DEPARTMENT OF AGRICULTURE

Status of Invasive Forest and Landscape Pests in Minnesota

Plant Protection Division

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Contents

Emerald Ash Borer

Emerald ash borer (EAB) *(Agrilus planipennis)* was discovered in five new counties (Cottonwood, Blue Earth, Freeborn, Nicollet, and Redwood) in Minnesota in 2021. Overall, the rate of spread in Minnesota continues to be much slower than the national average (Figure 1).

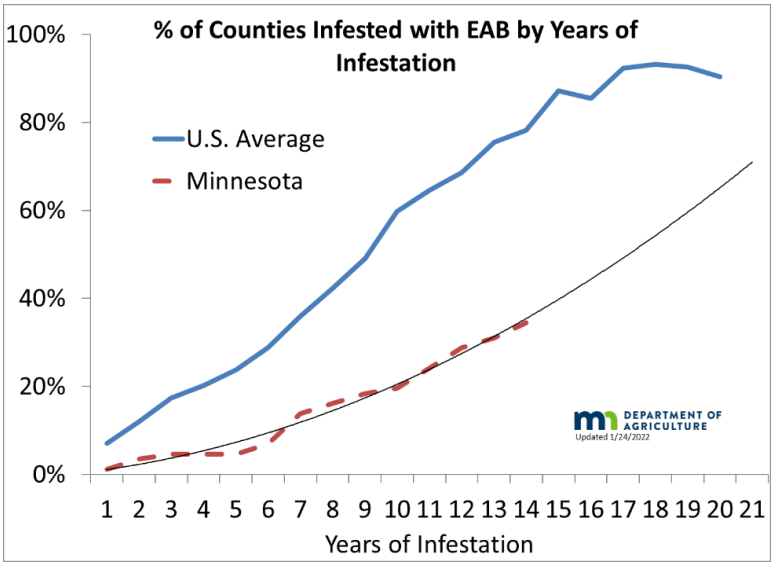

Figure 1. Rate of EAB spread to new counties in Minnesota vs the U.S.

Survey

In follow-up on citizen reports to the Minnesota Department of Agriculture (MDA) Report a Pest hotline, EAB infestations were discovered in a number of new locations within regulated areas as well as five new county level detections (Figure 2). New county detections all received a delimit visual survey by MDA staff to understand the extent and severity of the infestations. All known EAB-infested areas can be viewed online: www.mda.state.mn.us/eabstatus

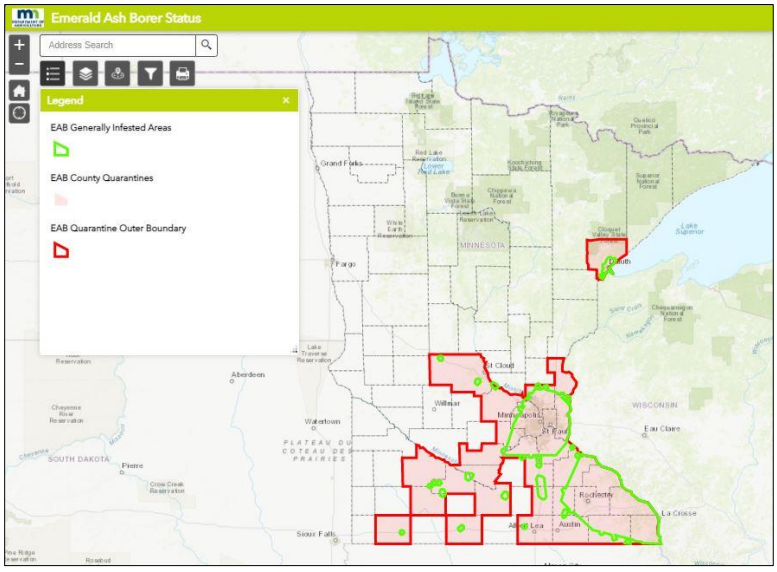

Figure 2. EAB-infested counties in Minnesota as of January 24, 2022.

Outreach

With support from the United States Forest Service (USFS), 13 EAB field workshops and two management webinars were held during 2021. The EAB field workshops were held in the cities of Faribault, Rockville, Lino Lake and Worthington, with over 150 people in attendance. Over 120 individuals from local governments, tree care services, and the public attended two separate webinars hosted by the MDA. One event focused on research updates from the University of Minnesota and the second on protecting community forests by managing ash for EAB grants. The webinars were recorded and made available for viewing afterwards. Additional delimit surveys, EAB biology, detection, and management workshops were conducted with 15 other units of local government to train staff. Over 670 people attended EAB-related outreach events in 2021. Additional field workshops and webinars are planned for March and April 2022. To register for the free hour-long workshops, webinars, or to view of previously recorded webinars, please visit www.mda.state.mn.us/eab

Two EAB informational meetings were held virtually in September and December for the public and local resource managers in February, April, August, and December in Cottonwood, Blue Earth, Freeborn, Nicollet, and Redwood counties to address the new county level finds. Several EAB informational webinars are planned for spring 2022.

Through a grant from the United States Department of Agriculture (USDA) Plant Protection Act 7721 (formerly known as the USDA Farm Bill), the MDA also conducted an advertising campaign in 2021 to highlight the risk of moving invasive species via firewood (Figure 3). Advertising occurred during the summer and fall through a variety of media, including online, billboards, streaming television, radio, and print.

Figure 3. A print advertisement used in the 2021 advertising campaign.

Biological Control

With support from the USDA EAB Parasitoid Rearing Facility, the MDA released 8,039 parasitic wasps at four sites in the Twin Cities area, southeast Minnesota, and Rockville. Since this project began in 2010, over 635,000 wasps have been released at 48 EAB-infested sites in Minnesota. Two species, *Oobius agrili* and *Tetrastichus planipennisi*, have been in use since 2010, and an additional species, *Spathius galinae*, was made available in 2016. Release numbers were down in 2021 compared to previous years due to production at the USDA Rearing Facility being impacted by COVID-19. The facility will focus on increasing production in 2022 and hopefully be on track to supply parasitoids to more cooperators and sites in 2023.

Figure 4. Cup of adult parasitoid wasps for release at EAB biological control sites.

Sampling for parasitoids resulted in the recovery of *T. planipennisi* and *O. agrili* from Bear Cave Park in Stewartville south of Rochester. *T. planipennisi* and *S. galinae* were also recovered from Central Park in Duluth. This was the first recovery of parasitoids in Duluth and the first time S. galinae has been recovered in Minnesota since approved for release in 2016.

The three-year project titled "EAB Biocontrol Phase 3 – Assessment & Citizen Engagement", funded by Environment and Natural Resources Trust Fund (ENTRF), was completed after a year delay due to COVID-19. Implementation and parasitoid recovery/monitoring showed increasing recoveries of *T. planipennisi* and *O. agrili* over time at sites in the Twin Cities and southeast Minnesota. Cold hardiness of *Spathius galinae* was evaluated with a published study forecasting its survival in North America (Wittman, Aukema, Duan, and Venette (2021) Forecasting overwintering mortality of *S. galinae* in North America. Biological Control. 160: 104694). The insect will survive best in areas where winter temperatures remain above -20 Fahrenheit. Two journal articles were also published detailing a checklist of buprestids found in Minnesota (Hallinen, Steffens, Schultz, Aukema (2021) The Buprestidae (Coleoptera) of Minnesota, with a discussion of the emerald ash borer, *Agrilus planipennis* Fairmaire. *The Coleopterists Bulletin* 75: 173-190). A free and accessible guide (The Buprestidae of Minnesota) can be downloaded from https://hdl.handle.net/11299/218928. More detailed project information and summary can be found at www.mda.state.mn.us/plants/pestmanagement/eab/eabbiocontrol/eab-biocontrol-lccmr

The USDA is working with states where parasitoids have established to study the population dynamics of parasitoids and EAB once EAB population density starts to decline after the initial outbreak phase. Study sites are in Iowa, Missouri, and Minnesota (Fort Snelling State Park and Whitewater Wildlife Management Area). EAB traps, tree felling, bark sifting, yellow pan traps, and sentinel logs will be used to determine the population density of EAB and to determine the percent of parasitism. Summer sampling began this year and will continue for four more years. Yellow pan trapping collected adult *T. planipennisi* and *O. agrili* from each site. These two sites also had *S. galinae* released as initial releases at these locations began before the widespread release of this parasitoid.

Sentinel logs were deployed at both persistence study sites. Twenty logs were deployed at each site; five in June, 10 in July, and five in August. The sentinel logs were made by infesting cut logs with EAB eggs, so not every log deployed ended up with viable EAB larvae. Seventeen of the logs deployed at Fort Snelling had larvae and 19 of the logs deployed at Whitewater had larvae. The deployed logs had an average of four larvae per log with a range of 1-8 larvae.

- Larvae in 41% of the logs deployed at Fort Snelling were parasitized by *T. planipennisi*. Parasitism rates of parasitized logs ranged from 25% to 100%. Out of a total of 69 larvae in the deployed sentinel logs, 20% (14 larvae) had been attacked by *T. planipennisi*.
- Larvae in 63% of log deployed at Whitewater Wildlife Management Area (WMA) were parasitized by *T. planipennisi*. Parasitism rates of parasitized logs ranged from 14% to 100%. Out of a total of 76 larvae in the deployed sentinel logs, 50% (38 larvae) had been attacked by *T. planipennisi*.

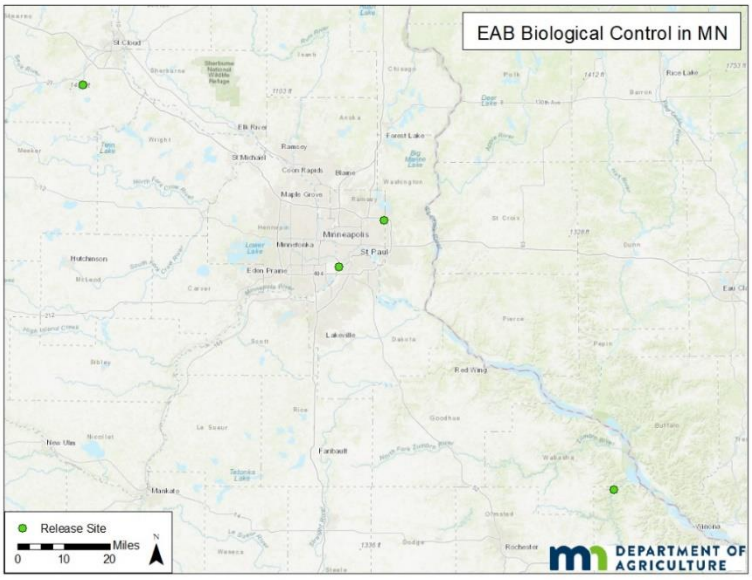

Figure 5. Map of EAB biocontrol sites that received wasp releases in 2021.

Regulatory

During 2021, Cottonwood, Blue Earth, Freeborn, Nicollet, and Redwood counties were formally quarantined. Once an emergency quarantine is put in place, public meetings are held and a 45-day opportunity for comment follows before the quarantine is formalized. Due to in-person meeting restrictions caused by the pandemic, virtual public meetings were held instead. The most current state quarantine information can be found at www.mda.state.mn.us/pestregs

The MDA now has nine USDA or MDA certified firewood producers in the state (Figure 6). A list of certified firewood producers can be found at www.mda.state.mn.us/plants-insects/firewood-producers

Figure 6. Example of the MDA certified firewood logo.

Spongy Moth (Formerly Known as Gypsy Moth)

The MDA's Spongy Moth Program consists of three parts: a state-wide trapping survey, treatments for population management, and quarantine enforcement. For more information visit www.mda.state.mn.us/spongymoth

Survey

In 2021, 21,303 pheromone baited spongy moth *(Lymantria dispar)* detection traps were set in Minnesota by the MDA and other cooperators. A north central area was added to include municipalities and high-risk sites. The results map shows the locations of the 21,303 traps set with the MDA's project area, positive trap locations, and the total number of moths trapped per county (Figure 7).

The survey season ran May through October, and the final statewide gypsy moth count was 12,104 moths in 1,682 positive traps. This is almost three times as many moths as were trapped in 2020. More detailed viewing of survey results can be found at www.mda.state.mn.us/gmresults2021

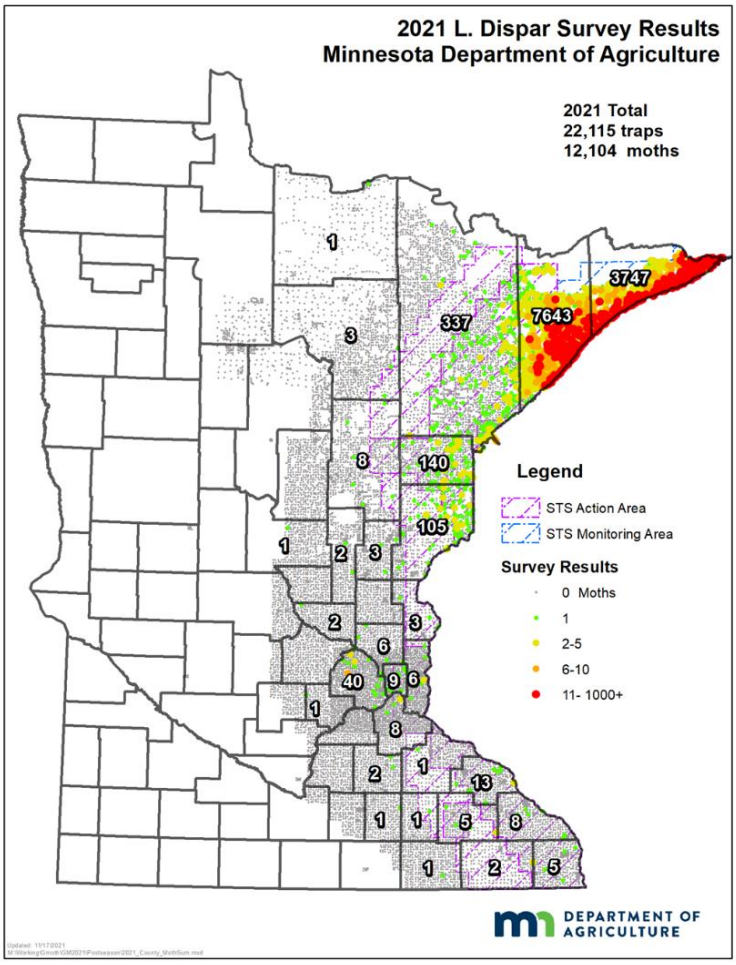

Figure 7. Locations of spongy moth traps and male moth catches in 2021.

2022 Survey Plans

The MDA trapping survey will continue to focus on the eastern half of Minnesota, with special attention paid to both the Slow The Spread (STS) area and high-risk sites, such as nursery, mills, parks, and urban communities. The goal is to maintain 20,000 early detection survey traps across the state in 2022 with a buffer zone of the trapping survey area extending west into the eradication area of the state. Minnesota's 2022 proposed trapping zones can be viewed in Figure 10 along with the proposed treatments.

Treatments

The MDA's 2021 spongy moth treatment areas were in both the uninfested area of the state and the STS action area (Figure 8). The MDA determined areas for spongy moth treatments based on alternate life stage surveys conducted in the fall of 2020 and through the analysis of trapping survey results with the STS Program Decision Algorithm.

The MDA had 13 treatment blocks in Minneapolis, portions of southeastern Minnesota, the Duluth area, and portions of the North Shore of Lake Superior. Three treatment blocks were treated with the product Foray 48B, which is a biological insecticide containing the active ingredient *Bacillus thuringiensis* var. kurstaki (Btk). The Loring Park block used ground applications of Btk, and the New Duluth and Pea Ridge blocks used aerial applications of Btk. These blocks had the management goal of eradication, and each had two applications spaced 3-9 days apart. Ten treatment blocks were treated with a mating disruption product in the STS Action area. The mating disruption treatments consisted of one aerial application of SPLAT-GM Organic in each block.

Two additional treatments were conducted by private businesses in Olmsted and Carlton counties. A nursery in Olmsted County completed two ground applications of MIMIC 2LV and a mill in Carlton County completed two aerial applications of Btk.

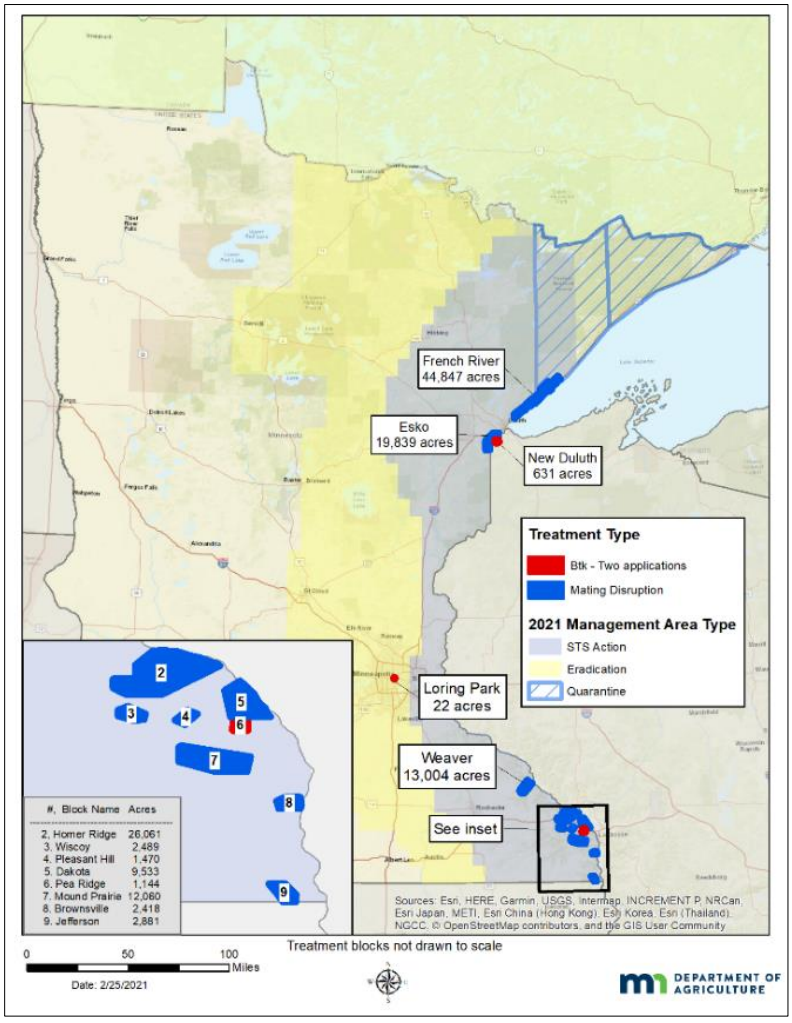

Figure 8. Locations of 2021 spongy moth treatments.

2022 Treatment Plans

Four areas of concern where alternate spongy moth life stages (egg masses, pupae, shed larvae skins) were found in the fall of 2021 have been identified as proposed treatment sites for 2022.

- An area in the New Duluth Neighborhood of Duluth and an area in Cloquet are proposed Btk treatments
- Two areas in Lake County are proposed mating disruption treatment

Figure 9. Spongy moth life stages found on burlap wrapped around the root balls of infested oak trees at a nursery.

All of the proposed treatment blocks fall within the 2022 STS Action Area and would fall under STS Foundation funding via the USDA USFS and will be treated via aircraft (Figure 10). For more detailed descriptions of the 2022 proposed spongy moth treatments, please visit the MDA's spongy moth treatment webpage at www.mda.state.mn.us/gmtreatments

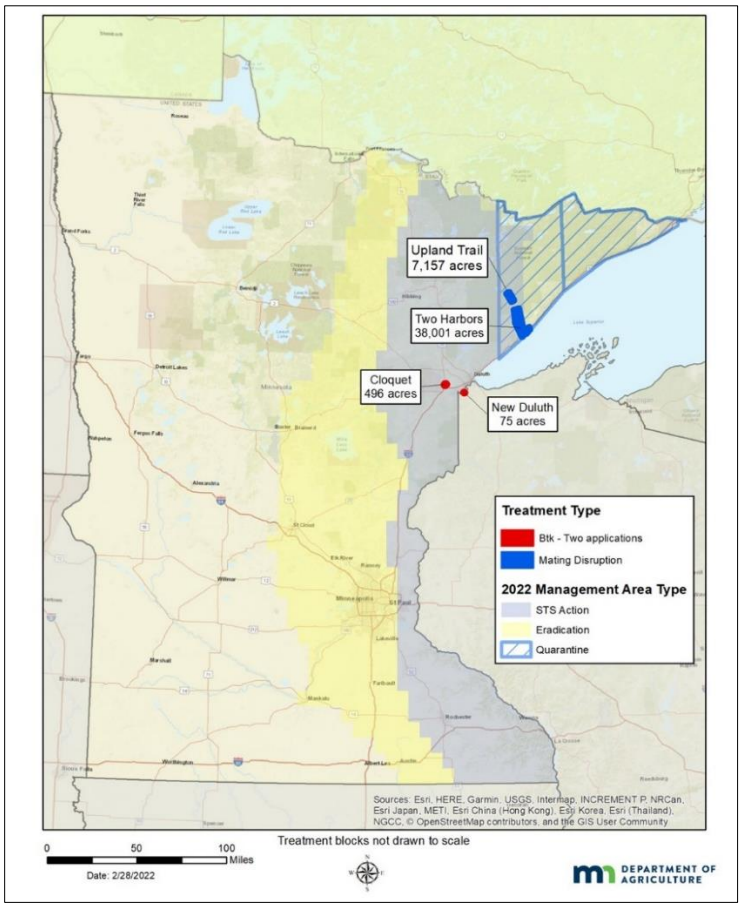

Figure 10. Proposed 2022 spongy moth treatments.

Regulatory

Quarantine Compliance

The MDA establishes compliance agreements with entities that wish to move regulated articles out of quarantine areas (Figure 11). The majority of regulatory activities occur in northeast Minnesota. Cook and Lake counties were quarantined in July 2014 and are also under a parallel federal quarantine.

Limited permits are required for the transport of pulpwood to approved receiving facilities, and they expire annually. Receiving facility and holiday greenery compliance agreements are also renewed annually.

The Spongy Moth Regulatory Program at the MDA is a multi-faceted program that relies on strong cooperative relationships with other state agencies and units within the MDA. The MDA cooperates with the Minnesota Department of Natural Resources to provide outreach at high-risk sites such as state parks, state forests, and public campgrounds. Outreach materials are also provided to privately owned campgrounds across Minnesota. The MDA cooperates with the Minnesota State Patrol to conduct commercial vehicle saturations. During these commercial vehicle saturations, log trucks are pulled over and their documentation is inspected to ensure quarantine compliance. The Plant Pest Regulatory Coordinator works closely with the Nursery Unit to ensure that nurseries and Christmas tree growers adhere to the federal quarantine.

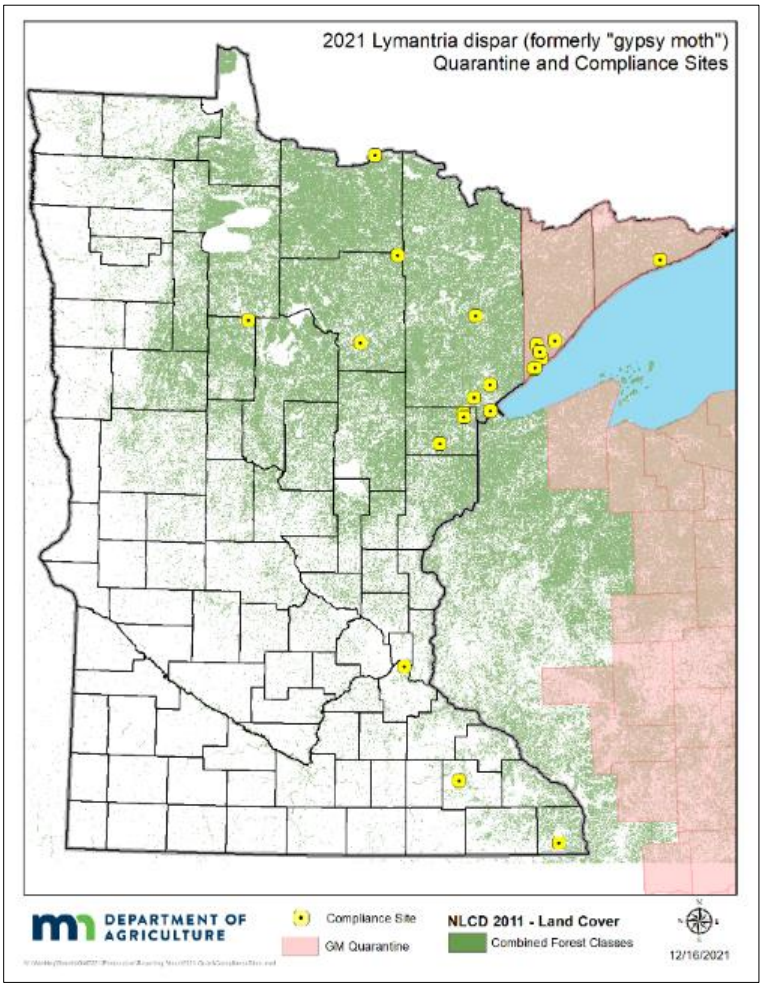

Figure 11. Locations of spongy moth quarantine and compliance sites in 2021.

Exotic Bark and Woodboring Beetle Survey

The introduction of wood boring insects is a continuous threat to the forest ecosystems of the United States. There are several pathways for these types of insects to reach Minnesota, such as live plants, solid wood packing material, rustic wood furniture, and firewood. Some of the most serious invasive pests in the U.S. (e.g., emerald ash borer and Asian longhorned beetle) have been introduced via these pathways. Other pests that are not established here or whose impacts remain unknown, such as the brown spruce beetle and the velvet longhorned beetle, can also spread this way. Early detection through survey is one of best ways to help safeguard our natural resources.

The MDA continued its fifth year of exotic bark and woodboring beetle survey funded by the Plant Protection Act 7721. Pests of concern include the velvet longhorned beetle, the pine processionary moth (*Thaumetopoea pityocampa*), and nine others (Figure 12). The purpose of this project was to survey for the presence of exotic woodborers that could affect a wide variety of forests in Minnesota. Survey sites included areas with preferred host trees near population centers where introduced insects could possibly become established such as campgrounds, city and county parks, nature/history centers, and cemeteries.

Figure 12. Larvae of pine processionary moth. Pest and Disease Image Library, Bugwood.org

Survey

Field work for the Forest Pests Survey began the week of May 18, 2021. Survey staff set USDA-approved funnel traps and cross-vane panel traps at 50 sites in 19 Minnesota counties (Figure 13). A total of 184 traps were set statewide with 1-6 traps at each site depending on host species presence. Traps were placed in different areas of the sites to avoid any intermingling of pheromones that might inhibit attraction to the traps. Each trap was checked biweekly by survey staff, and baits were changed as needed. The MDA surveyed for 11 exotic bark and woodboring insects; 10 were surveyed with traps and one was visually surveyed.

All trap catches have been screened. Three positive detections of velvet longhorned beetle (VLB) were confirmed from traps in Dakota, Olmsted, and Winona counties. Winona county is a first detection. No other target pests were found in 2021.

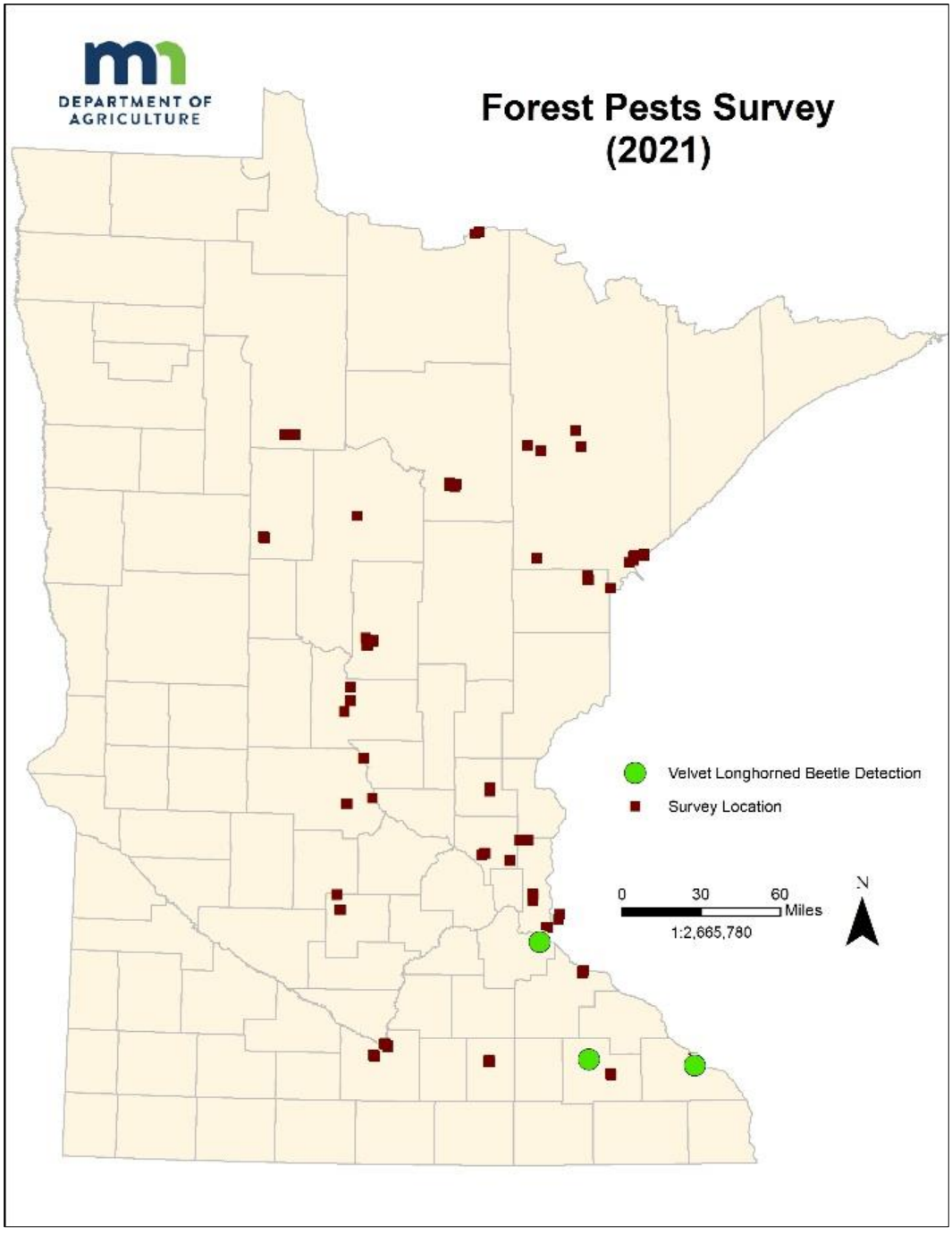

Figure 13. Map of 2021 Forest Pests survey site locations and positive detections.

Invasive Tree Disease Survey

In 2021, the MDA conducted a survey for three tree diseases with the potential to cause significant damage to trees in forests, landscapes, Christmas tree farms, and nurseries. These diseases were Chalara ash dieback caused by *Hymenoscyphus fraxineus*, Scots pine blister rust caused by *Cronartium flaccidum*, and Elm yellows caused by *Candidatus* Phytoplasma ulmi.

Staff surveyed for disease symptoms at 50 sites in 19 counties. At each site, host trees were identified, and an approximate number of trees was recorded. Pine trees were more common in the northern half of the state, elm trees were more common in the southern half of the state, and ash trees were found throughout all sites.

Scots Pine Blister Rust

Scots pine blister rust is caused by the fungus *Cronartium flaccidum* and occurs only in parts of Europe and Asia. This rust fungus infects several species of pine trees including Scots, Austrian, ponderosa, and mugo pines, which are important in landscapes, forests, and as Christmas trees. *Cronartium flaccidum* infects pine needles and then grows into branches and the trunk. The disease causes reduced and deformed growth and eventual death of the tree. Native red and white pines are resistant. Many popular garden plants like peony, verbena, and delphinium are alternate hosts to *C. flaccidum*. Introduction of this invasive fungal pathogen could occur through imported nursery stock.

Host trees for Scots pine blister rust were identified at 18 sites, 339 trees were inspected across all sites. Pines at each site were inspected every two weeks in June and early July, when spore filled pustules were most likely to be present. No trees with Scots pine blister rust were found in the 2021 survey.

On June 10, a pine tree infected with pine oak gall rust, caused by the native fungus *Cronartium quercum*, was observed in McLeod County (Figure 15). Powdery orange sporulation was observed on the infected galls throughout the month of June. Sporulation was not present in July or August. Observation of sporulation of this close relative of *Cronartium flaccidum* (Scots pine blister rust) during this period indicates that the scouting period of mid-May through June will provide a high likelihood of detecting Scots pine blister rust sporulation if present.

Figure 14. Like the white pine blister rust in this picture, scots pine blister rust causes branch and stem cankers that release spores from pustules in cracks in the bark. USDA Forest Service - Forest Health Protection Intermountain Region, Bugwood.org

Figure 15. Cronartium quercum, the fungus that causes pine oak gall rust, was observed sporulating throughout the month of June.

Chalara Ash Dieback

Chalara ash dieback, caused by the fungus *Hymenoscyphus fraxineus*, is causing widespread ash mortality in several European countries. It has not yet been detected in the United States. Green, white, and black ash can all be infected by *H. fraxineus*. This fungus spreads short distances by windborne spores and long distances on diseased ash plants, including nursery stock. Symptoms include brown, black, or wilted leaves hanging from branches, blackened leaf stems, diamond shape lesions on stems or branches that are centered on a branch or leaf entry point, and small fruiting bodies on blackened leaf stalks on the ground.

Host trees for Chalara ash dieback were found at 46 sites, approximately 1,240 trees were inspected across all sites. Ash trees at each site were inspected every two weeks from late July through early September when symptoms were most likely to be found. Only trees with diamond shaped cankers at the base of a dead branch, brown or necrotic leaves with black veins, or fruiting bodies growing from blackened stalks of fallen leaves were sampled (Figure 16). No trees with Chalara ash dieback were found in the 2021 survey.

Figure 16. Diamond shaped canker on a young ash stem from Chalara ash dieback. ©Crown copyright. Forest Research

Elm Yellows

Elm yellows is caused by the phytoplasma *Candidatus* Phytoplasma ulmi, a bacterium that lives only in the vascular system of elm trees and the leaf hoppers and spittle bugs that spread it. All species of American elm are susceptible to elm yellows, including the Dutch elm disease resistant varieties that are being widely planted in landscapes to replace ash trees removed due to emerald ash borer. The canopy of infected trees turns completely yellow, leaves bend downward without wilting, and the tree dies (Figure 17). There is no treatment for elm yellows.

There are three historical records of elm yellows occurring in southern Minnesota. These reports, however, are from prior to 1975 and modern diagnostic techniques to confirm infection by a phytoplasma were unavailable at that time. There are no reports of elm yellows in Minnesota since that time, and the current status of this disease in the state is unknown.

Figure 17. Young elm tree infected with elm yellows. Pennsylvania Department of Conservation, Natural Resources, and Forestry, bugwood.org

Host trees for elm yellows were found at 43 sites, 1,103 trees were inspected across all sites. Elm trees at each site were inspected every two weeks from late July through early September when laboratory tests were most likely to be successful. Only symptomatic trees were sampled. Young twigs with multiple leaves were collected and tested with PCR for the presence of phytoplasmas. Fifteen trees with possible symptoms of elm yellows were sampled and tested. No trees with elm yellows were identified in the 2021 survey.

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