North Dakota

Forest Health Report

Forest Health Report

2001-2002

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Introduction

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Introduction

The "North Dakota Forest Health Report 2001-2002" summarizes forest health conditions observed within the state of North Dakota. A brief narrative describes the distribution and uniqueness of North Dakota's forest resources, and provides a template for understanding forest health issues within the state. For each forest resource type, a brief summary of general conditions describes the overall health and potential threats to these resources. Lastly, specific insects, diseases, and abiotic agents of tree/forest decline are discussed.

The information presented in this report was compiled from various sources and methods. These included site visits, personal communication, and correspondence with local government agencies. Information regarding insect and disease conditions were gathered through communications with North Dakota Forest Service personnel, North Dakota State University plant pathologists, North Dakota city foresters, Soil Conservation District personnel, Natural Resources Conservation Service personnel, and North Dakota Parks and Recreation personnel. In addition, the USDA Forest Service-Region 1 provided aerial detection survey summaries and gypsy moth trapping survey summaries. The North Dakota Department of Agriculture and the USDA Animal and Plant Health Inspection Service also provided summaries. Other methods of gathering information included site visits and evaluations of various woodlands and rural plantings throughout the state.

Forest Resources in North Dakota

North Dakota is characterized as a prairie state due to its topography, soils, and climate, which limits the diversity and distribution of tree species and promotes perennial grasses and forbs. Despite this characterization, North Dakota possesses some diverse and unique forest resources. These forest resources can be classified into three types: native forests, rural plantings, and community forests. Native forests include deciduous and coniferous woodlands of sufficient acreage and stand density to be classified as forestland. Rural plantings include field windbreaks, shelterbelts, living snow fences, riparian buffer strips, and wildlife plantings. Community forests include boulevard trees and trees within city parks. These forest resources have unique management objectives, histories, and forest health issues.

North Dakota's native forests are an extremely valuable resource due to their limited size and distribution. These forest resources provide wildlife habitat, stabilize riparian soils, contribute substantially to the floral diversity of the state, and are utilized for a multitude of recreational activities.

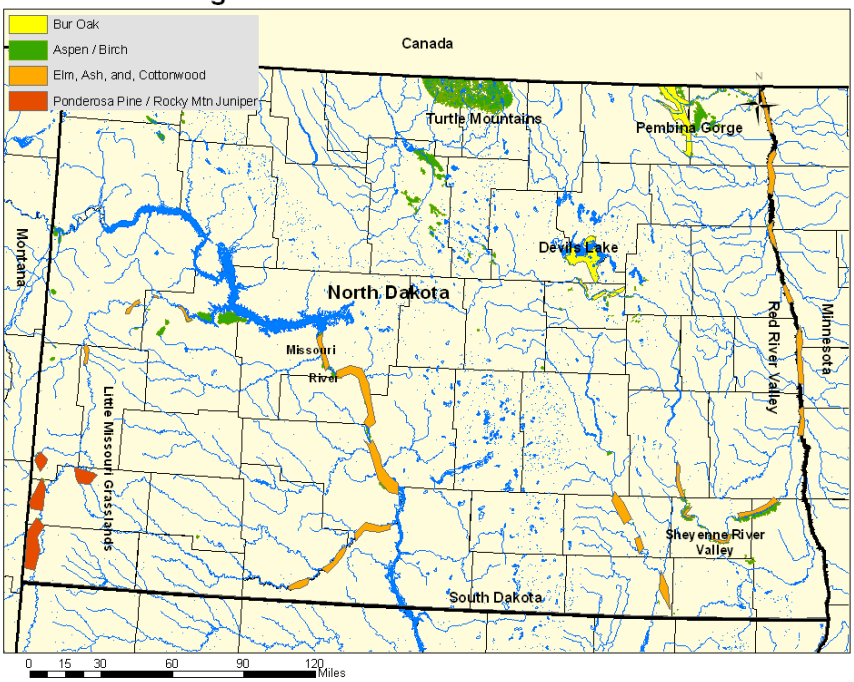
Prior to European settlement, forestland constituted approximately 700,000 acres within the state. A forest survey conducted in 1980 estimated forestland to cover 572,000 acres (Jakes and Smith 1982). The reduction in forestland is the result of conversion to agricultural land in the Red River Valley and Turtle Mountains, and inundation resulting from dam construction

along the Missouri River. The most recent report of forestland tallied 673,000 acres in 1994. This acreage increase was largely due to a forest inventory redefinition of forestland (Haugen et al. 1999).

North Dakota's native forests can be categorized as lowland deciduous forests, upland deciduous forests, and western coniferous forest. Lowland deciduous forests include stands dominated by American elm (*Ulmus americana*) and green ash (*Fraxinus pennsylvanica*) in the eastern half of the state, and cottonwood (*Populus deltoides*) forests along the Missouri River.

Stands dominated by aspen (*Populus tremuloides*) and bur oak (*Quercus macrocarpa*) represent upland deciduous forests and are found in the Turtle Mountains of the north central region, the Pembina Gorge region in the northeast, and the Sheyenne River Valley in the southeast portion of the state. Small pockets of western coniferous forests composed of ponderosa pine (*Pinus ponderosa*), limber pine (*Pinus flexilis*), and Rocky Mountain juniper (*Juniperus scopulorum*) exists in the southwest region of the state (Figure 1).

Figure 1. Forestland of North Dakota



Non-industrial private landowners own approximately 77% of North Dakota's native forestland. The majority of these landowners possess less than 50 acres of forestland. This creates a mosaic of small acreage-ownership distributed widely across the state. Native American Tribes and state agencies, with 9% and 6% ownership, hold much of the remaining forestlands (Haugen et al. 1999).

In addition to native forestland, rural plantings such as windbreaks, shelterbelts, and living snow fences are abundant throughout the state. North Dakota has a long history of tree planting efforts dating back to the Timber Culture Act of 1873. Early settlers planted trees to provide wind protection, fuel, and food. These planting efforts were accelerated by the Dust Bowl of the 1930s and have continued throughout the state into present times for conservation purposes. These plantings are critical for controlling wind erosion, reducing water evaporation from soil on agriculture lands, distributing snow in winter months, and providing thermal cover for livestock and wildlife. Species commonly found in rural plantings include American elm, Siberian elm (*Ulmus pumila*), hybrid poplars (*Populus* sp), green ash, ponderosa pine, and spruce (*Picea* sp).

Windbreaks, shelterbelts, and living snow fences contribute substantially to the forest resources of the state. It is estimated that rural conservation plantings encompass 1.5 million acres within the state. In linear terms, 55,000 miles of field windbreaks have been planted in North Dakota (Haugen et al. 1999).

The Towner State Nursery and the Lincoln-Oakes Nurseries produce the majority of tree stocks used in conservation plantings. The Towner State Nursery,

operated by the North Dakota Forest Service, specializes in the production of conifers and annually produces over 1 million seedlings. The majority of deciduous seedlings are produced by the Lincoln-Oakes Nurseries that are owned and operated by the North Dakota Association of Soil Conservation Districts. These nurseries have been instrumental in the extensive planting efforts conducted throughout the state.

The third most notable forest resource type in North Dakota is community forests. Community trees and forests have been planted by North Dakotans in residential areas for purposes of beautification, shade, and wind protection. Common tree species present in residential communities include cultivars of elm, linden or basswood (*Tilia americana*), and ash. Locally available species, such as the American elm, was the most commonly planted street tree in the early years of statehood. The devastation to elms caused by Dutch elm disease facilitated the development of several municipal forestry programs. Since the development of these programs, several other species and cultivars have been planted in residential areas for purposes of diversity and beautification.

Each of North Dakota's forest resource types possess distinct management objectives, such as beautification of residential areas, wind protection of agricultural crops, or stream bank stabilization along rivers. It is these unique management objectives that create unique forest health concerns in the state of North Dakota that in turn characterize plains forestry.

General Conditions of North Dakota Forest Resources

The following narratives provide information regarding the general conditions of each of the three forest resource types described in the previous section. These narratives do not necessarily describe specific causal agents of tree/forest decline but rather illustrate the general forest health issues facing each forest resource.

Native Woodlands

Bottomland Deciduous Forests

Bottomland forests consisting of American elm (*Ulmus americana*) and green ash (*Fraxinus pennsylvannica*) in the eastern half of the state, and cottonwood (*Populus deltoides*) forests in the western half of the state compose, the majority of North Dakota's native forests.

Forest health concerns in these riparian woodlands can be differentiated and attributed to two flooding regimes. Flooding in the eastern portion of the state, and lack of flooding in the western portion of the state, create two polarized forest health issues for lowland forests.

The elm/ash forests of the Red, Sheyenne, and Pembina River Valleys often experience summer flooding that contributes to forest decline within these areas. Floods occurring of sufficient duration during the growing season may cause fine root mortality and eventual tree death. In contrast, decline of cottonwood forests in the western portion of the state can be attributed to over-maturity and lack of flooding to promote cottonwood regeneration. The lack

of regeneration, coupled with gradual senescence and decline of old cottonwood trees, threatens the future sustainability of these unique riparian ecosystems.

Additionally, encroachment of species such as Russian olive (*Elaeagnus angustifolia*), buckthorn (*Rhammus* sp.) and brome grass (*Bromus* sp.) also disrupts cottonwood forest regeneration and succession.

In addition, eastern bottomland forests have been severely impacted by Dutch elm disease. This disease has eliminated many of the once abundant American elms that naturally occurred in these forests, and has shifted the species composition toward green ash and boxelder (*Acer negundo*). This disease is of particular concern because of the American elm's status as the state tree.

Upland Deciduous Forests

Over maturity and lack of disturbance are the most significant factors influencing the health of upland aspen forests within the state. Lack of fire disturbance and/or harvesting has resulted in a greater number of stands that are older and denser than historical conditions. These current conditions result in overmature, declining stands in which stem decay and root rots are the primary pathogens.

The mosaic of ownership contributes to the over maturity of these stands due to the dispersion of aspen resources, the lack of a significant forest products industry within the state,

and the small acreages possessed by landowners. As a result, non-industrial private forest landowners are left with few options to actively manage their woodlot on a rotational basis.

Coniferous Forests

Currently, few significant forest health concerns exist in the native ponderosa pine stands located in the southwestern part of the state. Sporadic top-kill caused by pine engraver beetles (*Ips* sp.) and low levels of turpentine beetle (*Dendroctonus valens*) attacks present no immediate threats to these forests. The greatest concern in these areas is wildfire. Years of past fire suppression and overstocked stands create conditions conducive to stand replacing fires. Compounding this problem is a recent drought cycle that has dried out downed woody fuels in this area of the state. Thinning and prescribed burning is planned for a portion of these stands near the Logging Camp Ranch in Slope County. Such management should improve stand health and reduce the risk of severe wildfires.

Rural Plantings

Windbreaks, shelterbelts, living snow fences, and other tree plantings are extremely valuable resources in the state of North Dakota. Field windbreaks are critical for preventing soil erosion, reducing evaporation from soils, and increasing crop yields, thereby serving long term economic and conservation goals. Consequently, forest health issues experienced in these resources must be recognized at local, regional, and national levels. In addition, rural plantings provide wildlife habitat and wind protection for livestock.

Many rural plantings are in need of renovation. Older windbreaks and shelterbelts show evidence of decline due to many biotic and abiotic agents. Herbicides, drought, floods, inadequate spacing, lack of maintenance, weed competition, insects, and diseases have contributed to the gradual decline of rural plantings through time.

Predisposing stressors such as herbicide drift and tillage operations that damage root systems exacerbate insect and disease problems. Dutch elm disease, stem cankers, herbicide injury, and defoliation have decimated many rural elm plantings. Pathogens, such as Cytospora canker and Rhizosphaera needlecast, decreases the utility of many spruce windbreaks. Other problems occurring in rural plantings include winter injury of conifers, canker diseases of hardwoods, and weed competition.

Community Forests

Trees growing in residential communities are often subjected to several insects, diseases, and environmental stresses. These pests and stresses can result in tree decline or mortality if left unchecked, but often are of concern because of aesthetic reasons. The multitude of pest problems is due in part to the variety of tree species planted in municipalities, the host-specific nature of many insects and diseases, and the harshness of the urban landscape. Frequently observed pest problems in residential areas include spider mites (Family Tetranychidae), aphids (F. Aphididae), cankerworms (F. Geometridae), ash anthracnose (*Gnomoniella fraxini*), and fireblight (*Erwinia amylovara*). Abiotic

stressors such as compacted soils, turf herbicides, over watering, nutrient deficiency, and mechanical injuries often exacerbate the damage caused by insects and diseases.

Despite the many less-prominent tree pests in the urban landscape, Dutch elm disease continues to be the most serious problem in municipalities. This disease has eliminated many of the stately elms that once graced North Dakota cities. Several of the larger cities have developed a sanitation and management program to combat Dutch elm disease. However, smaller communities that cannot afford to staff a forester have been severely impacted by this disease. The severity of Dutch elm disease has prompted the use of several ash cultivars. Future problems may emerge because of the over abundance of ash trees within residential areas.

Insects, Diseases, and Abiotic Agents of Forest Health Decline in North Dakota

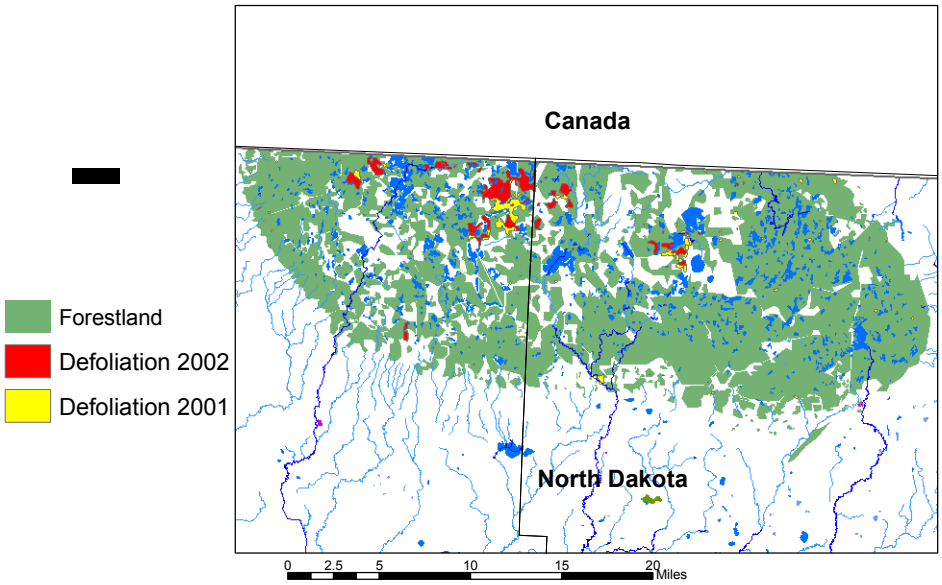
The following sections provide information about specific causes of tree/forest decline in North Dakota. The following narratives are not inclusive to all pests/stressors, but rather highlight the most significant forest health issues observed in 2001 and 2002. These summaries are intended to be qualitative except when specific figures regarding pests or pathogens are available.

Insects

Forest Tent Caterpillar (*Malacosoma disstria*)

The Turtle Mountains of the North Central region of the state encompass over 125,000-forested acres and annually experience some defoliation by the forest tent caterpillar. Defoliation by the forest tent caterpillar increased from 3,045 acres in 2001 to 4,345 acres in 2002 in this forested area (Figure 2). This defoliation was sporadic, variable in intensity, and

Figure 2. Forest Tent Caterpillar Defoliation in 2001 and 2002 of the Turtle Mountains, North Dakota

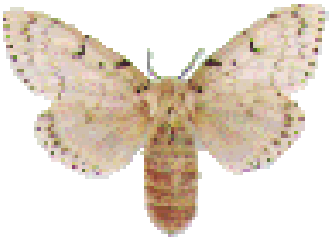


occurred primarily on aspen. These figures are significantly lower than the forest tent caterpillar peak in the late 1970s, when nearly all forested land within the Turtle Mountains experienced some defoliation. The Turtle Mountains are a popular summer recreation area in North Dakota. Defoliation and caterpillar larvae in campgrounds and state parks present a nuisance to campers. Repeated defoliation may speed the decline of these generally overmature stands. Monitoring efforts will continue in these areas of high recreational use to determine if control measures are warranted.

Small pockets of forest tent caterpillar defoliation were also observed in the Sheyenne River State Forest of the southeastern part of the state. This defoliation was light, sporadic, short in duration (lasting one year), and occurred on basswood (*Tilia americana*). Since the severity of defoliation was minimal and basswood in these areas is dominant and in a state of good vigor, the forest tent caterpillar posses little threat to the health of this resource.

Gypsy Moth (*Lymantria dispar*)

The North Dakota Forest Service, North Dakota Department of Agriculture, and APHIS conduct annual statewide gypsy moth detection trapping surveys. There were 403 and 365 gypsy moth detection traps placed in 2001 and 2002, respectively. These traps were distributed throughout the state to encompass major forest types and risk of gypsy moth introductions. No gypsy moths were captured in 2001 and 2002 during detection trapping efforts, and none have been captured in the state since 1998. Trapping efforts will continue in the future and include new areas of potential risk as the established range of the moth expands.



Courtesy of USDA-APHIS

Yellow-headed Spruce Sawfly (*Pikonema alaskensis*)

All species of spruce (*Picea* sp.) planted in North Dakota are susceptible to the yellow-headed spruce sawfly. Every year small and medium-sized spruce trees are lost to this insect. This insect is particularly troublesome in rural plantings where spruce is often used and open growing conditions provide favorable egg-laying sites (Katovich et al. 1995). Sawfly damage has been most significant in the north-central and northeast parts of the state over the past two years. The defoliation caused by the sawfly reduces windbreak efficiency and can predispose spruce trees to other damaging agents.

Poplar Borer (*Saperda calcarata*)

The poplar borer, a wood-boring cerambycid beetle, is a common pest of hybrid poplars and native cottonwoods in rural plantings throughout the state. Often this insect is a secondary pest, attacking trees of poor vigor and considerable stress. This beetle has been reported to cause substantial damage to hybrid poplars planted in the Lewis and Clark State Park along Lake Sakakawea. Based on communication with park personnel, it appears that the infestation has been accelerated by poor soils, canker disease, and drought that has likely weakened the trees and increased their susceptibility to the beetle.

Pine Needle Scale (*Chionaspis pinifoliae*)

The pine needle scale is commonly found on conifer hosts throughout North Dakota. Scales injure hosts by penetrating needles with their mouthparts and extracting nutrients. This feeding causes discoloration and yellowing of the needles, giving the tree a “sickly” appearance (Johnson and Lyon 1991). When infestations are great, entire trees

may be killed. Typically, this insect causes concern in community forests and landscape plantings because of the unappealing appearance of infested trees.

Diseases

Sphaeropsis Shoot Blight (*Sphaeropsis sapinea*)

Shoot blight, caused by *Sphaeropsis sapinea*, has been a problem observed in windbreaks of the Towner State Nursery for the past decade. Towner State Nursery annually produces 200,000 ponderosa pine seedlings, and there is concern that this disease could reduce the supply of pine seedlings the nursery will provide in the future. There is also the concern the fungus may be spread throughout the region by infected nursery stock if the blight is not suppressed or eliminated within the nursery. Removal of ponderosa pine tree rows is critical to the management of this disease. A survey identifying infected trees was utilized to prioritize windbreak removal.

A plan has been developed to prevent damage to nursery crops by monitoring the disease, systematically removing ponderosa pine tree rows and replacing with other species, applying preventive fungicides to nursery crops, and relocating ponderosa pine nursery crops to fields with minimum exposure to the disease. Forest Health Protection Funds were used to remove three windbreaks in 2002, and three more windbreaks will be removed in 2003. The Towner State Nursery will provide funds to replant the windbreaks with species other than ponderosa pine. This will reduce the potential for nursery stock losses, possible spread of the disease, and infection of pine provenance tests on adjacent federal lands.

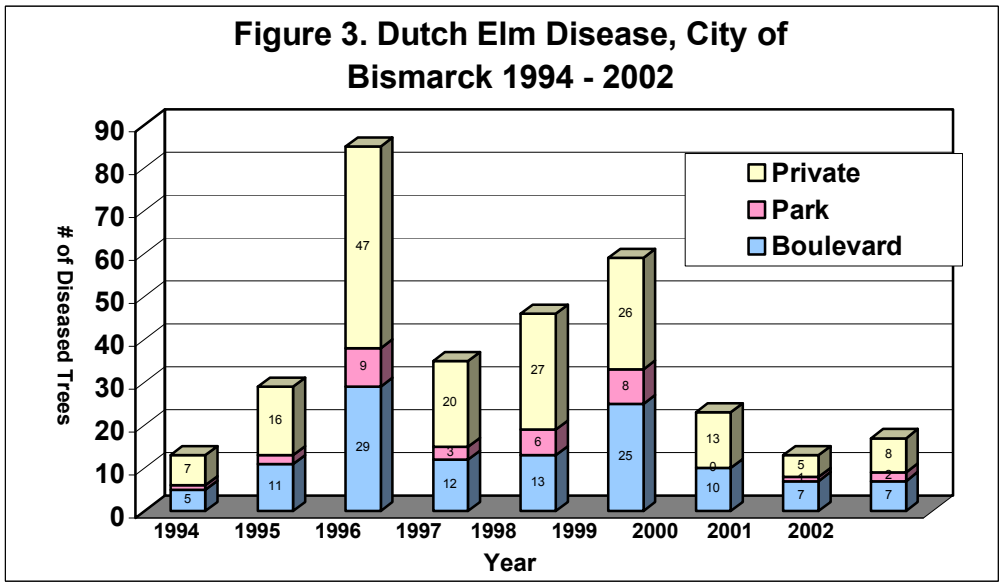
Dutch Elm Disease (*Ophiostoma ulmi*)

Dutch elm disease has been found in nearly all native woodlands, rural plantings, and municipalities throughout the state. This disease is of great concern because of the American elm's status as the state tree, and because it is one of relatively few species that possess the hardiness to be used in rural and landscape plantings.

Dutch elm disease has caused substantial damage in the riparian forests of the Red, Sheyenne, and James River Valleys. The disease has greatly reduced the elm component and has shifted the species composition toward green ash and boxelder in these forests. This disease has also caused significant windbreak decline as many older plantings composed of American elm have been decimated.

The disease consistently causes tree mortality in urban communities. Approximately 150 elms are lost to this disease annually in the City of Fargo. According to city forestry personnel, root grafting is responsible for the majority of new infections. The City of Bismarck reports 13 infected elms for 2001 and 17 for 2002. These figures are substantially lower than past years, when Dutch elm disease incidence peaked in 1996 with a total of 89 infected elms (Figure 3). In contrast to Fargo, the majority of new infections within Bismarck are attributed to vectoring of the fungus by the native bark beetle, *Hylurgopinus rufipes*. Larger cities, such as Fargo and Bismarck, conduct annual street surveys and implement pruning and sanitation to reduce the

impacts of this disease. Unfortunately, smaller communities that do not posses the means to staff a forester have been severely impacted by Dutch elm disease.



Courtesy of Bismarck Forestry Department

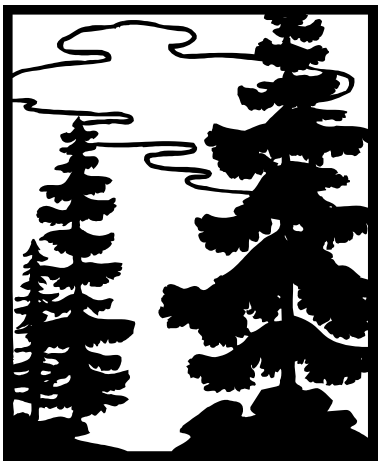
Cytospora Canker of Spruce *(Valsa kunzei)*

Cytospora canker, caused by the fungus *Valsa kunzei* (*Cytospora kunzei*, asexual stage) is a common problem of spruce in the state of North Dakota. Typically, this disease first occurs in the lower crown of the tree and slowly spreads laterally and vertically. If left unchecked, this fungus is capable of killing the tree.

Spruces are commonly used species in conservation plantings such as field windbreaks and living snow fences. Branch dieback, caused by the fungus, reduces the tree's ability to block wind, thereby impacting the utility of these rural plantings. The branch dieback and needle loss caused by Cytospora also gives spruce trees an unappealing appearance, creating concerns in urban landscapes.

Rhizosphaera Needle Cast of Spruce *(Rhizosphaera kalkhoffii)*

Another common disease of spruce within the state is Rhizosphaera needle cast caused by the fungus *Rhizosphaera kalkhoffii*. Although the incidence of this disease is aided by greater than normal spring rainfall, improper spacing in field windbreaks also contributes to the prevalence of this disease. Spruce trees planted closely together minimize airflow and creates moist conditions within the tree's inner foliage that enhances needle infection. This disease has a great impact in landscape plantings because of the unappealing appearance of infected trees and in rural plantings due to needle loss. This disease has been more prevalent in the northeast portion of the state where moisture conditions have favored infection of host trees.



Ash Anthracnose *(Gnomoniella fraxini)*

Ash anthracnose, caused by the fungus *Gnomoniella fraxini*, is a common foliar disease of ash in native woodlands, rural plantings, and community forests. Unless the disease causes complete defoliation and the tree is in a pre-existing state of low vigor, it rarely results in tree mortality. Generally, it is a cosmetic disease of landscape and boulevard trees. However, extensive damage caused by this fungus can weaken host trees, increase their vulnerability to other ash pests, and cause unacceptable aesthetic problems in community plantings.

Hypoxylon Canker of Aspen *(Hypoxylon mammatum)*

Hypoxylon canker caused by the fungus *Hypoxylon mammatum,* is a common disease of native quaking aspen within the state. It is not well understood how fungal infection occurs. As

cankers develop and expand on the lower bole, the tree may be girdled and killed (Anderson et al. 1979). This disease is common in native aspen stands of the Turtle Mountains in the north and the Sheyenne River Valley to the south. Further investigations are required to fully understand the incidence and severity of this disease and its impact on stand dynamics.

Western X-disease

Western X-disease continues to decimate chokecherry (*Prunus virginiana*) throughout the state. Since 1995, epidemic levels have been reported statewide and continue presently. The western X-disease pathogen causes reduced growth, shortened internodes, gradual decline and ultimate death. Chokecherry is a commonly used shrub in windbreaks and wildlife plantings in the state of North Dakota. This disease threatens the future use of several native and planted varieties of *Prunus* in conservation plantings. Currently, research is being conducted to identify resistant cultivars to this pathogen.

Ash Stem Decay *(Perenniporia fraxinophila)*

Stem decay of green ash caused by the fungus *Perenniporia fraxinophila* has been observed throughout the state. This fungus has been reported in many ash woodlands and plantings, including wooded draws of the Little Missouri Grasslands, forested areas along the Missouri River, riparian forests of eastern North Dakota, and field windbreaks. This fungus enters trees through wounds, branch stubs, or other openings in the bark. Although this fungus rarely kills the tree, infections increase the probability of stem breakage. Generally, incidence of stem decay increases with tree age. Further investigations are required to identify modes of infection and incidence of this fungus relative to tree/stand characteristics.

Phellinus Heart Decay of Aspen *(Phellinus tremmulae)*

Stem decay caused by the fungus *Phellinus tremmulae* is common in mature aspen stands throughout the state. Although the stem decay may not kill the tree, the reduced structural soundness increases the probability of top breakage and discourages utilization of aspen for wood products. The incidence of *P. tremmulae* tends to increase with tree age and the lack of disturbance has aged aspen stands and exacerbated the extent of stem decay.

The pathological rotation of aspen that is dictated by *P. tremmulae* is not well understood in North Dakota. Future surveys and investigations are required to identify the spatial and temporal relationships of *P. tremmulae* incidence to enhance management strategies.

Abiotic Factors

Abiotic factors have perhaps the greatest influence on forest health within the state for all forest resource types. Extremes in the North Dakota climate are limiting factors in the number of hardy species that can survive in the state, and also exert great stress on the native forest resources. Climatic extremes such as drought, flooding, late spring frosts, early fall frosts, and severe winter conditions can damage forest resources directly and often contribute to the severity of damage caused by insects and pathogens. In addition, human-caused (anthropogenic) disturbances also contribute to declines in forest health.

Climate

The harshness of North Dakota's climate presents difficult management issues to city foresters, extension personnel, and other land managers. Relatively few tree species possess the hardiness to survive the climatic extremes annually experienced in the state. Although the benefits of species diversity for pest management is well understood, the number of species

available in North Dakota is limited because of the hardiness issue. Therefore, a tradeoff occurs between species diversity and tree hardiness and as a result, future forest health issues may arise.

Drought

Drought conditions have characterized the western portion of the state in 2001 and 2002 . These conditions degrade tree defensive mechanisms over time, make trees more susceptible to pests, and create conditions conducive to pest population increases. This is particularly true for trees growing on lighter soils that possess reduced water holding capacity. Additionally, inadequate fall moisture has resulted in greater incidence of winter drying to many conifer species within the state.

Floods

In contrast to drought, flooding in the eastern part of the state has equally significant implications for forest health. Floods occurring during the growing season of sufficient duration may cause fine root mortality and eventual tree death. Although flooding has not been an issue in the past two years for the Red River, native woodlands surrounding Devils Lake have experienced inundation that will result in substantial acreages of tree mortality.

Iron Chlorosis

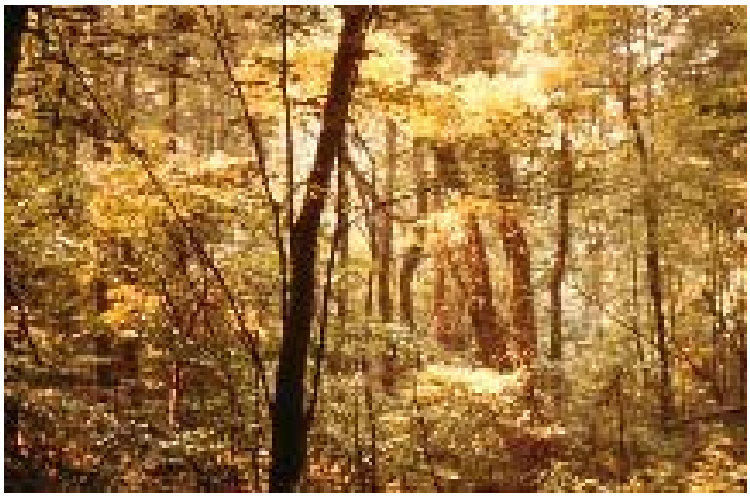
Iron Chlorosis is a common problem of maple in North Dakota. Chlorosis of maples occurs on soils with high alkalinity where iron exists as an insoluble form that is unavailable to the tree. Iron is required for the production of chlorophyll, thus iron deficiency gives the tree a yellow appearance. Severely affected trees will decline and may die if no treatments are applied. The cost of treatment can have significant economic implications to citizens in urban landscapes.

Anthropogenic

Human caused stresses also play a significant role in the decline of rural plantings within the state. Root damage from tillage operations and herbicide drift are frequent problems of rural plantings. Although growth regulator herbicides are important in agricultural systems, these herbicides are detrimental to farmstead windbreaks, particularly windbreaks composed of Siberian elm. Often injuries caused by herbicides predispose windbreak trees to canker fungi. In addition, tillage operations may cause substantial injury to conservation tree plantings. Root systems of trees within windbreaks often extend into adjacent agricultural fields. Often these extended root systems are damaged during tillage operations and contribute to windbreak decline.

Conclusions and Future Directions

Native woodlands, rural plantings, and community forests possess unique management objectives that characterize Plains Forestry in the state of North Dakota. The uniqueness of these management objectives create distinct forest health issues in comparison to issues faced in conventional forestry arenas. The management objectives placed upon forest resources in Plains Forestry dictate that pests and environmental stresses must be monitored at fine scales. As a result, early detection, prevention, and education must be emphasized to ensure the health of North Dakota's forest resources.



Through a cooperative agreement with the North Dakota Forest Service, North Dakota State University Extension Service, NDSU Department of Plant Pathology, and Department of Plant Sciences, a Forest Health Specialist has been funded for North Dakota. The Forest Health Specialist will coordinate and direct forest health monitoring and management throughout the state. Responsibilities of this position include; conducting insect and disease surveys, providing educational outreach, and delivering training and technical assistance to natural resource professionals. This position will increase the level of awareness of forest health issues and promote management techniques to ensure the future sustainability of North Dakota's forests.

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