believed these could be outlying pockets of FTC defoliation as well.

The regional nature of this FTC outbreak also became apparent when maple sugaring operations in western Maine along the Quebec border began reporting damage on sugar maple concurrent with ground observations by FHM staff. A flight to this area easily identified several large sugarbushes almost completely defoliated by caterpillars. These defoliated hilltops of concentrated sugar maples stood out like islands in a sea of green in the surrounding forest canopy. This damage was also highly visible in satellite imagery, which we used as a tool to compare to our aerial survey data.

In coastal Maine, winter moth proved to be the largest disturbance visible during aerial survey. These damage areas totaled 11,132 acres and ranged from Harpswell to as far up the coast as Deer Isle. Beech leaf disease continued to be visible from the air, as more and more stands become more affected each season. Previously a major feature, perhaps the most surprising result of aerial survey in 2024 was the overall lack of browntail moth (BTM) defoliation. Though BTM is certainly still present in many places, the amount of defoliation visible from the airplane decreased dramatically in 2024.

Overall, MFS covered 14.1 million acres of Maine's total land base during our aerial survey efforts in 2024 and documented 117,964 acres of damage from all damage causing agents mapped.

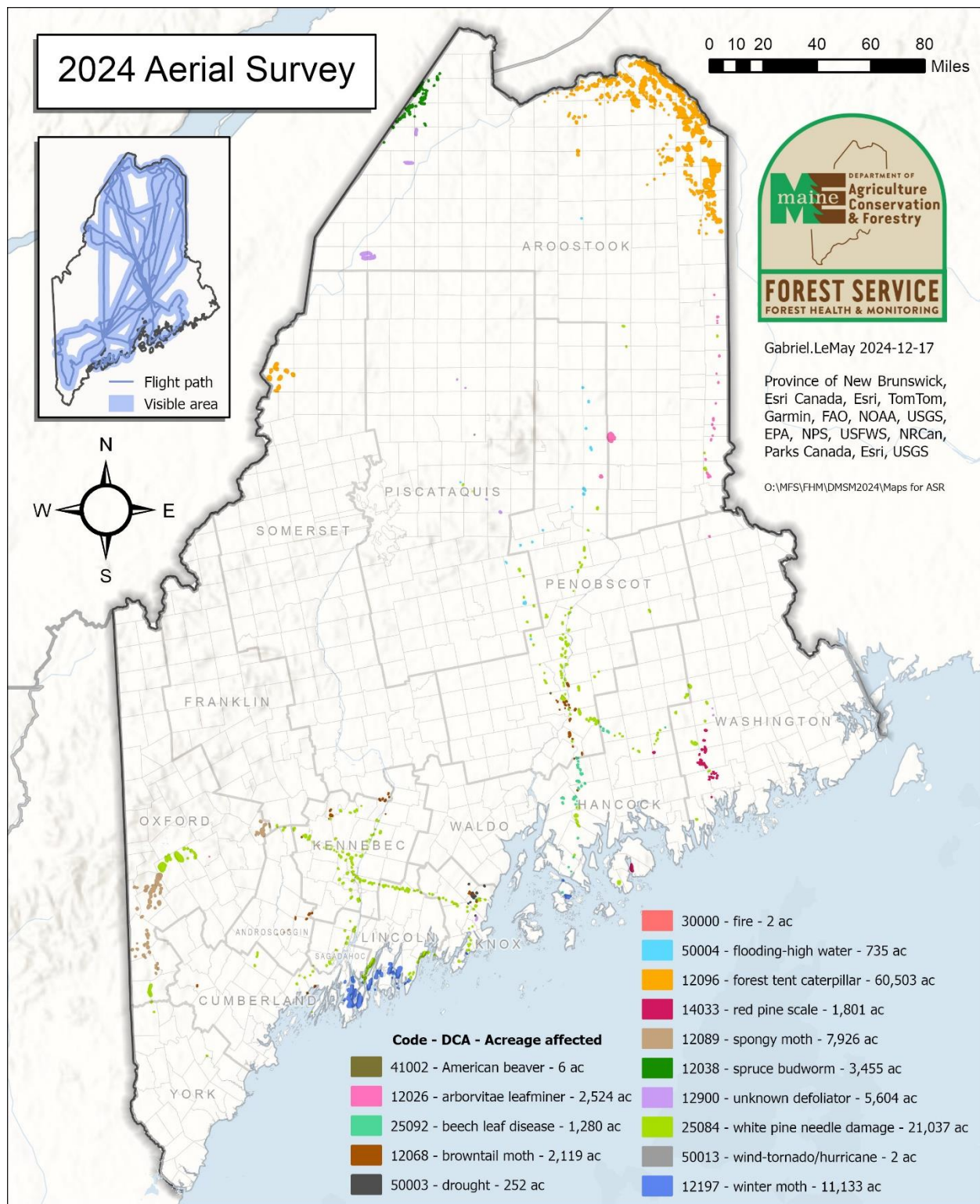


Figure: Map of 2024 Maine Forest Service aerial survey results.

INSECTS

Browntail Moth (*Euproctis chrysorrhoea*)

As already mentioned in the aerial survey summary, browntail moth (BTM) populations have experienced a large decline statewide. In 2024, our aerial surveys captured just 2,119 acres of BTM defoliation damage, compared to the 46,727 acres of defoliation documented during aerial survey in 2023. This decreasing trend has now spanned multiple seasons.

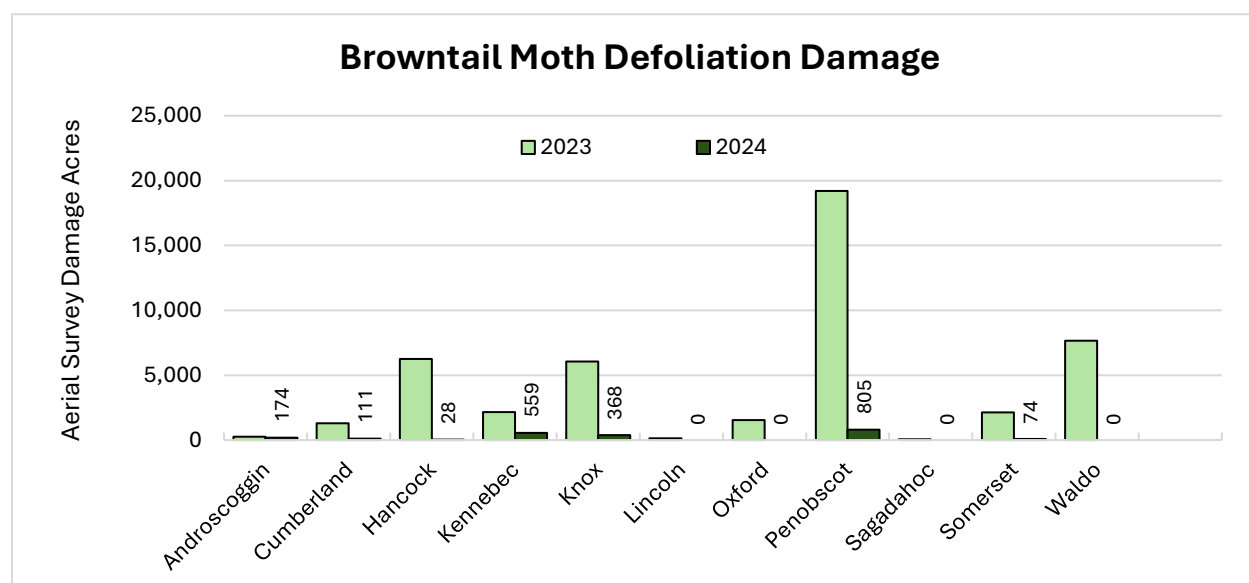


Figure: Acres of browntail moth damage captured via aerial survey organized by county during 2023 and 2024. Number labels represent the number of defoliated acres in 2024 seen during aerial survey.

On the ground, we monitored BTM at ten sites across the state throughout spring and summer to document development of caterpillars, presence of pathogens, and timing of pupation. Our observations were shared with our BTM mailing list subscribers as weekly updates, complete with photos, rash prevention strategies, and management suggestions, as well as posted on our [MFS BTM website](#). 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 our 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.

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.



Images: Examples of browntail moth caterpillars killed by pathogens in Maine during summer 2024.

Emerald Ash Borer (*Agrilus planipennis*)

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, featured on the map below.

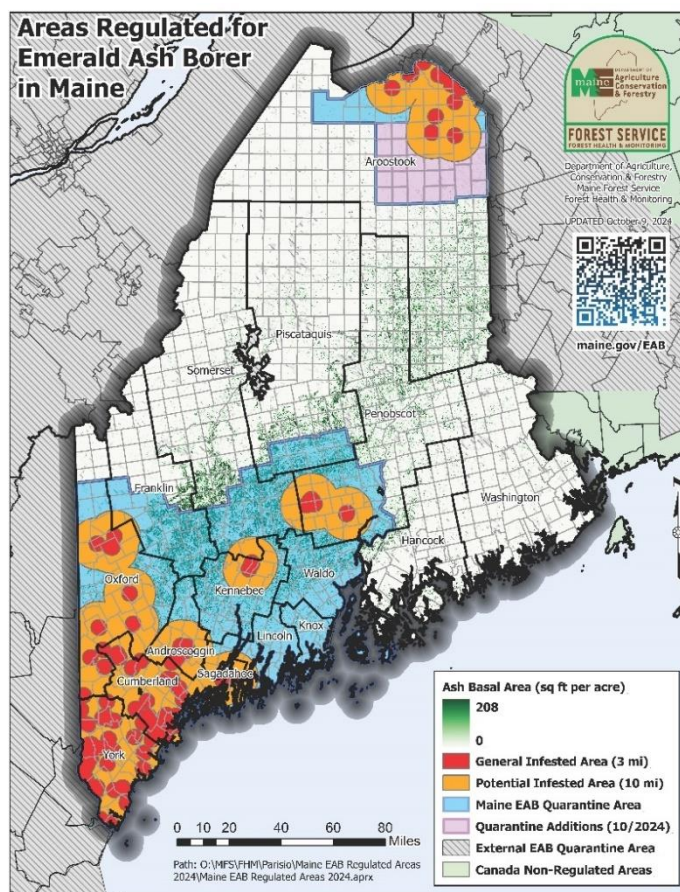


Figure: Map of EAB infested areas in Maine and regulated areas, showing the October 2024 additions to the quarantine zone in northern Maine in purple.

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.

Elsewhere, 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). Parasitoid releases were performed for the second time at an additional four 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.

EAB parasitoid recovery efforts at previous release sites entered the fourth year in 2024 with assistance from USDA. Staff from the US Forest Service Durham Field Office joined us for field activities. In 2023, four trees were felled at each of seven 'retired' release sites where releases had occurred for at least a year. 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 USDA Forest Service lab in Durham, NH. Although no evidence of parasitism was found during this peeling effort and no parasitoids were recovered from yellow pan traps in 2023, we were rewarded in 2024 when the rearing barrels were processed. This effort resulted in recovery of two *S. galinae* adults and eight *T. planipennisi* adults across our 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 barrel recoveries.

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, only a small handful of trees have been processed to date, also yielding negative results thus far. Girdled trap trees will continue to be processed over the winter months.

Maine resumed limited monitoring for emerald ash borer using green funnel traps in 2024. Three clusters of 10 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.



Images: (left) MFS staff injects a mature tree with emamectin benzoate. (right). Example of a tree tag indicating treatment for emerald ash borer for long-term project.

Hemlock Woolly Adelgid (*Adelges tsugae*)

During the summer of 2024, hemlock health in many parts of Maine affected by hemlock woolly adelgid (HWA) continued to improve. Maine continues to benefit from the extreme cold spells in January and February 2023 which led to very high winter mortality of HWA in many areas. However, the winter of 2023-2024 was mild and HWA winter mortality was lower than we had ever recorded. Mortality was highly variable between the six sites measured in 2024, ranging between as little as 9.5 percent and as high as 90.5 percent and averaged just under 33 percent. HWA populations are starting to increase again, but at the end of the growing season of 2024, they remain low overall and many trees in infested areas still appear to have improved vigor.

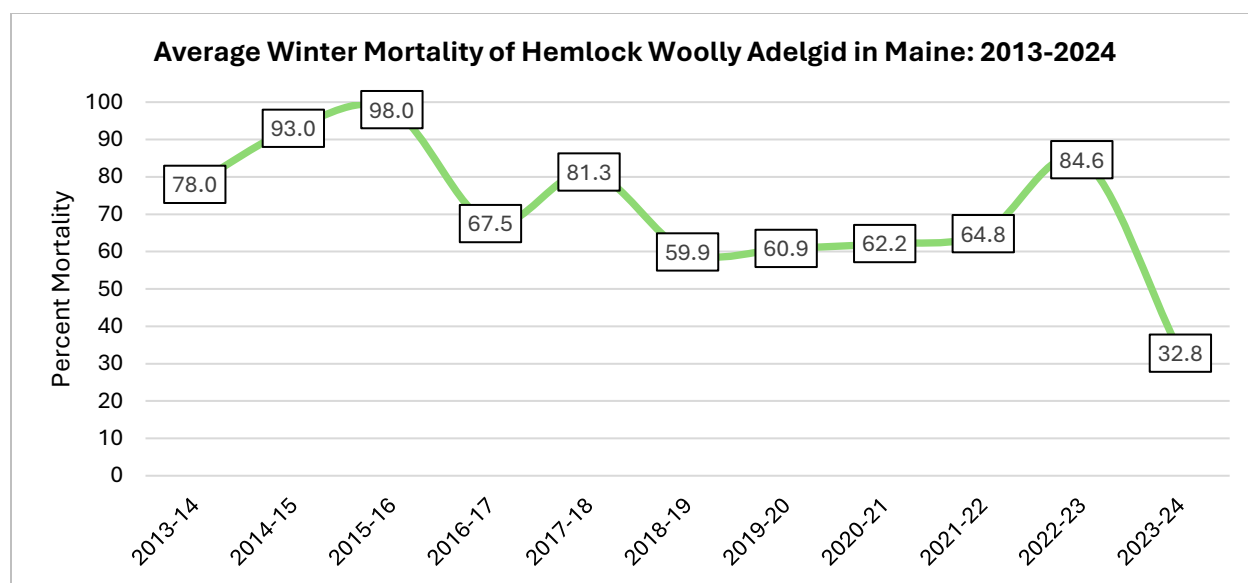


Figure: Average winter mortality rates of hemlock woolly adelgid across monitoring sites in Maine from 2013-14 to 2023-24.

2024 did not prove to be a significant season for detected HWA spread, with detections occurring in just two new towns: Liberty (Waldo County) and Parsonsfield (York County). Both towns records occur inside of Maine's existing HWA quarantine area. Interestingly for both new towns, there is a buffer of at least one town between them and the nearest town where HWA is already known.

There continues to be a high public interest in HWA biological control, often fostered by education and outreach efforts by multiple land trusts and conservation districts and the continuing efforts of MFS. In 2024, organizations and individuals released approximately 39,000 purchased *Sasajiscymnus tsugae* in locations throughout the range of HWA in Maine. One thousand lab-reared *Laricobius osakensis* were also released in Bremen (Lincoln County), 500 in Lincolnville (Waldo County), and 500 in Bar Harbor (Acadia National Park, Hancock County). Because a supply of early emerging beetles from rearing

colonies at Virginia Tech was also available, a further 1,000 *L. osakensis* were released in Acadia National Park. Given how early these beetles had to be released, it is uncertain whether these would be able to feed effectively on HWA that had not yet broken aestivation but releasing them seemed like a worthy endeavor versus letting them go to waste. Five hundred *Laricobius nigrinus* field-collected in Delaware were also released in the town of York (York County).

Forest Tent Caterpillar (*Malacosoma disstria*)

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 again repeated this year, with over 60,000 acres defoliated statewide. Most 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 percent 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.



Images: (left) One of several large sugar maple stands defoliated by forest tent caterpillar in Big Six Twp. (right) View from below the canopy of a severely defoliated sugarbush in Big Six Twp.

FTC defoliation of sugar maples has not occurred recently until now in Maine, 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 significantly affected. In terms of 2024 FTC egg masses, preliminary survey results of roughly 2-3 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 that day 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 2 to 5 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 also currently 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.

Spruce Budworm (*Choristoneura fumiferana*)

After a decade of intensive monitoring and uncertainty, 2024 left little doubt that spruce budworm has returned to Maine in a material way. Over the past several years, population monitoring has pointed to a few potential areas of budworm activity that proved to be the most problematic in 2024. Rumors of budworm damage started circulating in June, followed by photos that proved there was significant activity in northwestern Aroostook County along the Quebec border. After we gathered enough location information from on the ground reports, we took to the air to survey those spots and found almost 3,500 acres of discolored fir trees, highly visible from the air.



Images: Fir trees discolored by spruce budworm defoliation as seen during aerial survey in June 2024, with the Maine-Quebec border seen running north-south through both photos.

While the amount of new damage in 2024 was surprising, it was not a total surprise that there could be activity in this area. Some stands in the affected areas were even previously treated with aerial pesticide applications in 2023 and 2024 based on the results of Maine's SBW overwintering larval survey (known as L2 survey). Those treatments were made by landowners following the Early Intervention Strategy (EIS) pioneered in Atlantic Canada. The treatments focused on areas where a treatment threshold of seven larvae per branch had been reached at many sampling sites. These treatments did not encompass the entire area exceeding the treatment threshold, however, which with current data is modeled to cover nearly 160,000. Prior to 2024, SBW defoliation has only been visible during aerial

survey a single time since the early 1990s, when we observed around 850 acres in a different location in 2021. The 2024 mapped areas were unable to be flown in 2023 due to persistent poor weather conditions and wildfire smoke from Canada that kept us grounded during critical flight times. It is difficult to say what these areas might have looked like in 2023, though interestingly we received no reports of any damage in 2023 from anyone on the ground in these areas.

Following aerial survey flights, field staff headed to these areas to begin defoliation surveys on the ground. MFS typically evaluates the same 60 sites each year, spread across northern Maine. Defoliation levels at these sites were all below 10 percent in 2023 and below six percent in 2024. Additional sites were added in the core defoliation areas, resulting in a range of defoliation levels from as little as one percent to as high as 70 percent. In many areas, SBW larvae had consumed new growth only, but needles from previous growing seasons were consumed in others, indicating very high local populations.

The core damage areas are contiguous with a larger damage area across the border, which in turn is connected to the fringes of the massive regional outbreak that has been occurring in Quebec for decades. SBW populations in this area of Maine may be further bolstered by in-flights of moths from the Canadian side, now that affected areas lie due West of Maine and are aligned with typical wind patterns carrying moths eastward.

The bulk of the unfolding work in 2024 and early 2025 lies with the UMaine SBW lab. They are responsible for processing the larval samples that in turn will drive the decision making in 2025. Several landowners and managers are planning to respond with targeted aerial pesticide applications, in line with the EIS principles employed in Atlantic Canada to try and quell the outbreak before it becomes unmanageable over too large a geographic area. In addition to the 350 sample sites processed in a typical year, many landholders are submitting supplementary samples to determine their spray blocks, at least doubling the demand on the UMaine SBW lab. The results from each sample site are used to supply data for a model that interpolates the predicted SBW population between points. An example of the model output can be seen below. According to this preliminary data, the acreage that would be considered for treatment under an EIS approach (those areas shaded in yellow, orange and red) exceeds 230,000 acres.

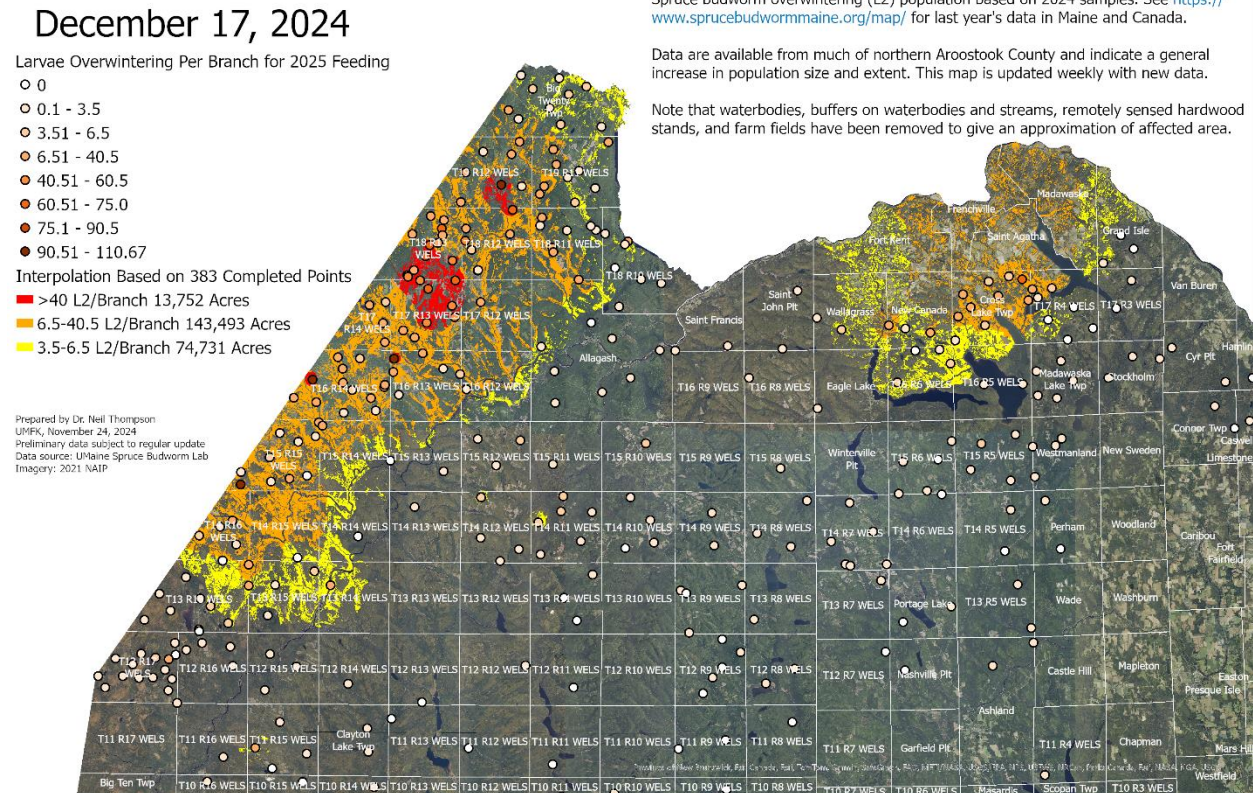


Figure: Map of the spruce budworm overwintering larvae population projection based on 2024 survey data as it becomes available and incorporated into the projection model. Courtesy of Dr. Neil Thompson, UMaine Fort Kent, Cooperative Forestry Research Unit.

Winter Moth (*Operophtera brumata*)

We received numerous reports in 2024 of severe winter moth defoliation from Phippsburg and Georgetown, as well as the surrounding areas of 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. Winter moth populations also appear to be building in places like Deer Isle and Yarmouth. The winter moth situation on 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. Because winter moth is almost inseparable from another species, Bruce spanworm (*Operophtera bruceata*), our collaborators at UMASS Amherst performed this analysis to confirm its identification.



Images: (left) Winter moth caterpillars and damaged oak leaf, East Boothbay Harbor, ME. (right) Winter moth defoliation damage viewed during 2024 aerial survey over West Bath, ME.

Continuing our long-term WM biological control campaign, we once again released the parasitic fly *Cyzenis albicans* in the most severely affected areas of Maine in 2024. The goal of this program is to bring winter moth into equilibrium with the rest of our native insect fauna to reduce the severity of outbreaks or possibly prevent outbreaks from happening at all. The site selected in 2024 was in West Bath and releases occurred on April 26. This year, 1,323 fly pupae were part of the release which were obtained from our caterpillar collection efforts at our release sites from previous seasons. Next year's *C. albicans* release in Phippsburg is slated for May 2025 and was chosen due to the severe defoliation also present on that peninsula. The emergence cage with 2,242 *C. albicans* pupae has already been placed in the ground to overwinter 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 within the affected area. On May 29, our staff and collaborators at UMass Amherst teamed up to collect 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, have not had previous releases of *C. albicans* and our intent was to determine if *C. albicans* is detectable in areas this far away from our historic release sites.

2024 also marks the second year of a winter moth flight period trapping study in collaboration with the Elkinton/Andersen lab at UMass Amherst. The goal of this study is to determine when winter moth flies in different parts of the northeast compared to the native congener, Bruce spanworm. The study also seeks to determine where winter moth populations from Atlantic Canada overlap genetically with winter moth in Maine, which are thought to represent two separate introductions separated by 70 years.



Image: Multiplier trap hung in Lubec, ME as part of the ongoing winter moth flight phenology study.

Aside from *C. albicans*, there is an ichneumonid wasp known as *Agrypon flaveolatum* that parasitizes winter moth in its native range in Europe. Because this wasp is a generalist and appeared to be unsuitable for biological control, it was never released in Maine, but it was released in Nova Scotia in the 1950s. In some unexpected news, ten *Agrypon* sp. specimens were identified in the 2023 caterpillar collections made in Maine across four sites. These include Fort McClary State Park (4) and Braveboat Harbor Road (1) in Kittery, South Bristol (3) and Two Lights State Park (2) in Cape Elizabeth. There are roughly 40 species in the genus *Agrypon*, so DNA work is currently underway to determine which species of *Agrypon* they belong to and whether these wasps are from the Nova Scotia releases or if they are a different species described in previous work done in Massachusetts.

DISEASES AND ABIOTIC CONDITIONS

Beech Leaf Disease (*Litylenchus crenatae mccannii*)

Since confirmation of beech leaf disease (BLD) in Lincolnville, ME (Waldo County) in 2021 BLD has spread rapidly and is now found in 15 of 16 Maine counties. This includes 202 towns, 105 of which were confirmed in 2024 (see ArcGIS BLD Dashboard and BLD Distribution map below). Survey for BLD was carried out in all of Maine's counties in 2024. BLD was visible during aerial surveys, although only 1,280 acres were mapped from the air. We know that the extent of significant BLD damage is much more extensive. BLD is likely found elsewhere in Maine and further survey efforts are planned for 2025.

BLD information and detections were communicated to the public regularly through various forms of media and in monthly Maine Forest Service Conditions Report bulletins throughout the spring, summer, and fall. We believe this has been helpful in raising awareness and generating the high number of reports received from the public (roughly 300 reports in 2024).

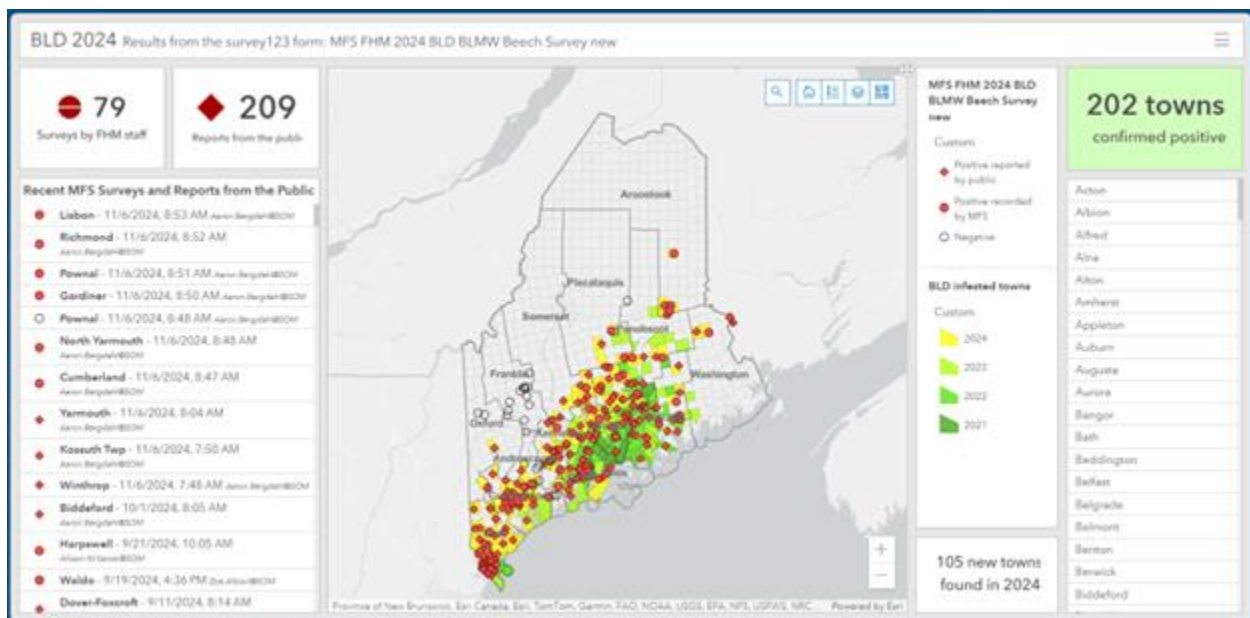


Figure: Screenshot of the Maine Forest Service Beech Leaf Disease Dashboard as of November 6, 2024. This is a tool developed by MFS to track BLD presence/absence data in Maine.

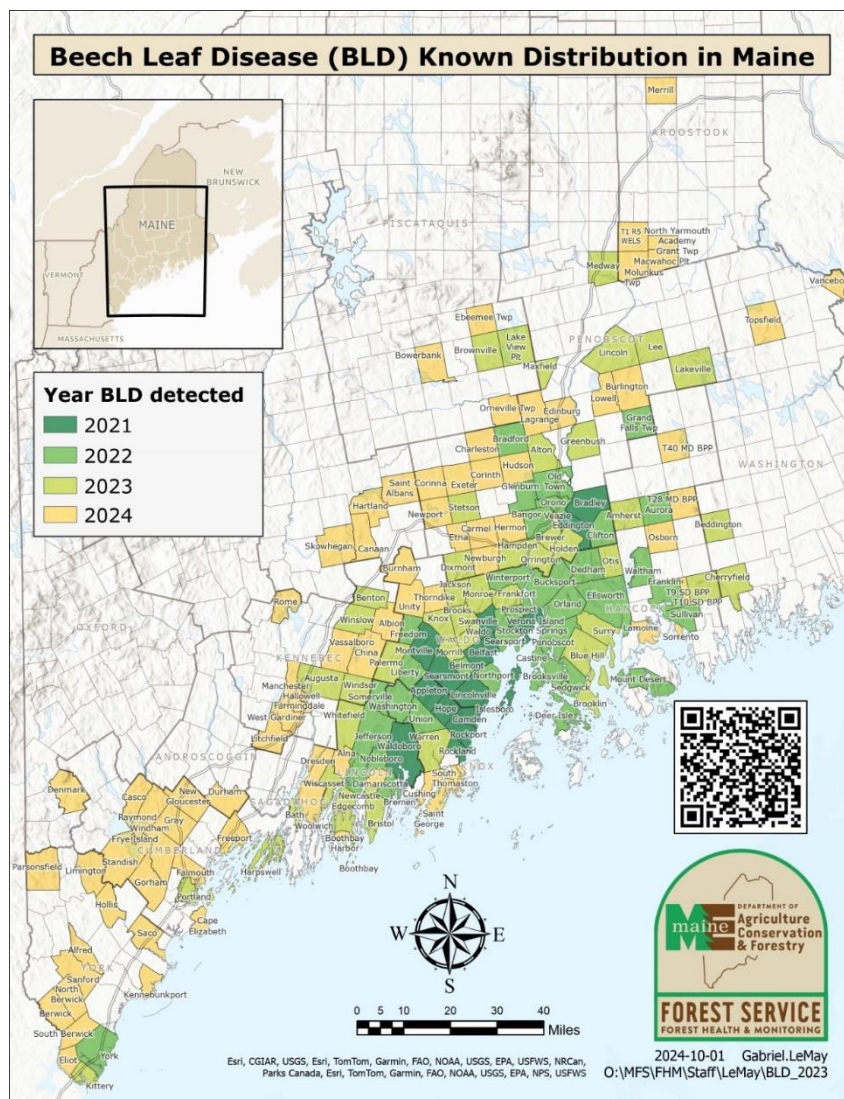
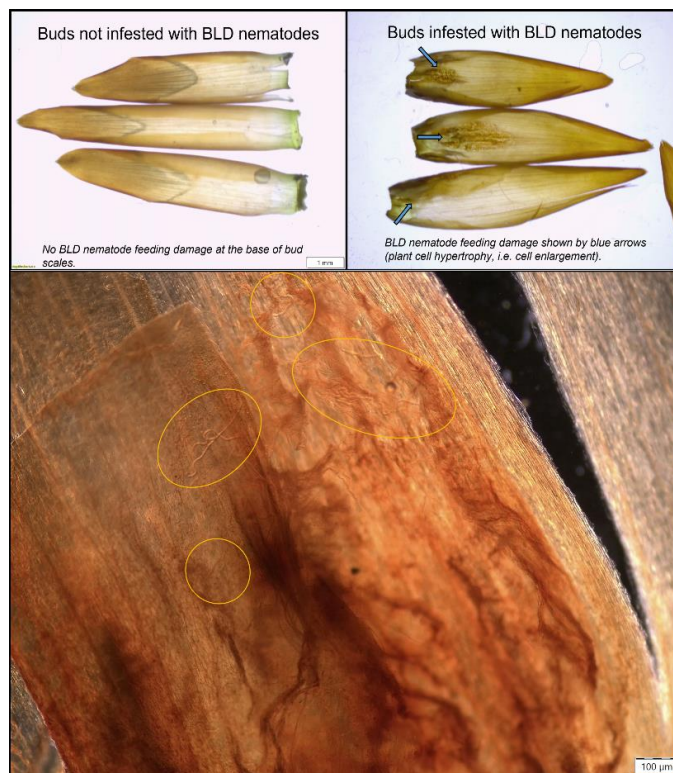


Figure: Current distribution map of confirmed reports of BLD in Maine as of November 2024.

MFS trialed a winter bud survey based on research by Wolf and Viera (2024) showing that *Litylenchus crenatae mccannii* (*Lcm*) overwintering in beech buds alters bud scale morphology in a highly characteristic and clearly identifiable way. Buds were collected at sites selected based on the following criteria: towns where BLD had not been confirmed, proximity to water bodies and ease of access. At least three buds were collected from a minimum of five trees and dissected under magnification in the lab. Presence or absence of the characteristic bud scale damage was noted. In some cases, plant-parasitic nematodes (presumably *Lcm*) were also seen in the buds. This information gave us a strong indication that *Lcm* was present in several new towns. Verification visits were made the following spring confirming BLD symptoms at all sites where collected buds showed the characteristic damage. However, we also conducted verification visits to sites where collected buds did not show the bud scale damage and found trace to light BLD symptoms. This indicated to us that the winter bud survey, while useful in predicting BLD

symptoms in areas where *Lcm* is well established, may not be predictive of symptoms in areas with lower nematode populations.



Images: (top left) Bud scales without characteristic damage from *Litylenchus crenatae mccannii*. (top right) Bud scales with characteristic damage from *Litylenchus crenatae mccannii* near the bud scale base. (below) Nematodes in the bud scale (yellow circles).

The nine established long-term BLD monitoring plots in Cumberland, Hancock, Kennebec, Knox, Oxford, Penobscot, Waldo (two plots), and York counties were measured for a fourth consecutive year (data has only been collected in the York County plot for three years). BLD symptoms still have not been detected in the Kennebec County, Oxford County and Cumberland County plots. However, buds were collected on the Cumberland County plot in 2023 as part of a non-structural carbohydrate study conducted by USFS researchers and Bartlett Tree Experts, locally facilitated by MFS forest pathology. Surprisingly, *Lcm* were confirmed in those collected buds prior to long-term monitoring work, so the causal agent of BLD is present, but asymptomatic, at the site.

In efforts to evaluate the effectiveness of currently available BLD management tools, the MFS forest pathologist, in cooperation with Viles Arboretum in Augusta Maine and MFS Community Forestry, established a polyphosphite [soil drench treatment](#) trial in an area of the arboretum where BLD was found at trace levels in 2023. Polyphosphite 30® is a fertilizer product consisting of a potassium polyphosphite inorganic salt solution. Exactly how this material elicits a defense response in beech trees (the mode of action) against *Lcm* is not currently understood. MFS applied a second year of treatments in 2024 with

applications of *Polyphosphite 30* in June and July. All treated and controlled trees were evaluated in accordance with the protocol of the BLD long-term monitoring plots. We will continue to work with partners to conduct this trial and monitor results in 2025.

In another 2024 management trial, MFS, in cooperation with Maine's Inland Fisheries and Wildlife (IFW), the Greater Augusta Utility District (GAUD), and the public, MFS was able to macro-inject Arbotect 20-S into 13 beech trees at seven sites. IFW offered two sites with clean beech (beech with demonstrated resistance to beech bark disease), GAUD offered one site with clean beech and the public offered sites with clean beech and beech with BLD symptoms, which will offer important comparison of the effectiveness of the application. While evaluating effectiveness is important to be able to verify this management tool for protection of high-value landscape trees, this is not a practical treatment on a landscape scale. Our greater aim is to preserve beech bark disease-resistant genes in Maine's beech resource. We are eager to see the results of the treatments after leaf-out in spring/early summer. According to out-of-state trials by Bartlett Tree Expert's Laboratories in past years, the treatment should yield excellent symptom reduction and protection from *Lcm* infestation that should last for two years.



Image: A beech tree showing high resistance to beech bark disease being injected with Arbotect 20-S.

As more is learned about BLD through the MFS pathologist's participation in monthly BLD National Research Group meetings and learning from other resources, we will continue to share information and engage the public through various forms of outreach. The public remains an important partner in identifying additional areas impacted by beech leaf disease and, in addition to reports submitted by partners, accounted for roughly 60 percent of all BLD reports since the disease was found in 2021. The remainder of reports have been made through survey by MFS staff. The [Maine Forest Service BLD website](#) has

been maintained and updated in 2024 with the most recent information about BLD at local and national levels.

Chaga/Tinder Conk (*Inonotus obliquus*)

Beginning in early 2024, the Maine Forest Service began a cooperative *Inonotus obliquus* inoculation project with the US Forest Service 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 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.



Images: (left) A chaga conk on a yellow birch; (right) A sawn white birch log with a chaga conk on it (orange arrow) showing the extent of staining and internal decay associated with the causal fungus.

White Pine Needle Damage

The white pine needle damage (WPND) complex consists of brown spot needle blight (*Mycosphaerella dearnessii* / *Lecanosticta acicola*), *Bifusella linearis* and Dooks needle blight (*Lophophacidium dooksii*). *Septorioides strobil* has also been found in Maine and has been associated with Eastern white pine damage in neighboring states and may therefore be considered part of the WPND disease complex.

White pine needle damage was extremely prevalent in 2024, perhaps due to a very wet June 2023 that created prime conditions for spore production, dispersal and infection by WPND fungi. The damage was so extensive in 2024 that mapping this forest health phenomenon was not possible during aerial survey because the impacts seemed to be seen on all white pine trees. Larger concentrated areas accounted for 21,037 acres documented during aerial survey, though still an underestimate of damage considering the number of small areas and single trees unable to be mapped. Reports of stands of severely yellowing white pine trees and needles blanketing roads, lawns and cars led to concerned questions from the public, foresters and other natural resource professionals about the possibility of large-scale pine mortality. However, this did not occur in 2024, although the future impacts of this extensive and severe WPND infection event are unclear.

Due to the disease impacts of WPND, Maine's pine trees were again left with far fewer functional needles than would be present on an uninfected, healthy tree. This causes crowns to appear thin and represents a stress that is now considered chronic throughout most white pine stands in Maine, as this disease has been consistently documented at varying severities for over a decade. The MFS continues to monitor for secondary pests that may take advantage of the stressed pine resource. To date, impacts of secondary pests in stands chronically impacted by WPND are infrequently encountered.

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