



THE  
UNIVERSITY  
OF RHODE ISLAND  
COLLEGE OF  
THE ENVIRONMENT  
AND LIFE SCIENCES



RHODE ISLAND  
**Woodland**  
PARTNERSHIP



CARING FOR RHODE ISLAND'S WOODS  
INCREASING RESILIENCY  
AND ADAPTING TO  
CHANGING CONDITIONS







Communication between a forester and landowner can be an important part of land stewardship.

## FORESTS CHANGE

Whether you spend time outside in the woods you care for or just enjoy the beauty of the trees and wildlife when passing by, you likely love the woods and want to keep them healthy.

Forests are always changing and adapting to new conditions. Some changes are as anticipated as the progression of green summer leaves to the bright red and gold of fall foliage or the annual return of brightly-colored migratory songbirds. Other changes to our woods are only visible when comparing differences across many years or decades.

### RESPONDING TO CLIMATE CHANGE

Do you wonder about the changing conditions in the woods? Many people are asking more questions about how a changing climate could affect forests and what actions they can take to ensure forests stay healthy no matter what the future holds.

There are two ways that you can help respond to climate change in the woods you care for. First, you can consider the ways climate change may affect the woods and work with a professional forester or natural resource manager to ensure that the trees, wildlife, and other forest species can cope with changing conditions – these adaptation actions are outlined in this booklet.

In addition to ensuring forests are healthy and productive over the long term, you can also consider actions that increase the ability of forests to absorb and store carbon from the atmosphere as a means to reduce the amount of heat-trapping carbon dioxide in the atmosphere. A forester can help you influence the amount of carbon stored in the woods and may suggest additional resources.



# CLIMATE CHANGE

Our climate is changing in ways that humans have never experienced before, resulting in rising temperatures and shifts in seasonal precipitation patterns. You may be noticing some of these changes in the woods – such as earlier dates for the first signs of spring leaf-out, unusual weather patterns and powerful storms, longer dry periods in summer, or rapidly spreading new plants.



Erosion (on unpaved roads and elsewhere) can be exacerbated by extreme precipitation and weather events.

## NOT JUST GLOBAL WARMING

The climate is changing in many different ways.<sup>1</sup>



Average temperatures in Rhode Island have risen almost **4°F** since the beginning of the 20th century. Winter temperatures have risen even more.

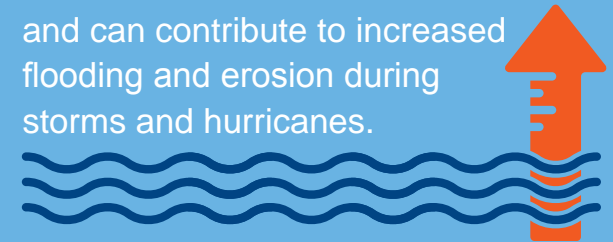


## ANNUAL PRECIPITATION HAS INCREASED

statewide, and warmer temperatures mean that more precipitation is coming as rain than snow.



Since 1930, sea level in **Narragansett Bay** has risen more than **9 inches**, faster than the global average. Sea level rise threatens the bay's coastal forests and salt marshes and can contribute to increased flooding and erosion during storms and hurricanes.



Precipitation patterns are changing, and some areas are experiencing more frequent heavy rain events and longer dry periods between events.



This century, temperatures are expected to continue warming with a potential increase of **5-10°F** with a longer growing season and more frequent extremely hot days.

<sup>1</sup> Runkle et al., 2022: Rhode Island State Climate Summary 2022. NOAA Technical Report NESDIS 150-RI. NOAA/NESDIS, Silver Spring, MD, 4 pp.

# HOW CLIMATE CHANGE AFFECTS FORESTS

Some forests are already facing threats from a variety of stressors, such as invasive plant species and introduced pests like the spongy moth, emerald ash borer, and beech leaf disease. A changing climate can increase the effects of existing stressors or introduce new threats.

There are practical strategies available for you to help the woods prepare for and cope with the unpredictable conditions that lie ahead. A first step is exploring the ways the forest you care for may be vulnerable to climate change, as well as what factors may help protect it.



An invasive vine chokes trees (left); an undersized culvert (top right); and southern pine beetle (bottom right)

## ARE YOUR WOODS AT RISK?

Climate change will not affect all forest species, communities, and parts of the landscape in the same way. Each property has unique conditions—factors such as soil type, elevation, slope, and past land use history – that may make it more or less vulnerable to changing conditions. A forester or natural resources professional can help you understand how climate change and other stressors may affect the woods – and what you can do about it.

**Increases in extreme precipitation events:** Extreme precipitation events are becoming more common and can lead to flooding, soil erosion, and sedimentation.

**Increases in storm frequency and intensity:** Climate change may increase the intensity, size, or frequency of stand-replacing weather events such as windstorms and ice storms.

**Elevated drought risk:** Warmer temperatures and altered precipitation patterns can increase risk of drought and associated tree mortality.

**Increasing occurrence of wildfire:** More frequent days with weather conditions suitable for fire, plus increasing fuel loads due to other disturbances, may increase the risk of wildfire.

**Increases in insect pests and forest pathogens:** Insect pests like hemlock woolly adelgid and southern pine beetle can expand their range northward under a warmer climate.

**Increases in invasive plants:** Invasive species may benefit from warmer temperatures and longer growing seasons, affecting forest growth and composition.

**Reduction in tree species habitat:** Some tree species in Rhode Island are projected to have reduced habitat suitability, including red pine, eastern hemlock, and eastern white pine.

**Rising sea levels:** Sea levels will continue rising, and intensifying coastal storms may increase coastal forest dieback and replacement with salt marshes.



# TAKING ACTION FOR THE WOODS

## How Climate Change Affects Forests

Taking an active role as a steward of the land can help the woods you care for adapt to warmer, drier summer conditions and more frequent disturbances from events such as wind, storms, or disease that can damage trees. A forest of healthy, diverse trees can better withstand stress and support the community of plants and animals that live in the woods, while helping protect soils and water resources.

The following pages provide ideas for actions that you might implement across a property and describe why they are important. Work with a professional forester to create a customized forest management plan that meets the needs of your unique situation and goals.



Taking an active role as a steward can help the woods you care for adapt to future conditions.

## Taking Action Checklist

As you read the actions on the following pages, use this checklist to identify those to discuss with your forester or natural resource manager.

### Actions to Protect Ecosystem Functions

- Keep forest land in forest use.
- Protect rare or sensitive plant and animal communities.
- Protect water and soils.

### Actions to Reduce Stressors

- Improve ability of trees to resist insect pests and disease.
- Prevent and control invasive plants.
- Manage damage to young trees from excessive deer browsing.

### Actions to Build Resilience

- Promote a diversity of tree species.
- Promote a diversity of tree ages and sizes.
- Promote strong, healthy trees to prepare for big weather events.

### Actions to Facilitate Transition

- Respond quickly after big disturbance events to help the woods bounce back.
- Proactively manage the forest for future conditions.

### Monitoring Over Time

- Monitor the woods and the effects of different management tactics.

# ACTIONS TO PROTECT ECOSYSTEM FUNCTIONS

The renowned conservationist Aldo Leopold advised, “To keep every cog and wheel is the first precaution of intelligent tinkering.” This wise guidance remains true in an era of unprecedented and sometimes unpredictable change. When working on the property you care for, look for opportunities to protect sensitive ecosystems and species – they need your assistance now more than ever.



Protecting forest habitat, water, and soils benefits plant and animal communities.

## **Keep forest land in forest use.**

Many forests in Rhode Island are being lost to other land uses, which fragments the remaining forests into smaller and smaller patches. Protecting forests and maintaining connected habitats helps reduce the impacts that climate change and other stressors have on plants and animals.

Private landowners concerned about the future of their land and interested in keeping their woods as they are, not cleared for housing or commercial development, can refer to the Rhode Island Woods website. Estate planning resources are available for private forest landowners to learn more about options for conservation and how to begin planning for that outcome now. When landowners keep their woods growing and care for them over the long term, they are helping to fight climate change and supporting a more resilient landscape for all.

## **Protect rare or sensitive plant and animal communities.**

Uncommon or fragile plants and animals will have the most difficult time adapting to changing conditions. While we can't be absolutely certain that our attention to these natural wonders will protect them into the future, we can try and give them the best possible chance. There may be stewardship practices you can implement, such as removing invasive plants, ensuring that the right amount of light or shade protects the community, or better managing wetland areas. Consult with a professional and monitor these situations closely. A forester or wildlife biologist can help you establish a plan to protect these natural communities.

## **Protect water and soils.**

Rhode Island forests are expected to experience more frequent and much more intense precipitation events in spring and fall. These events could cause wash-outs like you've never experienced before, so ensure that culverts and crossings can handle much larger stream flows than you might expect. Maintaining plants in areas adjacent to wetlands and streams will help ensure that less soil is washed away and will avoid filling and choking healthy streams. A professional can help you anticipate and design appropriate improvements you may need to protect water sources.



# ACTIONS TO REDUCE STRESSORS

Often our forests are already being threatened by a variety of stressors, including invasive plant species, insect pests, and pesky wildlife. Reducing the impact of these stressors on forests is a critical first step for ensuring that the woods are healthy for whatever may come. You may already be taking many of these actions – if so, keep up the good work! Even if you are just getting started on these actions, every little bit will help provide big benefits to the woods you care for and the wildlife that depend on them.



A slash wall of woody material can limit damage to young trees caused by deer browsing.

## **Improve the ability of trees to resist pests and disease.**

Promoting the growth of the healthiest, strongest trees in the woods will help a property withstand increased threats from pests and disease and provide a future seed source. Additionally, make sure the forest has a range of different tree species, so the woods won't be overly at risk if a pest attacks one particular tree species. Intentional actions to increase the diversity of trees can reduce the risk of pests and diseases affecting the woods and provide opportunities for a faster recovery when forests are affected.

## **Prevent and control invasive plants.**

The changing climate is projected to create even more attractive conditions for undesirable plants that are not native to our area. Unfortunately, non-native plants – and even some aggressive native species – often outcompete our native tree species and contribute very little to the values we appreciate most from the woods: strong root systems for clean water, native nuts and berries and shelter for wildlife, and even valuable wood to harvest for income to reinvest back into caring for the property. By staying on top of managing invasive plant threats, you will ensure the woods you care for are better prepared for the future.

## **Manage damage to young trees from excessive deer browsing.**

Young tree seedlings are the future of the forest – and often the tastiest morsels for the local deer population. By promoting a healthy community of younger trees, you can have more confidence that the woods will be more adaptable to changing conditions in the future. To prevent deer browsing, consider managing the deer population or using protective tubes or fencing to reduce their impact. Following a timber harvest, tree tops can also be used to create areas for seedlings to grow away from deer. A professional forester can help you think through the best solution for your situation.

# ACTIONS TO BUILD RESILIENCE

When thinking about the future, one of the most important things we can do is to support the natural capacity of ecosystems to cope with change. By ensuring that forests are healthy and resilient, we put them in the best position to withstand many kinds of stressors and bounce back from severe weather and other disturbances. There are a variety of actions you can take to help improve the ability of the forest to adapt to changing conditions, and a professional can help determine what actions are most suitable for the unique conditions on the land you care for.



The presence of a diversity of species, ages, and sizes of trees helps build resilience.

## **Promote a diversity of tree species.**

As the climate changes, the conditions for tree species will also change and not all species will react in the same way. You can hedge your bets and make sure the woods have a variety of native tree species present, so eventual “winners” will adapt and thrive, and the woods won’t miss a beat. On the other hand, if you focus on maintaining a single tree species on a property, you run the risk of that particular species being unable to handle future conditions — and the whole forest loses out. By considering the unique ways that climate change may affect your property, you will be better able to identify a variety of different tree species that are suited to your site.

## **Promote a diversity of tree ages and sizes.**

Having a diverse forest structure is just as important as having a variety of tree species. A woodland that has trees of all the same size can be affected by changes in the same way, which may mean a forest is less able to adapt and respond accordingly. Landscapes that contain a mixture of young trees, middle-aged trees, and old trees can provide diverse places for wildlife to live today. Many forests in Rhode Island contain trees that are all of a similar age, and a forester may suggest actions to regenerate areas with young trees to improve the ability of the woods to handle a variety of situations in the future.

## **Promote strong, healthy trees to prepare for big weather events.**

The healthiest and most vigorous trees are often better able to withstand damaging events and can provide a viable seed source and good genetics for the next generation of trees, too. You can work with a professional forester to favor the most healthy and vigorous trees in the woods while helping others to grow strong and sturdy. For example, thinning the trees in a crowded forest can enable the remaining trees to grow larger and wider, and develop more complex root systems that increase their ability to withstand drought and other stressors. Also, consider leaving groups of desirable trees in concentrated “islands” as these areas can be less susceptible to extreme wind.



# ACTIONS TO FACILITATE TRANSITION

Another sage piece of advice is to “prepare for the unexpected.” No matter how much we wish it wasn’t the case, it has always been impossible to predict the future. Our changing climate means that our future forests may look very different than those we have today. In some situations, we may be able to anticipate and prepare for these future changes, helping forests make a more graceful transition to their future state.

## **Respond quickly after big disturbance events to help the woods bounce back.**

A quick response after a damaging event is very important. If the woods you care for experience a sudden pest outbreak, you can work with a forester to evaluate and control the issue, preventing the threat from spreading further. Similarly, a big storm event might damage a portion of the woods. Play an active role to help ensure the woods recover as quickly as possible by encouraging the growth of native tree seedlings in these areas. This may include controlling invasive plants, which thrive after disturbances, and protecting seedlings from deer browse.

## **Proactively manage the forest for future conditions.**

Be thoughtful about which tree species are growing where. For example, a warmer climate may put some species like beech and eastern hemlock at greater risk, while many oak and hickory species may be better adapted to future conditions. A forester can help you consider if tree species are well suited to site conditions, both now and into the future. In some situations – such as when a forest has been heavily affected by an insect pest, drought, or other disturbance – there may be benefits to promoting a different mix of species that will be better able to thrive in our changing landscape. Actions may include allowing for natural regeneration of different plant communities, stewardship activities that slowly change the forest over time, or planting trees or seeds that will hopefully become the future forest.



Promoting or planting trees adapted to future conditions may help the woods transition over time.

# ONGOING ACTIONS

## **Monitor the woods and the effects of different management tactics.**

No matter what actions you may decide to take, you can monitor the changes in the woods. Regularly keeping an eye on the woods will help you better understand how the changing climate will affect the land you care for. Think about recording annual leaf-out dates, check for signs of pest infestation or disease on certain trees, and take note of the number and success rate of tree seedlings, as these little trees will ultimately determine the future the forest.





Coastal forests provide buffers that help protect against the effects of severe weather.

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## RESOURCES

The following resources can help you learn more about issues related to caring for your forest.

### **RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT, FOREST STEWARDSHIP PROGRAM**

Rhode Island's Forest Stewardship Program (FSP) was developed for woodland owners who want to know more about their woodland and how to manage it. The Rhode Island FSP, in cooperation with the USDA Forest Service, supports private forest landowners' efforts to manage, enjoy, and care for their land long-term.

[www.dem.ri.gov/natural-resources-bureau/agriculture-and-forest-environment/forest-environment/forest-stewardship](http://www.dem.ri.gov/natural-resources-bureau/agriculture-and-forest-environment/forest-environment/forest-stewardship)

### **UNIVERSITY OF RHODE ISLAND, DEPARTMENT OF NATURAL RESOURCES SCIENCE**

Active in public engagement as well as teaching and research, the Department of Natural Resources Science strives to educate, empower, and engage residents, communities, students, youths, land trusts, watershed groups and agricultural producers throughout Rhode Island and beyond to steward their local natural resources.

[www.uri.edu/nrs](http://www.uri.edu/nrs)

### **RHODE ISLAND WOODS**

This website maintained by the University of Rhode Island provides in-depth information on many different topics for landowners and those who care for forests in the state, including forest stewardship, wildlife, science and policy, succession planning, learning opportunities, and where to find forest-related products grown or made in Rhode Island.

[riwoods.org](http://riwoods.org)

Learn about climate-smart forestry resources and information about research on managing local forests for climate resiliency.

[riwoods.org/climate-smart-forestry](http://riwoods.org/climate-smart-forestry)

Learn about enhancing bird habitat through the Forestry for Rhode Island Birds program.

[riwoods.org/forestry-for-ri-birds](http://riwoods.org/forestry-for-ri-birds)

### **NORTHERN INSTITUTE OF APPLIED CLIMATE SCIENCE (NIACS)**

Woodland owners and forest managers can increase the resilience of their forests and help adapt to changing conditions. The Climate Change Response Framework provides tools and resources for climate-informed land management.

An ecosystem vulnerability assessment and related resources summarize information about climate change impacts on tree species and forests in New England.

[www.forestadaptation.org/new-england](http://www.forestadaptation.org/new-england)

Adaptation strategies describe options for responding to climate change and outline a variety of actions for climate-informed management.

[www.forestadaptation.org/strategies](http://www.forestadaptation.org/strategies)

The Adaptation Workbook can be used by you or your land manager to consider the effects of climate change and to design land management and conservation actions to help prepare for changing conditions.

[www.adaptationworkbook.org](http://www.adaptationworkbook.org)

### **USDA FOREST SERVICE**

The Climate Change Tree Atlas is a U.S. Forest Service resource that provides the current ranges and potential changes in habitat suitability for 125 tree species in the Eastern United States under future climate change. The website includes video tutorials on how to use the Atlas.

[www.fs.usda.gov/nrs/atlas/tree](http://www.fs.usda.gov/nrs/atlas/tree)

### **USDA NORTHERN FORESTS CLIMATE HUB**

The USDA Northern Forests Climate Hub, part of a national network of Hubs, develops and delivers science-based information and resources to help natural resource managers and woodland owners integrate climate change information into planning, decision making, and management activities.

[www.climatehubs.usda.gov/hubs/northern-forests](http://www.climatehubs.usda.gov/hubs/northern-forests)

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