

North Dakota

Forest Health Highlights

2023



NDSU NORTH DAKOTA
STATE UNIVERSITY

Overview

This report summarizes observations and activities of the Forest Health program in North Dakota for 2023 and includes an overview of notable forest health issues. Forest health surveys and reports, sick tree assistance requests, and personal communication with natural resource and community forestry professionals form the basis of the information disclosed in this report.

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Cover image: Overlooking the Little Missouri River, Little Missouri National Grassland, ND.

North Dakota's Forests

North Dakota's tree-covered landscape is made up of native forests, conservation plantings, and community forests producing a myriad of environmental and economic benefits to its residents. With a total estimate of 1,556,184 acres, this landscape can be divided into 796,878 acres of forestland and 759,306 acres of trees outside of forest (TOF). The definition of forest, according to the USDA Forest Service requires, "an area of trees at least one acre in size with a minimum dimension of 120 feet by 363 feet and 10% live canopy cover." This definition frequently excludes two important forest components in the plains states, conservation plantings and many of the riparian forests. These two components are both frequently found to be too narrow to satisfy the USDA definition.

Trees outside of forest, which could be argued to have made living and farming on the plains possible, contain approximately 29,000 miles of windbreaks found in North Dakota. Preventing soil erosion, increasing crop yields, and protecting homesteads and roadways, 470,766 acres of windbreaks, as determined through the Great Plains Initiative 2 (GPI2) project, perform innumerable benefits. Until the publication of these project findings, little had been quantified regarding their distribution and current state of health. GPI2 raised the importance of the health of the trees in these landscape components, motivating management to improve their condition.



Figure 1. Green represents the acres of forest distributed across the state in North Dakota's categories of forest (natural, community, and conservation plantings).

In both forestland and TOF, green ash is the dominant species. In natural forests, natural disturbance such as fire, allows for more diversity. In modern forests that experience strategies such as fire suppression, the lack of disturbance creates conditions that allow green ash to dominate. In TOF components, this dominance of planting ash stems from a misunderstanding of the ecological trajectory towards diverse conditions. The other prominent species on the North Dakota landscape are, by volume, cottonwood, bur oak, quaking aspen, and Rocky Mountain juniper. Maintaining the health and sustainability of our forest resources is a fundamental piece of the social and economic health of North Dakota. Programs like GPI2, the annual measurements done through Forest Inventory and Analysis, and community inventories and assessments guide the approaches and designations intended to address our resource needs.

Sick Tree Assistance Requests

The Forest Health program aids those experiencing tree health issues in their forests, landscapes, or windbreaks. During 2023 the program consulted with private and public landowners regarding an assortment of biotic and abiotic issues that range from animal and insect damage to the extremes of moisture availability. Figure 2 shows the break-down of seven general categories that represent the proportion of tree health issues found to be responsible for all requests. Table 1 shows a list of the general tree health categories and the most common issues that constituted each category. The most significant changes from requests received in 2021 were a 14 percent reduction in the presence of drought-related issues and a 27 percent increase in disease issues.

Table 1. The 2023 list of the general categories of health issues found to be associated with Sick Tree Assistance Requests through an online survey, email, and phone contacts.

General Category	Particular Issue
Drought	Foliar browning, Dieback, thin foliage
Insect	Pine moth, sap feeders, mites, endemic beetles
Veg. Mgmt.	Assistance with general vegetation management (pruning and density reduction)
Planting	depth, watering, sod competition, CACO3, transient salts, poor site
Disease	Needle casts, blights, stem cankers
Herbicide	Off-label applications
Animal	Beaver, sapsucker, woodpecker damage

The predominant tree health issues evaluated during the 2023 growing season were associated with the combined influence of the 2021 drought and the 2022 spring moisture conditions. Most tree health issues during the 2023 growing season could very frequently be tied to the lack of water causing a loss of tree vigor during 2021, creating vulnerabilities in tree defenses. This loss of vigor leads to reduced resistance to damaging agents and often leads to the presence of secondary insect and disease issues. In a general sense, the loss of vigor is often caused by multiple stressors, having additive impacts that are not equal in their consequence. As such, trees experience a loss in vigor from a

stressor, but can recover should the growing conditions permit adequate productivity for recovery. If there is no opportunity for recovery, then there is a steady state of decline and often compounding stressors.

With the weather conditions we have experienced in North Dakota during the past three growing seasons, there is a good chance we may see a steady state of worsening in tree health across the state during the 2024 growing season. Many trees have had to cope with the cumulative consequences of reduced growth from drought and the lowered resistance to any additional stressors. The condition of next year’s growth will be dependent primarily upon the available moisture for spring and early summer growth during 2024.

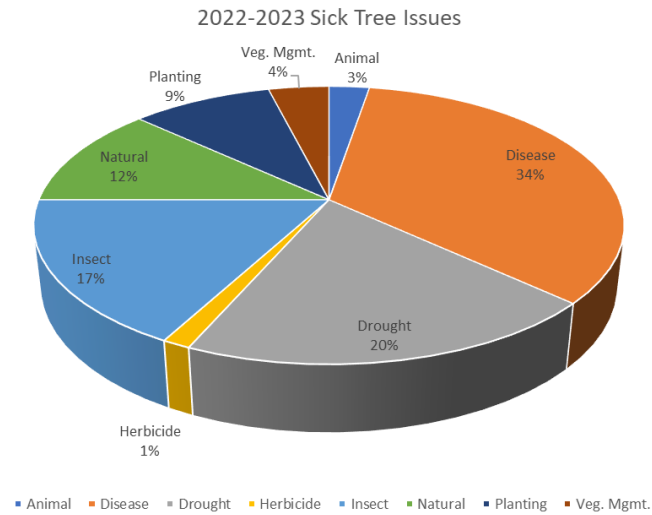


Figure 2. The proportion of Sick Tree Assistance Requests by general category of tree health issue.

Abiotic Tree Health Issues

Weather trends

The 2022-23 growing seasons were influenced by some of the most extreme contrasting weather conditions experienced on the North Dakota landscape since official weather record keeping began in 1895. 2021 was the 6th driest summer on record (Figure 3) and the period from March to November was the warmest nine-month period ever recorded. To follow this, the spring of 2022 was the 4th wettest on record (Figure 4). This information is important because these extremes on their own are each challenging for tree growth, but together they create a scenario that has the potential to cause severe and potentially long-term challenges to tree health. Spring 2023 was slightly cooler and drier than average, and the summer and fall were mildly warm and dry.

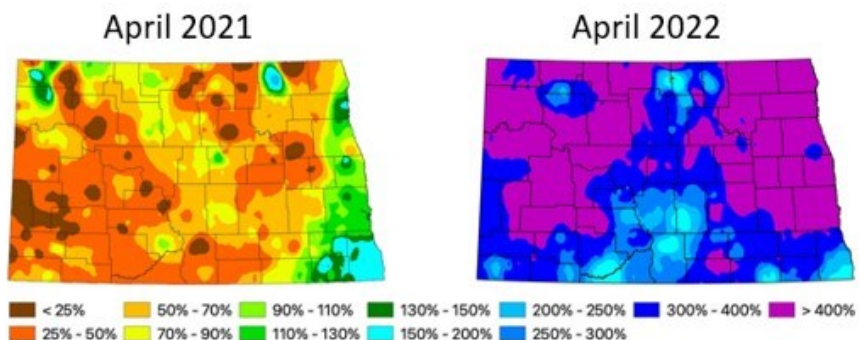
U.S. Drought Monitor North Dakota



Figure 3. The Drought Monitor map for North Dakota during the same period of time in 2021 and 2022.

The drier and warmer conditions of 2021 created shorter windows of tree water movement across the day and season. Combining this with increased temperature creates a situation where the atmosphere can absorb more water from vegetation; exacerbating drought conditions. Controlling water loss under these conditions reduces leaf moisture, increases leaf temperature and consequently limits carbon dioxide uptake. The prevention of water loss and carbon dioxide uptake reduces photosynthetic production of carbohydrates, the fundamental component that allows the tree to produce new tissues and maintain processes that help protect it from various types of damage or injury. If the tree cannot transpire water, the leaf will eventually wilt and start to dry at the margins which presents as red-brown discoloration that moves inward from the outer edge.

Percent of Normal Rainfall



Source: NDARB Cooperative Observer Network

Figure 4. The percentage of observed April rainfall for 2021 and 2022 as compared to the 30-year average (1997-2006).

Abiotic Tree Health Issues

Weather trends

As dry and warm conditions persist, trees become more and more vulnerable, increasing their susceptibility to insect and disease issues. Generally, dry periods cause the sap within the whole tree to become more sugar rich (Ryhti et al 2022), which is more productive to wood and bark boring insects that feed and develop in these tissues. Wet periods, on the other hand, are conducive to the spread of most diseases, since the moisture encourages fungal sporulation to occur and raindrop impact to spread spores.

The conditions of 2021, 2022 and 2023 created a scenario where trees were simply weakened by a lack of soil moisture and warm temperatures, limiting the production of photosynthetically-produced carbohydrates. The dry summer created a great opportunity for wood boring insects, while reduced productivity made trees more susceptible to diseases during the following spring as weather conditions became conducive to their spread.

Drought and trees

Drought stress during the growing season can lead to wilting, reduced leaf area, and early browning or discoloration of foliage. Long-term drought can lead to dieback of fine branch tips in the upper crown, eventually working into larger branches. Often first noticeable with growing season drought is the deterioration of foliage, starting from the outer edge moving inward towards the stem, a symptom frequently referred to as “scorch.” A lack of soil moisture and a high atmospheric demand for moisture can cause scorch by limiting the tree’s ability to support the path of water from root to foliage, leading to a loss of function and dehydration of leaves.

Limited water availability for tree growth is frequently caused by a lack of precipitation, but it can also occur because of competition. As trees grow and fill a space, there is an increasing need for resources (light, water, and nutrients) to assure adequate growth. A natural forest generally experiences a variety of tree-killing disturbances (storm damage, fire, insects, and disease, etc.) through time which redistributes resources by influencing the density of vegetation. Without this influence on density, the growing demand for resources can lead to steady overall decline.

Dieback in native species

The presence of dying crowns of green ash and cottonwood can be seen in many natural stands. Many of these are large, old, and growing at high densities, which means they have low productivity, limited growing space, and limited available resources. These two species in particular are experiencing a high presence of endemic insect disturbance, as would be expected with consequently low overall vigor. These endemic insects are a natural mechanism of disturbance which decreases density, freeing up available resources or removing a tree to introduce new growing space. This decline is a relatively slow process of mortality, becoming very visible in many communities and natural settings if management does not introduce change.

Abiotic Tree Health Issues

Planting and tree care issues

In 2022 and 2023, planting and vegetation management made up thirteen percent of the total number of assistance requests. Health issues resulting from vegetation management can usually be summed up as pruning and injuries that are associated with pruning. Creating a wound on a tree can cause the spread of disease, so the timing of pruning and careful consideration to cleaning pruning tools between cuts are methods to remedy this concern. Poor pruning can also lead to structural damage as trees increase in size, cracking or bending because of unbalanced loads.

Planting of landscape trees and conservation plantings in North Dakota account for a significant portion of our tree cover. Any tree that is planted has the potential to be challenged by less than ideal placement in the soil and position in the landscape. Planting a tree in a poor site or placing it too shallow or deep can create challenges that would not exist if the tree had established naturally. Therefore, health issues of planted trees should always consider the possibility of having been planted improperly. It may seem likely that a planted tree that has appeared to establish successfully has made it through the vulnerable period, but a poorly planted root system can eventually infringe on its own growing space as roots begin to cut off stem tissue of neighboring roots and stems.

Herbicide issues

Herbicide damage is a looming presence in North Dakota and plays a role in both urban and rural environments. Damage to trees and shrubs due to the improper or careless selection and/or application of pesticides make up a consistent number of annual homeowner inquiries regarding tree and shrub health. In most circumstances, herbicide injury to urban and rural trees is a consequence of indirect application targeted at neighboring agricultural vegetation. Instances of chemical volatilization, drift, and overspray should be thoroughly considered in accordance with herbicide labeling. No herbicide intended for agricultural use should ever be used otherwise. It is vital that the application of herbicides strictly follows the manufacturers labeled recommendations.

Biotic Tree Health Issues

Spruce disorders

Disorders of spruce trees are a consistent issue in North Dakota, since spruce trees are planted and not native to our state. Blue spruce, the most widely planted of the spruce species, evolved on porous soils in a cool climate with wet summers. Although being relatively drought tolerant, the minimum annual precipitation in its native range is equivalent to the highest average rainfall found in North Dakota. Planting spruce in North Dakota's fine-textured soils and dry climate creates a scenario that frequently causes stress, leading to the persistence of tree health issues.

North Dakota spruce are frequently plagued with three particular fungal diseases that are complicated by conditions that exacerbate their stress, like drought and flooding. The three predominant diseases are spread most effectively when trees are stressed and experiencing moist and cool spring growing conditions, much like those experienced during the spring of 2022. High relative humidity encourages fungi to sporulate, allowing spores to be dispersed by wind and raindrop impact. Two of these fungal diseases are needle casts *Stigmata lautii* and *Rhizosphaera kalkhoffii*, which cause needles to be prematurely shed. The third is a canker disease *Cytospora kunzei*, which causes a canker to form that disrupts the conductive tissues of stems.

Stigmata needle cast was first identified on our landscape in 2006 and has since become more common than its *Rhizosphaera* counterpart. Both of these diseases continue to be very important agents degrading the quality of often densely planted conservation and landscape plantings. The physical form of spruce is the reason it is valued, since it becomes a densely planted natural barrier, which is precisely the situation where needle cast disease can take hold. A lack of space and air movement between the trees and limbs is what encourages the presence of needle casts. Consequently, under most circumstances these diseases ultimately remedy this situation by removing foliage and increasing air movement within and between crowns.



Cytospora canker randomly occurs throughout a crown spreading from one damaged branch to the next.



Needle casts commonly occur near the ground and progress up the tree often on the side of the tree protected from drying winds.

The third spruce disease affecting spruce is *Cytospora kunzei*, a canker disease in spruce that causes a loss of needles on a branch. The most distinguishing characteristic that sets this disease apart from the needle casts is that affected branches are frequently distributed unevenly throughout the tree crown. This contrasts with the two needle casts, which tend to establish first nearer the ground and move up the tree causing the loss of needles.

Biotic Tree Health Issues

Bur oak disorders

Bur oak, *Quercus macrocarpa*, is the only native oak found throughout all of the North Dakota landscape except for the extreme northwest corner. This upland forest species is commonly found in natural forest stands growing in the varied topography in dry sites adjacent to river floodplains. Historically, it grew in low-density stands that experienced frequent fire disturbance. Since the settlement of the plains, recurring natural fires have been excluded from the landscape, leading these forests to become dense with species that can establish and grow under the crowns of oak. Most oak stands now contain species like green ash, hackberry, and elm. This increased density creates a scenario where light, water, and nutrients become limited, preventing vigorous growth.



Bur oak with declining upper crown following two growing seasons of TLCB infestation.

The associated stress from the 2021 drought created an inviting scenario for the two-lined chestnut borer (TLCB), *Agrilus bilineatus*, a native beetle that attacks bur oak. Always present in ND's oak forests, this beetle often first infests the upper branches by laying eggs in bark crevices of highly stressed trees. When the eggs hatch in late July, the larvae bore into the bark and begin tunneling through the cambium, slowly killing the branch. By the following summer, the larvae, which will grow for two years under the bark, cause the foliage to die on the branch in the late growing season. By the following season, those upper branches will be completely dead, producing no foliage. In the late growing season of 2022, dead branches in the upper crowns of bur oak in ND's forests were a fairly common sight, but it was not the only noticeable damage.

The cool moist conditions during the spring of 2022 spread fungal diseases that affect new growing tissues or wounds. By mid July dead and dying foliage could be found in oak crowns in most natural forest settings. *Botryosphaeria* canker, *Botryosphaeriaceae spp.*, is a general reference to one of the genera of canker-causing fungi from the order *Botryosphaerales*. *Botryosphaeria* infects the cambium of sapwood of weakened trees, which eventually leads to browning of leaves on the branch. The level of browning will depend on the severity of the stress or injury and can range from whole branches to branch tips. In 2022 the most prevalent browning occurred on the branch tips where the bark is thin and the new growing tissues are vulnerable. Weather related injuries, like strong wind and hail can cause small bark injuries that allow penetration into the bark. *Botryosphaeria* symptoms presented as foliar browning of intermittent branch tips in August of 2022 and into 2023.

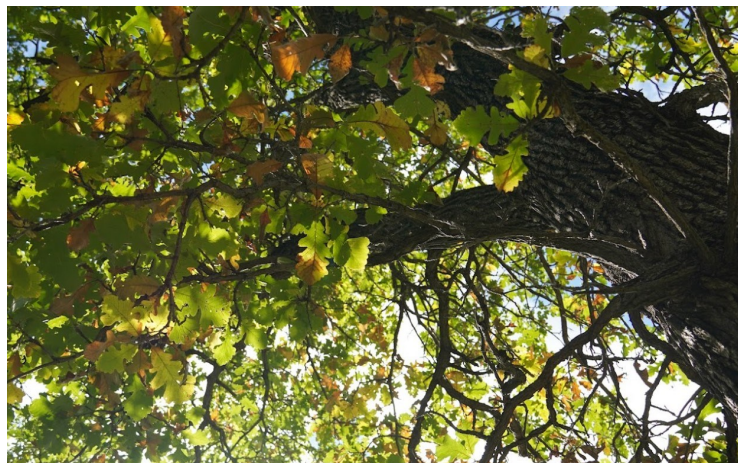


Botryosphaeria causing leaf browning on branch tips following the stress of the 2021 drought and a cool moist spring of 2022.

Biotic Tree Health Issues

Bur oak disorders

A second, less pronounced injury of oak, that was observed during 2022 also related to browning of foliage, but was more dispersed, affecting many individual leaves on branches. For the first time in North Dakota, bur oak blight (BOB), *Tubakia iowensis*, was detected in the Pembina Gorge area. This disease causes browning in leaves and a loss of productivity. Damage from BOB is distinct, causing necrosis of leaf vein and interveinal tissues. Despite the visible damage that becomes apparent in the later growing season, it rarely causes enough damage to kill the tree. Although several successive seasons of damage can kill a tree, the necessary growing conditions rarely persist long enough to reach this outcome.



Common BOB symptoms of vein and inter-veinal necrosis on a tree in Turtle River State Park (left). Damage can vary from year to year, rarely killing a tree without several successive years of heavy infestation. This tree is showing moderate BOB infection (right).

Another common issue with oak is the presence of sap-feeding insects that pierce and suck sap from branches and leaves, producing honeydew, an excrement that will frequently coat surfaces below the tree. There are several species of these insects that can commonly be found in oak, as well as many other trees in ND. Despite the damage caused by sap-feeding insects, only the TLCB can cause sufficient damage to kill an oak. Each of these disturbances becomes present only when growing conditions for the tree are difficult enough to cause stress. Therefore, the best management approach is to take actions that improve the availability of water to the trees. In a landscaped position, this usually means watering, while in a natural forest the best approach is to manage tree density with removals.

Biotic Tree Health Issues

Insect issues

European elm scale (EES), *Eriococcus spuriosus*, is a scale insect that was introduced to North America. This scale insect feeds on elm trees by piercing and sucking sap from branches and leaves. They are distinct from other scales by the waxy white periphery of the scale structure protecting the female insect. Scales are one of many possible sapsucking insects producing honeydew that rains down from urban trees coating surfaces in shiny sticky excrement. The honeydew contains sugars produced by the tree that are an excellent substrate for growing sooty mold, which blackens the bark surfaces that become coated.

Until recently, EES was not recognized in the Fargo area, only having been identified in Bismarck. Following a series of severe weather events in eastern North Dakota from June 19-24, the older urban canopies of American elm (*Ulmus americana*) in Fargo were assessed for EES. The storms caused significant wind damage to upper branches throughout neighborhoods with predominant elm canopies. The downed branches created an ideal circumstance to evaluate for the presence of tree insects in Fargo elm. It was this event that led to the identification of EES in Fargo elm and the broader assumption that it may also be present in communities between Fargo and Bismarck.

There is no need to address this insect's presence, but it is important to recognize that it is yet another piercing and sucking insect that challenges trees growing in urban environments. Urban environments possess many challenges to tree growth, like stem damage, soil compaction, and the presence of chemicals in the soil and air among many others. Giving your landscape trees the best opportunity to grow productively means homeowners should think about activities that may negatively affect the tree and make sure to supply adequate water.



European elm scale was found for the first time in Fargo after upper limbs were dislodged from the older canopy of elm throughout North Fargo following a June 2022 windstorm.

Biotic Tree Health Issues

Disease Issues

Diplodia pinea (= *Sphaeropsis sapinea*), is a fungal disease that causes pine shoot blight and cankers on stems that can be found on all size classes of pines in all growing circumstances. Like any insect or disease issue, this fungus establishes when stress from any number of variables causes a tree to be weakened, becoming vulnerable to infection. The fungal bodies of this disease can be found near the base of needles and on second year cone scales, maintaining a consistent presence in pine crowns and canopies. The fungus is passive until moist weather and decreased tree health allow the infection of recently developed tissues. High humidity and rain events allow it to spread readily to pine tissues, causing short needle growth and browning.



Diplodia shoot blight causes the death of young, actively-growing needles on infected shoots of pine (left). The presence of *Diplodia* in a stand can be rapidly spread by severe weather causing wind damage and hail injuries (right). A ponderosa pine stand with heavy *Diplodia* infection following hail damage to the thin bark near branch tips (center).

Diplodia can be found at persistent, but low, levels in many pine plantings across the state. With extremes in drought and precipitation this disease will always be present in the North Dakota landscape. By maintaining its presence, storm events can cause damage to tree crowns, allowing for circumstances that exacerbate infections. Small wounds from hail and wind damage create ideal circumstances for spores to enter the conductive tissues, causing a canker to form, cutting off any conductance to the distal end of a branch.

On July 5th, 2022, at approximately 10am, a storm with heavy hail passed through one of the very few natural pine stands in North Dakota. The storm's hail damage helped to paint a swath of *Diplodia* through roughly 1200 acres of ponderosa pine trees. The vast majority of the damage could be seen on the outer small branches, mostly on the windward side from which the storm approached. This is a relatively common series of events, causing damage that may take a few growing seasons to fade from the forest canopy, while causing only subtle mortality to already severely weakened trees.



A stand of Slope County ponderosa pine infected with *Diplodia* shoot blight following a July 5th, 2022 hail event.

Biotic Tree Health Issues

Disease issues

Fire blight is an infection most commonly seen on apple trees in the North Dakota landscape that is caused by the bacterium *Erwinia amylovora*. The bacteria overwinters in cankers under the bark until warm moist conditions permit bacteria growth, causing the cankers to ooze and become susceptible to spread to the apple blossoms from rain or insects. The young growing tissues of blossoms are susceptible and become an excellent vector for spreading by foraging insects, such as bees. Other damage to the bark and tissues from freezing, wind, or hail also create vectors into the conductive tissues that can easily be invaded by this bacteria.



Fire blight forms a typical "Shepherd's crook" at the branch end.

Portions of eastern North Dakota experienced extensive fire blight infection on damaged tissues and new succulent growing shoots, like blossoms. Fire blight causes the distal end of the branch to die, eventually forming the canker where the bacteria overwinter. The infected newly growing shoots eventually form a distinctive black crook at the end that can be visible randomly throughout the tree crown. Cankers that become established on larger stems will spread towards distal tissues until the infected wood eventually dies. This damage can be managed using sanitation efforts that remove infected wood and cankers through sound pruning practices done during the growing or dormant seasons.



Black rot (*Diplodia seriata*), a fungus that also infects apple trees and has symptoms similar to fire blight, was present in the North Dakota landscape during 2023 as a result of our weather extremes. In fact, black rot canker can easily infect the cankers and dead wood that forms because of fire blight infections. Overwintering of this fungus occurs in infected dead wood and mummified fruit, so, like fire blight, proper sanitation can reduce and control its presence. Pruning should be done during the growing season or dormant season with 10% bleach solution used to clean tools between cuts that are made at least 12 inches below (medial) the canker margin.

Black rot appears similar to fire blight, but is often caused by a black canker on the stem slightly back from the branch tip.

Biotic Tree Health Issues

Disease issues

Dutch elm disease (DED), *Ophiostoma novo-ulmi*, is a consistent issue with all North Dakota elm species, Ulmaceae, with native elm being most susceptible. There is an annual level of loss in communities where elm is still persistent as part of the forest canopy. In natural stands, elm continues to regenerate and is often attacked by elm beetles before the trees reach maturity. The combination of elm beetles and DED is endemic on our landscape and will always limit the health and distribution of naturally occurring and planted elm. High value elm trees in landscaped positions should be managed by maintaining tree vigor with good growing conditions and by recurring treatments of systemic fungicides.



Dutch elm disease is always present in our landscape, threatening all species of elm. The most susceptible are the native elms, but any elm can become diseased. The elm beetles sever the conductive tissue under the bark, causing “flagging” to occur. Eventually the disease, which is transferred by the beetle will infect the entire tree and its neighbors through root grafts if not removed when flagging first occurs.



Forest Health Surveys

Beetle trapping

In a collaborative effort with the North Dakota Department of Agriculture (NDDA), the North Dakota Forest Service (NDFS) assists in monitoring for the presence of exotic and non-native wood borer and bark beetles in North Dakota using multi-funnel Lindgren traps. This trapping effort is funded through the USDA Animal and Plant Health Inspection Service's (APHIS) Cooperative Agricultural Pest Survey (CAPS) Program. Trapping is generally targeted on four economically important exotic wood boring insects that have become established in the United States and Canada, but is effective for an assortment of tree pests.

The CAPS program trapping has been focused on areas of high traffic, commerce, or ports-of-entry, sampling within ten counties statewide using a series of insect lures. For 2022, the North Dakota Forest Service continued to implement an additional set of Lindgren trapping locations with three lures commonly used to encourage trap visitation by wood boring and bark beetles. The NDFS trapping was focused on expanding the survey to include sites that were considered to be closer to "natural" than the other CAPS locations. In this context, "natural" was considered to be sites that were in natural forest or planted stands of trees that exhibited growing circumstances that were closer to natural.

During the 2023 sampling season, none of the economically important species were trapped in any of the Lindgren traps deployed state-wide through the multi-agency effort. Despite not finding these species, there were new records of other wood and bark boring species from three families or subfamilies of interest that do pose potential challenges for trees and shrubs. Monitoring these species is of particular interest as North Dakota continues to experience highly variable weather circumstances, which can reduce tree resistance to insect disturbances. The species associated with Scolytinae, Cerambycidae, and Buprestidae all have their own life cycle preferences focused on the bark, wood, or both, respectively, which plays into the varied states of tree and forest health.

The sub-family Scolytinae contains the largest number of insects that tend to cause the greatest amount of damage to trees and shrubs by completing a portion of their life cycle in the vascular tissues of the bark. This damage is important because disrupting these tissues causes senescence of the connected distal components of the plant. The six new state records are all relatively innocuous, but are added to the list of possible damaging agents to the variety of planted and native species in the North Dakota landscape.

Forest Health Surveys

Beetle trapping

A comparison of monitoring between 2021 and 2022 indicated a jump in the presence of all bark and wood boring beetles starting in June. From historic data, this period of time, through July is when adults would be emerging from the bark to forage and seek out new egg laying sites. This seems to be a logical trajectory for expanding the number of species present, since it was following a year of severe drought conditions that would have benefitted beetle productivity (see figure 5).

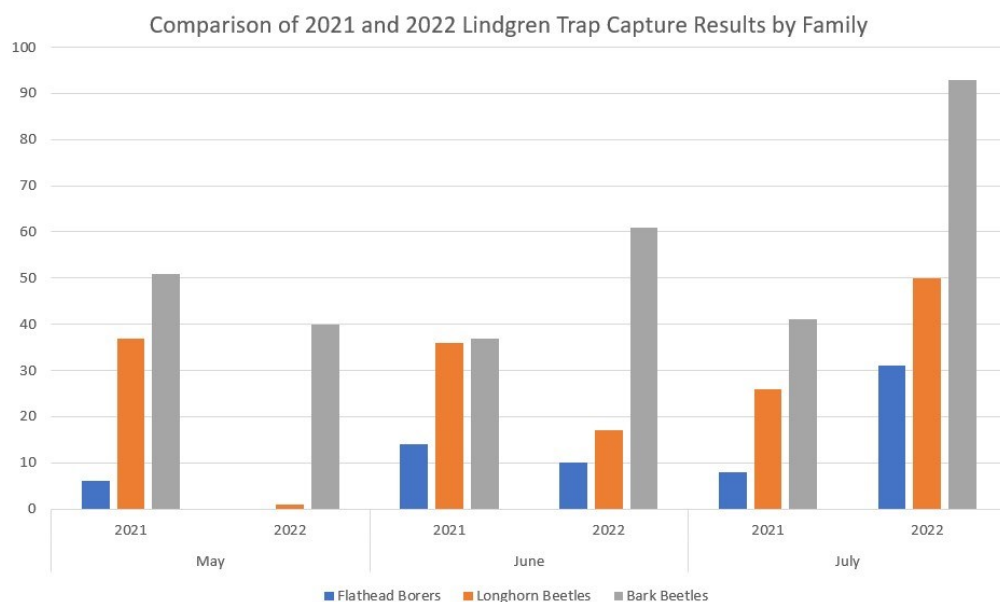


Figure 5. The number of captured species rose during the June and July emergence period for adult bark beetle (Scolytinae). Comparing the long horned beetles (Cerambycidae), there was a lack of their presence in the early part of the 2022 growing season.

Forest Health Surveys

2023 Aerial Detection Survey (ADS)

From June 20-24 of 2022, the Minnesota Department of Natural Resources (MNDNR) was contracted to fly 591 miles of the Sheyenne River and 550 miles of the Red River to assess for damage to the natural forest canopy. The assessment was focused on the riparian forest immediately adjacent to the rivers, with the intent of detecting all potential damaging agents. The long-term goal of aerial detection surveys (ADS) is to monitor the changing conditions of natural forests in order to address any possible occurrences that may have detrimental effects. One such example may be pockets of damage from the accidental introduction of a non-native beetle like the emerald ash borer.

The 2022 ADS did not detect any significant damaging agents that pose an unusual risk to the riparian forest canopy along either of these river corridors. Damage that was identified during the survey was primarily from drought, flooding, and age-related decline. Human influence on historical fire and flood disturbance regimes often produces homogenous forest conditions that become prone to age related decline. Future surveys to monitor these locations will help to predict trends in forest health issues throughout the North Dakota landscape. ADS was not planned for 2023.



An example of natural forest in the riparian corridor along a stretch of the Sheyenne River. Image taken during the June 20-24, 2022 ADS by the MNDNR.

Outreach and Education

The NDFS Forest Health program continues to be involved in education and outreach efforts to raise awareness of circumstances that shape the forested components of our landscape. During 2022 we used online resources and field experiences for outreach methods to engage a variety of audiences.

EAB awareness week - an annual collaboration with the NDDA and NDSU Extension, was focused on producing daily educational materials for social media. Materials were made available on all three agencies' social media outlets simultaneously during the week before Memorial Day. Materials covered a range of topics to help North Dakotans understand EAB, its signs and symptoms, the importance of not moving firewood, and the importance of diversifying new and existing plantings. The goal of EAB awareness week is to continue to prepare communities and property owners for the eventual arrival of this invasive beetle.

Forestry Fridays - an online video presentation series produced by the NDFS Forest Stewardship and Forest Health programs, focused on educating soil conservation district employees and the interested public about the challenges of planting and growing trees in North Dakota's prairie landscape. Forest Health's role in this endeavor was to educate about maintaining tree vigor by managing site conditions that will give trees the best opportunity to avoid insect and disease issues. With a primary focus on conservation plantings, Forestry Fridays reached approximately 300 individuals associated with managing the planted half of North Dakota's forest resource.

<https://www.ag.ndsu.edu/ndfs/documents/forestry-friday-2022-final.pdf>

North Dakota Envirothon - Over the past couple of years, the NDFS Forest Health program has been involved in the North Dakota Envirothon, which is an environmentally themed academic competition for high school students. The NDFS Forest Health staff taught forestry and tree health topics at three ND Envirothon competitions, educating approximately 300 students.



Students working on identifying aquatic invertebrates during the North Dakota state Envirothon competition near Crystal Springs, ND.

Outreach and Education

Paid advertisements

Since the movement of firewood is a pronounced way to disperse forest insects, the Forest Health program continuously runs “Don’t move firewood” ads in the Dakota Country Magazine and maintains leaflets at all highway rest areas.



Three past covers of Dakota Country Magazine.



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Any inquiries about the North Dakota Forest Service insect trapping or the Forest Health Program in general can be directed to peter.gag@ndsu.edu or (701) 231-5138. This publication is available in alternative formats by calling (701) 231-5138.

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