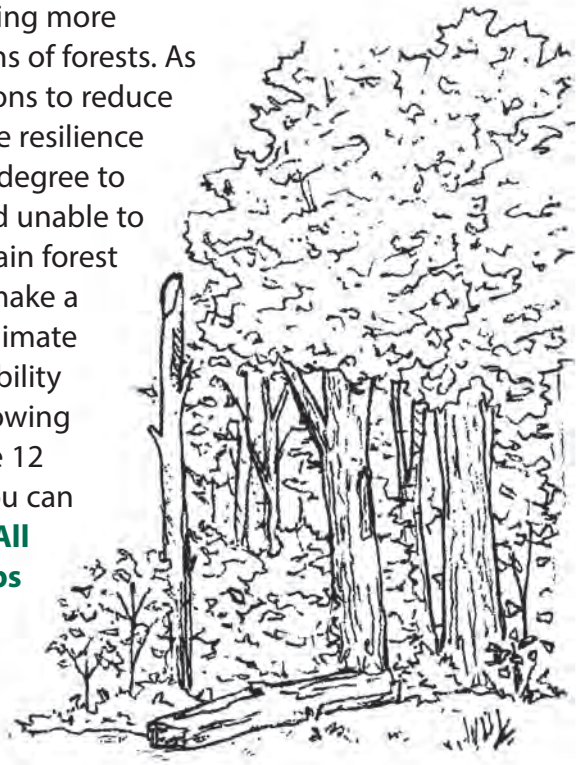
# 12 Steps for Climate Resilience:

# Managing your Forest with Climate Change in mind

The climate is changing and bringing more uncertainty to the future conditions of forests. As a landowner, you can make decisions to reduce the vulnerabilities and advance the resilience of your woods. *Vulnerability* is the degree to which a forest is susceptible to and unable to recover from climate change. Certain forest conditions and disturbances can make a forest more or less vulnerable to climate change impacts. *Resilience* is the ability of a forest to recover or adapt following disturbance or change. Read these 12 steps to learn more about what you can do, today, to protect your woods. **All landowners should perform steps 1-3 and step 12**. Steps 4 through 11 may not apply to all properties so focus on those that fit your management and your woods.



**Resources:**

- ***Climate Change in Vermont:*** chapter from the Vermont Climate Assessment about how Vermont's climate has changed and what we can expect for the future
- ***Climate Change in Forests:*** chapter from the Vermont Climate Assessment about how climate change may affect Vermont's forest
- ***Explore Climate Impacts:*** select the Northeast region on the map to read about expected changes in climate and how forests may be affected
- ***Forests and Climate:*** FPR's website for information and resources on climate change, carbon, and forest management

VermontWoodlands

WILDLIFE RECREATION TREE FARM WATER WOOD

FORESTS, PARKS & RECREATION VERMONT AGENCY OF NATURAL RESOURCES

THE UNIVERSITY OF VERMONT EXTENSION FORESTRY

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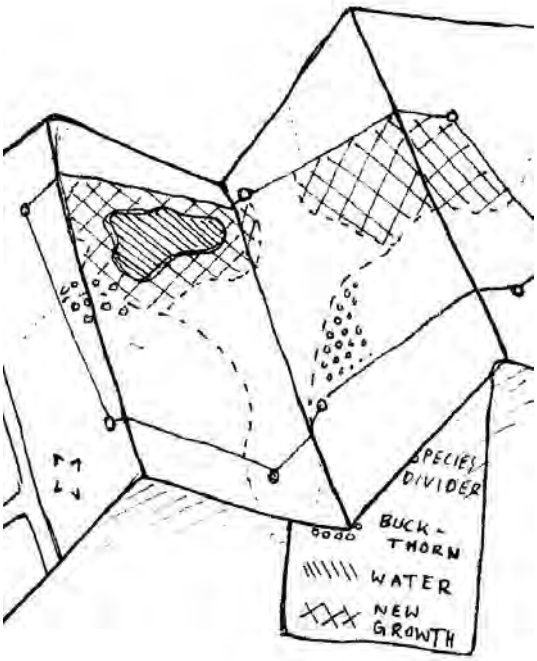
## 1 Get to know your land




Climate change will not affect all forests and locations the same way. Each forest has unique conditions based on the species, soil, elevation, slope, landscape position, past land use, and disturbance history that may make it more or less vulnerable to changing conditions.

A great way to start is by making a map of your woods. Start with the basics like boundary lines and compass directions so you can observe weather patterns. Make notes of locations of features like streams, wet areas, steep slopes, rocky areas, and roads and trails. If you have a forest management plan already, there may be a map included. Once you have developed your map, note where different species grow, locations of old or young forests, invasive plants, or areas with signs of animal browse that can lead to forest degradation.

**Resources:**

- ***Vermont Natural Resources Atlas:*** an online mapping tool to explore the features of your property like the soils, bedrock geology, locations of streams and significant wetlands, and to understand your land's relationship to the broader landscape
- ***iNaturalist*** and ***Seek:*** online and app-based tools to help identify and monitor different species
- ***Go Botany:*** online plant identification key for New England
- ***Reading the Forested Landscape*** and ***Forest Forensics:*** two books by Tom Wessels to help you understand different types of past land use and natural disturbances
- ***Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont:*** explore and learn about the natural plant communities that occur in Vermont in this guide book by Liz Thompson, Eric Sorenson, and Bob Zaino

## 2 Connect with a licensed forester

It is essential to talk with a forester when planning management actions on your land. A forester can help you understand how climate change and other stressors might affect your woods and opportunities to address those vulnerabilities and improve forest health. If you don't have a forester or want to talk to someone else, reach out to your FPR county forester.

**Resources:**

- ***Keeping Your Woods Healthy Through the Years Ahead:*** publication by the Northern Institute of Applied Climate Science, Vermont Coverts, and FPR with an overview of ways to steward your woods under climate change
- ***FPR County Foresters:*** refer to this list of FPR county foresters for free assistance available to all landowners
- ***VWA's list of Licensed Consulting Foresters:*** Speak to a few foresters in your area to select the best fit for a long-lasting relationship

## 3 Identify vulnerabilities

Once you've gotten to know your land and its features, you can assess possible vulnerabilities to climate change and other stressors, as well as steps you can take to address those vulnerabilities. A forest's vulnerability to climate change is a function of its exposure, its sensitivity, and its ability to adapt.

Walking your woods with a forester is the best way to identify these conditions and understand opportunities to improve the health and resilience of your woods. Identifying vulnerable locations or conditions on your land is critical in long-term planning. Here are some things to look out for: **(1)** conditions that may affect tree regeneration and the future forest, such as invasive plants (especially populations that are expanding in size), extensive animal browse on seedlings or saplings, or only a few tree seedlings and saplings in the understory. **(2)** conditions of the overstory trees that suggest they are less resilient to extreme events and disturbances, such as unhealthy-looking trees, trees with small crowns, trees that are very close together, trees of a similar size, and/or only a few species are present. **(3)** conditions of the forest that affect soils and water quality, like evidence of soil erosion or rutting, soil that is exposed and not covered in leaf litter, or a lack of deadwood in various stages of decay, including standing dead trees and dead logs on the forest floor. **Explore steps 4 through 12 for specific strategies you can use to improve the resilience of your forest, so focus on those that fit your management and your woods.**

## 4 Slow, spread, and sink water

Vermont is getting more rain, sometimes in stronger storm events. Heavy rain can wash away leaf litter, cause soil erosion, and result in nutrient losses. These impacts negatively affect streams, lakes, and ponds as well as the forest.

Certain management actions can help lessen the impact of these heavy rains and keep water in the woods where it can be absorbed. On roads and trails, it is important to use water diversion structures, like waterbars or dips, to move water off the traveled surface where it can cause erosion and rutting. When using culverts or bridges to cross wet areas, make sure they are large enough to accommodate extreme flows and are cleaned of debris frequently. Try to minimize the channelization of water, which leads to faster flows and more runoff and erosion. Instead, divert water into depressions or flat areas where it can be absorbed more slowly. Logs, branches, and other deadwood left on the forest floor can help slow down and retain water, especially when positioned perpendicular to the slope. A good way to identify problem areas is to walk your woods during or immediately after a heavy rainfall event and observe where water travels. Controlling runoff and erosion is also important to consider around your home and driveway.

**Resources:**

- *Climate Change and Adaptation:* New England and Northern New York Forests: interactive story map from US Forest Service explaining how climate change impacts forests, including examples of forest management around the region
- *New England and northern New York forest ecosystem vulnerability assessment and synthesis:* summary overview and highlights from US Forest Service report examining effects of climate change on the region's forests
- *VT Invasives:* information on identifying and managing invasive species
- *AVID:* a NY program for assessing and monitoring the impacts of deer on your woods with a lot of information relevant to VT forestland owners

**Resources:**

- *Landowner Guide to a Successful Timber Harvest: Water and Your Woods:* FPR's guide to navigating and understanding a timber harvest, which includes information on managing water
- *Slow it. Spread it. Sink it! A Homeowner's Guide to Greening Stormwater Runoff:* handbook with general stormwater runoff improvement practices
- *Culverts:* a short video by Dr. Tony D'Amato and UVM Extension that explains why considering culvert size and position is important to maintaining connectivity and resilience

## 5 Protect soils and water

Protecting soils and water quality is key to forest health and resilience. Compaction of soil reduces the air pockets necessary for roots and other living organisms. Rutting and disturbing soils with heavy equipment can lead to erosion and runoff into water bodies. Damage can take decades or longer for recovery.

Identify and protect water sources and sensitive soils, like areas that are wet, clayey, or mucky. When using equipment in the woods, whether for logging, trail building, or recreation, minimize impacts by using equipment designed to reduce damage, waiting until the ground is dry or frozen, or using bridges, logs, or tree branches to reduce soil compaction on traveled routes. Pay particular attention to areas near waterbodies. It is important to close out old, unused roads or trails as these can channelize water and be a significant source of erosion. Talk to a forester about how best to do this. Another good strategy is to maintain plants and trees along waterways, wetlands, and vernal pools to protect and cool water, as well as on steep slopes to stabilize soils.

**Resources:**

- *Acceptable Management Practices for Maintaining Water Quality on Logging Jobs:* These "AMPs" must be followed during timber harvests to protect both soil and water in your woods
- *Vermont Natural Resources Atlas:* an online mapping tool to explore soils and locations of streams and significant wetlands

## 6 Focus on regeneration

Key to forest resilience is ensuring the forest perseveres in the future. This means there are multiple generations of trees in the woods. An old forest needs young trees, and vice versa. But many forests lack sufficient regeneration due to land use history, deer browse, and other factors.

Promote tree regeneration by working with your forester to create canopy gaps and other conditions necessary for success. Some species require certain conditions in order to establish, for example, yellow birch needs exposed mineral soil while white ash needs large gaps in the canopy. A forester can help select the best options for your desired outcomes. Retain a diversity of large, healthy trees as a source of seed for the next generation. For established understory trees, thoughtful stand thinning can reduce competition for light, water, and nutrients. If young tree survival is low, control competition from other plants, like invasives or beech suckers, or by using branches, fencing, or other deterrents as protection from animal browse. Where natural regeneration is lacking, consider planting trees. If so, talk to a forester about what species would grow well and where to purchase or acquire them.

**Resources:**

- *Regenerating Your Next Forest: Keys to Success:* strategies to promote tree regeneration in your woods by Cornell University
- *How to Manage Deer Damage on Trees and Other Plants:* a comprehensive guide on managing deer impacts by the University of Minnesota Extension
- *Forest Finance 2: Fencing for Forest Regeneration: Does It Pay?:* information from Penn State Extension to help you consider if deer fencing is a good option

## 7 Create complexity

Forests that have more species and greater structural complexity – that is, trees of many sizes, ages, and conditions, including dead standing and downed trees, with irregular gaps in the canopy here and there – are more resilient to climate change. This is because if there is a disturbance, weather event, or insect outbreak, not all trees will be affected the same. Forests that are more complex are also better at capturing and storing carbon to help mitigate climate change.

Talk to your forester about using management to increase the number of species present in the woods or to create more variation in the forest structure. If present, retain old, large trees and dead logs.

When we think about complexity, it can also help to think about the larger landscape: are there similar or different conditions in areas adjacent to your property? For example, if the surrounding area is mostly mature forest, creating a few canopy gaps can help create landscape diversity and act as stepping stones for certain wildlife species. A forester can help you think about the larger context your land plays.

**Resources:**

- ***What is Forest Stand Structure?:*** a short article in Woods Whys by Michael Snyder explaining what forest stand structure is and how it is measured
- ***Structural Diversity and Biodiversity in sugarbushes:*** a short video by Dr. Tony D'Amato and UVM Extension explaining why structural complexity is a critical component of all forests, including sugarbushes
- ***Making an Unhealthy Pine Stand More Complex:*** a video by Chittenden County Forester, Ethan Tapper, on creating more complexity in the Maple Shade Town Forest in Westford

## 8 Increase deadwood

Standing dead trees and downed logs promote forest resilience by protecting soils, retaining water, and cycling nutrients. Plus deadwood provides food and shelter for many organisms. In most Vermont forests, there is a lack of deadwood because of past land use.

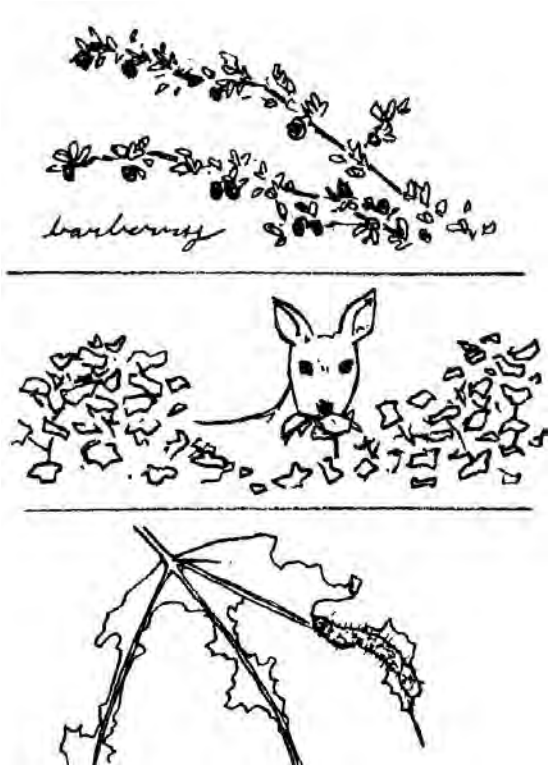
Where appropriate, keep dead trees and logs where they are. If your woods lack dead trees and downed wood, a timber harvest can be a good opportunity to create some: trees can be felled and left in place, pushed over with equipment to create tip-ups, or girdled* and left standing. Think about ways to increase deadwood across a range of sizes and conditions. The best deadwood comes from trees that die of natural causes. Talk to your forester about identifying old trees that could be a future source of deadwood.

**Resources:**

- ***Nothing Rotten About Deadwood:*** a short article in Northern Woodlands magazine by Joe Rankin about the importance of deadwood in forests

**girdling is achieved by cutting through the bark around the tree and allowing it to die slowly. This practice should not be done near trails, roads, or other locations that could create a hazard.*

## 9 Manage other stressors



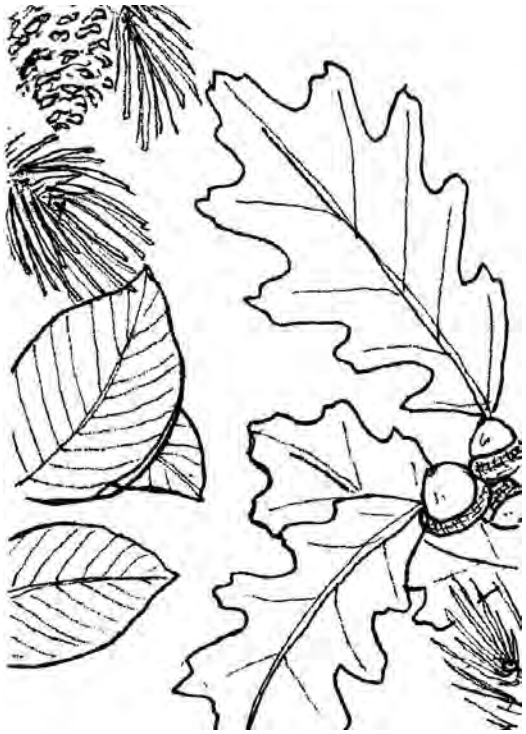

Forests face many stressors, like competition from invasive plants and damage caused by insects, diseases, animal browse, wind, ice storms, or fire. Climate change is expected to make all of these stressors more impactful. While we cannot fully eliminate risks, we can provide the forest with opportunities for resilience.

Some options include controlling or eliminating invasive plants, retaining deadwood to protect young trees from deer browse, using deer exclosure fences, or increasing deer hunting to reduce impacts. For many of the disturbances our forests face, a diversity of tree species and range of ages allow for greater resilience in the face of stress. Talk to your forester about management for specific issues.

**Resources:**

- *VT Invasives:* information on identifying and managing invasive species in Vermont
- *How to Manage Deer Damage on Trees and Other Plants:* a comprehensive guide on managing deer impacts by the University of Minnesota Extension
- *More Tree Species Diversity in Sugarbushes Reduces Maple Pest Levels:* results from a regional study on species diversity in sugar maple forests

## 10 Favor future-adapted species



In general, the future climate of Vermont will be more stressful to trees adapted to cold climates, like balsam fir, black spruce, and northern white-cedar. Species that are adapted to warmer climates, like oaks, hickories, and pines, may expand where they can grow in the future. Luckily we have a range of species that do or can grow in Vermont.

Depending on your site, favor tree species adapted to warmer conditions, like oaks, pines, hickories, and cherries, but also retain trees adapted to your site and its vulnerabilities. Cold-adapted species will still persist into the future, but where they grow might be limited to north-facing slopes and locations that stay cool. Overall, promote healthy trees that can withstand stressors and provide a source of pollen or seed for the next generation. A forester can help you evaluate your woods and which species may be best suited for conditions now and in the future.

**Resources:**

- *Climate Change Projections for Tree Species in the Vermont:* a list of tree species and the projected suitability of the future climate.
- *Climate Change Tree Atlas:* an online tool to explore the modeled potential suitable habitat for tree species by the US Forest Service

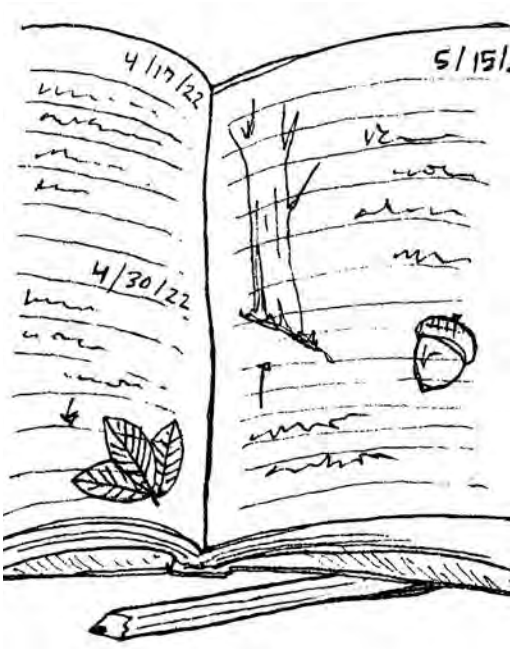
## 11 Protect the rare, unique, or significant

In addition to climate change, we are also facing a biodiversity crisis due to habitat degradation and loss. Every year we are losing forestland to development and agriculture, but you can help protect biodiversity by keeping your forest as forest through estate planning, conservation easements, or other strategies. Talk to a lawyer about ways to legally protect your forested land. You can also help promote biodiversity goals by protecting rare species, natural communities, or landscape features that you have in your woods or by using forest management techniques to improve habitat or provide food for wildlife.

**Resources:**

- *Ensuring Your Legacy:* information and guidance from UVM Extension on land planning
- *Foresters for the Birds:* a guide for managing forests for bird habitat by VT Audubon and FPR

## 12 Monitor and plan for the unexpected




Climate change will bring more extreme events, and while we can't prepare for everything, talk to a licensed forester about what you can do if there is a disturbance or pest that may affect your forest. Management to increase species and age diversity can reduce the impact of an unexpected event.

The only way to know if changes have occurred is through monitoring. This can be as simple or detailed as you want – find what works for you to keep track of events, seasonal observations, stressors, and management tactics and outcomes. Keys to success are working with a licensed forester, keeping your management plan and map updated, and taking advantage of the many resources and technical assistance available. Continue to learn about and support your woods so you can enjoy them long into the future.

**Resources:**

- *Creating and Maintaining Resilient Forests in Vermont: Adapting Forests to Climate Change:* a comprehensive guide to managing different forest types with climate change by VT FPR
- *iNaturalist:* online platform to help you report and track nature observations, which is especially important for rare or uncommon species