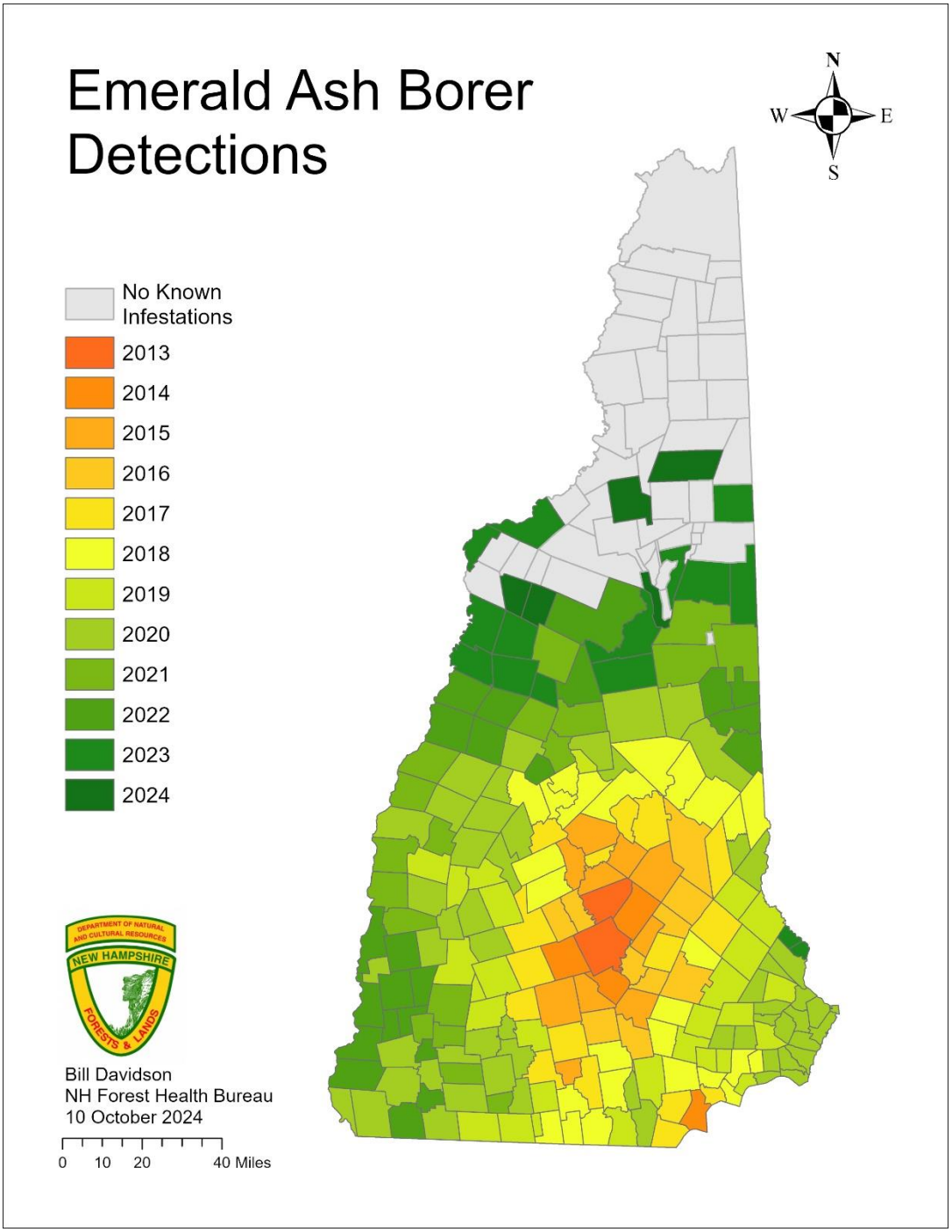
2024 New Hampshire Forest Health Update

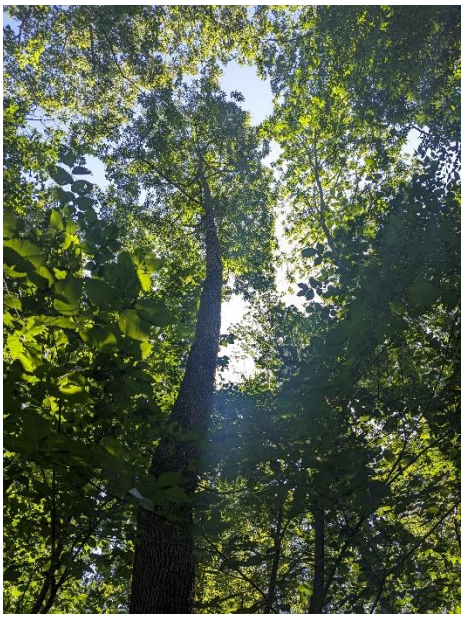
Emerald Ash Borer

Emerald ash borer was detected in 5 new towns in 2024 including Berlin and Jefferson, which represent the farthest north detections in New Hampshire. The gap between the farthest north detections and the large contiguous outbreak to the south is likely due to the White Mountains acting as a considerable impediment to survey efforts.

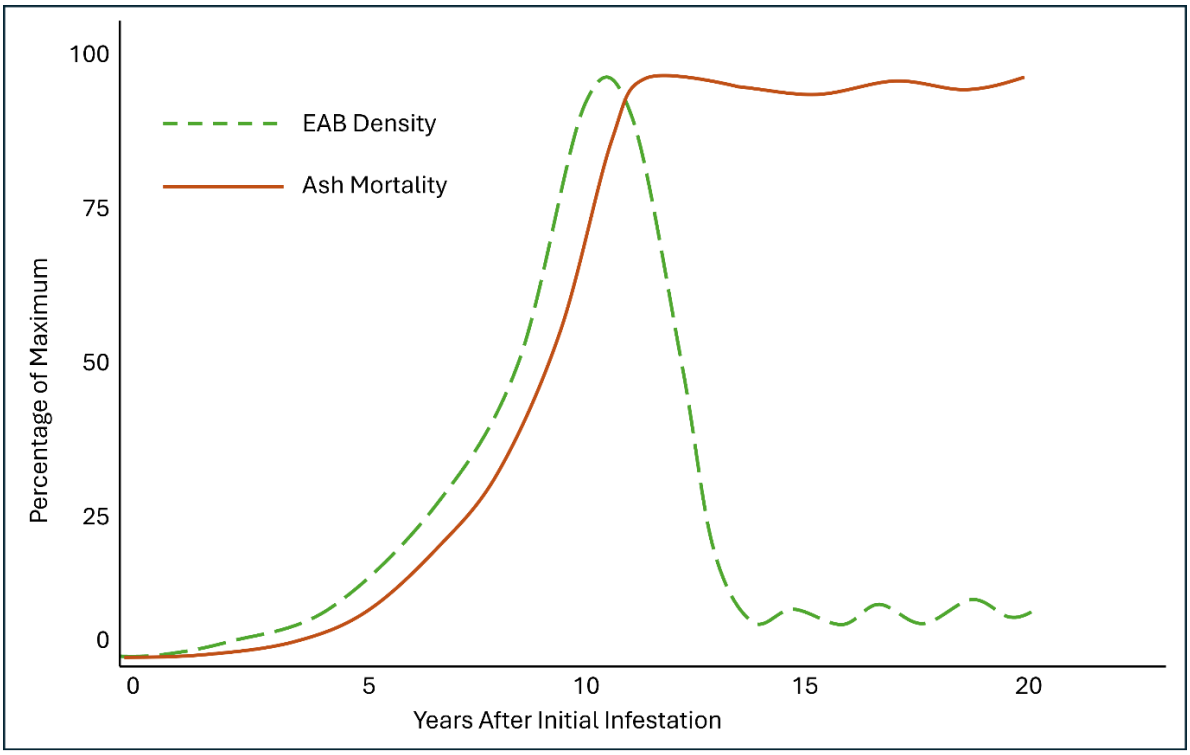


Concord and its neighboring towns represent the epicenter of ash borer infestation in New Hampshire. In the heart of the infestation nearly all mature ash have been killed off, resulting in a situation known as an "Aftermath Forest". Damage becomes less severe farther from the epicenter, where the infestation has had less time to progress.

Seedlings and saplings smaller than ~1" diameter are too small to be attacked and are therefore spared. These small trees make up nearly the entirety of the ash population in the Aftermath Forests. However, a very small percentage of ash on the landscape exhibit some degree of apparent tolerance to attack and survive longer than their more susceptible neighbors. This large green ash in Concord has remained healthy despite residing in the heart of the ash borer infestation for over a decade. Trees that persist long after surrounding ash have succumbed to the ash borer are known as "Lingering Ash". Researchers are working to identify Lingering Ash so that they can be propagated and bred with other lingering trees, hopefully producing offspring even more tolerant to EAB attack.



These areas have reached what is termed an "Aftermath Forest" where the precipitous decline of ash trees caused ash borer populations to plummet as they exhaust their food source. However, emerald ash borer does not disappear from the landscape entirely, but rather persists at low densities on the remaining seedlings and saplings as they grow to big enough to be attacked.

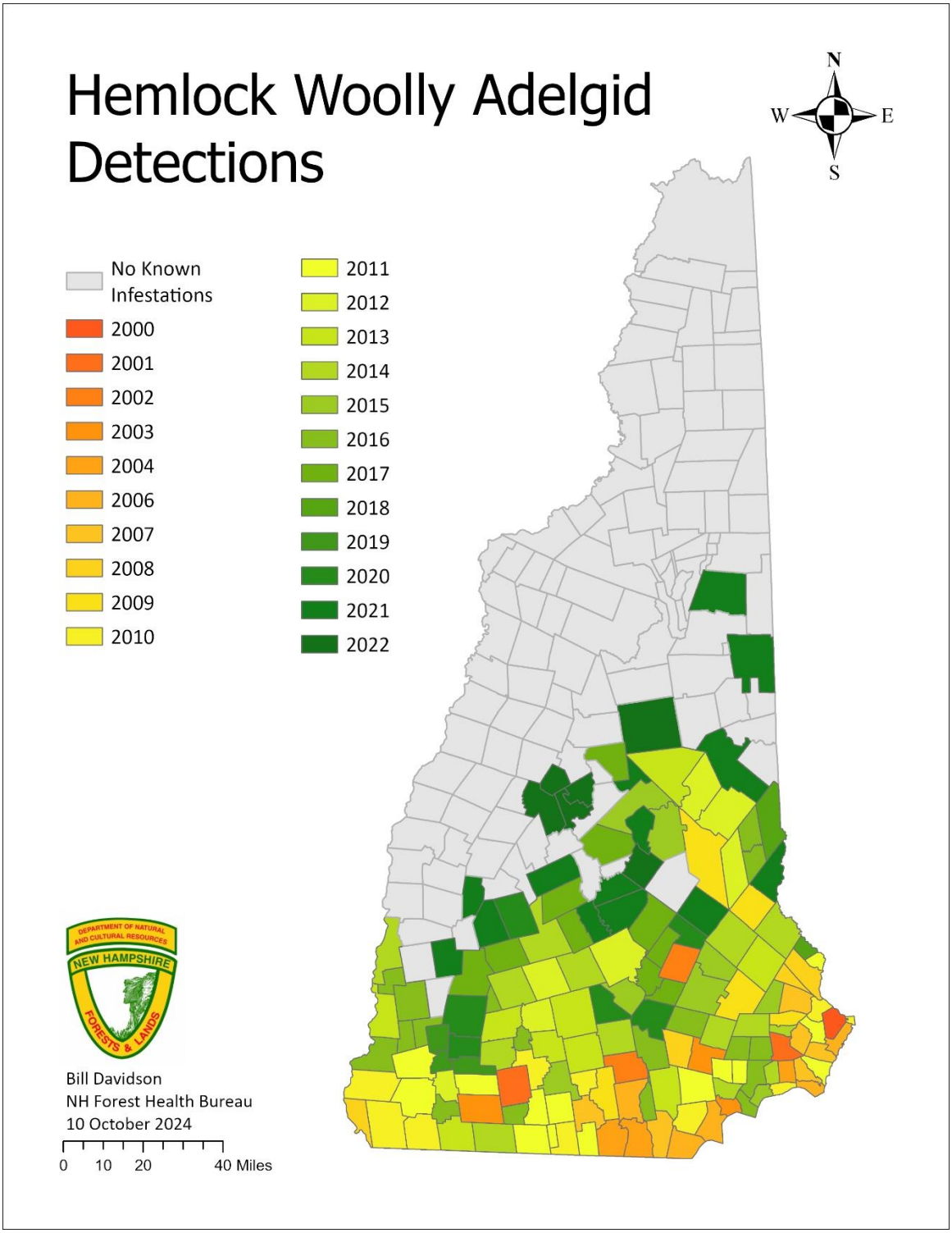


It is in this Aftermath Forest, with low densities of both ash trees and emerald ash borers, that the parasitic wasps released through the biological control program show the most promise. At lower ash borer densities, the wasps are capable of parasitizing high percentages of ash borer eggs and larvae, hopefully keeping the beetles below the threshold required to cause widespread ash mortality.

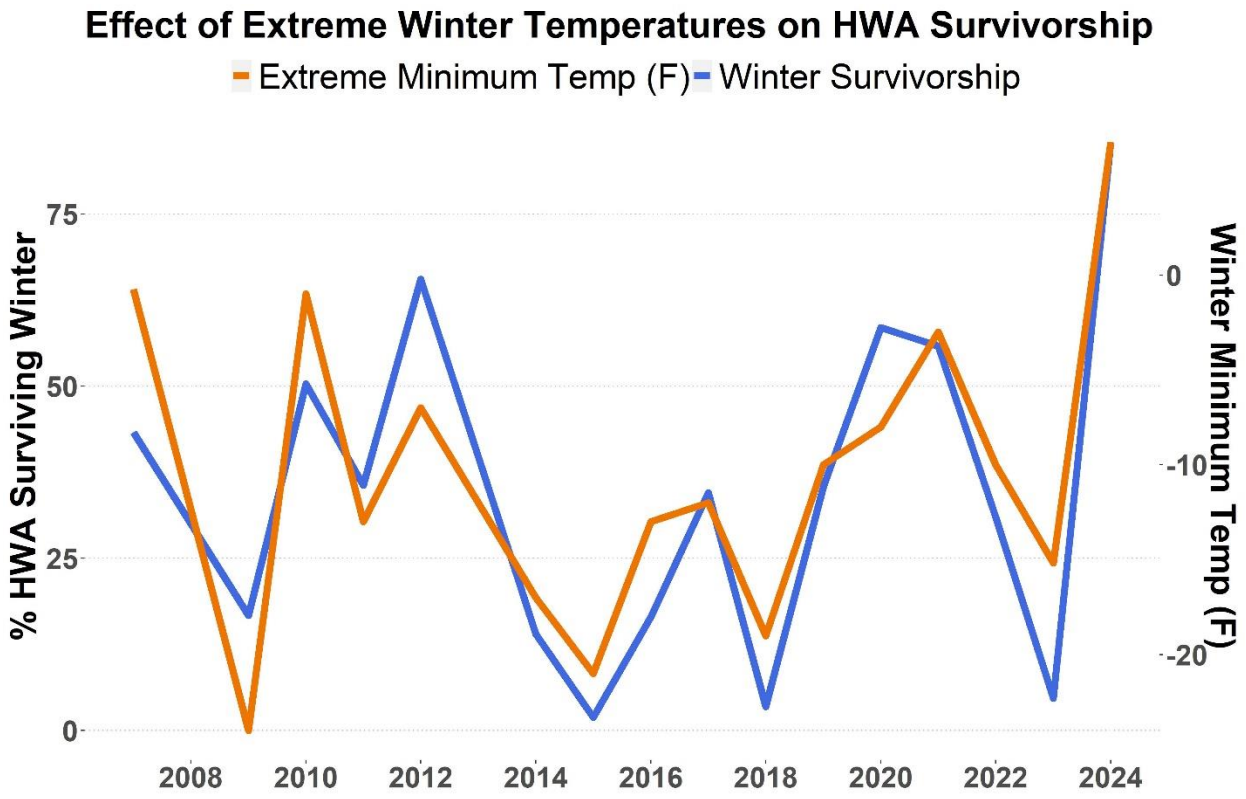
Evaluation of parasitoid establishment, spread, and rates of parasitism from within New Hampshire, and throughout the country, have yielded encouraging results that the wasps will help protect regenerating ash, allow the tree species to persist on the landscape for years to come. The NH Forest Health program continues to utilize small-scale insecticide treatments of forested trees to preserve local genetic diversity. To date, we have treated trees at over 80 locations distributed throughout all 10 of New Hampshire's counties. Nearly all treated trees have remained remarkably healthy despite high levels of ash mortality in their surrounding forests.

Hemlock Woolly Adelgid

For the second consecutive year, there were no new detections of hemlock woolly adelgid in New Hampshire.



In northern climates like New Hampshire's, winter cold has slowed the spread of hemlock woolly adelgid. Climate change has warmed our winters and facilitated northward spread into areas once too cold for them to survive.

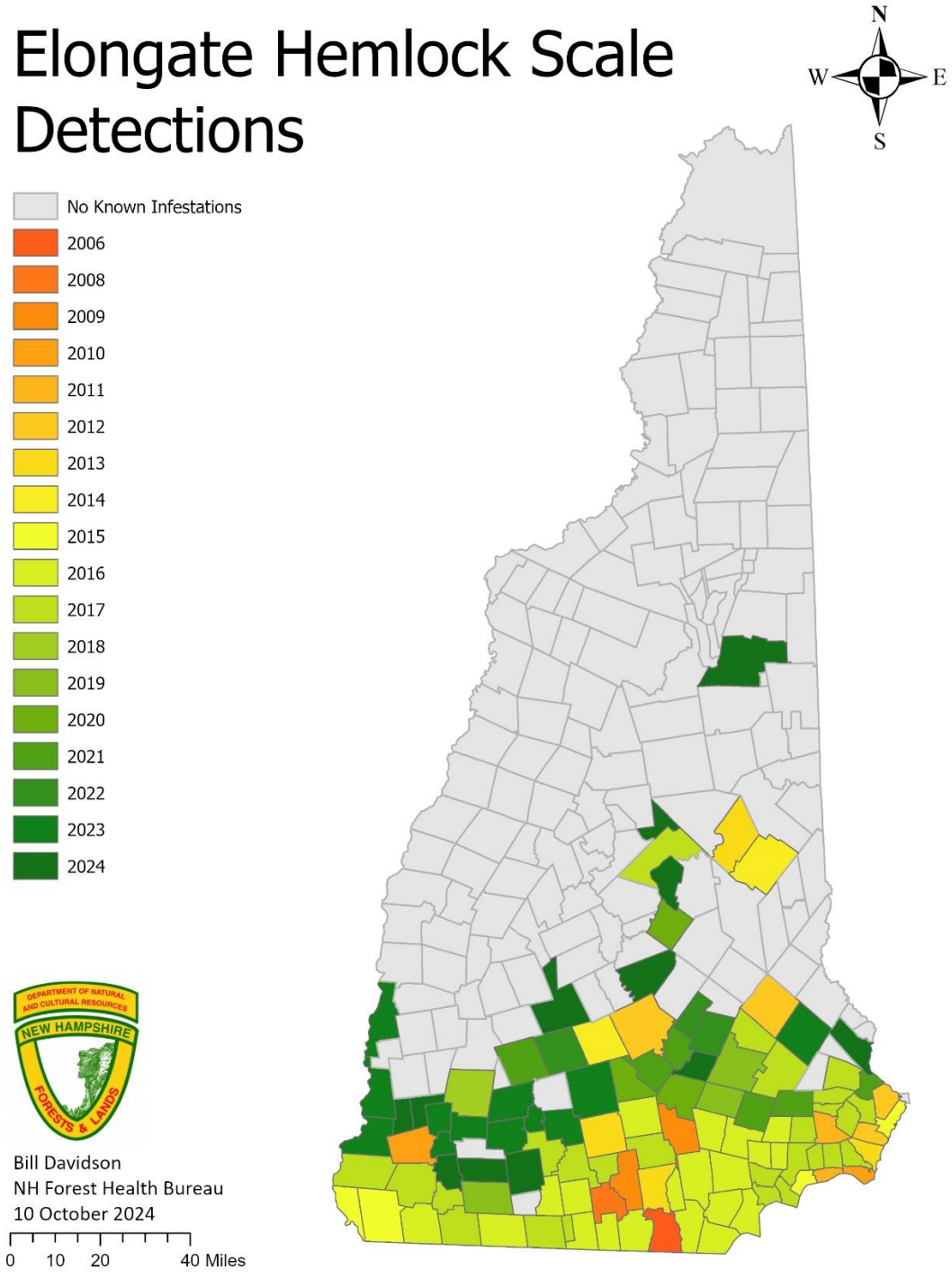


To control hemlock woolly adelgid, specialist predators have been released across New Hampshire in infested stands. Since 2008, the state has released about 16,000 *Laricobius nigrinus* beetles at sites throughout southern New Hampshire. This beetle has shown promise in more southerly states where it is well established and readily found feeding on adelgids. Within New Hampshire, establishment of *L. nigrinus* has been most successful in the seacoast region, likely due to the warmer climate in that region compared more inland locations. Two species of silver flies native to the Pacific Northwest have shown promise as a new biological control agent. Silver flies have two generations per year, unlike *L. nigrinus* which only has one, and are synchronized with the two adelgid generations. Research suggests that having a predator feeding on the summer generation and their eggs could be key in controlling populations. There is hope that the establishment silver flies in tandem with *L. nigrinus* could offer long-term protection of hemlock from the adelgid. In New Hampshire, silver flies have been released in 2023 and 2024, with a total of 5,000 released distributed between across locations.

Elongate Hemlock Scale

Elongate hemlock scale is another invasive pest on hemlock. These sap feeding insects look like small brown scabs on the underside of hemlock needles. Though less destructive than hemlock woolly adelgid, they weaken hemlocks and leave them vulnerable to succumbing to additional stress factors.

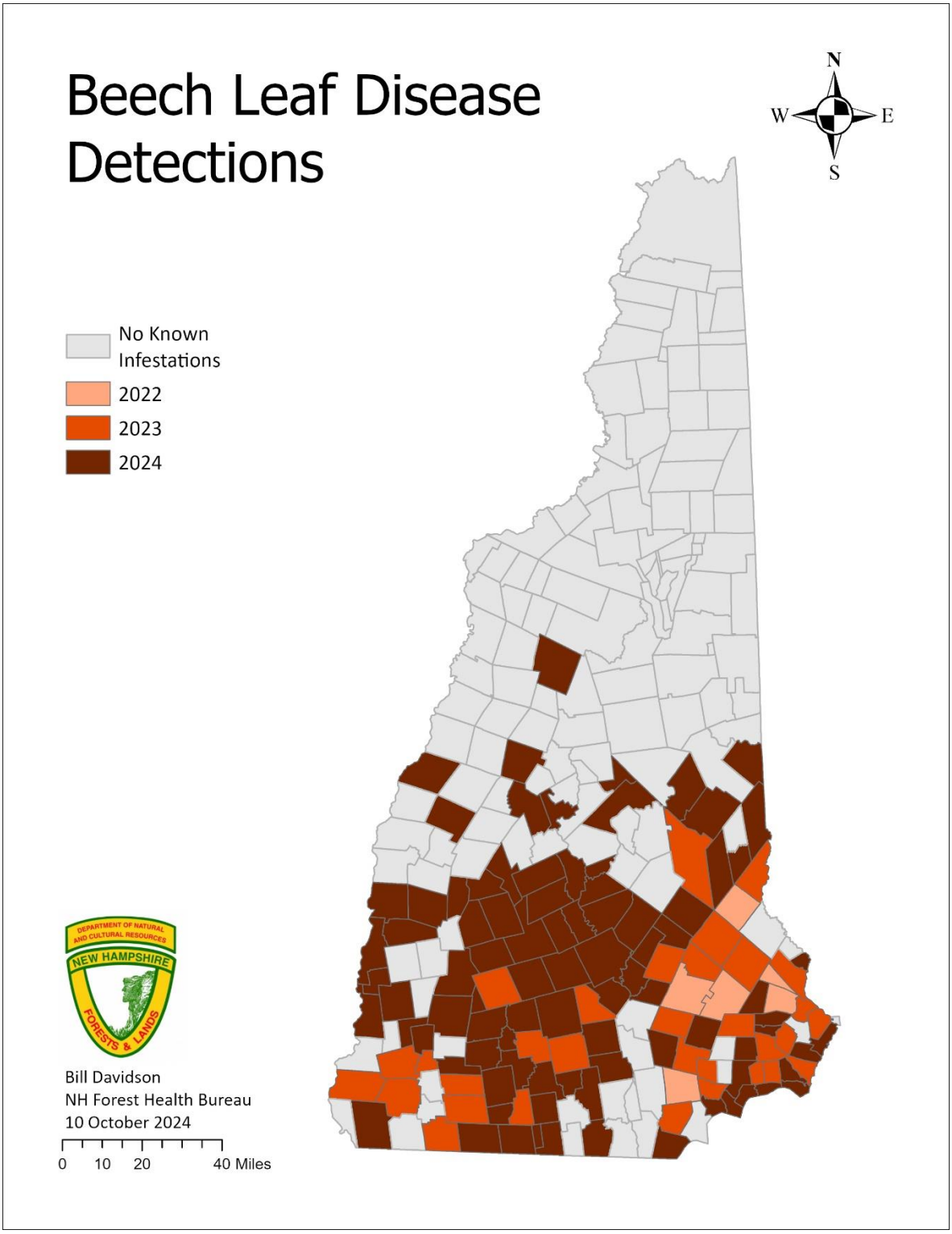
There is no longer an active biological control program for this pest as there are not effective predators or parasites available to control them. In New Hampshire, we have recovered a parasitic wasp, *Encarsia citrina*, from most locations where elongate hemlock scale can be found, but they do not occur with enough abundance to control the pest. In 2024, we have also recovered a small scale-feeding beetle, *Cybocephalus nipponicus*. This is an insect that has not been released in NH but has spread from other states. It unlikely that this beetle is offering any meaningful protection to hemlock from elongate hemlock scale.

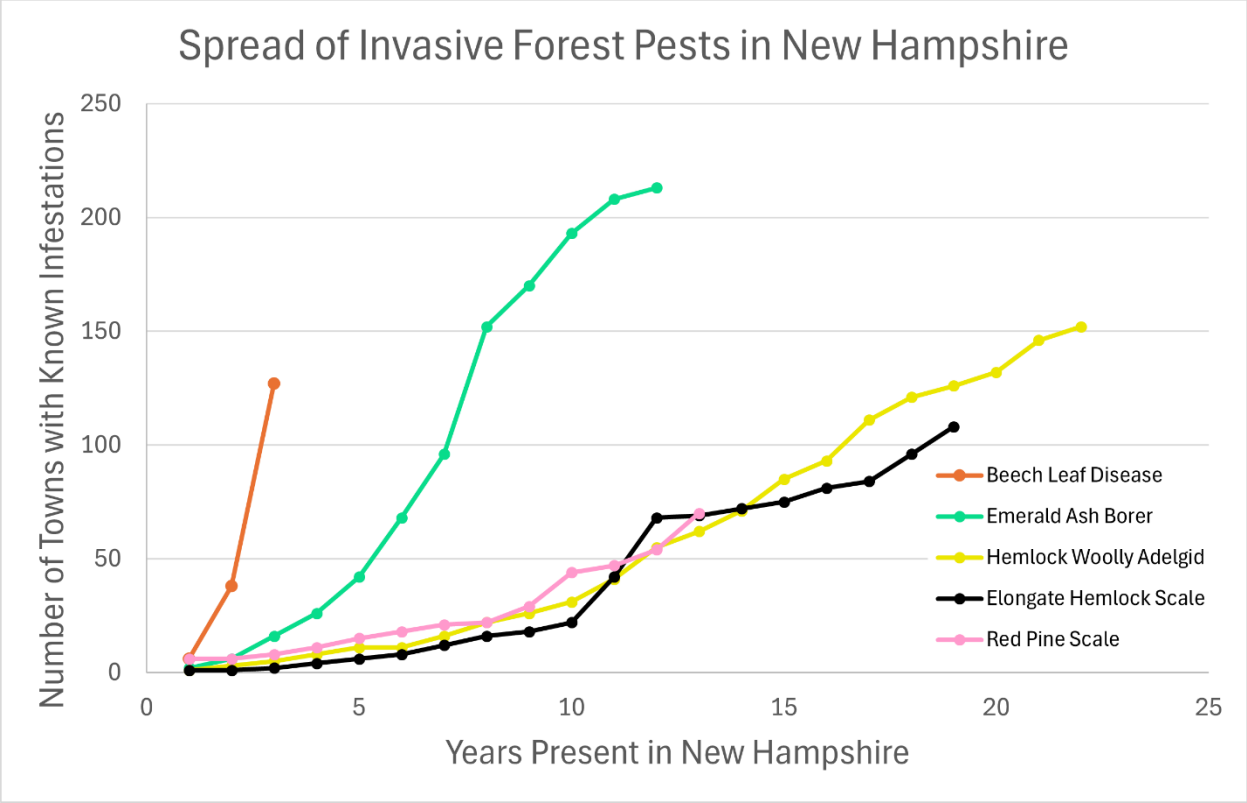


12 new towns were found to be infested with elongate hemlock scale in 2024. Most of this spread appeared to be short distance dispersal in the southern part of the state, to towns contiguous with the pre-existing infestation. However, a detection in Bartlett represents the farthest north this insect has been found in New Hampshire.

Beech Leaf Disease

Beech leaf disease was found in 89 towns this year, bringing the total to 127 tows just three years after its initial detection in New Hampshire. It is now present in nearly every town in southern New Hampshire and can be found as far north as Woodstock.





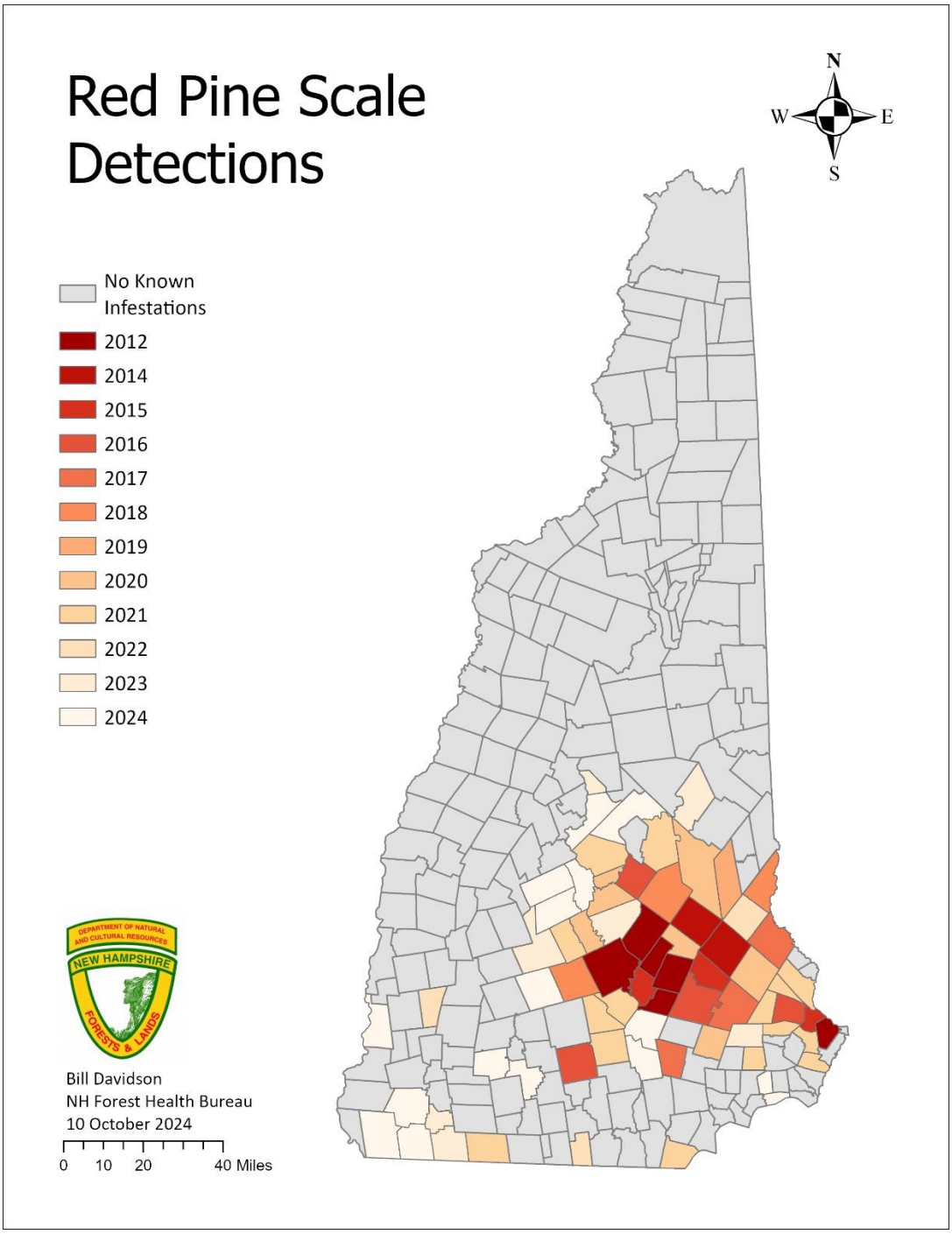
Beech Leaf Disease is spreading rapidly across landscape. Of the 5 invasive forest pests that we track on a town-by-town basis, it is far outpacing the rate of spread of the next fastest, emerald ash borer.

This disease is relatively new to science, with the first report occurring in Ohio in 2012. Being so new, much is still unknown about this disease and the nematode that causes it, including how it can spread at such an incredible rate. But being so small, it is thought that the nematodes can hitchhike on wildlife such as birds, mammals, and insects. It is also possible that they are being dispersed through water droplets during rainstorms and even via the wind. The previous two years, damage indicative of light infestation could be found in many forests throughout the state. This damage manifests as dark green bands between the secondary veins of the leaves. This banding turns brown in the fall as the tree begins going dormant for the summer. But now, we are starting to see affected areas expand within the forest. Some of the largest known infestations in the state encompass dozens of acres.

As the infestation progresses in severity, the damage to the leaves intensifies, eventually reaching a point where the leaves are no longer functional, drop off the tree, or fail to break bud in the spring. High levels of damage can lead to tree mortality. Unfortunately, we currently don't have any treatment options practicable at the forest scale. However, there are pesticides that can be used to treat individual landscape trees.

Red Pine Scale

Red pine scale has been present in the central and eastern regions of New Hampshire for several years, but 2024 saw several detections in the southwest. Infestations were discovered in 16 new towns this year. This stand of dying red pines in Swanzey was mapped during our annual aerial survey flights. Closer inspection revealed the scale insects responsible for the damage. Once infested, trees will die within a few years. Land managers operating in areas with red pine should prepare for the advancing infestation and have a plan for their trees prior to the arrival of the insect.



White Pine Needle Damage

In early June, white pines across the state turned yellow due to a pathogen complex known as white pine needle disease. The disease complex is caused by four fungi whose abundance and severity vary from year to year, however Canavirgella needle cast (*Canavirgella banfieldii*) and brown spot needle blight (*Mycosphaerella dearnessii*) tend to be the most common. In severe cases, nearly the entire crown was affected.

Individual needles of white pines typically live for 2-3 years before dropping. New needles grow from the tips of twigs in the spring and needles from previous years are set farther back on the twigs.

Needles are infected by fungi in the spring while they are elongating but do not become symptomatic until the following year. The widespread damage we observed this year is a result of infections that occurred last year. Copious amounts of rain that fell last summer facilitated widespread transmission of foliar pathogens, leading to the high incidence of needle disease observed this year.

By mid-summer, new needles have finished elongating and the infected one-year-old needles have dropped. The lack of older needles causes the trees to have thin crowns, but otherwise healthy trees should be able to withstand the temporary stress. While these needle diseases are present to some extent every year, as precipitation returns to more normal level, their prevalence is expected to decline.

***Caliciopsis pinea* Silvicultural Treatments**

During the winter of 2023/2024, two five acres blocks of low-density silviculture were performed at Bear Brook State Park to reduce the incidence and severity of pine canker, *Caliciopsis pinea*. The first 5 acres of dense saplings contained 1,800 stems per acre and had an average diameter of 6 inches. Pine canker was present on 90% of the stems. The treatment was to reduce the stocking to 150 trees per acre using a small excavator with a shear head. The results were excellent, and the cut stems were laid uniformly throughout the residual stand. After the first growing season there has already been an effect on caliciopsis severity in the treated stands. The number of trees rated "heavy" is down 13% and the number of trees with no current caliciopsis cankers went from 0 to 20%. The second 5 acre stand was stocked with 2,400 stems per acre and the average diameter was just 4 inches. The treatment was to reduce the stocking to 150 trees per acre but do the cutting with a mulching head on the mini excavator rather than the shear head. Results were great. No damage to the residual trees and the cut trees were either mulched or laying evenly throughout the stand. Caliciopsis severity stayed the same on 68% of the trees, dropped on 20% of the stems and was rated higher in severity on 12%.

Elm Zigzag Sawfly

Elm zigzag sawfly (*Aproceros leucopoda*) is a relatively new invasive species in North America that was first detected in Quebec, Canada in 2020. The caterpillar-like larvae feed on the leaves of elms, leaving behind characteristic zigzag patterns. The adults can travel over 50 miles in a single year.

This strong flying ability has facilitated rapid spread. While native to eastern Asia, it can now be found throughout the eastern United States and can now be found as far south as North Carolina. We discovered this species in New Hampshire this summer in several towns along the Connecticut River, from Colebrook to Keene, and as far east as Alton. In addition to the distinctive feeding galleries, the larvae can be identified by looking for black “T” shaped markings on the legs. Though sporadic complete defoliation of elms has been observed in other states, there have been no reports of tree mortality due to this insect. Most trees are resilient and can withstand sporadic defoliation events.

Browntail Moth

After many years of browntail moth population expansion in Maine there were finally several sightings of browntail moth caterpillars in NH. The first was a small outbreak discovered on Star Island, in the Isles of Shoals, off the coast of Portsmouth in April. This outbreak was addressed with the mechanical removal of nests in May. By the time of the removal operation, many of the caterpillars had already left their winter-webs, necessitating a return trip to deal with any stragglers. A joint operation with the NH Division of Plant Industry, the Fish and Game Department, and the Division of Forests and Lands collected and solarized several hundred browntail moth nests. The other confirmed browntail moths in NH were a trap catch in Ossipee and an iNaturalist picture submitted from Cow Island in Tuftonboro. A return trip was made to Star Island in October to remove winter-webs spun by the caterpillars that were left behind in May. We were able to remove all visible nests, however, due to the dense vegetation covering much of the island, we were not able to ensure the removal of every single nest. Residents and employees on the island agreed to perform yearly follow-up surveys and nest removals in an attempt to eradicate the population on the island.

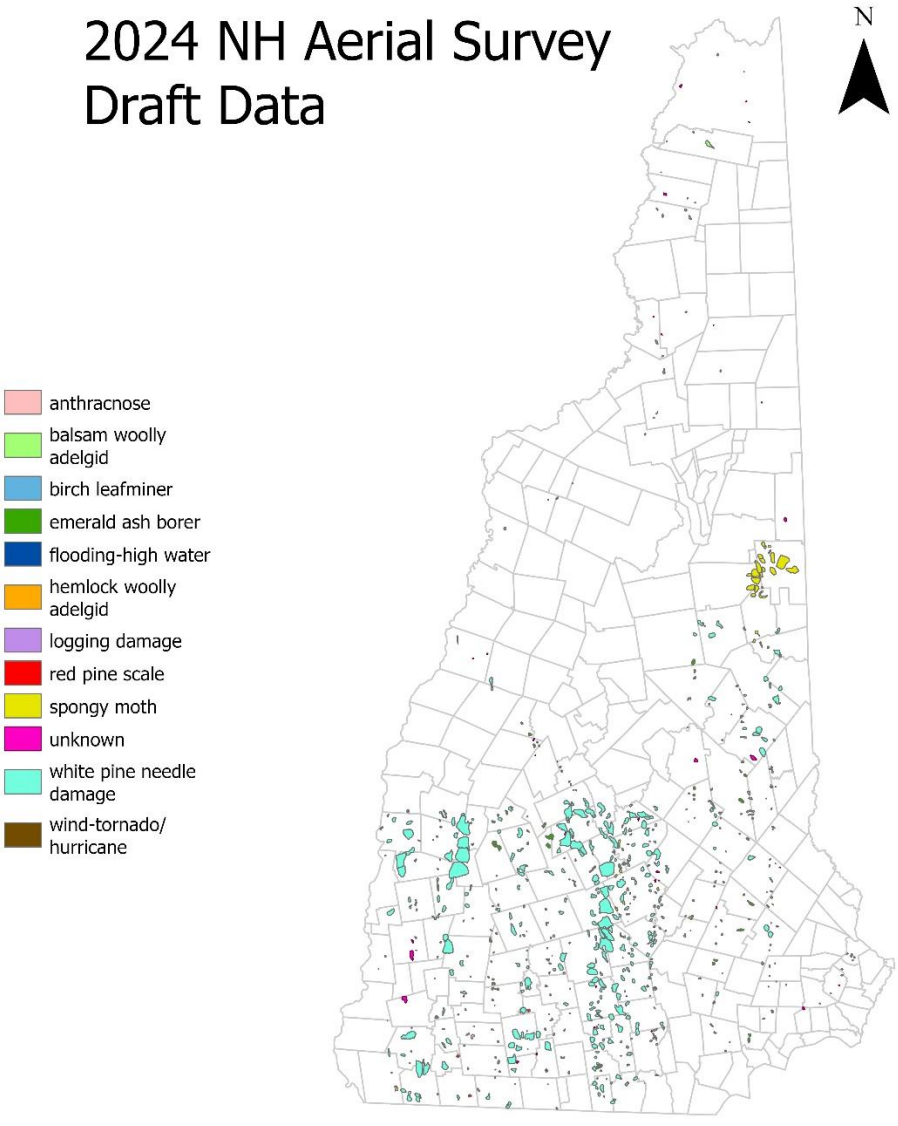
Butternut Restoration

Collections of nuts from known hybrid butternuts continued. These nuts have been planted at the State Forest Nursery and will be ready for out planting in May of 2026. The nuts collected in 2023 germinated well and will be ready for planting in May 2025. There is a wide variation in butternut nut characteristics depending on whether it is native butternut or some offspring of hybrid butternuts. These nuts were all collected from trees in New Hampshire in September 2024. The native butternut (N) tends to be larger with a suture that is difficult to identify. The hybrids (H) seem to be much more variable in size with a distinct point and a very recognizable suture. The heartnut (Heart), *Juglans ailantifolia,* is the tree originally responsible for pollinating native butternut creating a "buartnut".

These Buartnuts planted in NH long ago pollinated native butternuts creating what we have today called "hybrid butternuts" If you want to identifying hybrid butternuts and native butternut trees using twig samples the best key is the leaf scar. There is a cleft with hairy mustache along the top of the hybrid leaf scar while the native tree is hairy but straight across. The cleft is a trait gained from the Japanese walnut and the mustache is a trait gained from native butternut.

Aerial Survey

2024 was a busy aerial survey year. The most prevalent damage types were discolored white pines from the white pine needle diseases (114,000 acres), oak mortality from previous spongy moth outbreaks (13,000 acres), ash mortality from emerald ash borer (8,000 acres), and red pine mortality from red pine scale (1,800 acres). This picture, taken during an aerial survey flight along the Merrimack River in Canterbury, demonstrates the four most common types of damage observed in 2024. There was other damage that was severe but not as expansive, such as this tornado that touched down in Lyme over the summer. Other localized damage included water stress. This oak sapling, growing in a flood plain, was killed last summer as heavy rain raised water levels above the banks of the adjacent river.



Traps

Each year we deploy insect traps to monitor the spread and introduction of invasive insect species in New Hampshire. Typically trap catch must be hand sorted, and insect specimens identified to species using dichotomous keys, a process which is very time consuming and typically requires expertise in a variety of insect taxa. Environmental DNA or “eDNA” is a new method being used to determine what species of insect may have been found within a trap catch by DNA detection. A list of species is generated based on DNA detections within the trap catch. That list is queried for any non-native species and, if found, stored insect samples can then be sorted to confirm their presence in the trap catch. The technique is a work in progress and does have its shortcomings. Databases of known, identified insect species and their corresponding DNA sequences are required to obtain an ID from a sequence of DNA found within a trap, and these databases are not complete. This year, in participation with our partners at the USDA Forest Service, we paired these insect traps with spore traps to monitor for fungal pathogens of trees. The addition of these spore traps will increase our ability to monitor and detect tree pathogens and is a simple addition to our insect trapping programs (Spore trap Figure). Monitoring where invasive insects and tree diseases are in New Hampshire is the first step in their management.

UAV Projects

Recently, the New Hampshire Forest Health Program, in cooperation with the Urban and Community Forestry Bureau, has explored the utility of implementing unmanned aerial vehicles (UAVs) for forest health purposes.

The first project we embarked on was to map oak mortality on two properties in Conway, NH resulting from severe spongy moth outbreaks that coincided with prolonged droughts that occurred in 2021 and 2022.

For this project, we flew transects over a roughly 900-acre area of forest, collecting 1000s of photos. These photos were stitched together to create a single composite orthophoto. We ran an analysis of the orthophoto which categorized trees as either: healthy, declining, or dead.

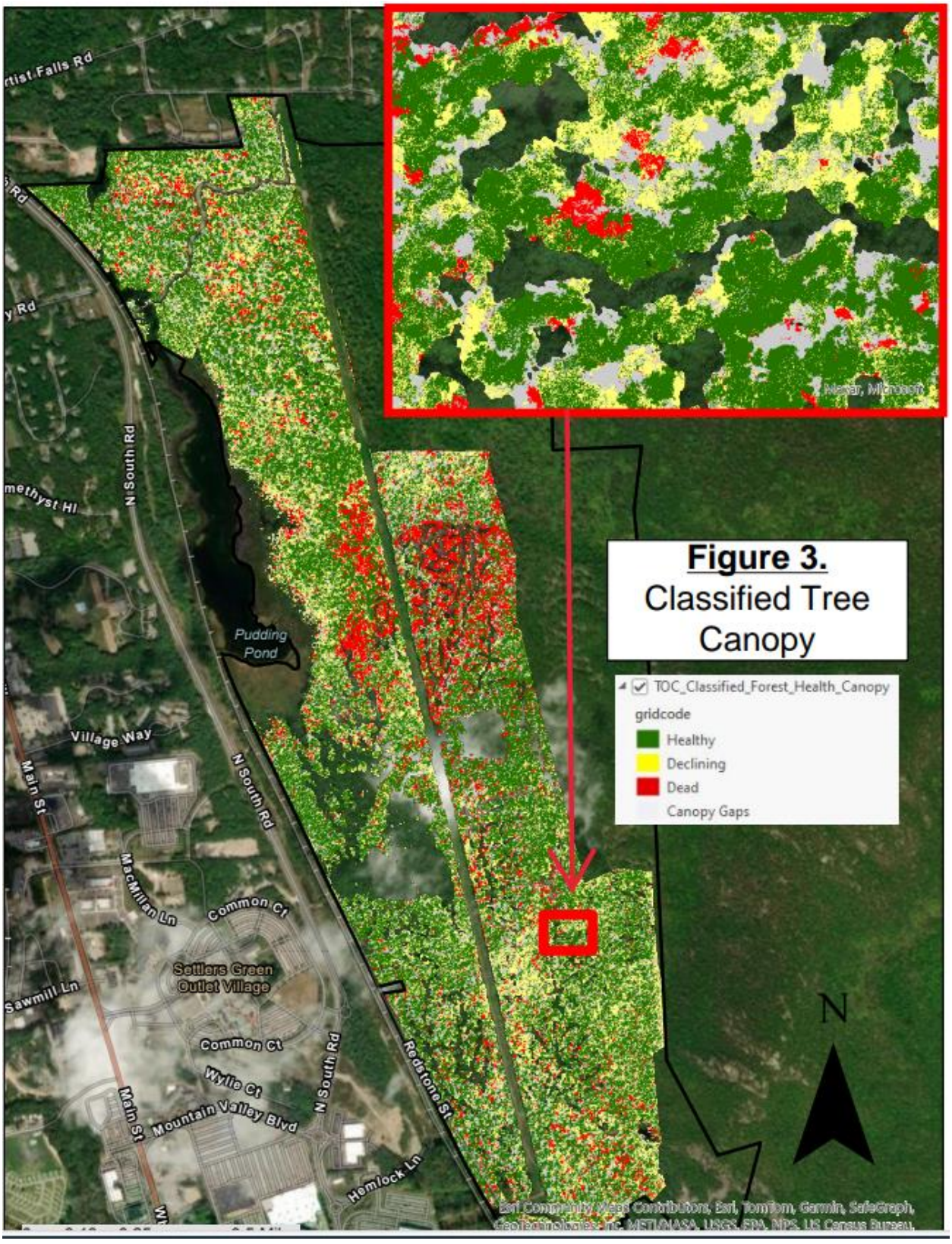


Figure 3.
Classified Tree Canopy
TOC_Classified_Forest_Health_Canopy
gridcode
Healthy
Declining
Dead
Canopy Gaps
N
N South Rd
Pudding Pond
Village Way
Main St
MacMillan Ln
Common Ct
Settlers Green Outlet Village
Sawmill Ln
Wylie Ct
Mountain Valley Blvd
Redstone St
Hemlock Ln
Esri Community Maps Contributors, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau

This analysis shows us how much of the forest is dead or declining, and where the damage is the most severe. Results can be used by foresters on the ground to optimize salvage efforts. Other projects in the works are using the UAV collected imagery to assess the health of insecticide treated ash trees compared to nearby untreated trees, as well as monitor ash regeneration in forests after emerald ash borer has moved through. We are also evaluating white pine crowns thinning because of white pine needle diseases.