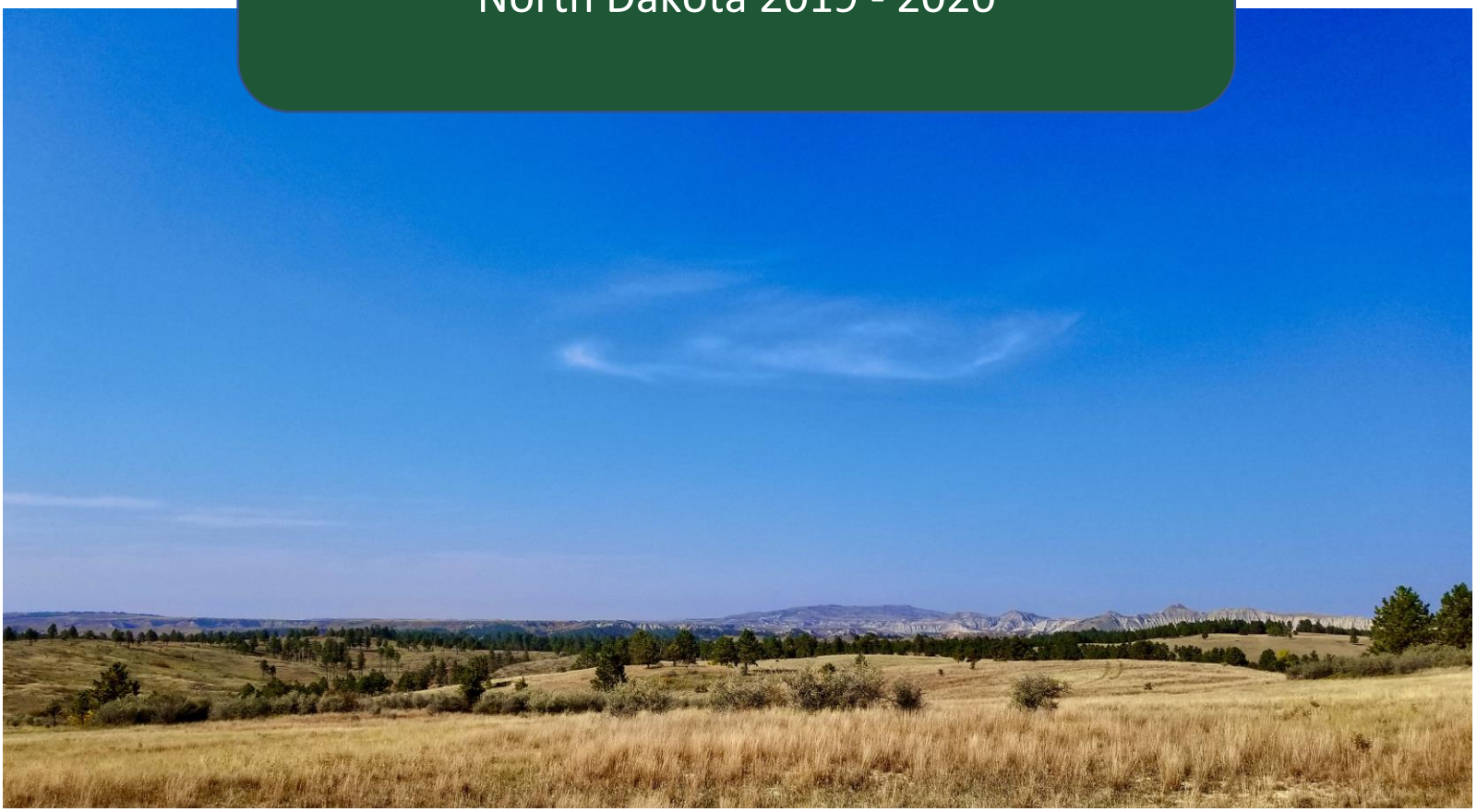
Biennial Forest Health Report

North Dakota 2019 - 2020



North Dakota Forest Service
March 31, 2021

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Overview

This report summarizes forest health conditions observed in 2019 and 2020 and describes emerging issues in relation to their effect on the sustainability and societal value of North Dakota's forested resources.

The term "forest health" does not denote the presence or absence of insect pests and diseases in the forest, nor is it equivalent to an arbitrary estimate of tree mortality. Forest health is more accurately understood as a depiction of forest sustainability, or the robustness of the forest's ability to provide social, economic, and cultural benefits while maintaining its ecological functions.

All forests undergo succession, a natural change in vegetation through time. Forest succession is driven by abiotic and biotic factors that influence the species composition of the forest and facilitate the death of weakened and less-fit individual trees and groups of trees. Abiotic factors include drought, flooding, temperature, soil properties, nutrient availability, fire, wind, sun, precipitation, and various human-caused injuries. Biotic factors include native or introduced insects, disease, fungi, invasive plants, animals, bacteria, phytoplasmas and nematodes that coincide with trees.

Abiotic and biotic factors are natural components of any site where trees grow, and the damage they cause should not be viewed as an imbalance of nature but rather a normal cycling and recycling of the forest. At times, however, the damage imposed by abiotic and biotic factors may exceed our perception of what is normal or conflict with our management objectives. Additionally, factors resulting from human activity and the introduction of non-native insects and pathogens may impair the long-term sustainability of trees and forests.

This report was compiled using NDFS documents by Peter Gag, Forest Health Manager, for the North Dakota Forest Service.

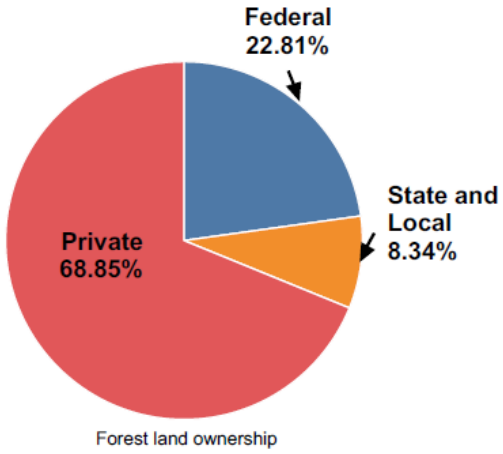
Cover Photo of the Theodore Roosevelt National Park, NDFS

Forestland Ownership Distribution

Forests are an important part of North Dakota's natural resource heritage and make up just under two percent of the state's landcover. They provide access to outdoor educational and recreational opportunities and managed wildlife habitat, while playing an important role in protecting watersheds.

Roughly 69 percent (564,000 acres) of forestland in North Dakota is categorized as privately owned (Figure 1). The federal government, primarily the U.S. Forest Service, is responsible for the management of roughly 188,000 acres of North Dakota's forestland, or approximately 23 percent, while state and local entities manage approximately 68,000 acres, or roughly 8 percent (USDA Forest Service, 2019).

Figure 1: Estimated forestland ownership in North Dakota based on field data collected using the USDA Forest Service Forest Inventory and Analysis (FIA).
USDA Forest Service, 2020



Conditions of North Dakota's Forest Resources

North Dakota's forest resources can be separated into three categories: native forests, conservation plantings, and community forests. These resources provide numerous ecological, social and economic benefits to North Dakota residents. The following summaries describe the general conditions of each category of the state's forest resources. These narratives do not necessarily depict specific causal agents of tree or forest decline, but rather describe the factors that frequently influence their current condition.

Native Forests
Native forests are distributed sparsely across the state and cover 815,000 acres, or approximately 1.8 percent of North Dakota's total area. These native forests are comprised of eastern deciduous and western coniferous forest types with a myriad of associated flora and fauna. The distribution of North Dakota's native forests creates ecologically diverse and unique zones of transition across the state.

Deciduous forest types account for 98 percent of North Dakota's forests. Common deciduous forest types in North Dakota include elm/ash/cottonwood, aspen/birch, and bur oak. These forest types are categorized by the dominance of one or up to a few tree species, although numerous species may be included in each forest type. Native forests provide wildlife habitat, recreational opportunities, and wood products; stabilize river banks; filter water runoff from adjacent agricultural lands; serve as seed sources for conservation tree production; and increase the botanical diversity of the state.

The elm/ash/cottonwood forest type is the most abundant and occurs along rivers, lakes, and streams throughout the state. Bur oak and aspen/birch forests are common in the Turtle Mountains (north-central), Devils Lake Hills (center of northeastern quarter), and Pembina Gorge (northeastern corner). Isolated stands consisting of ponderosa pine and Rocky Mountain juniper are in the southwestern counties of the state, making up only two percent of the state's forestland.

Forests are generally resilient to damage imposed by endemic insects and diseases. However, damage caused by these agents, coupled with other underlying factors, may threaten the long-term sustainability of the state's forests. These factors include:

- Reduced species diversity due to damage caused by non-native forest pests.
- Over-maturity of existing stands and the absence of disturbances essential to regenerate forests.
- Lack of forest regeneration due to heavy deer browsing pressure and alteration of natural flood plains along rivers.

Nearly one-fifth of North Dakota's forests occur within 200 feet of a stream or lake (Haugen et al. 2011). The majority of these forests consist of ash, elm, and cottonwood. The health and sustainability of these plant communities have important implications for water quality, flood control, wildlife habitat, and recreational opportunities.

The elm/ash forest type is the most abundant of all native riparian forestland in the state. These forests have experienced significant alterations during the past several decades due to damage caused by Dutch elm disease (*Ophiostoma ulmi* and *O. nova-ulmi*), overgrazing, altered water flows, and conversion to non-forestland. The threat of the emerald ash borer is another significant issue with the potential to drastically affect the elm/ash forest type along riparian areas due to the overall abundance of ash. Emerald ash borer has not been detected in North Dakota.

The cottonwood (*Populus deltoides*) forests that occur within the Missouri River flood plain are in poor condition, which has resulted from progressive mortality of mature trees and the absence of natural regeneration to replace this mortality. Prior to flood mitigation, the Missouri River flood plain experienced periodic inundation as high spring water flows scoured and deposited sand in low-lying areas. These moist sandbars served as seedbeds for cottonwood and were critical for natural regeneration of the species.

In the absence of flooding and subsequent sandbar formation, riparian cottonwood forest acres continue to decline because no young cottonwoods will be available to replace the over-mature trees that have succumbed to old age and senescence. While historic flooding along the Missouri and Souris rivers during the 2011 growing season have re-created a situation that would benefit the regeneration of cottonwood, the extent of regeneration is yet to be seen. Due to the infrequency of flooding events such as in 2011, sustainability of cottonwood regeneration on the Missouri River is not likely without direct management.

Nearly 20 percent of North Dakota's forestland is classified as the aspen/birch forest type. The majority of this forest type is in the Turtle Mountains, where the state's largest concentration of forestland is represented. Lack of fire disturbance and/or harvesting has resulted in older stands with minimal natural regeneration within these forests. The current condition of many stands is characterized by extensive stem decay caused by Phellinus tremulae and large stem mortality caused by hypoxylon canker (*Hypoxylon mammatum*).

In addition, the Turtle Mountains are prone to periodic defoliation caused by the forest tent caterpillar (FTC) (*Malacosoma disstria*) and more recently, large aspen tortrix (LAT) (*Choristoneura conflictana*). Defoliation reduces growth, predisposes trees to other damaging agents, and exacerbates the senescence of aging aspen stands. The declining aspen overstory may succeed to hazel (*Corylus spp*.) shrub land, in part due to the absence of shade-tolerant conifers in North Dakota.

Forestland owners have not actively pursued the harvest of aspen in the past several years. The vigorous regeneration of aspen that follows harvesting is important for the long-term perpetuation of this unique forested resource. Unfortunately, future opportunities to harvest North Dakota's timber will likely decrease due to the scarcity of sawmills, increasing mill production costs, and decreasing demand for aspen wood products from local sources.

Figure 2: Native aspen/birch forest of the Turtle Mountains.

Conservation Plantings

North Dakota is largely a rural state with an economy that is deeply rooted in agriculture. Conservation plantings are an important component of many agricultural systems and improve the quality of rural living in the Northern Plains. Conservation plantings are generally referred to as field windbreaks, farmstead shelterbelts, living snow fences, wildlife plantings, etc. Conservation plantings are designed to achieve conservation, economic, and societal goals. For example, field windbreaks reduce soil erosion during years of drought, reduce water evaporation from adjacent cropland, and increase crop yields.

Similarly, some plantings are designed to stabilize riverbanks, filter water runoff from adjacent agricultural lands, provide wildlife habitat, protect stretches of highways prone to severe snow accumulation, provide wind protection and increased gains for livestock, or protect farmsteads and rural homes from snow and wind, therefore saving energy while creating aesthetic value surrounding a homestead.

Although many conservation tree plantings occur in areas where the historical vegetation type was prairie, these resources are critical for the needs of rural residents who live in the current agricultural landscape.

Tree plantings of the northern Plains are exposed to numerous pests and environmental conditions that reduce their effectiveness, hinder planting success, and limit long-term survival. Deterioration of tree plantings is often incited by drought, flooding, wildland fire, early or late frosts, inadequate spacing, weed competition, herbicide exposure, defoliating insects, and foliar diseases. As trees become weakened, canker diseases and wood-boring insects may cause further damage to these plantings.

Preventing the deterioration of conservation plantings is more effective than treating the outcomes after the fact. Maintaining the availability of water, light, and nutrients to trees by incorporating various management techniques is fundamental. Using best practices for weed-control, planting density and arrangement, and species diversity will help prevent many

underlying factors that cause the decline of conservation plantings. Plantings composed of one or few species often experience episodes of elevated tree mortality simply because all trees are commonly vulnerable to the same damaging agents.

Some examples of planting failures associated with limited species diversity include the decline of single-row Siberian elm or green ash field windbreaks due to herbicide exposure, marginal cold hardiness, and canker diseases. The decline of Colorado blue spruce plantings is primarily due to yellowheaded spruce sawfly (*Pikonema alaskensis*) (predominantly in the western half of the state). Some spruce decline diseases are Stigmina needlecast (*Stigmina lautii*) and, less commonly, Rhizosphaera needlecast (*Rhizosphaera kalkhoffii*) (both predominantly in the eastern half of the state), and Valsa canker (*Valsa kunzei*), which commonly occurs statewide. The impacts of these damaging factors can be reduced by incorporating additional species into these or future plantings.

Figure 3: Conservation plantings in north eastern North Dakota, near the Pembina Gorge.

Community Forests

Community forests include boulevard trees, trees planted in city parks, and trees that naturally occur within city limits or public rights of way. As a whole, these tree resources provide many benefits to the community's residents, including reduced heating and cooling costs, wind and snow protection, beautification, recreational opportunities, and enhanced quality of life. Because of the need to address the relationships of neighboring trees, community forests must include trees that are growing on both public and private property. The management of such tree resources may fall under the responsibility of city foresters, public works departments, and/or community tree boards.

Trees planted in residential areas are exposed to numerous insects and diseases. The frequency and severity of pest damage often reflects the composition and abundance of host species in the community's forest. In addition, trees growing in residential areas are exposed to many environmental stressors, such as compacted soils, herbicides, variable watering, nutrient deficiency, and mechanical injuries. Such stresses compound the damage caused by insects and disease.

Additionally, Dutch elm disease continues to be a predominant tree health issue in our community forests. This disease has eliminated many of the stately elms that once graced North Dakota communities. Several larger communities have developed management programs to combat Dutch elm disease with notable success. However, many smaller communities that lack the financial resources and forestry staff, continue to be impacted by this disease.

Ash species and cultivated ash varieties have been the most common replacements for elm trees killed by Dutch elm disease. As a result, many community forests now have an overabundance of ash. Although ash performs well on a variety of sites and conditions, the overreliance on this species has made emerald ash borer (*Agrilus planipennis*) a considerable concern. This exotic ash-killing beetle has been detected as close as Winnipeg, Manitoba and Sauk Center, MN. Many North Dakota communities have realized the vulnerability of their community tree resource and are embracing tree species diversification. In 2015, ash trees still made up about 48% of municipal tree populations (Johnson, 2015).

Figure 4: One example of the many community forests that can be found encompassing all of our North Dakota communities.

Section 1 - Weather and Related Issues

Unlike the drought conditions in the fall of 2018, both the 2019 and 2020 growing seasons started without drought conditions due to the previous fall and winter precipitation. For both prior winters, snowfall was above the 1981-2010 average across much of the state. Equally important, fall rainfall events replenished water deficits across the growing season, prior to the onset of winter conditions and the accumulation of snow. This was particularly important during the fall of 2019, when fall rains far exceeded average, creating very wet soil conditions. This became more complicated by an early October snowfall, that affected most of the state.

In relation to tree growth, the importance of the timing of rain and snow events has implications for root functions during the winter and spring. The extent of fall and winter

precipitation prior to the 2020 growing season caused waterlogging of trees in positions of low slope. Waterlogging in heavy, fine-textured soils can severely limit root function and overall tree productivity, even causing death. In contrast, the accumulated precipitation that recharged soil conditions prior to the spring of 2019 was less than that of 2020, and did not create the boarder scale waterlogging conditions.

Following the onset of the growing season, precipitation conditions between 2019 and 2020 diverged. May 2019 precipitation was 30-50% of normal in the northern half of the state, while the southern half was 120-170% of normal (Figure 5). Moist conditions in the southern half of the state were generally wetter and cooler, creating conditions conducive to foliar fungal diseases. The northern half of the state was experiencing far more water stress as drought conditions increased through mid-September. By contrast, spring 2020 precipitation for the same time period was much lower, quickly elevating water stress levels state wide (Figure 5).

During both 2019 and 2020, growing season drought conditions worsened throughout much of the state, with the driest conditions persisting in the central and southwest regions of the state (Figure 6). Across the growing seasons, 2020 experienced a much more extreme range in available moisture than 2019, starting with extremely wet soils in many locations. Beginning the growing season with saturated soil conditions often lowers root system nutrient acquisition and gas exchange, causing reduced growth. Following these physiological conditions with the drought experienced later in the growing season exacerbated stress conditions and further complicated productivity.

The total number of severe weather events during both 2019 and 2020 were relatively consistent with the previous several years, but were down markedly from 2007-2011. The occurrence of severe weather, including heavy rainfall, high winds, and hail, have implications on tree and forest health conditions through injury. With a slight up-tick in 2020 from 2019, there will likely be a response in future disease transmission due to bark damage from wind and hail creating openings into conductive tissues.

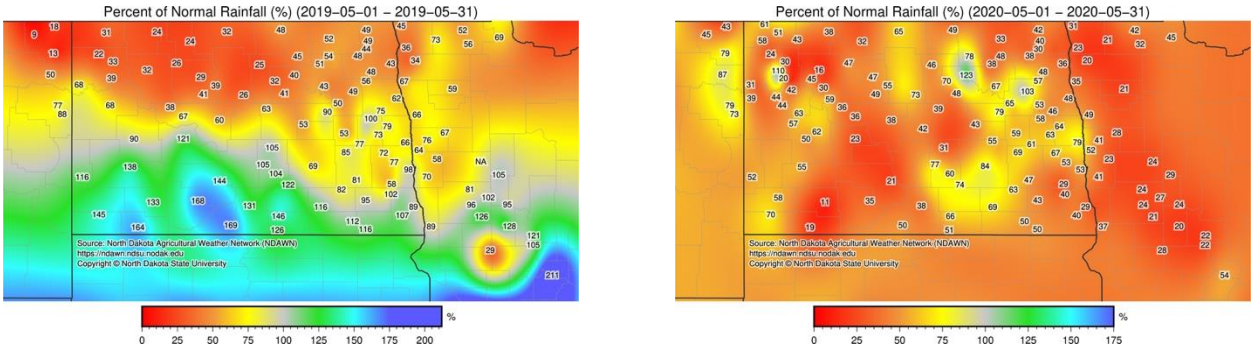


Figure 5: The percent of rainfall for the 2019 and 2020 period from May 1st through the 31st as compared to the mean rainfall during the same period from 1981-2010.

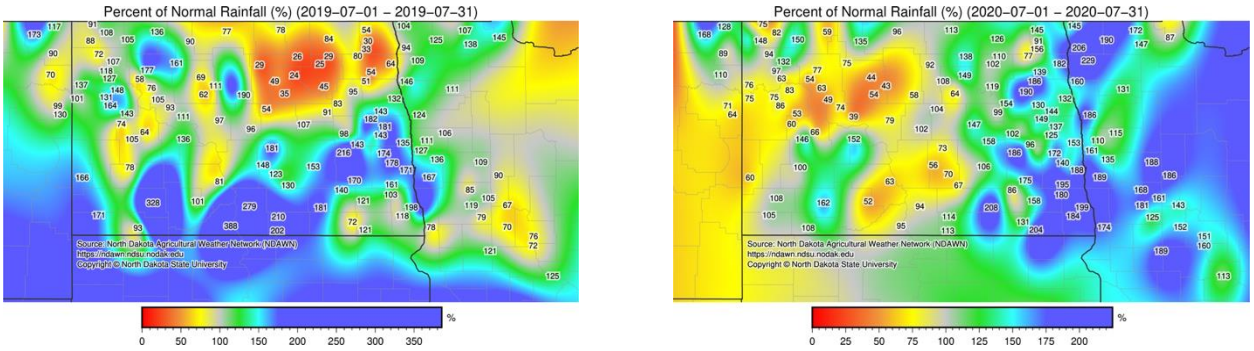


Figure 6: The percent of rainfall for the 2019 and 2020 period from July 1st through the 31st as compared to the mean rainfall during the same period from 1981-2010.

Section 2 – Forest Health Surveys

Invasive Insect Trapping – Cooperative Surveys

Japanese Beetle (*Popillia japonica*): The North Dakota Department of Agriculture (NDDA) conducts Japanese beetle counts in the state. This pest has potential consequences for the *Tilia* tree species that can be found in North Dakota's community and native forests. Of the 42 counties surveyed using 516 traps during the 2020 growing season, Japanese beetle was collected in 9 counties. This amounted to 402 beetles captured in 2020, down from a high of 1,467 in 22 counties in 2017, when larvae were accidentally introduced in nursery containers. Survey numbers for 2019 totaled 347 beetles found in 11 counties (Figure 7).

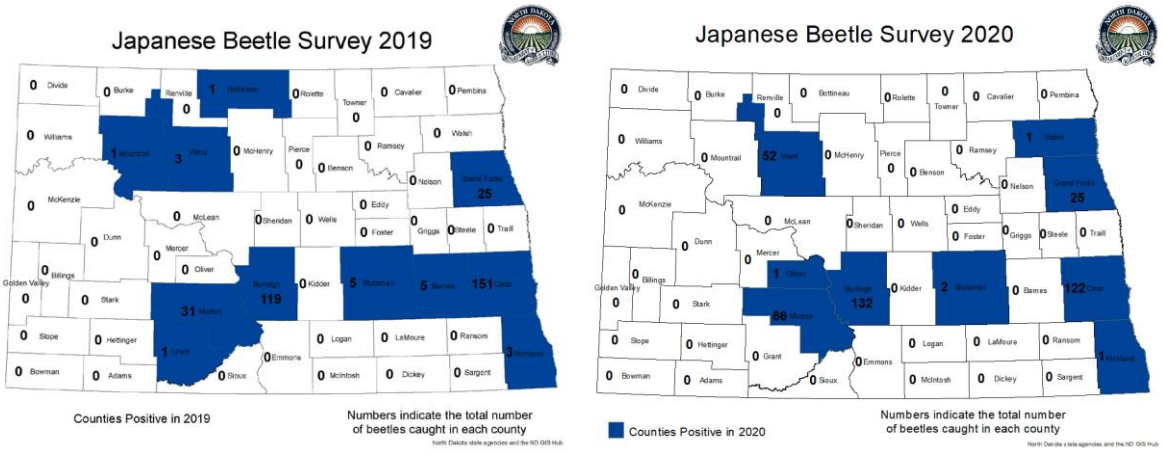


Figure 7: The total number of Japanese beetles caught per county in North Dakota during both 2019 and 2020.

Emerald Ash Borer (*Agrilus planipennis*): The United States Department of Agriculture (USDA) Animal Plant Health Inspection Service (APHIS) continues to supply the NDDA with purple prism traps. The North Dakota Forest Service (NDFS) and city foresters collaborate with NDDA

annually to install traps in high use areas around the state. There were 305 traps installed and maintained across 42 of the 53 counties in North Dakota during both the 2019 and 2020 growing seasons. EAB have yet to be detected in North Dakota.

Gypsy Moth (*Lymantria dispar*): During 2020 USDA APHIS placed 307 traps in North Dakota. Effort to delimit areas adjacent to two 2019 trap sites where moths were captured produced no detections. No beetles were detected during the 2020 growing season from any of the 307 traps.

Exotic Wood-boring Insect Surveys: The NDDA Cooperative Agricultural Pest Survey (CAPS) maintained 64 Lindgren traps, collecting 674 total specimens across 65 species. All specimens collected from the families Scolytidae, Cerambycidae, and Curculionidae were identified and recorded. During 2020, there were five new state records recorded, all in the Curculionidae: Scolytinae family and subfamily. There were also 29 county records during the 2020 growing season, despite the total collected specimens being approximately 38% of the average for the past 14 years.

Early Detection Rapid Response (EDRR): Twelve high-risk sites were surveyed for non-native bark and ambrosia beetles (Scolytidae). Three of the sites were located in the Dakota Prairie Grasslands Good Neighbor Authority hazardous fuels reduction project area. The survey was conducted from May 2, 2019 through August 22, 2019. A regional pre-screener/taxonomist identified all bark and ambrosia beetles in trap samples. Site and sample data were entered into a USDA Forest Service database used for sample tracking and reporting. Collections totaled 653 bark and ambrosia beetles representing 36 different species. Four individuals of *Xyleborus sp.*, one of the target species, were collected. Due to Covid-19, EDRR surveys were not conducted during 2020.

Section 3 - Recent and Common Forest Insects, Disease, and Abiotic Issues

The following section represents the most commonly encountered pests, pathogens, and abiotic issues encountered during 2019 and 2020. Many of these issues can be attributed to a particular species, forest category, or combination of the two. The conditions of North Dakota's forest resources are challenged by a changing climate, a reduced variety of natural disturbance mechanisms, and "off-site" planting. Trees that are considered off-site are not native to the site and its conditions, and are often further disadvantaged by common planting mistakes.

Planting creates a variety of situations that are uncommon to naturally-regenerating trees that have originated from seed. The first of these are errors in placing the bare root or container-grown root systems in the ground. Many times, these seedlings are planted too deep, causing roots to grow towards the more limited space nearer the soil surface. In other cases, older

planting stock have been imprinted, following the shape of the container. Both of these mistakes allow roots to grow over and around one another, girdling themselves and restricting water, nutrient, and carbohydrate transport. These circumstances often lead to poor resource acquisition and structurally unsound root systems, this in turn leads to an increased level of stress that makes way for secondary mechanisms of tree decline, such as wood-boring insects.

Forest Insect Issues

Spring (*Paleacrita vernata*) and fall (*Alsophila pometaria*) cankerworm are defoliators of tree species such as boxelder, elm, and linden. Cankerworm appears to be on a three-year cycle of population growth, that crashes following the third year. 2020 was the third year of the cycle in central ND, while one more year is expected in eastern ND.

Gall mites (*Eriophyid*) produce several types of galls on various species of deciduous and conifer hosts in North Dakota. During 2019 and 2020 it was common to find variably-colored bladder, finger, pouch, or bead galls on the foliage of many different landscaped tree species in our community forests. Galls of this nature are generally not a threat to the health of the tree, but can impact health if established in great numbers on a repeated annual basis. The moist spring conditions in 2019 and 2020 likely influenced the occurrence Eriophyid species.

Forest tent caterpillar (*Malacosoma disstria*) is a consist issue in native North Dakota forests. The caterpillar indiscriminately feeds on and defoliates deciduous trees. In North Dakota, the cyclic nature of FTC has not been determine, but tends to be about 13-15 years in neighboring states. Periodic monitoring efforts for FTC will continue using ground and aerial surveying to determine more about FTC behavior.

Disease Issues

Diplodia pinae is a common fungus found in conservation plantings of the Plains States. It often becomes more prevalent in older pine plantings, when trees are nearing 25-30 years of age. Diplodia pinea is frequently a consistent cause of stress to trees in these plantings, where competition for resources (water, nutrients, and light) are often maximized at sites that are dissimilar to the soil and climatic conditions where these pine would most often be found growing naturally.

Stigmina needlecast, caused by the fungus *Stigmina lautti*, is a common fungus found on spruce throughout North Dakota. Fungal bodies, called pycnidia, grow within the stomatal openings of the needles. In many locations, where the early growing season conditions were wet and humid, there was a preponderance of Stigmina. As is common with fungi, Stigmina prefers moist humid conditions which encourage sporulation. Sporulation of Stigmina occurs in the leaf litter below the tree, spreading up through the lower portions of the crown and canopy. Stigmina is commonly found in the central and eastern portions of the state.

Rhizosphaera needlecast (*Rhizosphaera kalkhoffi*) is a fungus of spruce that causes similar signs as Stigmina needlecast. Often being confused for Stigmina, this disease also causes a browning in all needles older than those produced during the current growing season. This is also a disease that works from the bottom up on spruce and some other conifers as a result of fungal sporulation in the litter from previously cast needles. Rhizosphaera is less common than stigmina and also found in the central and eastern portions of the state.

Valsa kunzei is a fungus that causes cankers on several species of spruce found in North Dakota plantings, but can also occur on other conifers. Valsa canker causes branch dieback most often in lower portions of the crown. Signs of this fungal canker are usually first noticed in the spring, when foliage on a branch will brown because the canker has cut off transport through the conductive tissues. Frequently present in conifer plantings, Valsa canker has become somewhat more prevalent with our cool wet springs, prime conditions for fungal growth. Canker growth that is significant enough to cut off conductive tissues causes browning of needles during the following growing season. Dead branches can be pruned out with careful tool cleaning to prevent spreading the disease.

Abiotic Issues

Weather, soil characteristics, and human induced conditions encompass the abiotic variables that have significant impacts on tree health in North Dakota.

Root Disturbance

Tree health issues are frequently challenged by poor planting practices. Excessive depth drives fundamental root structure problems that become increasingly complicated through time. Machinery use causes compaction of the soil under tree crowns, often leading to mechanical damage of the roots and trunk. Digging around trees damages root structures and can hinder physical and functional processes necessary for tree growth. These are consistent issues encountered in our community forests and conservation plantings in North Dakota.

Chemical damage

The application of herbicides is consistently seen as an agent of damage in trees of our community forests and conservation plantings. In most cases, applications placed on surrounding competing vegetation gets translocated into the tree through the root system or inadvertently applied to the foliage through overspray or drift. The majority of these circumstance stem from misunderstood or careless selection or application of a product that was done with good intention. Fertilizer, herbicide, and pesticide use have direct influence on foliage, beneficial insects, and competing vegetation. 2019 and 2020 were consistent with other years, where a large portion of assistance requests were in one way or another complicated by the application of these chemicals.

Soil Conditions

Most of North Dakota's soils have high alkalinity, which hinders the solubility of the essential nutrients for plant growth. Because high pH creates a situation where nutrients cannot readily dissolve into a soil solution, they cannot be accessed by the vegetation. This is a fundamental issue underlying the occurrence of health problems that are experienced by trees in North Dakota. Spruce (*Picea*) and pine (*Pinus*) are both species commonly planted in North Dakota that are intolerant of high pH soil, underscoring the initial stress of being planted in many places in the state.

One nutrient that is significantly affected by high pH soils is iron. The inability of many tree species to acquire sufficient iron from the soil is expressed through chlorosis in the leaves, where the leaf surface between the veins turns yellow. This symptom is a very common assistance request for a variety of species, but is most frequently seen in maples (*Acer spp.*).

Section 4 – Forest Health Assessments

Pine Mortality

During the 2020 growing season, pines in the central and south eastern parts of the state experienced high levels of mortality. In most cases, this mortality was influenced by the previous fall and winter precipitation. The percentage of normal rainfall for the month of September 2019 ranged from 150% to 900% of normal, following a growing season that was already experiencing normal or above normal rainfall (Figure 8). This frequently led to extremely high soil moisture content in most soils, but particularly those with fine texture and those found in poorly-drained, low-slope positions.

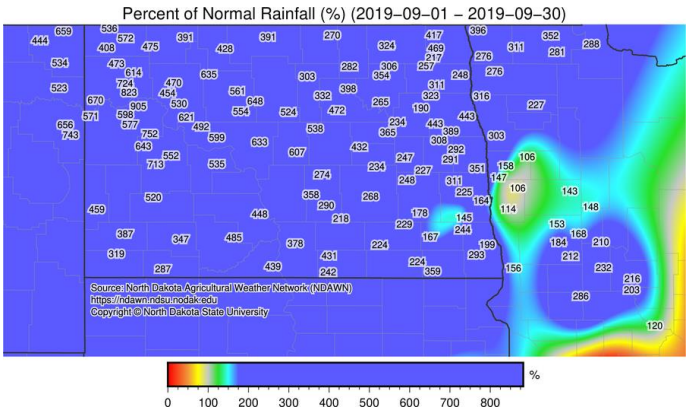


Figure 8: Total rainfall for the month of September of 2019 following a growing season with normal to above normal rainfall and a low occurrence of drought conditions statewide (North Dakota Agricultural Network).

Excessive soil moisture was then covered with a significant October snowfall that effectively insulated saturated soils, adding to the overall total moisture. The combination of available soil moisture, adequate radiation, and air temperature can allow conifer foliage to continue to transpire available water during the winter and early spring. With highly saturated, or waterlogged soil conditions, tree root systems would be unable to perform normal root

functions. Soil waterlogging commonly leads to depleted soil oxygen, which induces anaerobic conditions, reducing metabolism and nutrient availability, resulting in severe physiological injuries (Armstrong et al., 2009; Bailey-Serres et al., 2012; Herzog et al., 2016). The onset of these conditions will reduce root function, slowing shoot and needle growth, frequently causing plant death (Amador et al., 2012).

This response to waterlogged soils played an important role in the browning of most years of foliage held on many conifers. Conifers do not have energy stores or produce a flush of foliage following injury, like deciduous trees, so the browning of foliage removes the tissues necessary for growth, leading to death. Conifers that experience partial browning of their crown will have reduced vigor, making them vulnerable to secondary mechanisms of injury from tree insects and pathogens. In some cases, decreased vigor may have encouraged pine tip moth presence on new shoots or a fungal growth in young stem bark and current year needle growth. Trees that did not die from the loss of foliage due to waterlogging, very likely experienced decreased growth, which elevated tree stress in many locations. This circumstance may yet manifest as continued tree health issues during the 2021 growing seasons.

Figure 9: Image of frequently observed pine mortality in central and eastern North Dakota conservation plantings. Late 2019 growing season rainfall and heavy snowfall caused waterlogging soil conditions through the winter and early spring, resulting in severe physiological injury and death.

Section 5 - Forest Health Program Activities

All annual workshops and trainings sessions for the spring and summer of 2020 were cancelled due to the Covid-19 pandemic.

Emerald Ash Borer Awareness Week

Annual emerald ash borer awareness week activities for 2019 were developed by North Dakota's interagency planning team. EAB Detection and Management training was delivered through intensive and streamlined workshops for natural resource managers, arborists, and citizens.

EAB Planning Team:

- Dr. Joe Zeleznik, NDSU Extension
- Charles Elhard, North Dakota Department of Agriculture
- Lezlee Johnson, North Dakota Forest Service
- Peter Gag, North Dakota Forest Service

Participants received an information packet including existing and custom publications:
Emerald Ash Borer Detection and Response
Ash Tree Identification
EAB Biology & Integrated Pest Management in ND
Firewood Alert flier
Detection of EAB in Urban Environments
Joint Position Statement on Pesticide Use
Recognizing Insect Galleries in Ash Trees in MN
Profiles of Wood-boring Insects of Ash in ND
EAB Look-Alikes
EAB ID & Response Checklist
EAB ID Card
MN Guidelines to Slow the Growth of EAB

Bark Foraging Bird Survey

Given the success of finding emerald ash borer through observational surveys for woodpecker damage, the NDFS Forest Health program has introduced a project intended to engage all citizens in looking and listening for bark foraging birds. If the damage can guide us, why not the birds themselves? The program, started in 2020, is built around an online survey and training materials that can be used on mobile devices to record a particular set of variables that increase the possibility of using bark foraging bird behavior to guide forest health professionals to potential infestation sites. The intent of the project is to create a citizen science approach to increase the area that can be addressed while developing public interest in our natural resources.
https://www.ndinvasives.org/learn-about-eab-and-bark-foraging-birds

Training Sessions

EAB Detection and Response (streamlined) Soil Conservation District Employees Annual Conference and Tree Promotion meeting. March 6, 2019. 30 attendees.

Field Trip to Eagan, Minnesota April 9-10, 2019 (intensive). Attendance: 21 City foresters and arborists, NDFS staff, NDDA staff, Extension staff, Travel to Eagan on April 9, Training April 10. Conducted by Jennifer Burington, Minnesota Department of Agriculture (MNDA). EAB detection

and management presentations by MNDA, University of Minnesota, and City Foresters from Rochester and Eagan. Field experience - branch sampling.

Natural Resource Conservation Service (NRCS)/Soil Conservation Districts (SCD) EAB Detection and Management Training (intensive) 4-hour course given by the EAB Planning team March 26, 27, and 28 of 2019 at Devils Lake, Jamestown, and Dickinson to NRCS and SCD staff. Dickinson – 33 attendees, Jamestown 12 attendees, Devils Lake – 19. Field experience – branch sampling practice and larvae ID.

North Dakota Game and Fish Biologists Annual meeting August 14, 2019 (streamlined) 1-hour presentation on EAB detection and management to 60 biologists.

NDUCFA EAB Detection and Management Workshops (4-hour, intensive).
October 9 in Grand Forks (19 tree care professionals).
October 16 in Bismarck (21 tree care professionals).

Awareness Actions
NDFS continues to distribute the "Protect North Dakota's Trees" brochure through the North Dakota Department of Commerce Rest Area Literature Distribution program at all ND rest areas along I-94 and I-29.

EAB Awareness Week - NDSU Extension and NDDA developed content for a social media campaign.

NDFS Forest Health continues to maintain the website NDInvasives.org as an outreach method focused on broadening the avenues for disseminating pertinent forest health related materials and information, while also creating another process for assisting with public inquiries.

Forest Health Internship Program
The Forest Health Internship/Technician program continued to acquire high-caliber summer student interns and early career professionals to help conduct collaborative tree health activities across the state. During both the 2019 and 2020 field seasons, three employees were involved in collaborative survey efforts of Emerald ash borer sampling across the state, supported by Animal Plant Health Inspection Service (APHIS) and coordinated North Dakota Department of Agriculture (NDDA). They also worked in other aspects of the state's EAB efforts to inventory community forests and collect the data used to guide EAB planning, and conducted Lindgren trap surveys to monitor presence and absence of other non-target forest insects. This program continues to be vital to the collection of data necessary to help monitor health changes in North Dakota's trees and forests.

Forest Health Issues of Concern
The following issues remain significant management concerns:

- The absence of historical disturbance on the landscape is limiting the opportunity for natural regeneration, ultimately influencing sustainability.
- The threat of Emerald ash borer creates risk for all ash growing in North Dakota's plantings and community and native forests.
- Variability in temperature and precipitation events poses a significant issue, creating complex growing season conditions.

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