North Dakota Forest Health Report: 2003 – 2004

Michael Kangas
Forest Health Specialist
North Dakota Forest Service

Table of Contents

Introduction 3

General Conditions of North Dakota's Forested Resources 4

- Native Forests 4
- Rural Plantings 6
- Community Forests 7

Forest and Shade Tree Pests in North Dakota 8

- Insects 8
- Infectious Diseases 11
- Abiotic Factors Associated with Forest and Shade Tree Decline 15

Summary 16

References 16

Appendix 1. Forest Insect and Disease Notes 2003 – 2004 17

Introduction

The forested resources of North Dakota provide numerous ecological, social, and economic benefits to the state's residents. These forested resources can be separated into three categories: native forests, rural plantings, and community forests.

The North Dakota Forest Health Report is an assessment of the health and condition of the state's forested resources. This report summarizes forest pest conditions observed in 2003 and 2004, emerging forest health issues, and interprets trends related to the sustainability of North Dakota's forested resources.

For each forest resource category, a brief summary depicts the general condition, the overall health, and potential threats to each of these forest resource categories. Additionally, specific forest insects, diseases, and damaging abiotic factors are described. The information presented in this report was compiled from various sources and methods including: site visits, aerial and ground surveys, and personal communication with natural resource professionals.

General Conditions of North Dakota's Forest Resources

The following summaries provide information related to the general conditions of the state's native forests, rural plantings, and community forests. These narratives do not necessarily describe specific causal agents of tree/forest decline but rather depict the factors that have led to the current condition of these resources.

Native Forests

Native forests and woodlands are sparsely distributed across the state and represent approximately 1.5 percent of North Dakota's total land area (673,000 acres). Eastern deciduous forest types and western coniferous forest types are found in North Dakota however deciduous forest types comprise approximately 98% of the state's forestland (Haugen et al. 1994).

Some 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 a few tree species although numerous species may comprise each forest type. 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, the Devils Lake Hills, and the Pembina Gorge. Only 2% of the state's forestland is classified as western conifer forests. These isolated stands comprised of Ponderosa pine and Rocky Mountain juniper are located in the southwest counties of the state (Figure 1).

Despite their limited acreage, native forests are important resources in North Dakota. These forests provide wildlife habitat, provide recreational opportunities, stabilize river banks, filter water runoff from adjacent agricultural lands, provide wood products, serve as seed sources for conservation tree production, and increase the botanical diversity of the state.

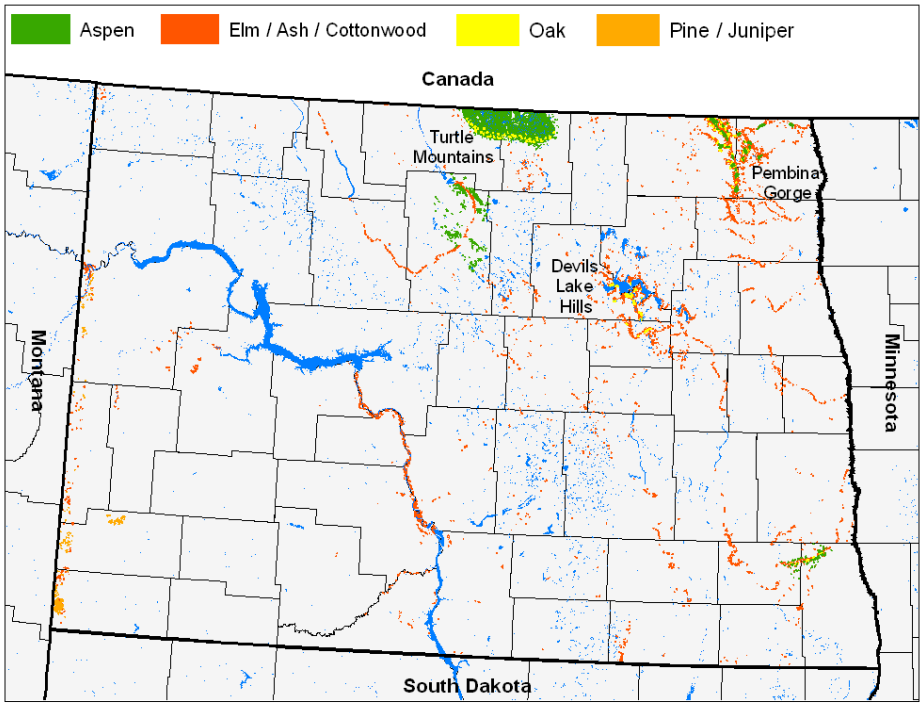

Figure 1. Distribution of forest types in North Dakota.

The mere presence or absence of pests within a forest does not determine the 'health' of the forest. The term 'healthy forest' is somewhat subjective and may take on many definitions based upon the social, ecological, economic, or cultural perspectives of people. All forests experience changes over time and a divergence from an existing condition to another (species composition, age, etc.) should not indicate that the forest is 'unhealthy'. That is, forests undergo succession where pioneer species naturally die out are replaced by other tree species over time. In contrast to this view of forest change, the establishment of non-native pests or plants, the disruption of natural disturbance regimes critical for forest regeneration, or conversion of forestland to non-forest may represent an 'undesirable' change. Similarly, outbreaks of endemic (naturally-occurring) pests may cause damage that exceeds our perception of 'natural' or may accelerate a progressive undesirable forest change. Such changes over time coupled with our perceptions and expectations determine which forests we consider 'healthy' and which are 'unhealthy'.

The forests of North Dakota's are generally resilient to undesirable changes, however issues have emerged within recent decades that have warranted concerns. The majority of North Dakota's forestland is under private ownership. Over-maturity followed by conversion to non-forest continues to be one of the most obvious sustainability issues. Such conversion for agricultural or residential purposes is ultimately based on the landowners' objectives however it is also apparent that these

decisions are driven in part by reduced productivity and/or degraded condition of the forest. Some of the factors that influence the condition of each forestland type are described in the following narratives.

Riparian Forests

The Elm/Ash/Cottonwood forest type is the most abundant of all native forestland and is found along rivers throughout the state. These forests have experienced significant alterations over the past decades to due damage caused by Dutch elm disease *(Ophiostoma ulmi* and *O. nova-ulmi)*, overgrazing, altered water flows, and conversion to non-forest.

Since the first detection of Dutch elm disease in 1969, the disease has spread throughout North Dakota. The American elm *(Ulmus americana)* was a major component of state's riparian forests and occupied a wide range of sites. Dutch elm disease spread aggressively and decimated the elm population that once comprised a large portion of the riparian forests along the Red, James, Sheyenne, and Pembina rivers. In addition, the disease continues to kill elms that occur in the wooded draws of western North Dakota. Although the American elm has not been eliminated entirely from these forests, the species primarily persists as a small understory tree, occupies a small proportion to the total stand basal area, and often succumbs to mortality prior to reaching maturity. The loss of American elm dominance in these systems has shifted the species composition toward green ash *(Fraxinus pennsylvanica)*, boxelder *(Acer negundo)*, and other species.

In addition to the impacts of Dutch elm disease, many riparian forests have been converted to non-forest through agricultural and residential development particularly along the Red River of eastern North Dakota. Other damaging factors include overgrazing and water flow alterations that can gradually reduce the vigor of existing trees and destroy understory woody vegetation. Such forest changes and conversions adjacent to watercourses have important implications for water quality, flood control, wildlife habitat, and recreation opportunities.

Cottonwood Forests of the Missouri Floodplain

The Cottonwood *(Populus deltoides)* forests that occur within the Missouri floodplain from Garrison Dam to Lake Oahe is in a poor condition that has resulted from progressive mortality of mature trees and the absence of natural regeneration to replace those that have died. Prior to flood mitigation, the Missouri floodplain experienced periodic inundation as high spring water flows deposited sand in low-lying areas. These moist sandbars serve as seedbeds for cottonwood and are critical for natural regeneration of the species (Burns et al. 1990). This historical disturbance regime of periodic flooding drove the succession, distribution, and age class structure of cottonwood forests along the floodplain (Ball 1997).

In the absence of flooding and subsequent sandbar formation, the current cottonwood forests are in a state of temporary existence as there are no young cottonwoods to replace the overmature trees that have succumb to old age and senescence. As a result, the floodplain that once persisted as a fluctuating mosaic of backwater wetlands, sandbars, and cottonwood forests now exists as a xeric, fire-prone floodplain bisected by a channelized river. The cottonwood component of the Missouri floodplain may eventually die out and give way to other tree species (both native and non-native) with the exception of a few isolated sites adjacent to the ever-deepening river channel.

Aspen Forests

Nearly 27 percent of North Dakota's timberland is classified as the Aspen/Birch forest type (Hagen et al, 1999). The majority of this forest type is located in the Turtle Mountains and represents the state's largest concentration of forestland. Quaking aspen *(Populus tremuloides)* is the dominant species in these stands however Paper Birch *(Betula papyrifera)*, Bur oak *(Quercus macrocarpa)*, and Green ash *(Fraxinus pennsylvanica)* can also be common on these sites.

A significant portion of this aspen resource can be characterized by low productivity, stem decay, and large stem mortality that is associated with stand over-maturity. In the absence of stand-replacing disturbances to encourage vigorous aspen regeneration, aspen stands age and deteriorate over time as the result of numerous inciting, predisposing, and contributing factors. These may include frost injury, drought, hail damage, and windstorms and several forest pests.

Forest pests such as defoliating insects, wood rotting fungi, and canker diseases also contribute to the deterioration of these aspen stands. The Turtle Mountains are prone to periodic defoliation episodes caused by the Forest tent caterpillar *(Malacosoma disstria)*. Defoliation reduces growth, predisposes trees to other damaging agents, and exacerbates the senescence of aging aspen stands. Internal decay of live aspen trees is common within mature aspen stands, particularly those over 60 years of age. Stem decay caused by the fungus, *Phellinus tremulae*, reduces the amount of useable wood within a stand in addition to increasing the probability of stem breakage. The wood volume loss due to this stem decay has been increasing as the aspen resource continues to age in the Turtle Mountains.

Similarly, mortality of large diameter trees due to Hypoxylon canker *(Hypoxylon mammatum)* contributes to the deterioration of older stands.

The damage caused by these pests should not be perceived as 'unnatural' but rather reflect a shift of the disturbance regime. Without disturbance (whether by fire, harvesting, bulldozing, or other means) to encourage vigorous aspen regeneration, pests and environmental factors deteriorate the aging aspen and give way other species. Throughout its western and eastern range, aspen is a pioneer species that is often succeeded (replaced) by shade-tolerant conifer species in the absence of disturbance. However many aspen forests of the northern prairie regions of North America convert to shrubland where shade-tolerant conifers do not naturally occur (Perala 1990, Harniss 1981). This successional scenario is apparent within some areas of the Turtle Mountains where beaked hazel *(Corylus cornuta)* dominates the under story of deteriorating aspen stands and prevents the establishment of other tree species.

In addition to the senescence of the aspen resource, many areas within the Turtle Mountains have been converted to pastureland. The acreage of the aspen forest type decreased from 98,297 acres in 1980 to 87,699 acres in 1995 (USFS Forest Inventory and Analysis data). This conversion may be driven in part by reduced productivity and vigor of the stands coupled with a lack of harvesting opportunities for private landowners. As a result, some private landowners are inclined to clear low-production forests and use the land for agricultural purposes that generate marginal economic benefits.

Fortunately, there has been a renewed interest by forestland owners to harvest aspen in recent years. Although clearcutting may look unappealing at first, the vigorous regeneration of aspen that soon follows is important for the long-term perpetuation of this unique forested resource. The young aspen stands that regenerate following harvest are beneficial to many wildlife species in addition to exhibiting fast growth rates.

Ponderosa Pine Forests

There are several animals, insect pests, and pathogens that are found in the native ponderosa pine stands of southwestern North Dakota. Of these, animal damage caused by deer and porcupines is most apparent. Additionally, shoot death and branch dieback caused by Western gall rust *(Endocronartium harknessii)*, Diplodia shoot blight and canker *(Diplodia pinea)*, and Pine pitch nodule maker *(Retinia metallica)* are commonly encountered. Such pests may incite tree mortality if conditions favor repeated infections/infestations over several years. Often pines weakened by these pests and other factors succumb to mortality following colonization by pine engraver beetles *(Ips pini)* or turpentine beetles *(Dendroctonus valens)*. Despite the presence of pests, these isolated pine stands are quite resilient and the level of tree mortality has remained low.

Perhaps the greatest concern in these areas has been wildfire. Years of past fire suppression coupled with high stand density create conditions that may intensify fire behavior. These wildfire concerns were realized when a large prairie fire spread into portions of the native Ponderosa pine stands of Slope County, ND in September of 2004. The fire (known as the Deep Creek Fire) burned through approximately 800 acres of privately-owned forest. Mortality may reach 100% in stands that experienced high fire intensity with severe needle scorching and stem charring. Conversely, estimations of tree mortality are uncertain within areas that experienced lower fire intensity. The dense stocking and general low vigor of these stands suggests that tree mortality could be significant within the following years. Surveys plots were created on these sites to assess delayed tree mortality during the following years.

Rural Plantings

North Dakota is largely a rural state with an economy that is deeply rooted in agriculture. Rural tree plantings are an important component of many agricultural systems and can improve rural life in the northern plains. Rural tree plantings generally refer to farmstead plantings, shelterbelts, living snow fences, wildlife plantings, and others that 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 streambanks, filter water runoff from adjacent agricultural lands, provide wildlife habitat, protect stretches of highways prone to severe snow accumulation, provide wind protection for livestock, or protect farmsteads and rural homes from snow and wind. Although many rural tree plantings occur in areas where the historical vegetation type was prairie, these resources are critical for the present needs of rural residents that live in the *current agricultural landscape*.

Tree plantings of the northern plains are exposed to numerous pests and environmental conditions that hinder planting success, reduce their effectiveness, and limit long-term survival. Deterioration of tree plantings are often incited by drought, flooding, 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.

Lack of species diversity is an underlying factor in the decline of many rural plantings. Plantings composed of one or few species often experience episodes of abrupt decline simply because all trees are vulnerable to the same damaging factors. Similarly, these plantings are more susceptible to pest outbreaks in comparison to those that consist of several different (or non-host) species. Some examples include: Decline of single-row Siberian elm field windbreaks due to herbicide exposure, marginal cold hardiness, and canker diseases and decline of Colorado blue spruce plantings due to Yellowheaded spruce sawfly, Rhizosphaera needlecast, and Cytospora canker. The impacts of these damaging factors could have been greatly reduced had additional species been incorporated into these plantings.

The damage to rural plantings caused by these interacting factors are more effectively prevented rather than treated. Incorporating various weed control techniques, manipulating planting density and arrangement, or selecting species most suitable for the site have been effective approaches to prevent the decline of tree plantings. In recent years, state, federal, and university forestry/tree care professionals have promoted species diversification of in an attempt to avoid past experiences in tree planting decline. In practice, these techniques greatly enhanced the effectiveness of rural plantings. Despite this, identification of species and seed sources that perform well in the northern plains is still a critical need for conservation tree planting. The number of suitable native species for the northern plains is relatively limited in comparison to more forested regions. Therefore the loss of a single species (due to the introduction of invasive pests or other factors) is magnified and further limits tree planting options and diversification efforts.

Community Forests

Community forests include boulevard trees, trees planted within city parks, and trees that naturally occur within city limits or public right of ways. The management of such tree resources may fall under the responsibility of city foresters, public works departments, and/or community tree boards. The community forest also includes trees that are planted on private or commercial properties. As a whole, these tree resources comprise the community forest and provide many benefits to the community's residents including: reduced winter heating and summer cooling costs, wind and snow protection, beautification, recreational opportunities, and enhanced quality of life.

Trees that are planted within residential areas are exposed to insects, diseases, and environmental stresses throughout the course of their life. Commonly observed forest pests in residential areas include various defoliating insects, piercing insects, wood-boring insects, foliar diseases, and canker diseases. The frequency and severity of pest damage often reflects the species composition of the community's forest. For example, communities with an abundance of ash and elm tend to experience a greater frequency of cankerworm outbreaks than communities with a smaller proportion of species preferred by the insect. In addition, environmental stressors such as compacted soils, turf herbicides, lack of (or too much) watering, nutrient deficiency, and mechanical injuries often exacerbate the damage caused by insects and disease.

Despite the copious environmental stresses and pests, Dutch elm disease continues to be the most damaging factor of community tree resources. This disease has eliminated many of the stately elms that once graced North Dakota communities. Several of the larger cities have developed management programs to combat Dutch elm disease with notable success. However, smaller communities that lack the tax base to support a forestry staff have been severely impacted by this disease.

Ash and cultivated varieties of the species were the most common replacements for dying elm trees following Dutch elm disease. As a result, many community forests that were once dominated by elm are now dominated by ash. Although ash performs well on a variety of sites and conditions, the overabundance of this species has raised concerns since the recent discovery of the Emerald ash borer (*Agrilus planipennis*, an exotic ash-killing beetle) within southern Michigan and neighboring states. Many North Dakota communities have realized that their community tree resource may be susceptible to another episode of tree mortality if eradication efforts fail and the Emerald ash borer spreads westward into the Plains States. As a result, many communities are beginning to embrace the concept of species diversification within community forests.

Forest and Shade Tree Pests in North Dakota

The following sections provide information about specific causes of forest tree and shade tree decline in North Dakota. The following narratives are not inclusive to all damaging agents, but rather highlight the most significant insect and disease trends in 2003 and 2004.

Insects

Forest Tent Caterpillar *(Malacosoma disstria)*

Approximately 125,000 acres of forestland are found in the Turtle Mountains of north central North Dakota. These forests are subjected to periodic defoliation caused by the Forest tent caterpillar. The most recent outbreak occurred during the late 1970's when nearly all forested lands in the Turtle Mountains were defoliated.

A single season of defoliation rarely damages host trees, however several successive years of defoliation reduces tree growth, contributes to senescence of aging forest stands and reduces the trees' resilience to other damaging agents.

The acreage of defoliation caused by the forest tent caterpillar increased substantially in 2003 compared to the previous year (Table 1). Based on USFS Region 1 aerial surveys, 17,800 acres were defoliated in the Turtle Mountains for 2003 (Figure 2). This represented a 4-fold increase since 2002 when only 4,300 acres were defoliated. The majority of this defoliation occurred from the western edge of the Wakopa Wildlife Management Area to Lake Metigoshe State Park and extended as far south as Willow Lake. Defoliation was most severe between Lake Metigoshe and Hartley Lake and extended as far south as Willow Lake.

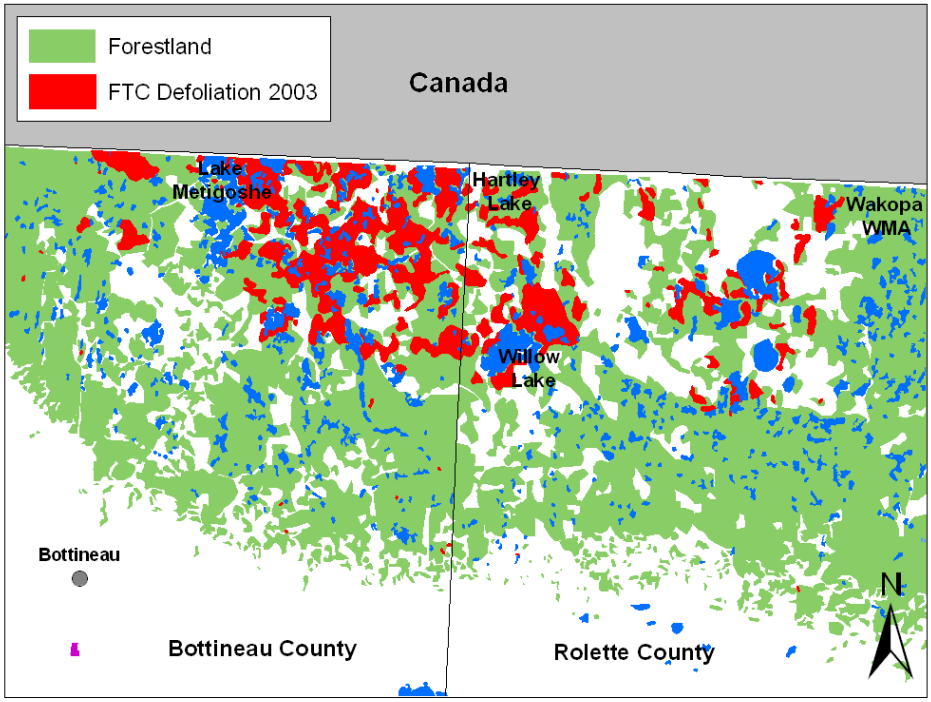

Figure 2. Forest tent caterpillar defoliation, 2003.

Table 1. Forest Tent Caterpillar Defoliation by Year.

Year	Defoliation (Acres)
2002	4,300
2003	17,800
2004	No Reports

Based on egg mass surveys conducted in October 2003, FTC defoliation was expected to increase in 2004. However, a sudden hard spring frost occurred during larval emergence, killed the majority of young larvae and caused the FTC population to collapse. As a result, there were no reports of defoliation by local land managers, natural resource professionals, or private landowners during 2004.

Yellow-headed Spruce Sawfly *(Pikonema alaskensis)*

The Yellowheaded spruce sawfly is a damaging defoliating insect of spruce plantings in North Dakota. The insect is found throughout the northern half of the state and is most damaging in the northern tier counties and counties of the north central region. Infrequently the insect is found in the southern half of the state however severe damage is rarely observed.

There are no native spruce stands in North Dakota however spruce is commonly used in rural and landscape plantings. Open growing conditions associated with these plantings provide favorable egg-laying sites (Katovich et al. 1995) for the sawfly. Female sawflies lay eggs in needles during shoot expansion in the spring. Larvae emerge within 5 to 10 days and feed on the new spruce needles for 4 to 5 weeks. Once the new foliage has been consumed, the larvae migrate to older foliage and continue feeding. Under severe infestations, entire trees can be defoliated and killed. Even moderate defoliation

can significantly reduce the efficiency of windbreaks and predispose spruce trees to other damaging agents.

All species of spruce planted in North Dakota are susceptible to the Yellowheaded spruce sawfly however Colorado blue spruce *(Picea pungens)* appears to be preferred by the insect and sustains the greatest amount of damage. Additionally, the insect is most damaging to young spruce trees (less than 15 years old) whereas older trees appear to be avoided by the insect.

Yellowheaded spruce sawfly damage is observed annually in nearly all counties of the northern half of the state and outbreaks, characterized by moderate to severe defoliation, occur periodically. Sawfly outbreaks typically last for 3 to 4 years and often occur in intervals of 7 to 12 years. Sawfly defoliation was most severe in Benson and Ramsey counties for 2003 and 2004. McHenry and Wells County also observed significant defoliation for these years however the damage was less severe (Figure 3).

Gypsy Moth
(Lymantria dispar)

The North Dakota Forest Service, North Dakota Department of Agriculture, the U.S. Forest Service and the USDA Animal Plant Health Inspection Service conduct annual statewide gypsy moth detection surveys. There were 312 and 363 gypsy moth detection traps placed in 2003 and 2004, respectively. These traps were distributed throughout the state to encompass major forest types at risk of gypsy moth introduction.

One gypsy moth was detected near Jamestown in 2003 (Stutsman County). Two additional gypsy moths were detected in 2004. One moth was caught again near Jamestown and the second moth was caught at the Grand Forks Air Force Base (Figure 4). These sites will be trapped again in 2005 coupled with visual inspections to assure that no Gypsy moth population is established. Despite these recent detections, there are no known established populations in North Dakota as of this date and trapping efforts will continue in the future and include new areas of potential risk.

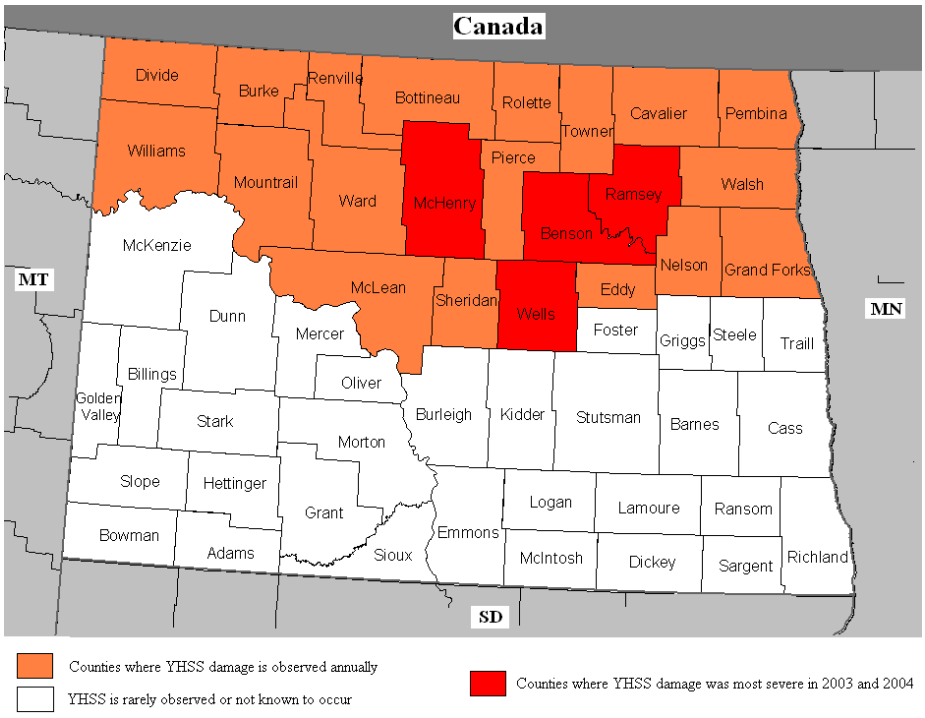

Figure 3. Yellowheaded spruce sawfly distribution in North Dakota.

Oak Rough Bulletgall Wasp
(Disholcapsis quercusmamma)

Several reports were received for the Oak rough bulletgall wasp in 2003 and 2004. Galls produced by the insect are common on twigs of Bur oak *(Quercus macrocarpa)* within plantings and native woodlands. Numerous galls may cause stunting or dieback on twigs. Severe infestations may incite decline of host trees however such situations are rare.

This pest was found throughout the state and the incidence of the pest did not appear to vary significantly with regards to geographical location. Despite this, the number of reports and casual observations suggests the conditions were favorable for the insect in 2003 and 2004 compared to past years.

European elm scale
(Gossyparia spuria)

The European elm scale has caused progressive decline and death of some elm varieties in western N.D. Prolonged infestations cause leaf yellowing, leaf drop, weaken branches, and lead to gradual decline and senescence of host trees. Entire trees may be killed over a period of 6 to 10 years under severe infestations. Damage from this insect has been most severe in Dickinson (Stark County). Similarly, damage from the scale has been observed in Minot (Ward County) and may occur in other communities of western North Dakota.

Poplar bud gall mite
(Aceria parapopuli)

Damage to Cottonwood and Hybrid poplar caused by the Poplar bud gall mite was observed in various locations within the state. Although the mite is likely to occur throughout the state, the pest is more apparent in western North Dakota where drier conditions may exacerbate damage.

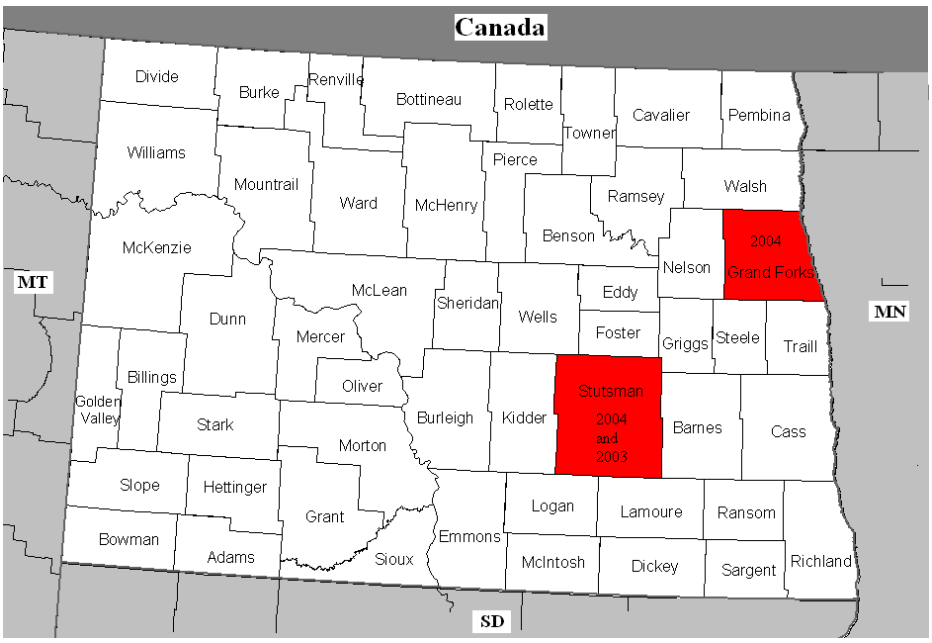

Figure 4. Counties with Positive Gypsy Moth detections in 2003 and 2004.

Bronze birch borer
Agrilus anxious)

Damage caused by the Bronze birch borer is observed frequently in North Dakota communities. Damage often occurs in association with birch trees that are exposed to stresses such as inadequate moisture, herbicide exposure, compacted soils, and improper cultural practices. Such factors weaken birch trees over time, lead to progressive decline, and predispose the trees to the bronze birch borer. The beetle also occurs naturally in native birch stands within the state. However in these areas, damage is restricted to old, senescent birch trees that have been weakened by drought, defoliation or other factors.

Spring Cankerworm
(Paleacrita vernata)

The spring cankerworm is a common defoliating insect of rural plantings and community forests. Common host trees of the spring cankerworm include: elm, ash, maple, basswood, oak and apple and the incidence of spring cankerworm defoliation is reflected by the abundance of these host species. Additionally, Siberian elm (Ulmus pumila) field windbreaks frequently endure spring cankerworm defoliation. Outbreaks of this insect occur periodically within the state however no outbreaks were reported in 2003 and 2004.

Cedar Bark Beetle
(Phloesinus spp.)

Dieback of numerous Juniper trees and shrubs were observed in and around Bismarck (Burleigh County) in 2003. The cedar bark beetle was found in association with the decline. Beetle within this genus tend to colonize hosts weakened by other factors. Predisposing factors associated with the presence of these beetles were not determined.

Giant Bark Aphid
(Longistigma caryae)

Decline of Flame willow (*Salix alba* 'Flame') were observed in 2004 throughout Cass County, North Dakota. Symptoms of this decline include progressive stem dieback and eventual mortality. This decline is apparently due to extensive stem feeding by the giant bark aphid. In addition, cankers are often found in association with the gregarious feeding habit of the aphid. Canker symptoms were similar to those reported for the genus *Cryptodiaporthe* (Sinclair et al. 1987) however the causal pathogen of the cankers has not been identified to this date. It remains unclear whether the aphid serves as a vector of the pathogen or if extensive feeding increases the stems susceptibility to colonization by the pathogen.

Banded Elm Bark Beetle
(Scolytus schevyrewi)

Recent detections of the Banded elm bark beetle throughout the western United States have raised concerns within the Plains States. USDA APHIS and the North Dakota Forest Service sampled 4 areas with Lindgren traps as part of a preliminary survey in 2004. Two sites were located near Bismarck and two sites were selected near Fargo. Insect collections form these traps did not yield any Banded elm bark beetles.

Infectious Diseases

Diplodia Shoot Blight
(Diplodia pinea)

Recently, shoot blight, caused by Diplodia pinea (syn. *Sphaeropsis sapinea*) has been confirmed in many Ponderosa pine plantings throughout the state. Symptoms include shoot blight and twig dieback. Severely infected trees may be deformed and killed. Trees of all ages are susceptible however older, cone-bearing trees appear to sustain the greatest amount of damage.

Diplodia shoot blight has been found periodically throughout North Dakota in past years however the incidence and severity of this disease has increased recently (Figure 5). This trend may be attributed to moist conditions in recent years that favor infection and cone production associated with aging Ponderosa pine windbreaks. As a result, many questions have arisen regarding the susceptibility of pine provenances and inoculum sources that infect these isolated pine plantings.

In addition to rural Ponderosa pine plantings, Diplodia shoot blight has been observed within the pine windbreaks surrounding the Towner State Tree Nursery in Towner, N.D. Low levels of the disease were first observed within the nursery windbreaks in 1984 (Walla 1986). Over the past 5 years, the number of symptomatic trees within these windbreaks has increased substantially. Towner State Nursery annually produces 200,000 ponderosa pine seedlings for conservation plantings in North Dakota and throughout the Northern Plains. There are concerns that Diplodia infections may reduce the supply of pine seedlings in addition to spreading the fungus throughout the region by infected nursery stock if the blight is not suppressed within the nursery.

A plan has been implemented to prevent damage to nursery crops by monitoring the disease, systematically removing ponderosa pine tree rows and replacing with non-host species, applying preventive fungicides to pine seedlings, relocating ponderosa pine nursery crops to fields with less exposure to diseased windbreaks, and testing seedlings for latent infections. Removal of infected ponderosa pine tree rows is critical to the nursery's management of this disease. Surveys of nursery windbreaks were conducted to determine infection levels of windbreak trees, prioritize windbreak removal, and identify areas of high inoculum sources within the nursery. Forest Health Protection (USDA USFS) Funds were used to remove heavily-infected windbreaks in 2003 and 2004. Only a few pine windbreaks can be removed every year because conifer seedling production at the nursery requires wind protection for transplant beds. Therefore, newly planted non-host windbreak species must become established prior to removal of all pine windbreaks.

Other management strategies at the nursery include: application of fungicides to pine seedling crops during critical infection periods, alteration of irrigation schedules to reduce moisture retention on seedling shoots, and relocation of pine seedling fields farther from heavily-infected windbreaks to minimize inoculum exposure. In addition, asymptomatic seedlings have been tested for the presence of latent infections and to assess the effectiveness of the current management strategies.

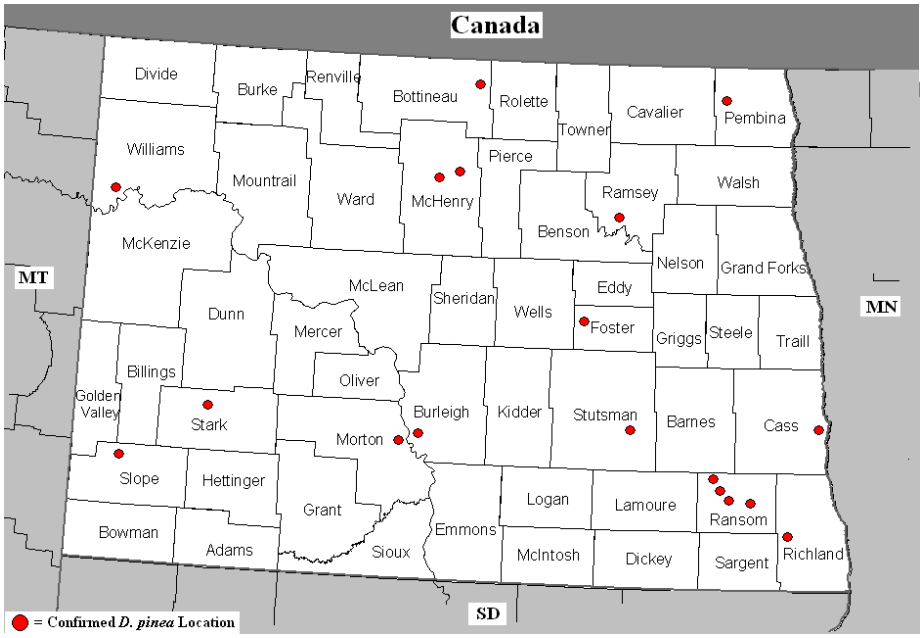

Figure 5. Confirmed locations of D. pinea within Ponderosa pine windbreaks in 2003 and 2004.

Dutch Elm Disease
(Ophiostoma ulmi)

Dutch elm disease (DED) is one of the most damaging infectious tree disease in North Dakota. This disease has significantly altered the native forests and rural tree plantings of the state over the past 35 years. DED continues to impact community forests (including boulevard trees, city park trees, and residential home landscapes). Every year community forestry departments, utilities, and tree boards spend considerable time, effort, and money to minimize the impacts of DED.

Thirty North Dakota communities were polled to obtain information regarding DED trends. These communities represent a broad range of populations, geographical areas within the state, and provide baseline information for DED impacts. Each polled community was asked to provide information regarding: number of DED removals in 2003, number of DED removals in 2004, and average annual DED removals (based on the community records).

Since smaller communities have a smaller proportional tree resource, the communities were categorized based on population size: communities under 1,000 persons, communities with 1,000 to 10,000 persons, and communities over 10,000 persons. The number of DED-infected elms removed in 2003 and 2004 were compared to the average number of DED removals (based on community records) using analysis of variance.

Based on the survey, the incidence of DED across the state was below average in 2003 and 2004 when compared to the average annual removals reported by communities (Table 2 and Figure 6). Despite this general pattern, the observed differences were not statistically significant from the average reported removals by the community ($p = 0.975$; $F = 0.12$). This may be attributed to the fact that some communities experienced above average DED removals whereas some observed below average removals. Similarly, as the proportion of elms within a community decreases due to removals over time, the number of annual DED infections is likely to decrease correspondingly. Therefore without a complete tree inventory of the community, it may be difficult to interpret DED trends from year to year. As additional data is collected, a more thorough picture of DED impacts will emerge.

Table 2.

Population of Community	*n*	2003 Removals	2004 Removals	Average Removal (Annual)
Under 1,000	10	5.2	10.9	11.1
1,000 to 10,000	12	28.0	38.2	36.4
Over 10,000	8	131.6	156.8	189.2
Means	30	48.1	60.7	70.8

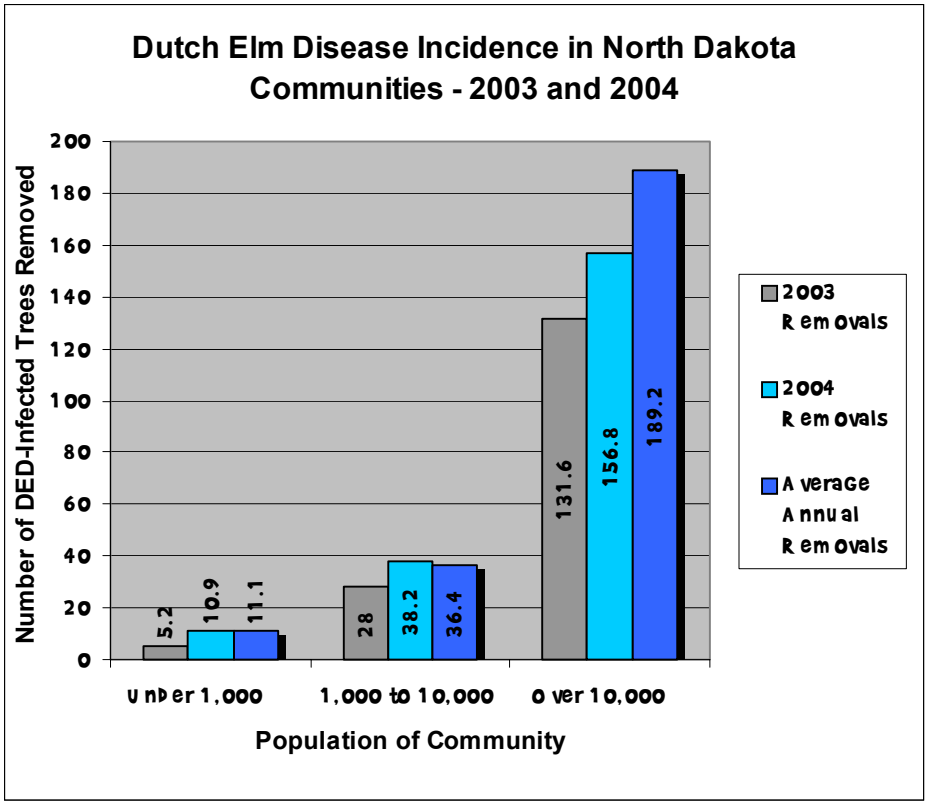

Figure 6.

Foliar Diseases of Deciduous Trees

Cool wet conditions in 2004 were favorable for infection and disease development of several foliar diseases. Some of the commonly observed foliar diseases of deciduous species included: Ash anthracnose *(Gnomoniella fraxini)*, Oak anthracnose *(Discula umbrinella)*, Oak leaf blister *(Taphrina caerulescens)*, and Septoria leaf spot *(Septoria musiva)* of Populus spp.

These foliar diseases occur throughout North Dakota however disease incidence is generally sporadic and associated with localized site characteristics during years of normal early summer moisture. Moisture conditions from late-May through July were well above average in 2004. As a result, the incidence and severity of these diseases was greater throughout the state. Generally the impact of these diseases depends on the interaction of host condition, disease severity, and the outbreak duration. Healthy, vigorous trees may suffer little damage from foliar diseases. In contrast newly planted trees or older trees in a state of poor vigor, may be severely damaged as

the result of a season of high disease pressure. If conditions remain moist and the disease pressure remains high, some tree decline may be observed in the ensuing years as the result of these foliar pathogens.

Rhizosphaera Needle Cast of Spruce
(Rhizosphaera kalkhoffii)

Rhizosphaera needle cast is a common foliar disease of spruce *(Picea spp)* in North Dakota. All planted spruce species are hosts to this pathogen however Colorado blue spruce *(P. pungens)* appears to be most susceptible. The incidence and severity of this disease is influenced by moist, humid conditions during the period of shoot expansion and improper spacing of host trees in tree plantings that restricts airflow and creates suitable conditions for infection.

This disease causes premature needle loss that reduces the trees photosynthetic capability, predisposes infected trees to other damaging agents, and reduces the longevity and function of spruce windbreaks. Rhizosphaera needle cast has been most prevalent in the northeast portion of the state where greater moisture conditions are persistent and favor infection.

Cytospora Canker of Spruce
(Valsa kunzei)

Cytospora canker of spruce is common throughout the state. Desiccation and death of branches distal to cankered tissue are the most obvious symptoms of this disease. Often initial infections occur in the lower crown and may spread laterally and vertically in subsequent years.

Spruce species are commonly used for conservation tree plantings and as ornamental landscape trees. Severe Cytospora canker infections reduce the function of spruce windbreaks, lead to premature mortality, and degrade the appearance of ornamental trees.

Hypoxylon Canker of Aspen
(Hypoxylon mammatum)

Hypoxylon canker is a common disease of Quaking aspen *(Populus tremuloides)* throughout its native range. The mode of infection is not completely understood however wounds caused by insects or by other factors have been implicated as infection courts (Ostry and Anderson, 1990). Tree mortality may occur as expanding stem cankers effectively girdle the tree's conductive tissues (Anderson et al. 1979). Hypoxylon canker is common in young stands and plays a vital role in the natural development of aspen stands. However, in mature stands the disease may accelerate overstory mortality, reduce stand volume, or may conflict with management objectives. Hypoxylon canker is common in the Turtle Mountains, the Pembina Gorge, the Sheyenne River Valley, and other areas in the state where Quaking aspen naturally occurs.

Based on aspen surveys of the Turtle Mountains, Hypoxylon canker was observed on 7 percent of the aspen stems and accounted for 1.7% annual mortality in all stands surveyed. Disease incidence was greater in stands over 35 years of age as cankers were present on 9% of aspen stems and accounted for 2.5% annual mortality. Currently this disease does not appear to cause substantial damage to the aspen resource however it may become more damaging as mature aspen stands continue to senescence.

X disease of Chokecherry

X disease is an economically important pathogen of *Prunus* species that causes reduced growth, shortened internodes, and reduced the longevity of plantings. Chokecherry *(Prunus virginiana)* and Wild plum *(P. americana)* are native to the state and are propagated for use in rural tree plantings. X disease symptoms have been observed on chokecherry throughout the state in recent years.

The disease is systemic and causes a slow gradual decline of chokecherry. Symptoms include: early-season reddening of leaves, stunting of leaves and shoots, deformity and discoloration of fruit, reduced winter hardiness, and mortality of branches and whole plants. These symptoms may be confused with other damaging agents. In addition, weakened, declining chokecherry plants may be attacked by secondary pests that may further complicate diagnosis. Currently, research is being conducted to identify chokecherry varieties that are less susceptible to this disease.

Decline of Black Ash

Progressive decline and death of Black ash *(Fraxinus nigra)* and cultivated varieties has been observed in eastern North Dakota over recent years. Black ash and the cultivated variety 'Fallgold' have been commonly used as boulevard species in North Dakota communities. Recent observations of decline, dieback and death of these trees have concerned several city foresters within the eastern half of the state. A survey was conducted in 2004 to assess the health and condition of these boulevard trees within the city of Fargo and identify potential causes.

The city forestry department of Fargo lists approximately 1,500 Black ash in its tree inventory database. One hundred of these were randomly selected from the database. Each randomly-selected Black ash was inspected for abnormalities and rated based on its overall condition (example: 0 = dead, 50 = 50% crown dieback, 100 = no crown dieback etc.). Commonly observed abnormalities included: splitting and cracking of bark, basal swelling, evidence of herbicide use within the area, evidence of improper cultural practices, and extent of branch dieback.

Based on the survey, only 48% of the sampled trees were given a rating of 75 or above. Thirty percent of the trees sampled fell in the condition class 50 to 75, 15% fell into the condition class 25 to 50, and 7% showed severe dieback symptoms and were placed in the condition class 0 to 25 (Figure 7).

Common abnormalities included cracking and splitting of the main trunk and swelling of the trees base above the soil line. These symptoms correlated closely with condition class (figure 8) however it is not known whether these symptoms reflect causative or secondary factors of the tree decline. Bark removal yielded necrosis of the phloem and outer sapwood in association with bark splitting and cracking along stems. Samples of necrotic tissue were collected and plated on various artificial media however no causal agent has been identified as of the date of this publication.

At the time of this publication a non-native leaf feeding psyllid was detected in Fargo and Bismarck. The insect, known as the cottony ash psyllid *(Psyllopsis discrepans)*, attacks black ash, Manchurian ash *(F. mandshurica)*, and cultivated varieties/hybrids of the two. The psyllid has been found in other locations of the state. However this insect was not observed during the Black ash survey in Fargo not was it observed by other tree professionals assessing the dieback problem during 2003 and 2004.

Insect feeding causes curling of leaves and defoliation under severe infestations. The psyllid has been found on both Manchurian and black ash varieties within the state however the ash decline has not been observed on Manchurian ash varieties. This suggests that the black ash decline is not solely attributed to psyllid feeding and other factors may be involved. As additional information is obtained, a clearer

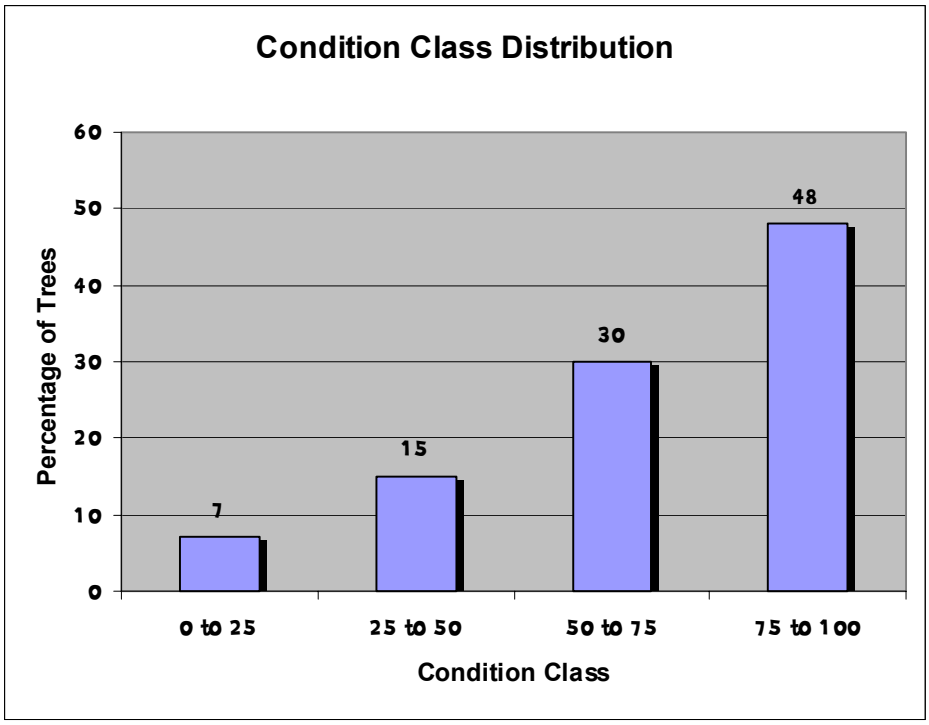

Figure 7.

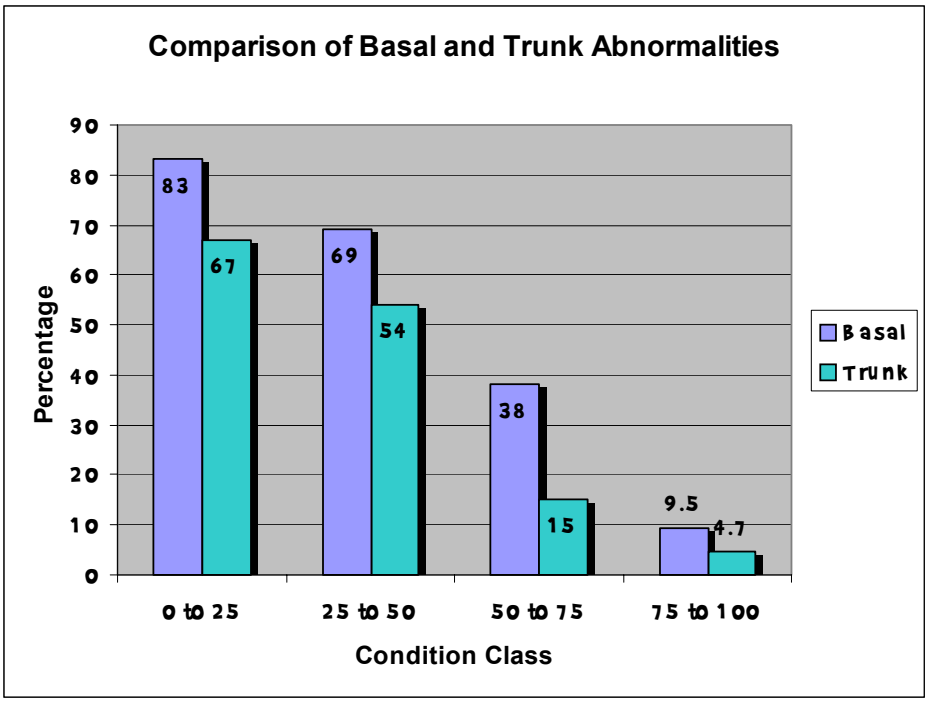

Figure 8.

picture of the factors associated with the Black ash decline should emerge.

White Pine Blister Rust
(Cronartium ribocola)

Branch flagging caused by White pine blister rust was found on an ornamental 5-needled pine on the North Dakota State University campus in 2003. The disease, although rare, has been found periodically within the state in past years (Walla pers comm.). The alternate host (*Ribes* spp) is common however there are few five-needled pine plantings in North Dakota. Similarly, only 1 isolated stand of limber pine *(Pinus lambertina)* occurs in the southwest portion of the state. Despite the limited extent of naturally occurring or planted aecial hosts, White pine blister rust could potentially cause significant damage to the unique Limber Pine Research Natural Area and to the increasing variety of 5-needled ornamental pines.

Abiotic Factors Associated with Forest and Shade Tree Decline

Abiotic factors have a great impact on the health of trees and woody plants within North Dakota. Climate extremes are limiting factors for the long-term health and survival of woody plant species used for plantings in the northern plains. Environmental factors such as drought, flooding, late spring frosts, early fall frosts, and severe winter conditions can damage forest resources directly and often exacerbate the damage caused by insects and pathogens. In addition, human-caused (anthropogenic) disturbances also contribute to declines in forest health.

Weather Related Effects on Tree and Woody Plant Health

The 2003 growing season was characterized by below average moisture throughout the mid to late growing season. The southwestern portion of North Dakota was exposed to the most severe drought conditions. These conditions degrade tree defenses over time, make trees less resilient to damage caused by pests, and may allow secondary pest populations to increase. Many trees exhibited drought stress symptoms in mid-July and several species began to drop leaves by mid-August. Trees most severely damaged included recently planted trees, trees growing on sandier soils, drought-intolerant species, and deciduous trees defoliated by insects in the early growing season. Additionally, inadequate fall moisture has resulted in greater incidence of winter drying to many conifer species within the state.

The 2004 growing season was characterized by moist cool conditions. Below average temperatures delayed the leaf emergence of many tree species. Many species exhibited frost damage. The cool moist conditions were also favorable for infection and development of many foliar diseases. Although the combined effects of cool temperatures and foliar disease resulted in less than optimal growth, these same conditions also delayed the emergence of many defoliating insects. Similarly, many defoliating insects that emerged early were killed by early summer frost.

Floods

Flooding is a common occurrence in North Dakota. Many watercourses within the state are prone to overland spread of spring water flows that breach banks. In addition, flooding may occur near lakes and wetlands as water tables rise and inundate trees throughout the growing season. Depending on the length of inundation and the particular tree species, growing season floods may cause root mortality, tree decline or death. Such flooding associated with a raised water table has damaged native woodlands surrounding Devils Lake (Benson and Ramsey Counties) in recent years. Although the acres of dead trees currently surrounding the lake appear unsightly, this is a natural phenomenon. Historical records show that water levels exhibit cyclical fluctuations on Devils Lake. Trees may become established in previously inundated areas during periods of falling water levels only to become inundated and killed years later as water levels eventually rise. Such disturbances influence the species composition and age class of these unique forests.

Ice Storm

A late spring ice storm damaged community and forest trees in the northeastern part of the state. Several communities within Cavalier and Pembina counties reported many boulevard trees that were windthrown or had large branches ripped off. In addition, many rural plantings and trees adjacent to forest edges were severely damaged.

Herbicides

Although any number of chemicals can kill or injure trees, herbicides are the most common chemicals associated with tree disorders in North Dakota. Herbicides are formulated to kill weeds and when applied inappropriately, they can be very damaging to trees. Growth regulator herbicides such as 2,4-D and Dicamba are the two most common herbicides associated with tree injury in the state. These products are systemic and move throughout the tree. Exposure to these herbicides is often the result of drift, accidental spraying, or movement of the product through the soil. Herbicide injury is most commonly observed in rural plantings adjacent to cropland. Symptoms of herbicide exposure often appear as cupping of leaves, wilting, and twisting of shoot tips. Often this damage may predispose tree to secondary pests.

Summary

Despite limited forest acreage, forest and tree resources are extremely important to the residents of North Dakota. Native forests, rural tree plantings, and community forests provide unique benefits that in turn define which factors restrict their intended function or threaten their sustainability. Although North Dakota's forested resources are generally resilient to pest damage, sustainability concerns have arisen for some in recent years. Some of these concerns reflect successional changes within forestlands, decline of plantings due to prolonged pest outbreaks coupled with neglect, or losses of valuable boulevard species due to non-native pest introductions.

Although many forest pests are natural components of the environment, some (especially pests introduced from other regions or countries) may cause substantial damage. Direct management of such pests (whether native or not) is difficult to implement on broad scales and is therefore best dealt with through indirect means. Consequently, educational efforts directed at prevention of pest outbreaks, management of native woodlands to mimic natural disturbances, pest identification training and guidelines for local tree planting entities, and species diversity will be important to improve the condition of the susceptible forested resources within the state.

In addition to the current conditions, several non-native (invasive) pests have raised concerns within the Plains States. Recently, detections of the Emerald ash borer *(Agrilus planipennis)*, Asian longhorn beetle *(Anoplophora glabripennis)*, and the expansion of the Gypsy moth *(Lymantria dispar)* within the Lake States region has generated great concern among natural resource professionals in North Dakota. The greatest of these new threats is the Emerald Ash Borer, an exotic wood-boring beetle responsible for ash decline in Southeastern Michigan. As a result, much time and effort has focused on early detection of invasive pests, educational outreach, coordination of agencies, and preparation for such invasive tree pests.

References

Anderson, R., Anderson, G., and Schipper, A. 1979. Hypoxylon Canker of Aspen. USDA Forest Service. Forest Insect and Disease Leaflet 6. 5 p.

Ball, J.J. 1997. Restoration of Bottomland Forests: Challenges and Opportunities. Proceedings of the North Dakota Academy of Science. Vol 51. supplement 1. pp 40-43.

Burns, Russell M., and Barbara H. Honkala, tech. coords. 1990. Silvics of North America: 1. Conifers; 2. Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol.2, 877 p.

Harniss, R.O. 1981. Ecological succession in aspen and its consequences on multiple use values. P 31-39 in NV DeByle, ed. Proc. Symp. Situation Mgmt. Two Intermt. Species: Aspen and Coyotes. Vol 1. Aspen. Utah State Univ. Logan, Utah.

Haugen, D.E.; Piva, R.J.; Ronald J.; Kingsley, N.P.; and R.A. Harsel. 1999. North Dakota's Forest Resources, 1994. Res. Pap. NC-336. St. Paul, MN: USDS, Forest Service, NC Research Station. 101 p.

Hinds T.E. 1985. Ecology. In Aspen: Ecology and Management in the Western United States. DeByle and Winokur Eds. USDA Forest Service GTR RM-119. 283 Pp.

Jackson, M.B., Glogoza, P., Knodel, J. Ruby, C. and J. Walla. 2002. Insect and disease management guide for woody plants in North Dakota. NDSU Ext. Serv. Fargo, ND. F-1192. 39 p.

Jakes P.J. and W.B. Smith. 1982. A Second Look at North Dakota's Timberland, 1980. USDA Forest Service. North Central Forest Experiment Station. Res. Bul. NC-58. 86 p.

Johnson, W. and H. Lyon. 1991. Insects that Feed on Trees and Shrubs, 2nd Edition. Cornell University Press, Ithaca. 560 p.

Katovich, S.A., D.G. McCullogh, and R.A. Haack. 1995. Yellowheaded Spruce Sawfly – Its Ecology and Management. USDA Forest Service. North Central Research Station. GTR NC-179. 24 p.

Ostry, M.E. and N.A. Anderson. 1990. Disease resistance in a wild system: Hypoxylon canker of aspen. USDA Forest Service. NC For. Exp Sta. St. Paul, MN. GTR NC-140.

Perala D.A. 1990. Quaking aspen. In Silvics of North America. Burns, Russell M., and Barbara H. Honkala, tech. coords. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol.2, 877 p.

Riffle, J., and G. Peterson., technical coordinators. 1986. Diseases of Trees in the Great Plains. Rocky Mountain Forest and Range Experiment Station, USDA Forest Service. GTR RM-129. 149 p.

Sinclair, W., Lyon, H., and W. Johnson. 1987. Diseases of Tress and Shrubs. Cornell University Press, Ithaca. 575 p.

Walla, J.A. 1986. Disease survey of conifer border rows at Towner Nursery. A report to Roy Laframboise, Nursery Manager. NDSU – Dept. of Plant Pathology. 12p.

Appendix 1. Forest Insect and Disease Notes 2003-2004

There are numerous insect pests, infectious diseases, and non-infectious diseases of trees and shrubs in North Dakota. Many of these damaging agents are frequently observed within the state however the imposed damage is often restricted to localized sites and have not warranted concern on a broader scale. Regardless, these pests are reported here to aid in interpretations of long-term trends. For each pest, the host range and known distribution within the state is listed. In addition, a damage code (listed below) is assigned that generally classifies its position in the tree decline process.

Host Range: *Hosts observed within North Dakota*

State Distribution: *Statewide, East, West, Unknown, or Specific Counties Listed*

Damage Code: *Inciting- a primary stressing agent that may incite the decline of an otherwise healthy tree: Contributing – an agent that may kill or damage a tree weakened by other factors; Aesthetic – a cosmetic pest that may alter the appearance of the tree but does not threaten the tree's health*

Trend: *Increasing over past 10 years, Decreasing over past 10 years, Static (unchanged), or Unknown*

Infectious Diseases

Crown Gall of Willow *(Agrobacterium tumefaciens)*

- Host Range ..... Salix spp.
- State Distribution ..... Statewide, more common in Red River Valley
- Damage Code ..... Inciting
- Trend ..... Static

Ash Rust *(Puccina sparanginoides)*

- Host Range ..... Fraxinus spp.
- State Distribution ..... Statewide
- Damage Code ..... Inciting/Aesthetic – dependent on host and severity
- Trend ..... Unknown

Cedar-apple rust (Several *Gymnosporangium spp*)

- Host Range ..... Juniperous and Rosaceous species
- State Distribution ..... Statewide, Common
- Damage Code ..... Inciting/Aesthetic – dependent on host and severity
- Trend ..... Static

Ash Stem Decay *(Perenniporia fraxinophila)*

- Host Range ..... Fraxinus spp.
- State Distribution ..... Statewide, Common
- Damage Code ..... Contributing
- Trend ..... Increasing over past 10 years

Eutypella canker

- Host Range ..... *Acer* spp.
- State Distribution ..... Unknown
- Damage Code ..... Contributing
- Trend ..... Unknown

Cankers of Russian Olive (*Tubercularia, Phomopsis*, and others)

- Host Range ..... Russian olive
- State Distribution ..... Statewide, Common
- Damage Code ..... Contributing
- Trend ..... Static

Cankers of Siberian Elm (*Tubercularia, Botryodiplodia* and others)

- Host Range ..... Ulmus pulima
- State Distribution ..... Statewide, Common
- Damage Code ..... Contributing in conjunction with herbicide exposure, cankerworm defoliation and lack of cold hardiness
- Trend ..... Increasing over past 10 years

Apple scab *(Venturia inaequalis)*

- Host Range ..... Malus spp.
- State Distribution ..... Statewide, Common
- Damage Code ..... Inciting
- Trend ..... Increasing over past 10 years – recent wet period in Eastern N.D. may have increased incidence

Ash Flowergall Mite

- Host Range ..... *Fraxinus* spp.
- State Distribution ..... Statewide, Common
- Damage Code ..... Aesthetic
- Trend ..... Increasing

Botryosphaeria canker of Apple
(Botryosphaeria obtusa)

- Host Range ..... Malus spp.
- State Distribution ..... Unknown
- Damage Code ..... Contributing
- Trend ..... Unknown

Black Knot *(Apiosporina morbosa)*

- Host Range ..... Prunus spp.
- State Distribution ..... Statewide – less prevalent to the West
- Damage Code ..... Contributing
- Trend ..... Decreasing slightly since 2000

Fireblight *(Erwinia amylovara)*

- Host Range ..... Mountain ash,Apple, Cotoneaster, Crabapple, other Rosaceous hosts
- State Distribution ..... Statewide, Common
- Damage Code ..... Inciting/Aesthetic
- Trend ..... Increasing over past 10 years/Static

Melampsora Leaf Rust *(Melampsora medusae)*

- Host Range ..... Populus spp.
- State Distribution ..... East/Unknown – Disease incidence unknown to West
- Damage Code ..... Inciting
- Trend ..... Unknown

Plum Pockets *(Taphrina communis)*

- Host Range ..... *Prunus* spp.
- State Distribution ..... Unknown
- Damage Code ..... Inciting/Aesthetic – may limit fruit production
- Trend ..... Unknown

Powdery Mildew
(*Microsphaera, Erysiphe* species and others)

- Host Range ..... Numerousdeciduous woody plants
- State Distribution ..... Statewide
- Damage Code ..... Inciting / Aesthetic
- Trend ..... Static

Western Gall Rust *(Endocronartium harknessii)*

- Host Range ..... Pinus spp.
- State Distribution ..... Statewide
- Damage Code ..... Inciting – particularly to Asian Pinus hosts
- Trend ..... ncreasing over past 10 years

Verticillium Wilt *(Verticillium dahliae)*

- Host Range ..... Several species, Most common on Elm and Maple
- State Distribution ..... Unknown
- Damage Code ..... Inciting
- Trend ..... Unknown

Wetwood (Numerous bacterium)

- Host Range ..... *Ulmus/Populus* spp.
- State Distribution ..... Statewide, Common
- Damage Code ..... Contributing/Aesthetic
- Trend ..... Static

Noninfectious Diseases

Iron Chlorosis

- Host Range ..... Silver Maple,some Birches nd Hybrid Poplars
- State Distribution ..... Statewide/East – Most common in Red River Valley
- Damage Code ..... Inciting/Aesthetic
- Trend ..... Static

Winter Injury of Conifers

- Host Range ..... Numerous conifer species, especially *Picea* spp.
- State Distribution ..... Statewide – Most common in drier western sites
- Damage Code ..... Inciting/Aesthetic
- Trend ..... Static

Insects

Ash Bark Beetles (*Hylesinus* spp)

- Host Range ..... *Fraxinus* spp.
- State Distribution ..... Statewide, Common
- Damage Code ..... Contributing
- Trend ..... Static

Ash Lilac Borer *(Podosesia syringae)*

- Host Range ..... Fraxinus and Syringia spp.
- State Distribution ..... Statewide, Common
- Damage Code ..... Inciting/Contributing
- Trend ..... Static

Redheaded Ash borer *(Neoclytus acuminatus)*

- Host Range ..... *Fraxinus, Tilia, Ulmus* and other spp.
- State Distribution ..... Statewide, Common
- Damage Code ..... Contributing
- Trend ..... Static

Ash Plant bug (*Tropidesteptes* spp)

- Host Range ..... *Fraxinus* spp.
- State Distribution ..... Statewide, Common
- Damage Code ..... Aesthetic
- Trend ..... Static

Carpenterworm *(Prionoxystus robiniae)*

- Host Range ..... Several species, common on ash and elm
- State Distribution ..... Statewide
- Damage Code ..... Contributing
- Trend ..... Static,remains at low level

Chokecherry midge *(Contarinia virginianiae)*

- Host Range ..... *Prunus* spp.
- State Distribution ..... Unknown
- Damage Code ..... Aesthetic
- Trend ..... Unknown

Cottony maple scale *(Pulvinaria innumerabilis)*

- Host Range ..... Several species, Maple, Elm, Boxelder, Linden
- State Distribution ..... Statewide, Common
- Damage Code ..... Inciting
- Trend ..... Decreasing over past 10 years

European fruit lecanium scale *(Parthenolecanium corni)*

- Host Range ..... Ash andother deciduous speceis
- State Distribution ..... Statewide, Common
- Damage Code ..... Inciting
- Trend ..... Unknown

Fall webworm *(Hyphantria cunea)*

- Host Range ..... Chokecherry, ash, and other deciduous hosts
- State Distribution ..... Statewide, Common
- Damage Code ..... Aesthetic
- Trend ..... Static

Maple bladdergall mite *(Vasates quadripedes)*

- Host Range ..... Red and Silver Maples
- State Distribution ..... Statewide, Common
- Damage Code ..... Aesthetic
- Trend ..... Unknown

Oystershell scale *(Lepidosaphes ulmi)*

- Host Range ..... Several deciduous species
- State Distribution ..... Statewide
- Damage Code ..... Inciting
- Trend ..... Static

Pine needle scale *(Chionaspis pinifoliae)*

- Host Range ..... Conifers, Common of Spruce and Pine
- State Distribution ..... Statewide, Common
- Damage Code ..... Inciting – More damaging to the west
- Trend ..... Unknown

Poplar Borer *(Saperda calcarata)*

- Host Range ..... Aspen, Cottonwood, Poplar, Willow
- State Distribution ..... Statewide, Common
- Damage Code ..... Contributing – particularly in west
- Trend ..... Unknown

Spruce spider mite *(Oligonychus ununguis)*

- Host Range ..... Conifers, Most common on Spruce
- State Distribution ..... Statewide, Common
- Damage Code ..... Inciting
- Trend ..... Decreasing over past 10 years

Spring Cankerworm *(Paleacrita vernata)*

- Host Range ..... Numerous deciduous species, particularly *Ulmus* and *Fraxinus*
- State Distribution ..... Statewide
- Damage Code ..... Inciting
- Trend ..... Decreasing over past 10 years

Acknowledgements

The author expresses his sincere appreciation
to all state, federal, and university personnel
that assisted in the production of this report.

Special thanks are extended to
the North Dakota Forest Service,
NDSU Department of Plant Pathology and Extension Service,
the USDA Natural Resource Conservation Service,
the Bismarck Forestry Department,
the Fargo Forestry Department,
the North Dakota Department of Agriculture,
and the USDA Forest Service.

North Dakota Forest Service
Molberg Center
307 First Street East
Bottineau, ND 58318-1100
(701) 228-5422
www.state.nd.us/forest

NDSU is an equal opportunity institution