

Keep Penn's Woods Healthy

A Tool to Assess Risk and Resilience in Changing Forests



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PHOTO BY: LAURA KIRT

Whether you spend time outside in your woods or just enjoy the beauty of your trees and wildlife from the window, you likely love your woods and want to keep them healthy. Forests are always changing and adapting to new conditions. Some changes, like the progression of green summer leaves to bright red and gold fall foliage, or the annual return of migratory songbirds, are expected. Other shifts, such as earlier spring leaf-out or an increase in nuisance plants such as buckthorn, are only visible when comparing differences in woodlands across many years or decades.

Maintaining a healthy forest is getting harder and harder. In today's world, there are an increasing number of stressors acting on forests. Insect pests, tree diseases, wildfire, and invasive plants are becoming more challenging to manage and often coincide with warmer winters, longer

growing seasons, extreme rainfall, more frequent heat waves, and late summer moisture stress. Despite these challenges, you still depend on your woods and keeping them healthy will help ensure the many benefits such as clean water, wildlife habitat, timber, and recreation continue.

Actions you take today can help your woods be more resilient, healthy, and productive in the face of changing conditions. Active forest management, including timber harvests for ecological outcomes, is an important supporting tool to achieve a wide range of goals and objectives related to forest resilience in the face of both current and anticipated changes.

Forest Resilience: The capacity of a forest to withstand or recover from disturbance and stress.

How to Use This Guide

This guide can serve as a tool to help consulting foresters and woodland owners assess the resilience of a woodland. It contains background information on the important characteristics of resilient and healthy forests and provides examples of potential adaptation strategies. The checklists and strategies in this guide are meant to help you look at your woods both as a whole and in smaller parts, so you can make decisions that fit each area of your land. They ask you to look at your parcel of the woods and also at the surrounding landscape within which your woodlands sit. The included checklists can be used in the field to evaluate the resilience of a woodland, which can then be used to start a conversation between a woodland owner and a forester or other service provider. Help in using this tool can also be provided by the James C. Finley Center for Private Forests, Penn State Extension, your local DCNR Bureau of Forestry Service Forester, and your consulting forester or other natural resources professional with whom you engage.

Your Role in Keeping Forests Healthy and Resilient

Your woodland is a valuable part of a large, interconnected puzzle across the Commonwealth; an estimated 51 percent (8.4 million acres) of forests are owned by woodland owners like you. As of the last USDA Forest Service National Woodland Owner survey (2018), 163,000 families with 10 or more acres each collectively owned 7.5 million acres across Pennsylvania. Statewide trends indicate improvements in tree regeneration and forest growth, while concerns include the overall loss of forest land and more areas where the built environment meets that forest land.

However, many woodland owners are concerned about invasive plants, water pollution, and insect pests and diseases. While creating a management plan is important for keeping Penn's Woods healthy, only about 6 percent of woodland owners have a management plan and are actively addressing these threats. Having a management plan can help landowners participate in programs designed to certify sustainable wood products, optimize forest-based goods and services, and plan for the future.

This guide contains checklists that can help you 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 to reduce risk. Working with a forester or other natural resource professional is recommended to help you identify strategies to maintain or improve the condition of your woods.

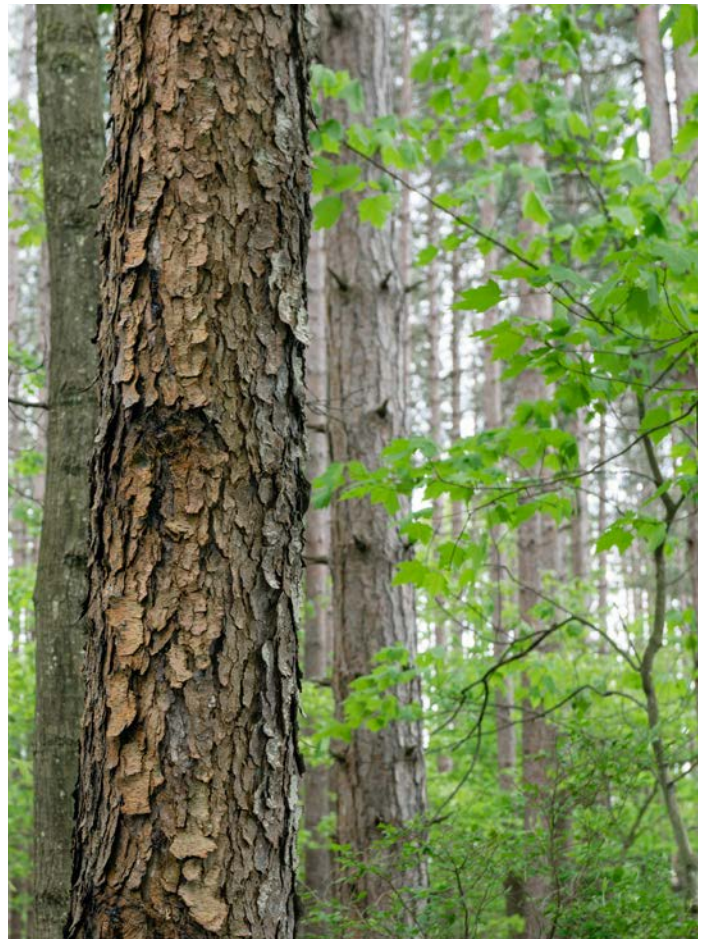


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Forest Health and Resilience Principles

A healthy forest hosts structural and biological diversity that ensures sustained flows of goods and services such as clean air, clean and abundant water, productive soils, and a sustainable supply of forest products. Here are some high-level principles to keep in mind as you consider how to prepare your woods to cope with the unpredictable conditions that lie ahead.

1. Keep Forests as Forests

Forests provide many benefits, such as clean water, wildlife habitat, and wood products. The ability of forests to provide these goods and services depends on keeping them as forests—something that’s becoming more challenging due to threats like urban sprawl and other land use changes. There are legal tools to continue your legacy and protect your forest from development and other land-use change. Talk to a professional about land conservation options, including legacy planning, indirect ownership, or conservation easements. Your long-term planning will be fruitful only if the forest is there for the long term.

Resources to get you started in considering long-term conservation strategies, including conservation-based estate planning, can be found on the James C. Finley Center for Private Forests website:
<https://ecosystems.psu.edu/legacy>

2. Maintain Forest Health and Vigor

Maintaining a healthy, vigorous forest is one of the best protections against many stressors. Actively managing a forest to promote growth, species diversity, and stand structure has many benefits, including reducing environmental stress and vulnerability to pests. Pennsylvania’s forests are susceptible to stressors associated

with a changing climate, such as more frequent droughts, which in turn can create attractive conditions for some invasive species, forest pests, and pathogens. A diverse forest with healthy trees can be in a better position to withstand these stressors.

3. Identify and Address Potential Vulnerabilities

Addressing potential vulnerabilities today can help build a brighter future for your woods and protect ecosystem benefits that woods provide. Areas of vulnerability to pay attention to include changes in health, productivity, species diversity, and forest cover. Certain risk factors, such as lower-than-expected species or structural diversity, may not be signs of an immediate crisis but rather a signal that there has been too much emphasis on a particular species or age class in your “forest portfolio.” The checklists on the pages that follow show you how to use landscape features to identify areas of potential vulnerability, which can be addressed over time through forest management.

4. Forest Management Can Help

Forest management is the purposeful intervention by humans in forests, using ecological principles, to optimize forest health, along with desired goods and services. We have the tools to anticipate changing conditions and the potential consequences of those changes, which might be beyond the ability of your woods to cope naturally. 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 chance for a successful outcome. A forester or other natural resource professional can help you determine the specific practices for the unique conditions on your land.

Expected Changes in Pennsylvania Forests

Forest ecosystems are inherently able to cope with a range of changing conditions; in fact, forests in Pennsylvania have expanded and adapted through past periods of glaciation and warm spells. As the climate warms, physical processes—like drought, extreme rainfall, and species composition changes—are intensifying. This section describes some of the drivers of forest change and associated challenges that are common across Penn’s Woods.



WARMER TEMPERATURES

- Average annual temperature in Pennsylvania increased nearly 2°F in the past century, with faster warming since the 1970s. This may not sound like much, but it’s enough to have set in motion many of the changes already being experienced.
- Weather data shows the number of hot days (above 95°F), and warm nights (no cooler than 68°F) have increased since the 1970s, and that heat waves are twice as common.
- Temperatures are becoming warmer in all seasons, but winter is warming the fastest, reducing the amount and duration of snowfall and frozen ground conditions.



DROUGHT STRESS

- Drought may become more frequent in the future 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 soil types, 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 RAINFALL

- Pennsylvania has experienced dramatic increases in the frequency of extreme rainfall (inches of rain per hour) over the past several decades, and scientists predict that this trend will continue in the future.
- Low-lying forests may be exposed to higher and more prolonged floods in the future, and upland forests or steep slopes may experience more erosion from extreme rain events.
- Early and rapid snowmelt and rain-on-snow events are expected to become more common due to warmer conditions, which can lead to flooding.



DEER BROWSE

- In some areas of Pennsylvania, forest regeneration is severely limited by deer browsing.
- Landowners in areas with high levels of browse damage may be limited in terms of deer-resistant species to plant or may need to invest extra time and resources to install tree fences, tree tubes, or other deterrents to protect vulnerable seedlings.
- While deer populations may remain relatively constant over the next several decades, their impacts, when combined with other stressors, may exceed a forest's ability to tolerate additional changes.



INVASIVE AND COMPETING PLANTS

- Disturbances such as flooding, ice storms, and wildfire can open forest canopies, expose mineral soil, and increase light, providing greater opportunities for establishment of invasive species.
- Some invasive plant species are tolerant of drought and fire and may be at a greater advantage if disturbances occur more frequently and with more intensity. Other invasives, such as garlic mustard and Japanese stiltgrass, are not particularly drought tolerant, but their persistent seedbanks enable them to recover in wetter years. Woody invasive species like buckthorn may increase wildfire risk because they are often more flammable than native plants and can serve as ladder fuels that transfer fire to the forest canopy.
- Native species can also become problematic under some conditions. For example, in areas with high deer browsing impacts, native plant species that deer do not eat—like red maple, sweet birch, and rhizomatous ferns (New York fern, hay-scented fern, and bracken fern)—can dominate the understory plant community. In normal conditions, these plants are important to functioning ecosystems but when they dominate, forests become less diverse, robust, and resilient.



INSECT PESTS AND PATHOGENS

- When forest pests and pathogens respond rapidly to a warming climate they may be able to damage forest ecosystems that are already stressed. The leading causes of substantial defoliation or tree death in recent years include emerald ash borer, spongy moth, hemlock woolly adelgid, beech bark disease, and oak wilt.
- Scientists predict that warmer winters will drive population increase and extent of hemlock woolly adelgid, while drought, excessive moisture, and wind damage will likely contribute to higher disease prevalence.

While forests are inherently adaptable to disturbance and change, severe change can overwhelm their ability to adjust to new conditions. Long-term forest monitoring and scientific models can describe forest trends and predict future change and impacts. This information can help woodland owners understand their forests over time, prepare for change, and mitigate potential risks to forest health.

Woods Health Checklists and Actions

The remainder of this guide is structured into “Checklists” for assessing your forest and corresponding “Actions” to help reduce risks. The checklist elements are colored light green, and the action elements are colored dark green.

Assess the Condition of Your Forest

Each Woods Health Checklist can help you assess how resilient your forest may be to changing conditions. This evaluation can help you identify potential risks and highlight management options that may increase the forest’s ability to cope with change. The tool can be used in a very flexible manner and the assessment can be done over a long or short timeframe, during or after a woods walk. You may be able to answer some of the questions on your own; other assessment questions may benefit from professional guidance. For each checklist, consider the condition of your woods and indicate the level of risk for each variable. Discuss these topics, especially those of high risk or those about which you don’t know, with a forester or resource professional to help you plan for the future.

Preparing to Use the Checklist

- Gather property maps, aerial photos, inventory data.
- Locate your property using regional soils, topography, or hydrology data.
- Map out your property and note stands, or areas of similar tree species, age, and history.
- For complex properties with multiple stands, consider using a checklist for each stand. Create an identification scheme (for example, maple stand 1, lowlands maple stand) to easily note where each checklist refers.
- Take photos or identify plants in the spring, summer, and fall when flowers and foliage are visible.

Helpful Resources:

Climate Change Response Framework | www.forestadaptation.org

USDA Forest Service Climate Change Atlas | <https://arcg.is/00jHzH1>

USDA Northern Forests Climate Hub | <https://www.climatehubs.usda.gov/hubs/northern-forests>

Managing Your Woods | <https://www.pa.gov/agencies/dcnr/conservation/forests-and-tree/managing-your-woods>

Helpful Resources (continued):

Major Forest Types of Pennsylvania | <https://www.dcnr.pa.gov/Conservation/ForestsAndTrees/ForestTypes/Pages/default.aspx>

USDA Web Soil Survey | <https://websoilsurvey.sc.egov.usda.gov>

Invasive Plant Fact Sheets | <https://www.dcnr.pa.gov/Conservation/WildPlants/InvasivePlants/InvasivePlantFactSheets/Pages/default.aspx>

Take Action to Improve Forest Resilience

Once you complete a Woods Health Checklist, the accompanying Woods Health Actions (dark green pages) can help you decide how to take action. Complete each checklist and use the notes pages to describe the conditions of your property. Any topics you leave blank or aren't sure about can be ideas to discuss with a forester. Next, review each Checklist and address the high-risk areas first. An Actions page presents potential strategies to address areas that may need improvement. A forester can help fit goals, objectives, and associated practices that improve resilience into your long-term management plan and a forester can also help prioritize activities over time. The suggested actions are general and won't include all the possible options, and every site location is at least a little bit different. However, the suggestions can guide your planning.



PHOTO BY: NANCY BAKER,
PA FOREST STEWARDS STEERING COMMITTEE CHAIR

THE CHECKLISTS AND ACTIONS ARE ORGANIZED INTO FOUR CATEGORIES:



Property-Level and Forest Stand



Forest Structure



Forest Diversity and Composition



Tree Regeneration

Property-Level and Forest Stand Checklist



Woodlands will be affected differently by disturbance and forest stressors depending on their location in the landscape, what kind of soils are present, whether the topography is flat or steep, and other site characteristics. 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 property characteristics can help set some expectations for how you might plan for change.

FACTORS THAT INCREASE RISK OF FOREST IMPACTS	TOPIC	FACTORS THAT DECREASE RISK OF FOREST IMPACTS
Drought-prone soils or south-facing aspect; marginal conditions for forest type; moisture-dependent ecosystem	<p align="center">Moisture Stress/Drought</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Moist to wet soils or north-facing aspect; optimal soils for forest type
Steep terrain, evidence of soil erosion or uncharacteristic flooding	<p align="center">Extreme Rainfall</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Flat topography, well vegetated, no uncharacteristic ponding or flooding
The risk of blowdown is higher in stands that are small and isolated, located on a high ridge top or contain shallow rooted species	<p align="center">Extreme Wind Events</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Trees are part of a large forested area, located in protected coves, or contain species that are deep-rooted and not prone to uprooting
Generally wet soils for much of the year or access requires frozen ground or deep snow to minimize soil damage	<p align="center">Shorter, Milder Winters</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Soils are coarse and dry, thus relatively resistant to compaction, rutting
Forest is dense with abundant downed wood or hazardous fuels that create elevated fire risk, especially during extreme heat or drought.	<p align="center">Wildfire Risk</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Woods are open, have moist soils throughout the year, and understory plants are fire-resistant.
Property has uniform topography and a single forest type	<p align="center">Landscape Diversity</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Property has diverse topography and several forest types

Property-Level and Forest Stand Actions



Strategies to address property-level considerations 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.

CONCERN	STRATEGIES
<p>Moisture Stress/Drought: Soils and landscape position may make my property more prone to drought stress, or forest types may be mismatched to the soils on my property.</p>	<ul style="list-style-type: none"> • Maintain and enhance filtration and water storage capacity of forest soils by minimizing soil exposure, compaction, and soil disturbance. • Maintain and restore hydrologic connectivity by removing barriers to water flow or treating compacted soils. • Manage systems to cope with decreased water levels and limited water availability by adjusting stocking level or species composition (for example, plant drought-tolerant species).
<p>Extreme Rainfall: My property contains areas that would be heavily affected by extreme rainfall, such as a floodplain or steep, highly erodible slopes.</p>	<ul style="list-style-type: none"> • Plant flood-tolerant species, such as swamp white oak and silver maple, on sites that are expected to become more prone to flooding. • Reduce soil erosion and sediment deposition by directing overland flow into forested areas using bioswales. • Maintain or restore forest and vegetative cover in riparian areas.
<p>Extreme Wind Events: My property contains areas that can be significantly impacted by extreme wind events such as high elevations or areas above the surrounding landscape.</p>	<ul style="list-style-type: none"> • Thin stands to increase space for tree growth and enhance sturdiness of the residual stand, favoring the healthiest trees. • Encourage diversity of tree species to promote resilience of your woods in the face of storms (this also helps control invasives, which take advantage of disturbance). • Design canopy gaps and harvest edges with an orientation and shape informed by the prevailing winds to reduce the risk of windthrow.
<p>Shorter, Milder Winters: Warmer winter conditions may create challenges to my management goals (for example, if wet soil types need frozen ground for a timber sale).</p>	<ul style="list-style-type: none"> • Promote long-lived conifers with wide ecological tolerances, such as eastern white pine. • Time the season of harvest operations to match site conditions and minimize risk to soils. • Limit harvest or management-related disturbance in areas that may be especially sensitive to environmental changes (e.g., spring-fed stands sheltered in swales).
<p>Wildfire Risk: My woods contain abundant downed wood or hazardous fuels that elevate wildfire risk.</p>	<ul style="list-style-type: none"> • Decrease tree density through mechanical thinning or fire to improve the capacity of trees to resist insect pests or pathogens. • Remove and prevent establishment of non-native invasive species that alter fuel regimes. • Restore or maintain fire in fire-adapted ecosystems (e.g., using prescribed fire).
<p>Landscape Diversity: The landscape around my property has uniform topography and a similar forest type, which is not expected to thrive under future conditions.</p>	<ul style="list-style-type: none"> • Consult a forester to discuss how the woods could contribute to boosting 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 neighbors about shared forest interests and discuss management options.

Forest Diversity and Composition Checklist



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 forest that contains a variety of tree species that are well-suited to both current and future climate conditions will be more resilient. You may also consider forest diversity across the landscape and how your woods might contribute important variety to the surrounding area.

FACTORS THAT INCREASE RISK OF FOREST IMPACTS	TOPIC	FACTORS THAT DECREASE RISK OF FOREST IMPACTS
One or two species dominate the site	<p align="center">Species Diversity</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Site has a diverse mix of native tree species
Many tree species expected to decline over the next 50-70 years	<p align="center">Species Suitability</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Many tree species expected to do well over the next 50-70 years
Trees have weak crowns, rotting trunks, or non-age-related mortality	<p align="center">General Tree Health</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Trees have fully green crowns typical for the species, undamaged trunks and limbs
Trees are currently affected by insects or disease or vulnerable to nearby outbreaks	<p align="center">Insects and Diseases</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	No current insect or disease damage

Forest Diversity and Composition 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.

CONCERN	STRATEGIES
<p>Species Diversity: Species diversity, among trees and in the understory, is lower than what is expected for my forest types.</p>	<ul style="list-style-type: none"> • 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 planting a variety of native species expected to do well under future conditions. • Consider deer browse levels before deciding what to plant and what kind of protection may be required.
<p>Species Suitability: Many of my tree species are not expected to do well under future climate conditions.</p>	<ul style="list-style-type: none"> • 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 before deciding what to plant and what kind of protection may be required.
<p>General Tree Health: My woods are growing poorly and/ or have high amounts of nonnative and competing vegetation.</p>	<ul style="list-style-type: none"> • Optimize stocking levels for my forest type by encouraging regeneration and tree recruitment. • Manage invasive species or competing vegetation that can cause harm, such as mile-a-minute. • When appropriate, thin forest stands to remove crowded, damaged, or stressed trees to reduce competition for light, nutrients, and water. • Consider regeneration strategies appropriate for the soil types and expected climate conditions.
<p>Insects and Diseases: My woods are growing poorly and/or have high amounts of damage from insects or diseases.</p>	<ul style="list-style-type: none"> • Consult a local forest health professional for detailed recommendations. • Conduct a salvage harvest of affected tree species, when feasible. • Create a diverse mix of forest or community types, age classes, and stand structures to reduce the availability of host species for pests and pathogens. • Treat diseased trees or remove severely damaged trees in order to protect remaining trees.

Forest Structure Checklist



Some forests in Pennsylvania have a more simplified forest structure due to past management that created low age class diversity. Complex forest structure can be created by 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 forest structure can help provide a variety of conditions (light, moisture, and competition) for many species to grow and regenerate. This can help a forest tolerate and respond to stress and disturbance.

FACTORS THAT INCREASE RISK OF FOREST IMPACTS	TOPIC	FACTORS THAT DECREASE RISK OF FOREST IMPACTS
Single age class and simple structure; forest layers that should be there are missing	<p align="center">Structural Diversity</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Diverse age classes and complex canopy, midstory, and understory structures
There are no or few large standing or down dead trees present, or an excess of dead trees indicate a forest health problem	<p align="center">Standing and Down Dead Trees</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Trees are generally healthy and there are several standing and down dead trees per acre and some are large
Trees are crowded and seem to compete for resources, or trees are stocked too low and widely spaced	<p align="center">Tree Crowns and Spacing</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	Trees have adequate growing space and stocking levels that develop a healthy forest canopy
The landscape around my woods is of a similar age and structure	<p align="center">Forest Landscape Structure</p> <p align="center">HIGH RISK MED. RISK LOW RISK</p> <p align="center">←.....→</p>	There are a variety of forest ages and structures on the broader landscape

Forest Structure Actions



Strategies to increase or maintain structural diversity will vary from region to region and among different sites. Different forest types are expected to have different structural complexity at different ages, and a forester can help you determine what kind of structural characteristics are suitable for your woods.

CONCERN	STRATEGIES
<p>Structural Diversity: My woods contain trees that are primarily a single age or size class, creating a simple canopy when a more complex structure can be expected.</p>	<ul style="list-style-type: none"> • 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 the woods to reach an older age.
<p>Standing and Down Dead Trees: No or few large standing or down dead trees are present.</p>	<ul style="list-style-type: none"> • Leave or create standing dead trees during forest management activities where they do not create a hazard. • 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.
<p>Tree Crowns and Spacing: My trees may be too crowded and competition may be slowing growth, or they are inadequately stocked and too widely spaced.</p>	<ul style="list-style-type: none"> • In overstocked stands, identify desirable crop trees and thin around them 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 create conditions for regeneration.
<p>Forest Landscape Structure: The landscape around my woods is primarily of a similar age and structure.</p>	<ul style="list-style-type: none"> • Consult a forester to discuss how the woods contribute to structural diversity in the surrounding area, and how forest characteristics could be managed to boost landscape structure. • Talk with neighbors about shared forest interests and discuss management options.

Tree Regeneration Checklist



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

FACTORS THAT INCREASE RISK OF FOREST IMPACTS	TOPIC	FACTORS THAT DECREASE RISK OF FOREST IMPACTS
Tree seedlings and saplings are absent in the understory	<p style="text-align: center;">Desirable Regeneration</p> <p style="text-align: center;">HIGH RISK MED. RISK LOW RISK</p> <p style="text-align: center;">←.....→</p>	Tree seedlings and a sufficient number of saplings are present and the species mix is adequate for management goals
The species mix of tree seedlings and saplings are expected to struggle over the next 50 years	<p style="text-align: center;">Species Suitability</p> <p style="text-align: center;">HIGH RISK MED. RISK LOW RISK</p> <p style="text-align: center;">←.....→</p>	The species mix of tree seedlings and saplings are expected to thrive over the next 50 years
Invasive plants, animals, insects, or earthworms are established and widespread	<p style="text-align: center;">Invasive and Competing Plants</p> <p style="text-align: center;">HIGH RISK MED. RISK LOW RISK</p> <p style="text-align: center;">←.....→</p>	Invasive plants and animals are absent on the property or are confined to limited areas
Moderate to severe deer impacts are observed and create substantial challenges for tree regeneration and recruitment	<p style="text-align: center;">Deer Browse</p> <p style="text-align: center;">HIGH RISK MED. RISK LOW RISK</p> <p style="text-align: center;">←.....→</p>	Deer impacts do not pose a substantial challenge to desired tree regeneration

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 about what makes sense for you and your woods.

CONCERN	STRATEGIES
<p>Desirable Regeneration: Tree seedlings and saplings are absent in the understory or are dominated by undesirable species.</p>	<ul style="list-style-type: none"> • Retain desirable tree species in the overstory so that they may provide a future seed source. • 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.
<p>Species Suitability: Regeneration is mostly tree species that are not expected to do well under future conditions.</p>	<ul style="list-style-type: none"> • 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.
<p>Invasive and Competing Plants: Invasive plants such as buckthorn, autumn olive, and garlic mustard, or invasive animals such as earthworms are impeding natural tree regeneration. Native invasives may also be a concern.</p>	<ul style="list-style-type: none"> • Thin stands by identifying crop trees, creating room for desirable species of good form to grow. • Prevent new invasive species from establishing and managing existing populations or seed sources of invasive plants through physical or chemical treatments. • Monitor regularly for the presence of new invasive plants or animals.
<p>Deer Browse: Moderate to severe deer browse may create substantial challenges for tree regeneration and recruitment.</p>	<ul style="list-style-type: none"> • Install fences, bud caps, or other physical barriers to prevent browsing damage. • Use treetops 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.

Notes

Use the spaces here to add notes and describe the conditions of your property or to record if you left a topic's checkboxes blank or aren't sure what risk levels may be to consider discussing with a forester.



PROPERTY-LEVEL AND FOREST STAND



PHOTO CREDIT: LAURA KIRT



FOREST DIVERSITY AND COMPOSITION



FOREST STRUCTURE

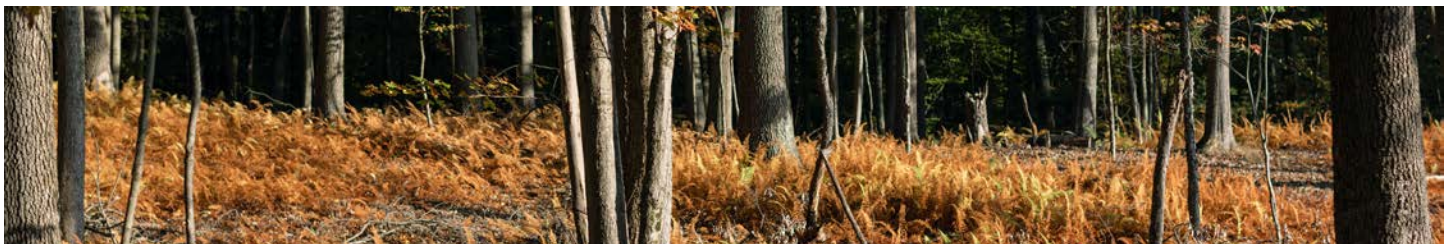


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TREE REGENERATION

Let us know your experience with the use of this tool!

Please contact privateforests@psu.edu to share comments or offer suggestions and recommendations for improvements. Thank you for your valuable feedback!

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