Keep Your Woods Healthy for Tomorrow

A Tool to Assess Risk in Minnesota's Changing Climate

Maintaining a healthy woodland is getting harder and harder. In today's world, there are an increasing number of stresses on your woodland. Despite this, you still depend on your woods for many benefits such as clean water, wildlife habitat, timber, and recreation.

One of these stresses is climate change. Our climate is changing at a pace faster than at any time known in history. While woodlands are adaptable, the pace of change may overwhelm the forest's ability to adjust. Landowners will need to consider how to prepare and respond appropriately.

Actions you take today can help your woods be more resilient, healthy, and productive in the face of climate change. This publication can help you quickly and easily assess the resilience of your woods. It does not list every possible scenario or impact, but it can help you consider important risk factors and offer suggestions about ways to reduce risk. You may wish to consider working with a forester, or other natural resource professional, to help you identify strategies to help keep your woods in good condition.

Woodland Resilience: The capacity of a woodland to withstand or recover from disturbance and stress.

Woodland Health and Resilience Principles

Climate change will alter the frequency and intensity of threats, such as pest outbreaks, invasive species, wildfires, and storms. Our Minnesota woodlands face threats from pests like the emerald ash borer, spruce budworm, oak wilt, eastern larch beetle and more. A changing climate, combined with existing threats, can further jeopardize the health of your woods. Here are some principles to keep in mind as you consider how to cope with the unpredictable conditions that lie ahead. A forester or other natural resource professional can help you determine the specific practices for the unique conditions on your land.

PRINCIPLES OF RESILIENT WOODLAND MANAGEMENT

1. **Keep Woodlands as Woodlands.**
   Woodlands provide many benefits, such as clean water, wildlife habitat, carbon sequestration, and wood products. But woodlands can only provide these goods and services if they remain as woodlands. To continue your legacy and protect your woods from development and other land-use change consider the future of your land. Contact the Minnesota Land Trust (https://mnland.org/) or a similar organization about conservation easements. The University of Minnesota Extension has information on woodland transition planning that can help you work with your heirs (z.umn.edu/landtransitionplan). Your long-term planning will be fruitful only if the woodland is there for the long-term.

2. **Maintain Woodland Health and Vigor.**
   Maintaining a healthy, vigorous woodland is one of the best protections against risks. Actively managing your woodland to promote growth, species diversity, and a complex stand structure reduces vulnerability to pests. The changing climate is expected to create more stress. For example, more frequent drought stress is expected for Minnesota, and this can create attractive conditions for some invasive species, forest pests, and pathogens. A woodland with a diverse mix of species may be able to withstand climate change and the accompanying stressors.

3. **Address Vulnerabilities.**
   Your woods may be vulnerable to climate change if there is a risk of declining health, productivity, or forest cover, or if there may be a substantial shift in identity (one forest type converting to another). The scorecards on the pages that follow are designed to help you identify potential risks for your property. These risks can be addressed over time. Some risk factors, such as lower than expected species diversity, may not be a sign of an immediate crisis but rather that past practices have encouraged a particular species or age class.

4. **Woodland Management Can Help.**
   Woodland management is the purposeful intervention by humans, using ecological principles, to optimize woodland health, along with desired goods and services. If your woods are vulnerable to climate change or if they are challenged by current disturbances, management can help ensure that you have the best possible change for a successful outcome.

Minnesota's Native Plant Communities

The Minnesota DNR has developed a useful system of Native Plant Community classification (https://www.dnr.state.mn.us/npc/index.html). Plant species composition drives the native plant community classification, but the system also takes into account geography, environmental conditions, and natural disturbance processes. Learning about the Native Plant Communities in your woodlands can help you understand how the woods typically function and whether they might be missing important components.

Printable books are available with all system summaries in each of Minnesota's ecological provinces:

- Laurentian Mixed Forest

- Eastern Broadleaf Forest

- Prairie Parkland

- Tallgrass Aspen Parklands
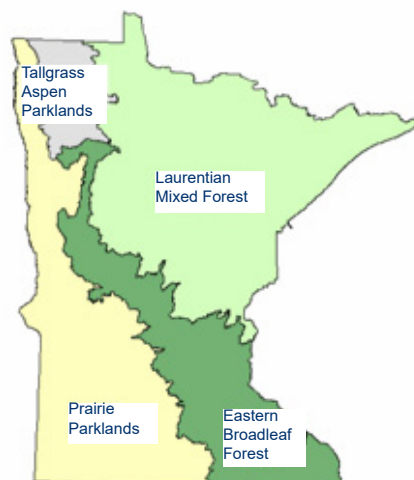
Native Plant Community Class and Type

Native Plant Community (NPC) classes are units of vegetation that have uniform soil texture, soil moisture, soil nutrients, topography, and disturbance regimes. Differences in the timing and severity of disturbances and differences in seasonal delivery and movement of essential nutrients are important characteristics of NPCs.

Further subdivision into NPC Type is based on canopy composition, substrates, moisture and nutrient availability. Canopy composition within types are usually uniform. Each NPC class and type is given a unique code to aid in native plant community data management and map labeling.

Understanding your woodland's NPC class and type can provide you ideas for assessing risk and responding to climate change.

Photo: MN DNR

This example native plant community is a fire dependent (FD) forest/woodland system found in the northern floristic region (n). The first number in an NPC class indicates moisture availability, ranging from 0 (driest) to 9 (wettest). A "4" for the FDn43 class indicates moderate moisture availability.

The second number in an NPC class indicates nutrient availability, ranging from 0 (poorest) to 9 (richest). A "3" for the FDn43 class indicates moderate to somewhat poor nutrient availability.

Common tree species include pine, aspen, northern white-cedar, and birch. Sites are located on loamy soils over bedrock in scoured bedrock uplands and on loamy, rocky, or sandy soils on glacial moraines, till plains, and outwash plains.

Historically, the primary disturbances included crown and severe surface fires. Catastrophic fires occurred approximately every 220 years. Severe surface fires occurred approximately every 260 years.

Within this class there are three NPC types, each which differ in the tree species:

- White Pine - Red Pine Forest (FDn43a)

- Aspen - Birch Forest (FDn43b), and

- Upland White Cedar Forest (FDn43c)

Woods Health Scorecards and Actions

The remainder of this guide is structured into "Scorecards" and corresponding "Actions." The scorecard elements are colored blue and the action elements are colored maroon.

Assess the Condition of Your Woodland

Each Woods Health scorecard (blue pages) can help you assess how resilient your woodland may be to changing climate conditions. Consider the condition of your woods and check the appropriate boxes during a walk in your woods. This evaluation can help you identify potential risks and highlight management options that may increase the forest's ability to cope with changing conditions. You may wish to discuss these topics with a natural resource professional.

Helpful Resources:

Climate Change Response Framework
www.forestadaptation.org

U.S. Forest Service Climate Change Atlas
www.nrs.fs.fed.us/atlas

Minnesota Ecological Classification System
https://www.dnr.state.mn.us/ecs/index.html

Woodland Stewardship, A Practical Guide for MidwesternLandowners
https://open.lib.umn.edu/woodlandstewardship

Minnesota Woodland Stewardship Plan Preparers
https://z.umn.edu/FindAForester

Woodlands of Minnesota Landowner Handbooks
https://www.dnr.state.mn.us/woodlands/index.html

Minnesota Invasive Species
https://www.dnr.state.mn.us/invasives/index.html

Take Action to Improve Woodland Resilience

Once you complete a Woods Health scorecard, the accompanying Woods Health Actions (maroon pages) can help you decide how to take action. Review each scorecard and address the high-risk areas first. Any topics you answer with "Don't Know" can be discussed with a forester or natural resource professional. Action pages present potential strategies to address areas that need improvement. A forester can help fit goals, objectives and associated practices that improve resilience into your management plan. The "take action" suggestions are general and won't include all the possible options, and every site location is different. However, the suggestions might help spark your imagination.

The Scorecards and Actions are organized into four categories:

PROPERTY-LEVEL CONSIDERATIONS

WOODLAND STRUCTURE

WOODLAND DIVERSITY AND COMPOSITION

TREE REGENERATION

Scorecard

Woodlands will be affected differently by climate change depending on their location on the landscape. For example, woods along waterways may be more vulnerable to extreme rain events or flooding. Different areas of the landscape may be exposed to higher or lower pressure from deer browse. Getting a sense for these overall considerations can help set some expectations for how you might cope with future change.

DROUGHT STRESS

Higher Risk

Soils and landscape position may make the property more prone to drought stress, or forest types may be mismatched to the soils on the property.

☐ ☐ ☐

◯ Don't Know/Not Sure

Lower Risk

Soils and landscape position are expected to retain water, and forest types are well-matched to soil conditions.

EXTREME RAINFALL

Higher Risk

Property contains areas that would be heavily affected by extreme rainfall, such as a floodplain or steep, highly-erodible slope. Early and rapid snowmelt can also cause flood conditions.

☐ ☐ ☐

◯ Don't Know/Not Sure

Lower Risk

Extreme rainfall would not cause problems at this location.

ACCESS FOR MANAGEMENT

Higher Risk

Warmer winter conditions create challenges to management. For example, if you have wet soil types that need frozen ground for a timber sale.

☐ ☐ ☐

◯ Don't Know/Not Sure

Lower Risk

Warmer winter conditions may increase opportunities for management. For example, you may find that some areas of your property are accessible during different seasons.

DEER BROWSE

Higher Risk

Your woods are in an area of high deer populations and are exposed to moderate to high browse pressure.

☐ ☐ ☐

◯ Don't Know/Not Sure

Lower Risk

Your woods are in an area with relatively lower deer numbers.

Explanations

An individual woodland owner can't do much to change these property-level considerations. Nevertheless, these topics are still useful to recognize and discuss with your forester. These considerations may help determine different risks from climate change, as well as the range of options that are available to adapt and prepare. Rather than concrete "actions," this page will present a little more explanation about the topic.

EXPLANATIONS

Drought Stress

- Drought may become more frequent under climate change as growing seasons become longer and warmer, snowmelt comes earlier, heavy rain events occur more often, and there are longer stretches between rain events.
- Drought stress won't be uniform across the landscape so it's important to consider whether factors such as soils, topography, and forest types might make your property more vulnerable.
- An example "mismatch" might be a sugar maple forest growing on sandy soils that would historically not have supported this forest type.

Extreme Rainfalls

- Minnesota has already experienced dramatic increases in the frequency of extreme rainfall over the past several decades, and this trend is expected to continue under climate change.
- Lowland forests such as forested wetlands and swamps may be exposed to larger floods in the future. Upland forests or steep slopes may experience more erosion from large rain events.
- Early and rapid snowmelt and rain-on-snow events are also expected to become more common under climate change, and these can also lead to flooding.

Access for Management

- Winters have warmed more rapidly than other seasons in Minnesota over the past several decades, and winter is expected to continue warming across the state.
- In some regions, forest management and trucking depends on frozen ground conditions or deep snowpack during the winter. These rules are in place to protect wetlands and sensitive soils.
- Warmer winters will mean a shorter window of opportunity with reliable conditions for forest management, particularly for properties with low areas or wetlands. Timing of harvest operations is important to minimize risks to forest soils.

Deer Browse

- In some areas of Minnesota, forest regeneration is severely limited by deer browse.
- Landowners in areas with high deer populations or winter deer yards may be limited in terms of what species you are able to plant, or you may be required to invest extra time and resources into installing tree fences, bud caps, or other deterrents to protect seedlings.

WOODLAND DIVERSITY AND COMPOSITION
Scorecard

Composition refers to the variety of species, communities, and ecosystems in an area. Every property is different and will contain a different mix of tree and plant species due to the conditions unique to that place and the history of the land. In general, a woodland that contains a variety of tree species that are well-suited to local conditions as well as future climate conditions will be more resilient. You may also consider woodland diversity across the landscape and how your woods might contribute to variety in the surrounding area.

SPECIES DIVERSITY

Higher Risk ☐ ☐ ☐ **Lower Risk**

Missing tree species and understory plants that would be expected for that ecological classification/forest type.

◯ Don't Know/Not Sure

Contains a mix of tree species and understory plants appropriate for that ecological classification/forest type.

SPECIES SUITABILITY

Higher Risk ☐ ☐ ☐ **Lower Risk**

Many species not expected to do well over the next 50 years, or many species not well-suited for the soils on the property.

◯ Don't Know/Not Sure

A mix of species that are expected to fare well under a changing climate, and species that are well-suited for the soils on the property.

GENERAL TREE HEALTH

Higher Risk ☐ ☐ ☐ **Lower Risk**

Trees are not healthy and have weak crowns, rotting trunks, and/or too many dead or dying limbs.

◯ Don't Know/Not Sure

Trees have fully green crowns typical for their species. Trees tend to be healthy and growing well.

INSECTS AND DISEASES

Higher Risk ☐ ☐ ☐ **Lower Risk**

The woodland is currently affected by insects or diseases. There are looming threats such as nearby outbreaks.

◯ Don't Know/Not Sure

There are no current or looming forest insect or disease issues. No evidence of major insect or disease problems.

LANDSCAPE DIVERSITY

Higher Risk ☐ ☐ ☐ **Lower Risk**

The landscape around my property has uniform topography and a similar forest type. The surrounding forest types are not expected to thrive under climate change.

◯ Don't Know/Not Sure

The landscape around my property has diverse topography and a variety of forest types. Many surrounding forest types are expected to fare well under climate change.

Actions

Strategies to increase or maintain diversity and composition will vary from region to region and among different sites. These strategies are general suggestions, and they may not be suitable for all situations. Talk with a forester about what makes sense for you and your woods.

CONCERNS	STRATEGIES
Species Diversity Species diversity, among trees and in the understory, is lower than what is expected for my forest types.	• During timber harvest, select against over-represented species in the overstory and understory, where appropriate for the site and soil types. • Promote regeneration of a variety of species through harvesting, or plant a variety of native species expected to do well under future conditions. • Consider deer browse levels in your area before deciding what to plant and what kind of protection may be required.
Species Suitability Many tree species are not expected to do well under continued climate change.	• Promote species with a wide range of moisture and temperature tolerances if they are present, or plant if needed. • Promote a variety of native species expected to do well under future conditions if they are present, or plant if needed. • Consider deer browse levels in your area before deciding what to plant and what kind of protection may be required.
General Tree Health My woodland is growing poorly and/or have high amounts of damage from insects, diseases, or weather events.	• When appropriate, thin forest stands to remove crowded, damaged or stressed trees to reduce competition for light, nutrients, and water. • For stands with too few trees, consider regeneration strategies for tree species appropriate for the soil types and expected climate change conditions.
Insects and Diseases My woodland is currently affected by insects or diseases. There are looming threats such as nearby outbreaks.	• Consult a local forest health professional for detailed recommendations. • Conduct a salvage harvest of affected tree species, when feasible.
Landscape Diversity The landscape around my property has uniform topography and a similar forest type/ecological classification that is not expected to thrive under climate change.	• Consult a forester to discuss how your woods could boost diversity in the area. • Consider if management could add diversity to the overall landscape, such as a patch cut in the middle of a uniform canopy. • Talk with your neighbors about shared woodland interests and discuss management options.

Scorecard

Many woodlands in Minnesota currently have simplified forest structure. Characteristics of a complex woodland structure include having a diversity of tree sizes and ages, varying the number of trees per acre, and ensuring the presence of dead wood — both standing and down. A complex woodland structure can help provide a variety of conditions (light, moisture, and competition) that create opportunities for many species to find suitable opportunities for growth and regeneration. This can help a woodland tolerate and respond to stress and disturbance. Different forest types or native plant communities are expected to have different amounts of structural complexity at different ages.

STRUCTURAL DIVERSITY

Higher Risk

Size classes and forest layers that should be there for my woodland are missing.

☐ ☐ ☐

◯
Don't Know/Not Sure

Lower Risk

My woodland has properly developed size classes for the forest /ecological classification.

STANDING AND DOWN DEAD TREES

Higher Risk

No or few large standing or down dead trees are present.

☐ ☐ ☐

◯
Don't Know/Not Sure

Lower Risk

There is an appropriate amount of standing and down dead trees (several per acre), and some are large. Note – if there are excessive dead and down trees, this could indicate a forest health issue. For example, if there are many dead trees all of the same species.

TREE CROWNS AND SPACING

Higher Risk

Trees are crowded and competition for resources is slowing growth, or less commonly, trees are inadequately stocked and too widely spaced.

☐ ☐ ☐

◯
Don't Know/Not Sure

Lower Risk

Trees have adequate growing space that enables them to have healthy crowns and develop healthy forest canopies.

LANDSCAPE STRUCTURE

Higher Risk

The landscape around my woods is primarily a similar age and structure.

☐ ☐ ☐

◯
Don't Know/Not Sure

Lower Risk

There are a variety of forest ages and structures on the landscape around my property.

Actions

Strategies to increase or maintain structural diversity will vary from region to region and among different sites. Different forest types/ecological classifications are expected to have different amounts of structural complexity at different ages. Talk to a forester about these suggestions.

CONCERNS	STRATEGIES
Structural Diversity The woodland contains trees that are primarily a single age or size, creating a simple canopy, when a more complex structure can be expected.	• In certain forest types, use forest management to mimic aspects of natural disturbance to support the establishment of different age classes. • Retain individual trees or groups of trees during harvest actions to allow some portions of your woods to reach an older age.
Standing and Down Dead Trees No or few large standing or down dead trees are present.	• Where they do not create a hazard, leave or create standing dead trees during forest management activities. • Allow some trees to grow to larger sizes so that they can provide value to wildlife and serve as future dead wood. • Leave large pieces of woody material on the ground after disturbances and forest management activities.
Tree Crowns and Spacing Trees are too crowded and competition is slowing growth, or less commonly, trees are inadequately stocked and too widely spaced.	• In overstocked stands, identify desirable crop trees and thin to create room for these individuals to grow. • In understocked stands, plant (and protect) a variety of native species expected to do well under future conditions. • In understocked stands, introduce natural or mechanical disturbance to mimic conditions for regeneration.
Landscape Structure The landscape around my woods is primarily a similar age and structure.	• Consult a forester to discuss how your woods contribute to structural diversity in the surrounding area, and how their characteristics could be managed to boost landscape structure. • Talk with your neighbors about shared forest interests and discuss management options.

Scorecard

"Regeneration" refers to seedlings, usually under two feet tall. "Recruitment" consists of larger saplings that will likely become the new forest. In many situations, regeneration is not a problem but recruitment is a serious problem. Many factors contribute to a healthy, or unhealthy, forest understory. In Minnesota, deer browsing may be the most important barrier to tree recruitment and understory diversity. Climate change will modify the microclimate conditions under which seeds germinate and seedlings survive.

DESIRABLE REGENERATION

Higher Risk   ☐ ☐ ☐   **Lower Risk**

Tree seedlings and saplings are absent in the understory or are outcompeted by undesirable species, including invasive plants.

○ Don't Know/Not Sure

Tree seedlings and a sufficient number of saplings are present in the understory; the species mix is desirable for achieving management goals.

SPECIES SUITABILITY

Higher Risk   ☐ ☐ ☐   **Lower Risk**

Regeneration consistis mostly of tree species not expected to do well under continued climate change.

○ Don't Know/Not Sure

Regeneration includes a variety of tree species expected to do well under climate change.

INVASIVE SPECIES

Higher Risk   ☐ ☐ ☐   **Lower Risk**

Invasive plants such as buckthorn and garlic mustard, or invasive animals such as earthworms are impeding natural tree regeneration. Some native species that rapidly proliferate may also be a concern.

○ Don't Know/Not Sure

Invasive plants and animals are absent on the property or are confined to limited areas.

DEER BROWSE

Higher Risk   ☐ ☐ ☐   **Lower Risk**

The occurrence of moderate to severe deer browse creates substantial challenges for tree regeneration and recruitment.

○ Don't Know/Not Sure

Deer browse does not pose a substantial challenge to tree regeneration.

Actions

Strategies to manage tree regeneration will vary from region to region and among different sites. These strategies are general suggestions, and they may not be suitable for all situations. Talk with a forester or natural resource professional about what makes sense for you and your woods.

CONCERNS	STRATEGIES
Desirable Regeneration Tree seedlings and saplings are absent in the understory or are dominated by undesirable species.	• Retain desirable tree species in the overstory so that they may provide a future seed source. • Consider creating a seedbed for seedling germination by scarification of selected areas of your woodland. • Remove undesirable tree species to enhance regeneration of desired tree species. Consider manual removal for small areas, or explore mechanical removal, prescribed burning, or chemical control. • Provide soil surface conditions appropriate to desired tree species. This may entail exposing mineral soil. • Assess whether deer browse is limiting desirable regeneration.
Species Suitability Regeneration consists mostly of tree species that are not expected to do well under continued climate change.	• Favor species currently present that can persist under a wide variety of climate and site conditions. • Identify and promote species that currently occupy a variety of site conditions and landscape positions.
Invasive Species Invasive plants such as buckthorn and garlic mustard, or invasive animals such as earthworms are impeding natural tree regeneration. Some native species that rapidly proliferate may also be a concern.	• Thin stands by identifying crop trees, creating room for desirable species of good form to grow. • Prevent new invasive species from establishing and manage existing populations or seed sources of invasive plants through physical or chemical treatments. • Monitor regularly for the presence of new invasive plants or animals in your woods.
Deer Browse Moderate to severe deer browse may create substantial challenges for tree regeneration and recruitment.	• Install fences, bud caps, or other physical barriers to prevent browsing damage. • Use tree tops from forest harvest or plantings of non-palatable tree species as locations for "hiding" desirable species from herbivores to reduce browse pressure. • Increase hunting pressure and/or hunter effectiveness. • Identify areas of your woods that may be naturally protected from deer due to steep slopes or other factors, and emphasize regeneration in these areas.

Photo: Northern Institute of Applied Climate Science

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The Nature Conservancy® and Cornell Cooperative Extension

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